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FOREWORD

Our "Futures of a Complex World" conference 2017 was a success by all standards. We got record amount of participants – 330 experts from 29 countries – with fascinating array of topics from future of agriculture to new modeling tools. Feedback we received in and after the conference was very positive, encouraging us to continue to bring together researchers from various disciplines all having their focus on what's happening next, or after next.

This publication, based on papers presented in the conference, is a token of the fascinating variety of approaches we can adopt while penetrating the future with the tools of our research. As such, it also represents in a splendid way the complexity of our world, embedded with grand challenges as well as fascinating new developments. Complexity science itself proves us that we need particularly two capacities to thrive in the ever more complex world: on the one hand we need to build more resilience into our systems, on the other, we should create new capacities to transform, if necessary. Both aspects are well represented in the articles of this publications.

We like to thank all of our contributors for their hard work. We hope this publication serves as a humble gift to authors who have put time and energy for preparing the articles for this publication. We also like to extend our thanks to all participants of the conference. It is due to your active engagement that our event became a living proof of rigorous spirit of exploration in our worldwide futures studies community.

Future is complex, but it is also a paradox. As the founder of Finland Futures Research Centre Professor Pentti Malaska once commented, we live on the verge of incomprehensible ignorance. The more we know, the more we understand how little we actually know. However, this notion should not discourage us but make us more determined to continue our exploration to a largely unknown future.

On the behalf of Scientific Committee of the Conference

Markku Wilenius
Chairman
Professor
Finland Futures Research Centre
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1. COMPLEXITY AND FUTURES OF GOVERNANCE

(A)Political Futures: The rationale, form and function of independent fiscal councils in policy making

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Abstract

The aim of this paper is to review the rationale, nature and operation of independent fiscal councils, and forecasting in particular, as a means to considering the challenges and opportunities for strategic foresight in policy making. A review of independent fiscal councils provides a number of insights into how futures are being configured at executive levels of government and an opportunity to examine how futures could be incorporated in policy making. The transparent and non-partisan forecasts of independent fiscal councils are designed to limit the excesses of politicised policy actors and help ensure the discipline of fiscal policy and the sustainability of public debt. However it is argued that attempts to secure the de-politicisation of policy making is neither possible nor desirable. It is argued that strategic foresight can be used to create an open form of policy making that deepens and extends an understanding of what the future could be and the different means by which such futures can be created.

Introduction and Background

The future is vital to policy making, but presents a number of challenges to policy makers. Policy makers need to make sense of what might be ahead and in the process develop accounts and claims as to the nature and scale of a given problem and subsequent solutions (Fischer, 2003). This sense making is made all the more difficult when there are no future facts and therefore the grounds for making claims are unclear and uncertain (de Jouvenel, 1967). Policy makers are also required to mobilise support and attend to opposition in order to realise their plans (Connor, 2013). In this regard, the process of organizing and managing coalitions cannot be divorced from questions of meaning making and power (Bacchi, 2009; Baumgartner & Jones, 1993; Hall, 1993; Ham & Hill, 1993; Heclo, 2010; Majone, 1996; and Vink *et al*, 2013). Understood through this lens, the future is a contested and potent site that plays a vital role in processes of meaning making and the mobilisation of power.

The future is a domain where both visions over what the future is and should be and the policies and practices that this future requires, are subject to conflict (Dunmire, 2010). Both appeals to a better

tomorrow, or the fear of what is to come, can serve as means by which policy makers seek to legitimate the actions, conflicts and sacrifices taken today. Subsequently, claims to know the future are inherently political. Knowledge claims and forecasts in particular become a resource for determining what is and will be deemed realistic and what actions are taken to be feasible in and towards the future (Heller, 1999).Consequently, agencies granted a licence by authorities to know the future have the capacity to wield significant influence over what is deemed possible and desirable (Graham, 2004) and the potential to shape today and tomorrow (Edelman, 1988). Therefore attention needs to be given to who receives a licence for representing the future and the conditions under which these licenses are held.

In an effort to gain insights in to the role the future does and could play in policy making this paper reviews the nature and operations of independent fiscal councils (IFCs). IFCs are a set of institutions that have been granted a license to know the future. Described as one of the most important innovations in public financial management, IFCs are independent and publicly funded institutions established with the aim of strengthening the commitment of elected officials and wider publics to sustainable public finances (IMF, 2013; OECD 2014). A review of IFCs provides a number of insights into how futures are being configured at executive levels of government and an opportunity to examine how futures could be incorporated in policy making. Rather than seek to evaluate the work of IFCs *per se*, the paper uses IFCs as case studies for examining the actual and potential role of futures in the interplay between the exertion of power and construction of meaning in long term policy making (Vink *et al*, 2016).

Particular attention is drawn to the rationale and form of IFCs. With respect to the rationale, it is the remit of IFCs to draw attention to the future consequences of today's fiscal policies that is of particular interest to this paper. IFCs are designed to counter the alleged tendency of elected officials to use their discretionary powers to focus on accruing short term electoral gains at the expense of medium and long term economic costs, in the form of increased public deficits and debts. In terms of form, the perceived independent status of the assessments produced by IFC is central to their remit to counter and minimise the alleged tendency of governments to produce over-optimistic forecasts and or use technical loopholes to bend, if not break, fiscal rules. This places the onus on IFCs to demonstrate the rigour and independence of their work.

Within this paper it is argued that IFCs exhibit what is described as a technocratic approach to making sense of the future and policy making. Such a technocratic approach reflects a particular understanding of the problem of public debt and a limited understanding of the future and policy making. If unproblematized, IFCs have the potential to enact a form of temporal imperialism (Sardar, 1999) where what are deemed 'realistic' views of the future displace what are deemed as unrealistic alternatives - closing the future as a space for projecting a range of fears, hopes, and calls for another world (Nowotny, 1994). As a rejoinder to attempts to colonise and depoliticise the future, it is argued that strategic foresight can enable an open approach to futures and policy making. Strategic foresight enables the necessary *ficta* for policy making, where engaging with futures is not a struggle between

advocates of the real and the possible, but a question of asking what do we take to be real and what is really possible?

Accounting for Public Debt

In the years following the Global Financial Crisis of 2008–09, public debt[1] to Gross Domestic Product (GDP) ratios reached near historical highs (see Figure 1) (Abbas et al, 2010; Reinhart et al, 2012). Concerns over the sustainability of fiscal policy were in evidence prior to the Global Financial Crisis (Blanchard *et al*, 1990; Buchanan, 1958; von Hagen & Harden, 1995), but the deficits and debts that followed, provided a platform for raising questions of fiscal discipline (Beetsma & Debrun, 2016; Reinhart & Rogoff, 2009).

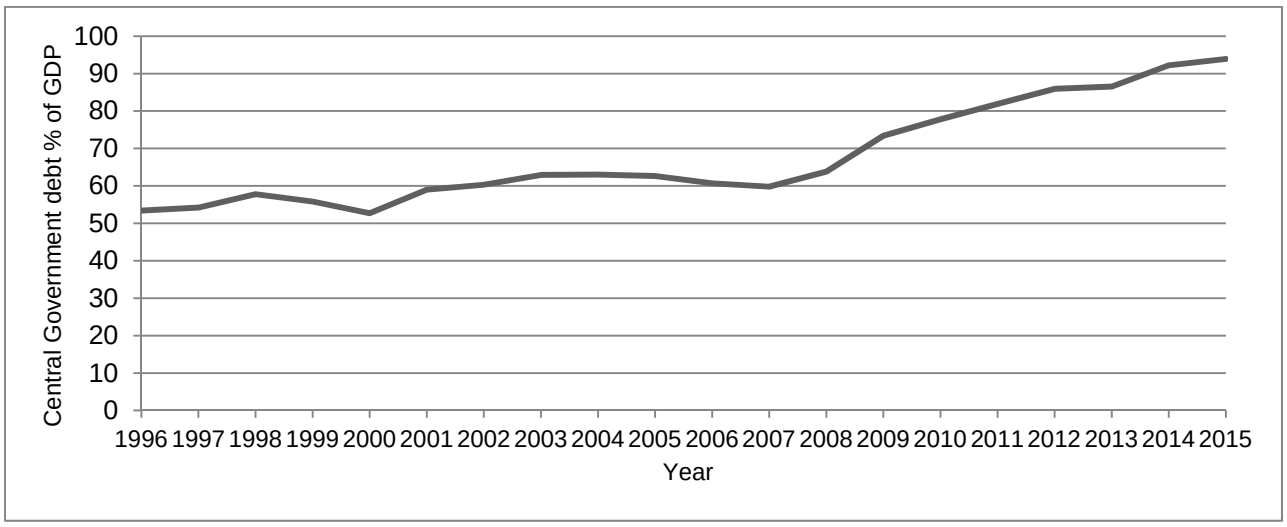

Figure 1.Central Government debt, Global total (% of GDP) (Source: World Bank, 2017)

In attempts to explain the rise in public debt, it has been argued that the demands and short sightedness of voters, combined with the opportunism of politicians keen to satisfy the electorates' appetites particularly on the eve of elections, have created an inherent tendency for political democracies to live beyond their means and accumulate debt (Beetsma & Debrun, 2016; Buchanan & Wagner, 1977).

A first wave of measures to tackle the alleged fiscal indiscipline of political democracies was the establishment and use of fiscal rules on acceptable levels of debt, deficits or expenditure (IMF, 2009;

[1] Debt is described as the entire stock of direct government fixed-term contractual obligations to others (including domestic and foreign liabilities such as currency and money deposits, securities other than shares, and loans) outstanding on a particular date, reduced by the amount of equity and financial derivatives held by the government.

Wyplosz, 2005). Continued concerns over government debt, led to calls for additional measures to ensure the transparency and accountability of fiscal policy (Hagemann, 2011). In part drawing on the precedent of independent central banks operating in the domain of monetary policy, proposals for the establishment of a new wave of IFCs, tasked with improving policymakers' incentives to opt for sound fiscal policies and avoid deficit bias, were made (Calmfors & Wren-Lewis, 2011; Debrun et al, 2009).

Unlike central banks, IFCs would not have discretion to set policy instruments, as elected officials would retain ultimate responsibility for fiscal policy. Instead, IFCs would provide independent and transparent assessments of the fiscal policies produced by governments (IMF, 2013). IFCs would have a remit to highlight broken commitments, unsound policies and missed targets. The rationale being that the scrutiny provided by IFCs would dis-incentivise elected officials from providing overly optimistic assessments of fiscal policy for short term electoral gain (Calmfors & Wren-Lewis, 2011). Subsequently, the transparency that it is hoped IFCs provide over the political cycle, would discourage any opportunistic pre-election tax give-aways or spending sprees - improving democratic accountability and realigning policy makers and the wider publics' expectations as to what constitutes a sustainable fiscal policy (Hagemann, 2011). Implicit in this assessment is a recognition that the actions that will need to follow from an independent assessment will not be welcomed or prove popular with a wider public. Subsequently, the role of IFCs can be described as helping policy makers and the wider public to face facts and adapt to future requirements. Arguments for the establishment of IFCs with a remit to ground and limit the excesses of politicised policy actors and help ensure the discipline and sustainability of fiscal policies have proved irresistible. Advocates for the establishment and operation of IFCs include the IMF, World Bank, OECD and European Union (EU).

Material and Methods

The OECD (no date) provides principles for independent fiscal institutions and the OECD Network of Parliamentary Budget Officials and Independent Fiscal Institutions (PBO) reviews and discusses how fiscal councils can affect fiscal performance. For the purposes of this paper the IMF Fiscal Councils dataset was used (IMF Fiscal Council Dataset, 2017; Debrun, Zhang, and Lledó, 2017). The IMF fiscal dataset describes key features of 39 institutions identified as fiscal councils (as of end-December 2016) across 37 different countries. The dataset includes general information such as the official name and acronym of the council and the date of creation or major reforms, the main features of the council's remit, their specific tasks and instruments to influence the conduct of fiscal policy as well as key institutional characteristics such as the existence of formal guarantees of independence, accountability requirements, and human resources. The aims of the paper are to review IFCs' orientations to the future and policy making and to identify opportunities and lessons for developing strategic foresight and policy making. Therefore particular attention has been given to those aspects of the IFCs' form and function that pertain to futures work.

Results

A number of governmental and non-governmental agencies provide forecasts and undertake assessments of government programmes. What distinguishes IFCs is that they possess macroeconomic competence, are independent from the political system, and arguably, most importantly for the purposes of this paper have a clear watchdog function that includes assessing the long term sustainability of fiscal policy (Calmfors & Wren-Lewis, 2011).

At the time of writing, there are 39 national IFCs recorded in 37 countries and the number of IFCs is expected to continue to rise. IFCs have been in existence since the middle of the 20th century, but it was the Global Financial Crisis in 2008-09 and significant increases in government deficits and debts that followed that gave real impetus to the development of IFCs and a trebling in the number of IFCs since 2008 (see Figure 2).

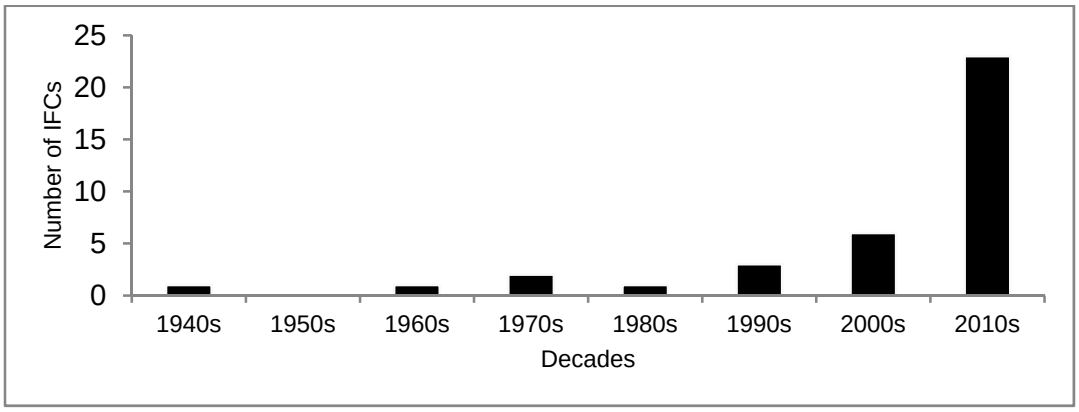

Figure 2. Number of IFCs that started activity in each decade (Source, IMF Fiscal Council Dataset, 2017; Debrun, Zhang & Lledó, 2017)

How IFCs assess and promote the credibility of fiscal plans does vary (Beetsma & Debrun, 2016).There is no one size fits all model for IFCs as there are variations with regard to status, mandate and tasks, leadership, staff arrangements, and budget. The heterogeneity of IFCs, in part reflects the values, resources and requirements of particular jurisdictions and contingent factors explaining levels of deficits and debts (Kopits, 2013). What is shared is a contracting out the production and or assessment of fiscal forecasts. A commitment to non-partisanship is considered central to the work of IFCs, particularly with regard to assessing and promoting credible fiscal policies (Beetsma & Debrun, 2016; Von Trapp *et al*, 2016). A number of measures are built into or adopted the form of IFCs (see Table 1).

	Independence / Non-partisanship		Management Independence	
Aspect of IFC	Legal	Operational	Safeguards on budget	Right to select staff
Percentage of IFCs that have adopted measure	87% 32/37	76% 28/37	57% 21/37	84% 31/37

Table 1. Measures to ensure the independence and non-partisanship of IFCs (Source: IMF Fiscal Council Dataset, 2017; Debrun, Zhang & Lledó, 2017).

The importance of non-partisanship is based on the rationale that even if the wider public disagree with the particular conclusions that have been reached there is the reassurance that the conclusions reflect dispassionate professional judgement - rather than the wishful thinking of politicians. It is the independence and more specifically, impartiality of IFCs that is most valued (Connor, 2013). That is, IFCs are impartial with respect to their forecasts, in the sense that they are not seen to be influenced by those who may be benefited or harmed by such forecasts and assessments.

Ex-Ante Analysis				Ex post analyses
Forecast preparation	Forecast Assessment	Long term sustainability	Costing of measures	
46% (17/37)	81% (30/37)	62% (23/37)	43% (16/37)	84% (31/37)

Table 2. Futures tasks and instruments of IFCs (Source: IMF Fiscal Council Dataset, 2017; Debrun, Zhang & Lledó, 2017)

A vital part of IFCs corrective function is the use of forecasts (see Table 2). Proposals for the establishment of IFCs focus on the benefits that independent and transparent assessments and forecasts can bring to policy making (Wren-Lewis, 1996; Wyplosz, 2005). The forecasts undertaken by IFCs can take several forms and functions, in part depending on the nature and relation of an IFC to other government agencies responsible for forecasting (Calmfors & Wren-Lewis, 2011). IFCs in the Netherlands and the UK have a remit to produce the official economic and fiscal forecasts used by governments. IFCs in Canada, Denmark, Korea, Mexico and United States produce alternative forecasts, while IFCs in Austria, Finland, France, Ireland, Italy, Portugal, Spain and Sweden provide an opinion on, or endorsement of, the government's forecasts. A common feature of the forecasts produced by IFCs is the projection of what is likely to happen if policies are to remain unchanged.

More broadly, forecasts have a tendency to project existing social practices, visions and interests, so that the future is little more than a linear projection of yesterday (Nandy, 1999). The probabilistic projections of forecasts have the potential to annihilate any future that is not contained in the present (Grosz, 1999). Furthermore, there is a tendency for a hegemonic present to become the norm against

which futures are assessed. This is not to say that forecasts should not play a part in the work of IFCs or that the use of forecasts in IFCs is not reflexive. There are IFCs, a notable example being the Congressional Budget Office in the USA, that examine what 'unchanged policy' actually means and consider different debt targets and alternative paths for reducing debts. However, the scenarios developed tend to assume and operate within the unstated parameters that today's predominant social, political, economic relations will continue far into the future. Furthermore, discussions regarding the social impact of such measures and a deeper questioning of the relations and interests that create the problem of debt are notable by their absence.

Forecasts used in budget	Binding forecasts	Comply or explain	Formal consultation or hearings	Can stall the budget process	Public reports
11% (4/37)	5% (2/37)	22% (8/37)	49% (18/37)	3% (1/37)	97% (36/37)

Table 3. Role of IFCS in budget process (Source: IMF Fiscal Council Dataset, 2017; Debrun, Zhang & Lledó, 2017).

There is a significant variation in the form of relationship and remit IFCs have with regard to the budget process (see Table 3). A potential threat to the perceived impartiality of IFCs stems from the remit to promote sustainable fiscal policies and make direct contributions to public debates on fiscal policy. Through the use of comply or explain clause, briefings, hearings and most notably the open publication of independent analysis, assessments, and forecasts, IFCs seek to raise public awareness about the consequences of certain policy paths and contribute to the development of a stability culture, which in turn is intended to reduce a public appetite for fiscal indiscipline (Debrun & Kinda, 2014). Thus not only are IFCs to be judged on the accuracy of their forecasts but the potentially contradictory measure of IFC's capacity and record for initiating necessary changes. The reputational damage that IFCs can pose to elected officials may well be a vital tool in seeking to keep elected officials on course, but it also politicises the project. Where the assessment of an IFC counters a government's position or accords with one party's views, it is almost inevitable that offended parties will be quick to question methodologies and the independence of an IFC.

Discussion and Conclusions

In reviewing the rationale, form and function of IFCs, the claims of independence and transparency within the current configuration of IFCs, over what are inherently political questions and approaches, means that the work of IFCs may at best be considered laudable but naïve, and at worst, represent an ideological sleight of hand in attempts to project established interests into the future. The establishment of IFCs have enabled the marshalling of the necessary expertise to make sense of the complex and uncertain realm of macroeconomics and policy making, but also reflect and help realise what are

described as technocratic tendencies in policy making - where politics is substituted for expertise. Expertise forms an important part of policy making, but the privileging of technical knowledge and expertise, unconstrained by political processes, is what characterises technocracy. Technocracy is most visible when individuals with technical expertise occupy the positions of government normally taken by politicians (McDonnell & Valbruzzi, 2014). More broadly, technocracy is also evident when democratic deliberations by elected officials are substituted for the application of the scientific method and specialised knowledge to address social issues and questions of policy making. The logic behind technocratic tendencies is that experts are able to establish what needs to be done. Such a tendency is evident in IFC's remit to align popular opinion with realistic assessments as to what the future will and implicitly, should be, though admittedly the emphasis is on aligning the public and politicians with the 'new realities' of fiscal policy.

The technocratic practices of IFCs can be seen as a legitimating practice and part of an increasing tendency to de-politicise policy making (Burnham, 2001). The rise of technocracy, at the expense of deliberative mechanisms, poses a number of challenges (Pastorella, 2015). Most notably, a monopoly of technocratic elites in policy making can lead to a reduced capacity to scrutinize or hold to account decision making and to make particular policies appear inevitable (Loye, 1978). Within this paper it is argued that the future is too vital to be entrusted exclusively to technocrats and a useful augmentation, if not rejoinder, to technocratic approaches is strategic foresight's focus on systematically exploring, creating, and assessing alternative futures. The value of strategic foresight is found in its potential to extend the horizons of what are recognised as possible and plausible futures (Habegger, 2009; Wilkinson, 2016) and reassert the primacy of the future as a domain of the possible. Where orthodox planning may seek to assess different options in order to arrive at an optimum process and outcome, strategic foresight is most potent when not only seeking to extend the realm of possible futures, but also deepening understandings of how futures can be realised and the values and interests that support particular visions of the future (Inayatullah, 2004; Slaughter, 1995).

Strategic foresight's orientation to the future in policy making can not only able to maintain a commitment to independence and non-partisanship, but also address a notable tension in the operation of IFCs. Rather than seek to provide a view from nowhere or promise a false sense of certainty, strategic foresight has the potential to consider a plurality of positions and thereby extend the menu of options for what could be done and the likely winners and losers of each position. This open approach to futures and policy making offers a rigorous and creative approach to highlighting the choices that are available, the anticipated outcomes of those choices and the interests and assumptions that those choices reflect. Given the foregrounding of the future in the work of IFCs, it will be interesting to see if and how strategic foresight can be used to further deepen and extend debates on fiscal policy. Though it should be noted that those who intend to project their current interests and status into the future may be reluctant to make use of strategic foresights potential to further enhance the capacity of policy actors to scrutinise policy proposals and articulate and extend what are deemed as possible and desirable futures.

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The Future of Government Workforces: Serving the People in the 21st Century

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Abstract

We explored the future of government workforces and assessed the implications for them of five critical issues: 1) do more with less, 2) do it with fewer people, 3) meet more and new demands for services, 4) work with an aging population and aging workforce, and 5) do it all digitally. The research started with an exploration of Maine State Government's future work and workforce in 2025, and was enhanced with an examination of how other governments are tackling these workforce issues. The results identified four significant outcomes for future government workforces plus five new roles: Participatory Careerists, High tech-High Touch, Citizen Enablers, Knowledge Users, and Flexible Functionaries. We concluded that new generations of government leaders who have an easy understanding of technology will use that understanding along with foresight to transform and manage complex government systems. We recommend a detailed workforce planning and talent development strategy to bridge the performance gap anticipated in 2025 and beyond.

Introduction and Background

Governments are heading into difficult waters in almost all countries, in part because most governance models are centuries out of date, inflexible, underfunded and rarely foresight-focused. As foresight consultants, we were fortunate to work with the State of Maine's human resources commissioner who was willing to raise questions about the future of her state's government workforce and its long-term engagement with the state's citizens.

In the US, state governments, positioned between the federal government and their city and local governments, have a long tradition of supporting their state's economic development, investing in state university systems, boosting trade and foreign investment, etc. As budgets shrink, and less Federal money is available, state governments are leaving this work to their big cities. This matches a long-term demographic trend of people moving into cities, and all but abandoning small towns and rural areas.

Maine, like many state governments in the United States, and similar sized governments worldwide, will need to reckon with specific realities over the next decade. Maine is the US state with the oldest population, with a median age of 44.6 years (United States Census, 2017). The state operates in national and global economies that are undergoing economic transformations. It can no longer rely on traditional mainstays of extractive industries and tourism; it needs new industries and businesses for a successful future. Finally, Maine faces a 'new normal' in society and commerce: the dominance of digital technology, digital processes and data-intensive fruits of their application. The work of fitting state systems and skill sets to digital realities is open-ended, because the technology is always evolving.

The primary research question driving the project's structure was: What will the state government's work, and correspondingly the workforce, look like in 2025? The client asked us to address an additional 17 questions identified in the flowchart below.

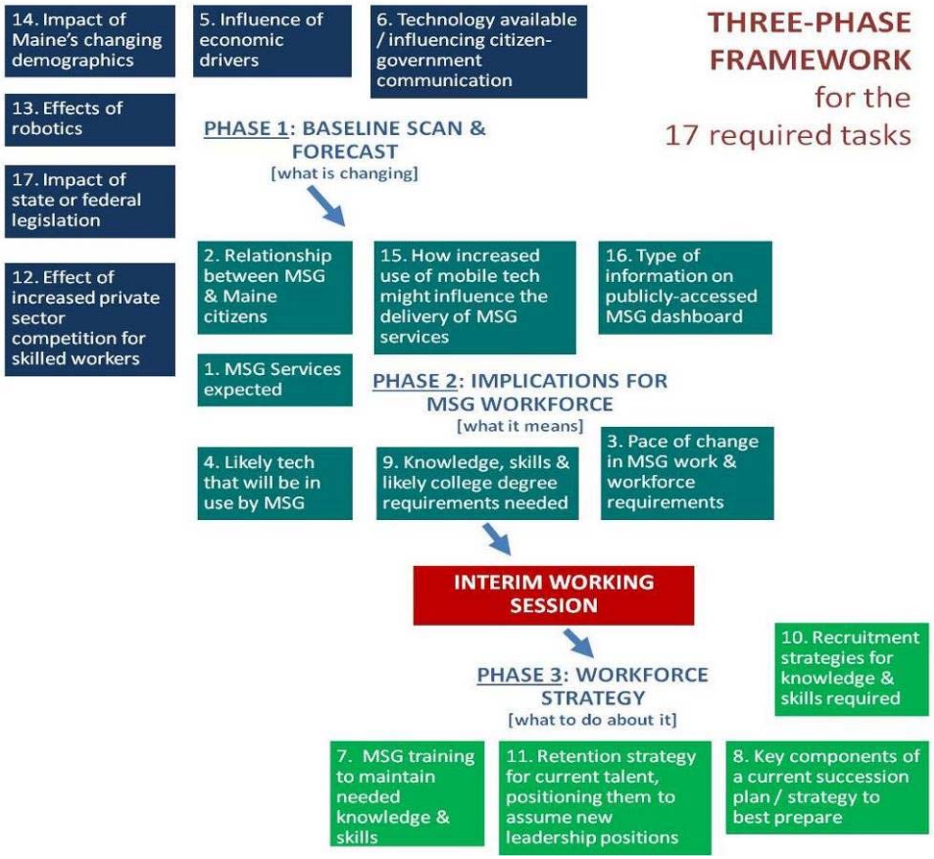

Figure 1. Three Phase Framework for 17 Tasks

From our engagement with the State of Maine and its future, we concluded there are 5 critical issues facing some, if not all, governments. These issues confront governments at this level with challenging conditions in the near and longer term:

1. Do more with less (smaller budgets, part of a long-term conservative trend in the US)
2. Do it with fewer people (combination of less money and tough recruiting climate)
3. Meet more and new demands for services (greater responsibilities in a more complex society)
4. Work with an aging population and aging workforce (most developed countries face aging population issues, and many government workers are on the edge of retirement. Maine's situation is extreme in this respect) and
5. Do it all digitally (there is no turning back from the digital revolution).

Taken together, these new realities, along with other shaping forces, tell us about how Maine and the demands on its government's 2025 workforce will change.

Material and Methods

Our Approach

The research approach used several futures methodologies: 1) a review of relevant information from our extensive database on the future of work, 2) a scan of external trends, 3) the completion of conversational Delphi interviews with key representatives from a wide cross section of organizations and individuals plus Maine State Government (MSG) staff, 4) the development of four scenarios depicting possible futures for the Maine State government, 5) the facilitation of a workshop with HR leadership to validate initial findings, and 6) the facilitation of a government leaders' workshop to interpret findings and consider future courses of action.

Scanning Results

The future of work is a broad topic. We reviewed ours, and others', prior research on the future of work, examining broad issues and trends nationally and locally, as well as across industries and sectors. From this review, we selected specific trends relevant to MSG's future workforce and its relationship with its citizens.

Conversational Delphi Interviews (CDI)

The client identified over 30 potential interviewees from inside and outside government including: academia, heads of government departments, legislators, community and business leaders, and MSG staff. In CDI, interviewees are asked to identify important changes they have observed over the past decade. They are then asked to identify changes they anticipate for the next ten years. The interview results were analyzed for patterns and themes that informed the next phase of the research--scenario development.

Four Scenarios

Four scenarios of possible conditions existing in the Maine of 2025 were developed, describing different futures in which the state government's workforce could be required to operate and serve the citizens. These stories explore "what if?" ideas about the future, and should not be taken for forecasts or predictions.

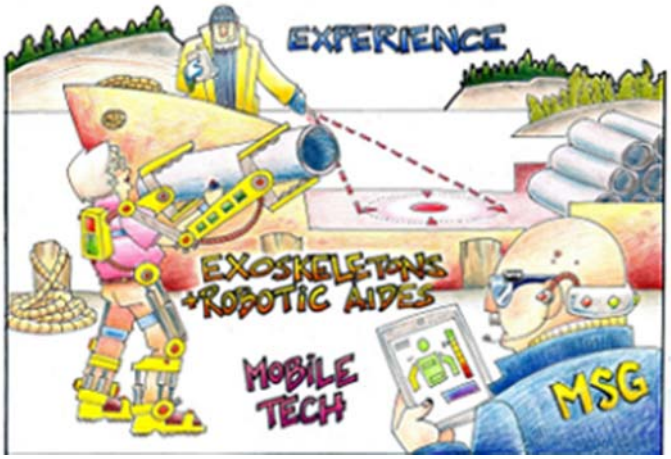

Figure 2: Scenario image: The Senior Civil Service 2025 Setting an international example for an active and productive older workforce

Image: Simon Adams, www.simon-adamsart.wordpress.com

Figure 3: Scenario image: Virtual Maine 2025—Maine leaps forward into online government service, embraces technology to build more community, social focus

Image: Simon Adams

Figure 4: Scenario image: New Economy Maine 2025—A technically expert, younger government workforce backs a growing high-tech economy in the state

Image: Simon Adams

Figure 5: Scenario image: A Workforce Left Behind 2025—With fewer employees, government workers struggle to serve the state's many and growing needs

Image: Simon Adams

Results

Work Implications for 2025

Taken together, the foregoing creates new demands and expectations of the state government. Though the trend has been towards a shrinking government workforce, new demands could reverse that pattern, at least in some departments. At the core are demands for new services from MSG. Meanwhile, these trends and a wave of emerging technology align to drive evolving relationships between the State Government and the Maine citizenry-- more people will embrace digital life as the state uses technology to streamline work and reduce costs.

Maine State Government services expected

Broadly, the state's evolving economy and population will raise the demand for services in five areas:

- Supporting business and economic development
- Serving an older population
- Addressing the needs of new Mainers, including a more diverse population
- Aligning services and regulation, permitting, taxation, and enforcement with the rise and growth of new kinds of businesses and industries.
- Raising the digital competence of the State Government, and serving the citizenry with a cost efficient, effective suite of digitally-based services.

Maine State Government Relationship and Digital Services

Constituencies that the state government serves will demand access 24 hours a day, 7 days a week, using multiple contact options. Many citizens will prefer to use mobile apps, and self-serve, automated systems, while others will expect legacy systems. The State Government will find itself choosing which services can be supported with technology, and which must employ human staff. Private sector customer service experiences flavor the expectations citizens will bring to interacting with government. They will expect best of class approaches.

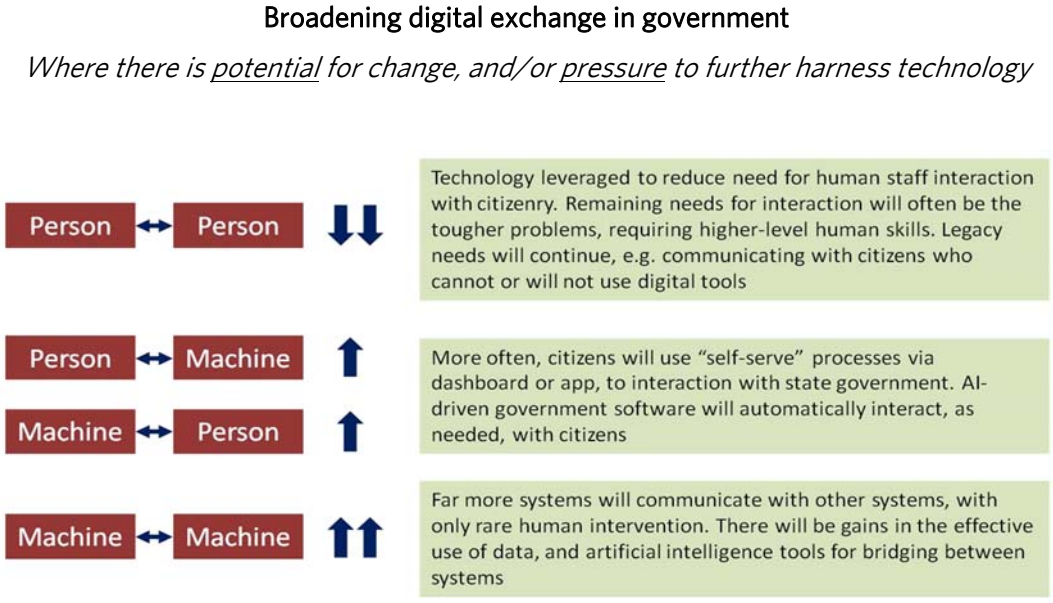

Figure 6: Broadening digital exchange in government. Source: Leading Futurists LLC.

Workforce Implications for 2025

The workforce of 2025 will span five generations – 18 to 75+ – by design, not by default. Workers will be expected to value learning, and be held responsible and accountable for using that learning to enhance and innovate. Technology will be both a means for getting work done and a familiar presence at work. Workers growing comfort with and inclination to use technology will make it a valuable co-worker. Workers' relationship with state government will be less defined by where how and when work is done. Maine will influence, and be influenced by, a global economy that operates across borders and time zones thus requiring greater knowledge of other people and cultures.

Workforce requirements for 2025

The following describes 2025 outcomes implied for MSG's future workforce.

- *Lean/effective*. 2025 state government workers' capabilities portfolios include: multi-disciplinary knowledge, inter- and intra-personal skills, creativity and innovation, problem solving, self-directedness, and technological competence. These workers function well with continually changing work priorities and goals, moving into and out of stable, ad-hoc and virtual teams. Workers transition into and out of leadership roles, defined by task.

Workforce requirement for 2025

- Lean and effective workforce
- Digital workers and data analysis
- Age diverse work plan
- Continuous learning and development
- Intelligent innovation and change
- Employment relationships more flexible
- Cultural fluency and global competencies

Figure 7: Workforce requirements summary

- *Digital workers and data analysis*. Workers use technology seamlessly to interact with citizens, mastering devices connecting and engaging with the digital world. Workers retrieve, analyze, and use data to solve complex problems, and rely on data interpretation to predict and anticipate services' design and needs. Some workers design apps and/or systems, others manage or maintain the technology; still others teach other MSG workers about technology's leading edge products and services adapted for use within state government.
- *Age diverse work plan*. An age audit, completed in 2015, revealed an imbalance of workers' ages with a significant skewing of workers beyond age 50+. A rebalancing plan has extended employment of retirement-eligible workers long enough to build a replacement workforce of younger workers. Educational programs shift attitudes and practices to support aging workers. Older workers lead and manage MSG legacy operations providing the time needed for HR to recruit, develop, and position the next wave of younger workers. The plan redefines primary working ages to 24-75+.
- *Continuous learning and development*. Workers continually update technical and work knowledge, skills and certifications to keep up with evolving expectations and needs. Training is offered, accessed, and evaluated in a 24/7 environment with instant feedback on learning mastery. Learning is captured, stored, and available for the government workforce through enterprise-wide knowledge management systems. Learning mastery influences workers' access to future assignments, job opportunities, and salary increases.
- *Intelligent innovation and change*. Workers are responsible for using innovation to work smarter and better as shifting challenges reset priorities, resources and time. The flow of work is fluid, and change is anticipated and planned for in work allocation. Project management rests on multi-dimensional work efforts using rapid prototyping, simultaneous solutions, crowdsourcing and when necessary, the outsourcing of innovation to solve irregular or sustained problems. The pace of change is marked by continual, daily adaptations involving incremental changes, accompanied by irregular bursts of substantial transformations in work and workflow. Collaboration, within and outside of government, is critical for workers engaged in innovating and problem solving.
- *Employment relationship*. Employment categories within the 2025 state government will range from full-time (includes essential, core, and operational) to part-time, including temporary, ad hoc, situational and seasonal. Regardless of employment category, MSG talent recruitment efforts find and evaluate candidates for the right fit, placing greater emphasis on 'potential to perform' rather than on past performance.
- *Career path*. Workers self-direct and self-manage their own career paths. Multiple options exist for career growth. Some paths lead to the leadership pipeline, other career options entail varied work experiences and opportunities designed to keep workers engaged rather than upwardly mobile. The government provides development options that align staff interests with the government's work goals, thereby maximizing worker efforts that support meeting the goals and mission.

- *Cultural fluency and global competence*. Workers are aware of global current events and demonstrate specific cultural competence about countries that Maine considers its trading partners. Of particular importance are Maine's northern neighbors in Canada and Iceland. Within the US as a whole, Hispanic language and culture will be a larger force in many aspects of the US economy.

Workforce Readiness in 2025 – Training and Succession Planning

Workforce readiness in 2025 assumes workers demonstrate a cluster of important attributes: ***learner, interpreter, communicator, and connector*** for example. Workers will need to learn about emerging changes that affect their work, interpret the implications of the change for a wide audience, communicate the relevance and importance of that change, and connect with appropriate social networks impacted by the change. Workers will have to be knowledgeable operators within the regulatory, legal, and programmatic context of their work.

Succession planning for Maine State Government will be critical and essential. Planning reduces risk by ensuring that no one person who retires or exits the organization can impair government operations. Planning also reduces cost. It is more cost effective to plan for a replacement than to hire in a crisis.

Succession planning combined with planned workforce development ensures against work slowdowns or interruptions, and serves as an effective recruitment and retention tool. Clear career paths and job development opportunities are desirable recruitment and retention strategies for both younger generations looking to initiate careers and middle-aged workers who want to invest in a longer working future.

Discussion and Conclusions

In our work with Maine State Government, the four scenarios depicted possible futures of a unique state government. When we step back from this view, and consider the future of government workforces as a whole, we have five basic conclusions. Caveat: The particular design and structure of US governments implies certain outcomes that might not be true for all government workforces everywhere else.

Key Outcomes for Government in 2025+

- *Smart Government* - where government and citizens alike rely more on the understanding and effective use of digital technologies
- *Global Citizens-Local Government* – government workers can work anywhere
- *Government needs new allies, cooperation* - climate change driven migration may overwhelm single government systems as mass migrations of people move away from less hospitable climates to more desirable ones
- *New Relationships* – a 'shared' enterprise as more Public Private Partnerships (3P's) emerge to fund, build and operate functions, systems historically performed by government

- *Universal Basic Income* – may be a competitive advantage for governments, as they streamline diverse income and support systems no longer needed

Key Implications for the Workforce

- *Anticipatory Careerists* – Reinvent the concept of work, as it is experienced at ages 18 through 80 with multiple entry and exit points throughout a career. However, issues of economic security will have to be resolved.
- *Citizen Enabler* – if a future premise is that the role of government is to enable and facilitate a quality, healthy, safe lifestyle and not just provide basic services and a safety net – future generations will be more willing to let go of legacy concepts of government's purpose, role, and operations.
- *High tech – High Touch* – increased use of technology requires an equal measure of an ability to maintain the 'human' in interactions. Future workers will need the ability to interact, govern, implement laws and connect with citizens in a digital world where government and citizens rely on technology.
- *Knowledge Users* – a bifurcated workforce in which some users will need fewer skills and less knowledge as Artificial Intelligence and robotics assume higher cognitive tasks. Some workers will need more technical skills to leverage big data, and to make sense of data for decision-making and governing.
- *Flexible Functionaries* – workers will likely become adept at operating in fluid organizational structures, with changing roles, shared leadership opportunities, and rotations into and out of ad hoc teams.

The potential exists to transform government and its operations in the future. The digital revolution is radically reshaping all pre-Internet systems, as well as helping create post-digital workforces, such as those in the gig economy. Future e-governments will need to choose how much to automate, and to what degree they will use big data analytics and AI in operations and governing.

There are likely to be fewer government workers. Specific jobs may give way to daily assignments or tasks, creating more fluid organizational settings of roles, responsibilities and leadership. Government work in the future may be less about meeting citizens' needs for services and governance and more about providing opportunities for engagement as volunteers or paid workers contribute to making government work.

In our research, we have come across government leaders (more commonly in city governments) who believe their ultimate goal is e-government driven by citizen engagement. There is an increased use of apps, smart traffic controls, mobile information on-demand, profiling and instant feedback. These services require a sophisticated and collaborative workforce united around one goal.

In 2025, the government workforce will likely be led by post-Baby Boom generations who are comfortable using technology to govern and operate in a way that serves citizens 24/7 with both technology and the human touch.

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The Future of Deliberative Policy-Making in Finnish Welfare Services

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Abstract

The research discusses and outlines the possibilities of addressing the future challenges of welfare complexity by participatory instruments: involving the inhabitants and welfare service users in defining and visioning the future welfare by exercising the norms of deliberative democracy in municipalities. The aim of the study is to gather information about the possibilities and obstacles of the deliberative policy-making future in welfare services at the municipal level in Finland. One of the empirical parts in the research consists of a Delfoi-study of an expert panel with 37 participants representing the executive managers of 3rd sector organizations, the chairpersons of the municipal councils or welfare service boards and the leading office-holders of municipal welfare offices estimated and discussed the projections of municipal welfare policy-making for the year 2030. The results of eDelfoi indicate that despite the approving attitudes towards more discursive administrative culture, the participative practices to function as a means of or policy-making in welfare services are not fully trusted. Future citizens' influence in welfare services was primarily seen channelled through consumerism. Increasing individualism and inequality was considered inhibiting the deliberative policy-making practices.

Introduction and Background

Welfare policies, in relation to other policies, should rest its preferences on citizens affected by them. However, these preferences are not generally sketched at any particular time or occasion beyond voting for national or regional delegates with legislative and representative accountability. Yet, the policies built upon electoral trust have the comprehensive and temporally extensive effects of the well-being of those very citizens. This contradiction poses a dilemma not only for representative responsibility but more broadly, the basis and legitimacy of the democratic policy-making process. (Thompson 1988.) The call for refining and amplifying participation and is methods can be seen to have grown along with people becoming estranged from traditional, representative democracy and political decision making. Political activity and policy-making can presently be perceived as an isolated system apart from citizens.

The ambition of the notion can be construed to pursue the embracing of participation beyond the representative politics. Since evolving from its classic form of "government", governance extends over closed establishments and party politics to a wide range of decision-making by a variety of assemblages of diverse actors. In the European Union context, the concept is alleged to restrain the "democratic deficit" by improving the legitimacy of the decision-making process in a multi-level structure of

the EU. (Magnette 2003) The White Paper on European Governance (COM 2001) names five principles to underpin good governance: openness, participation, accountability, effectiveness and coherence. Inclusive, participative practices are stressed in the paper and the reinforcing of civic involvement pronounced as the main objectives of the governance reform.

In the context of welfare, the advantages of participative concepts are eminent especially approaching an inevitable discrepancy between increasing demands of welfare services and respectively diminishing resources. Internationally observed there is a strong shift towards emphasizing service users' perspectives in service planning and welfare policy decision-making (e.g. Martin 2008; 2011; Vigoda 2002). The WHO (Jakubowski & Lister 2006) defines participation as an inseparable component of the governance in welfare services: "The definition of good governance entails a participatory process, responsiveness of governing institutions to the views and preferences of consumers and a consensus orientation"

In Finland, there is a slow awakening to the significance of service users' expertise of the services while the methods of public guidance are still sketching their outlines (Raisio 2010; Möttönen 2012). The shift is somewhat perceptible in documents concerning service planning and reforming; e.g. the Ministry of Social affairs and Health (STM) is framing customer orientation in its strategy as "an offset of developing services as well as a strategic choice aimed to shift emphasis towards preventative and achievable care". Reforming of services is implemented through "the active participation of service users", assigning the communities (municipalities, regions) to determine their means of citizen involvement. Despite the efforts of Finnish ministries and public offices in developing citizens' engagement and municipal democracy (e.g. Open Government Action Plan 2015–2017), the experiments in participative policy-making have remained local and relatively small-scale.

The research leans on the perception of the growing role of deliberative democracy in future governance. The Finnish Institute of Deliberative Democracy (DDI) defines the conception of deliberative democracy as follows (translation): "Deliberative democracy provides answers to the challenges in representative democracy by strengthening democratic legitimacy and considering of the common good. Deliberation emphasizes reciprocity and appreciation of the diversity in opinions as well as increases the informed opinion as a foundation for decision-making." The Institute of the Languages in Finland has proposed that the term of Deliberative Democracy (suom. puntaroiva demokratia, keskusteleva demokratia) should be equivalent to "discursive democracy" in English, which emphasizes interactive and dialogue in decision making.

Deliberative democracy theory is a normative theory focusing in objective of policy legitimation by means of communicative processes (Chambers 2003; Dryzek 2005). The conception rests upon the ideal of collective argumentation, emphasizing its participative (e.g. citizens, service users, inhabitants) attributes. By means of various deliberative arrangements (e.g. citizens' juries or panels, deliberative polling) an equal discourse is reached. Ideally, after introductions given by various experts, exchanging the views and profound reflection of issue addressed, a conclusion, which all members of the deliberation can engage in, is reached and presented. (e.g. Raisio & Vartiainen 2015.)

Some interpretations of deliberative democracy do not comprehend a universal agreement as an essential requirement for deliberation to function in democratic purposes, albeit a quarter century of experimentations in deliberative practices have proven the publics' ability to make sound choices. A significant outcome of deliberative democracy is the confidence in a fair process and of being heard despite the disagreement, or even exposing the underlying, fundamental conflicts and perspective differences without the objective of consensus. (McAfee 2008; Mansbridge 2008.)

The aim of the research is to gather information about experts' conceptions of the true possibilities and obstacles of future deliberative democracy in welfare service decision-making at the municipal level in Finland, which is presently built on the so-called "dual model" of elective politicians making decisions based on the office-bearer prepared presentations. The research discusses and outlines the possibilities of addressing the future challenges of welfare complexity by participatory instruments: involving the inhabitants and welfare service users in defining and visioning the future welfare by exercising the norms of deliberative democracy in municipalities. The arrangement contrasts the premises of anticipatory thinking with contemporary administrative science discourse.

Based on the results of a survey it is intended to compose a vision of the factors affecting discursive democracy development in the context of welfare decision making.

Material and Methods

The survey was implemented as an eDelfoi-survey in October–December 2015 in three periods, each active for two weeks. The survey was built of future assertions (claims), which were anonymously commented by experts (panelists). The first period consisted of six future claims based on the activity theory developed by Yrjö Engeström. After analyzing the comments from the first round, next assertions were presented for the discussion. This was repeated for the last round.

The panelists were asked to evaluate the probability and desirability of each assertion with a scale (seven-level Likert). In addition, the panelists were asked to justify the estimates or judgements verbally after each claim and encouraged to question or challenge each other's arguments. It was possible for the panelists to comment on other panelists' remarks as well as to revise one's own responses. A panelist could choose a suitable moment for responding, within the timeframe of two weeks. A panelist also received a note to his/her e-mail once there is a comment made of his/her response in a conversation.

The expert panel consisted of 37 participants representing Finnish

- service users (the executive managers of non-profit, 3rd sector organizations)
- political decision-makers (the chairpersons of municipal councils or welfare service boards) and
- office-bearers (leading municipal welfare officials).

All panelists had a substantial experience in welfare policy-making practices. The answers were anonymous and they panelists represented views as private individuals, not as organization representatives. To secure the anonymity, the panelists of the 2 last groups were selected from different municipals with no announced, cooperative affiliations or consolidations.

Results

The basic principles of a SWOT-analysis were utilized in analyzing and structuring nearly 200 comments of the first round to 61 variables and further to 19 themes. The preliminary results of the first round are demonstrated in Figure 1.

enabling elements (26)	**inhibiting conditions** (86)
Antecedents to progression of participative decision-making practices. Reflecting current system, partly controllable by present day competences or circumstances.	
Technological skills, web coverage. Strong (existing) representative system and incipient hearing practices. *Opportunities in municipal or legislative readjustment (welfare, regional and government reform).* Experimental courage.	*Cultural inertia.* *Lack of PD knowledge.* Increasing inequality and consumerism in welfare services. Challenges in incorporating PD with current representative system. Challenges in municipal readjustment or governing structures in general.
favorable prospects (45)	**unfavorable consequences** (32)
Resultans of progression in participative decision-making practices. Future assosiated, partly nebulous or intangible.	
Legitimacy improvement. *More equitable and flexible resource distribution.* Regenerating the modi operandi of council work. Increasing health empowerment. Reconcilement of complex welfare issues.	*Tokenistic participation.* *Unequal coverage of involvement.* The decline in political representativeness. *Socieltally poor decisions.* Eroding liability.

(*In Italic*: Variables over the amount of 1/4 or 1/5 in its category.)

Figure 1. Preliminary results of the first round analysis. Antecedents to and resultants of progression in participative decision-making practices.

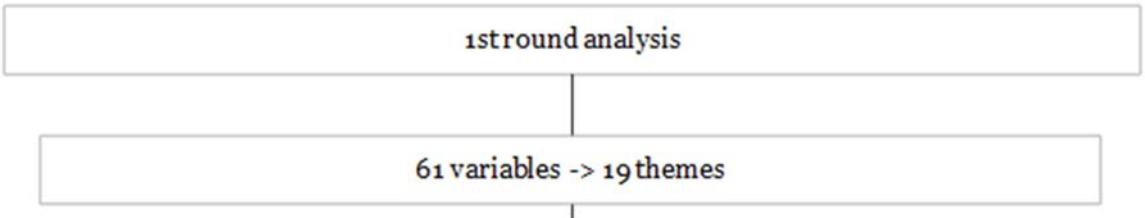
The panelist conversation embraced both current attributes and future prospects that were further categorized as positive (enabling elements and favourable prospects) and negative (inhibiting conditions and unfavourable consequences).

Considering the participative or deliberative policy-making development concerning current administrative attributes, few themes stood out:

- technological skills and opportunities in current welfare reform as enabling elements, and
- cultural stagnation and the lack of knowledge in participative practices as inhibiting conditions.

The future prospects of the different participative decision-making practices were mostly seen to improve decision-making legitimacy and equity, when tokenism and inequality as well as the low quality of policies were seen as the unfavourable consequences.

19 themes were further constructed into three main categories which were expanded in following rounds. Figure 2. illustrates the structuring of the iterative process.



Main categories	Future claims of rounds 2 and 3
Service outcomes	7 Universal services
	9 Service prioritization
	10 Service equity
Structures of involvement	11 User imperatives
	13 Reallocating municipal roles 2/2
	14 Autonomy policies
Administrative interrelations	8 Forces of influence
	12 Reallocating municipal roles 1/2
	15 State steering 1/2
	16 State steering 2/2

Figure 2. The iterative process of the first found themes/analysis. Topics discussed in round two marked with green and topics discussed in round three marked with blue colour.

Emerging over the conversations in rounds two and three, the underlying issues affecting the future of deliberative policy-making practices were divided according to main categories:

- Service outcomes:
- Increasing, general inequality and individualism.
- Public funding insufficiency or economic myopia.
- Emphases on (health care) professionalism.

Structures of involvement:

- Systemic and attitudinal challenges.
- Marginal involvement.

Administrative interrelations:

- The strong role of Finnish welfare reform and the role of the municipalities.
- Increasing consumerism in welfare services.

Discussion and Conclusions

In spite of the general, increasing appetite for participative arrangements, the concept of participation is restrictedly comprehended. Being widely understood and loosely outlined, an increasing number of procedures to enable involvement are used and developed, ranging from straightforward polls to complex deliberative arrangements. (Rowe & Frewer 2005). The interpretation of good governance from the participative perspective has developed Finnish municipal counselling bodies and policy planning processes in order to meet the manifold claims of participation and minority representation. Despite the various efforts developing public governance to meet those exigencies, the experiments in participative policy-making have remained local and relatively small-scale.

The preliminary results of eDelfoi research presented here show that regardless of strong trust in technological preparedness and the structural opportunities in the extensive Finnish welfare reform well in progress, the cultural inertia and unawareness generate attitudes inhibitory of participative decision-making practices progression. Even though the resultants in advancing the participative practices were considered influential to decision-making legitimacy as well as the very central idea of welfare services, equal and flexible resource distribution, there were reservations about the inclusion of participation. Some of the panelists were also concerned with the deteriorating validity as well as the liability of the decisions reached by means of participative practices.

Several undercurrents affecting the future development of deliberative progress in decision-making were discernible in the conversations. Increasing consumerism in welfare services in tandem with the public funding insufficiency were emphasized, collectively proliferating general inequality and individualism.

The present and extensive efforts to rearrange future welfare services in Finland highlight the desideratum of policy-making discussion. Regardless of the recently revised Local Government Act, which enables the municipalities to develop a range of participative activities and regulates the inhabitants' right to take part in them, it does not ensure the implementation of the law in local welfare policy.

It is stated that the past Finnish health care reforms have so far failed to meet their objectives due to the disconnection between issues addressed and the challenges of the society (Vartiainen 2010). The current evident and harsh disrespect of the citizens' initiative regarding the health care reform demonstrate the lack of dialogue in policy-making and justification, as well as the insufficiency of the present practices in citizens' involvement. According to this research, the signals of weakening universalism and equity – the very essence of the Finnish welfare system – have harmful effects on the development of deliberative practices in welfare decision-making. Yet, diminishing of these values creates a demand for a high quality dialogue of our future welfare policies and goals.

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Business and Peacebuilding: Towards a Framework for Mapping Governance Linkages

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Abstract

Around the world, private companies are increasingly participating in peacebuilding activities. Many scholars, politicians, and business leaders are enthusiastic about what they now call "business for peace. However, the results to date of corporate involvement in peacebuilding have been mixed, particularly in the extractives sector. Current single-factor explanations for the successes and failures of "business for peace" do not reflect the sheer complexity of peacebuilding contexts. This paper proposes an alternate conceptual approach rooted in complex systems theory and global governance literature to disentangle the dynamic web of agents, rules, norms, and activities involved in foreign-owned mining and peacebuilding, drawing on literature from complex systems theory and global governance. This paper does not engage in futures forecasting, but rather engages the complexity of the present and illustrates how complex systems approaches can inform and improve the effectiveness of public and private governance activities.

Introduction and Background

Around the world, private companies are become increasingly involved in peacebuilding activities. Many scholars, politicians, and business leaders are enthusiastic about what they call "Business for Peace." Myriad initiatives are emerging, such as the United Nations Global Compact, Sustainable Development Goals, and Business and Human Rights, which advocate the positive impact companies can have if they link efforts with governments in peacebuilding (Honke 2014; BHR 2015; UNGC 2013, 2015a, 2015b). To date, however, the results of corporate involvement in peacebuilding are unclear, particularly in the extractives sector where the often adverse environmental and social effects of mining activities are well documented and have received high pubic attention (ICMM 2015; Rustad et al. 2012). Research on the increasing involvement of private companies in other areas of social policy suggests that the expanded role of private companies in governance activities outside their traditional business sphere (such as peacebuilding) expands their influence in society (Bailey et al. 2015; Jacques 2016; Ong 2006, 19). At the same time, scholars also emphasize that recent emergence of norms for corporate conduct (such as corporate social responsibility, the "social license to operate," and Business and Human Rights) have begun to fundamentally impact companies' business strategies (Davis & Franks 2014; Dashwood 2012; Prno & Slocombe 2012). One of the key challenges underpinning policy and planning discussions is the fact that the current single-factor explanations for the successes and failures of "business for peace" cannot capture the sheer complexity of peacebuilding contexts.

A first step towards overcoming this challenge is to develop a conceptual framework that can better capture the various direct and indirect ways in which mining operations and peacebuilding activities may be interconnected. This paper presents a framework rooted in complex systems theory, comprised of three key elements. First, interconnections between mining and peacebuilding are conceptualized as occurring within the broader dynamics of a "social-ecological system," drawing on the work of Berkes et al. (2003). Second, focusing on the "social" side of this social-ecological system in further depth, the dynamics of society (i.e. social systems) are conceptualized in terms of three dimensions: Structural, Attitudinal, and Transactional, drawing on the work of Ricigliano (2012). Third, "mining" and "peacebuilding" are conceptualized as complex systems in themselves, which are comprised of various Structural, Attitudinal, and Transactional elements. A closer examination of mining operations and peacebuilding efforts is undertaken to identify their various structural, attitudinal, and transactional elements. All together, the utility of this framework is that it provides a starting point for identifying linkages between mining and peacebuilding, as well as a tool for synthesizing research from diverse fields on various aspects of these enterprises.

Material and Methods

Social-Ecological Systems

The concept of "Social-Ecological Systems" emphasizes the reality that social life relies materially on the environment (Berkes et al. 2003, 3; Escobar 2008).[1] At the same time, society also materially impacts the environment, for example, through the over-consumption of certain resources, pollution, or other environmental transformations (e.g. clear cutting). By putting in place measures for collective action, society can also sustain, conserve, or restore ecosystem services, for example, through creating rules and norms, organizations and other collectivities to motivate (or compel) transformations in behaviour (Berkes et al 2003). Social-Ecological Systems can be understood as comprised of "Social systems" and "Ecological systems," which are interconnected and interdependent. Social systems can be understood as the enduring series of relationships, patterns of activity, and ideational that produce and reproduce collective social action (Giddens 1985, 24–25); ecological systems refer to the self-regulating communities of living organisms and abiotic materials of the earth (Ash et al. 2010, xi; Berkes et al 2003, 3).

[1] For example, societies rely on the earth for food (through agriculture, raising livestock, fishing, or hunting), fresh water, and other material resources like timber, minerals, and metals. Broader ecological dynamics like the climate also impact material aspects social life, for example, by affecting agricultural yields, the prevalence of diseases, or the frequency and impact of major weather events (Ash et al. 2010, xi, 4-5, 128–29).

The proposed conceptual framework considers the broader social-ecological context in which mining and peacebuilding activities are taking place in each case. Then, the framework considers the specific ways in which mining and peacebuilding activities rely on and impact the social and environmental spheres. Finally, the framework considers whether, and to what extent, interconnections between mining, peacebuilding, and the social and environmental spheres may alter the broader social-ecological context, or whether mining or peacebuilding activities themselves may be altered by these interconnections, as illustrated in Figure 1.

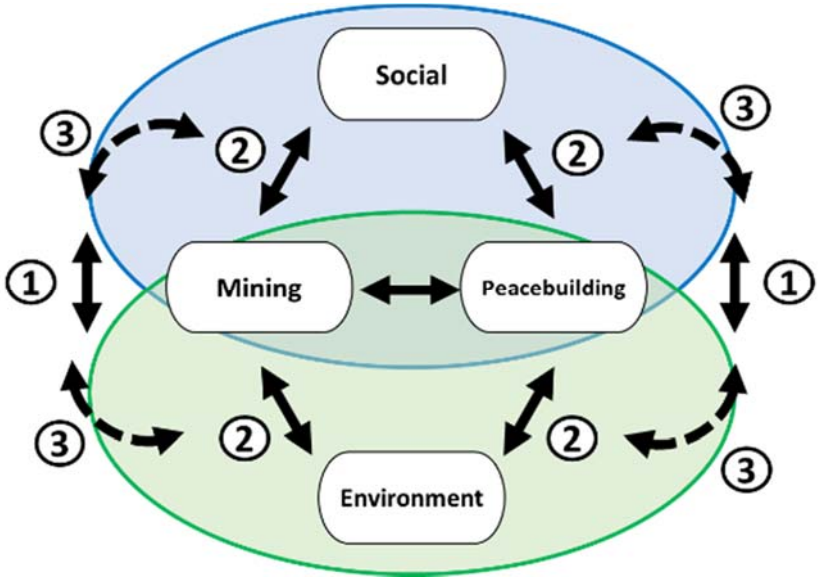

Figure 1. Linkages between Mining, Peacebuilding, and the Broader Social-Ecological System.

Social Systems: Structures, Attitudes, and Transactions

Although social systems and ecological systems are interdependent, social systems contain other unique elements, such as norms, beliefs, and values, which do not have an equivalent in ecological systems (Westley et al. 2002, 107). These unique elements are relevant to social-ecological system dynamics, thus need to be included into conceptualization work. Ricigliano's (2012) "SAT Framework" considers three relevant and interlinked dimensions of social systems: Structural, Attitudinal, and Transactional. The "transactional" dimension concerns the capacities, behaviours, and activities of "agents," as well as the series of interactions that occur among "agents." The "attitudinal" dimension concentrates on various perceptions, beliefs, values, and goals held by "agents." The "structural" dimension focuses on the enduring web of rules, norms, and institutions that characterize societies. "Agents," for the purposes of this framework, refer to collective organizational units and sub-units (rather than individual persons), such as businesses and business sub-units, government departments, or NGOs, and are the ones undertaking transactions, holding attitudes, creating and being bound by structures.

Unfortunately, Ricigliano (2012) does not propose any specific mechanisms through which the Structural, Attitudinal, and Transactional dimensions are interconnected. Based on an analysis of his work, and drawing on the work of Giddens (1985), the following mechanisms are proposed:

- Attitudes to Transactions – Perceptions, experiences, beliefs, values, and goals motivate and shape activities, capacities, and interactions of Agents.
- Transactions to Attitudes – Agents reflect on their transaction experiences, which shape their perceptions, beliefs, values, goals, motivations, and strategies.
- Transactions to Structures – The enduring nature of repeated activities and interactions create and sustain structures.
- Structures to Transactions – Structures provide a "setting" for activities and interactions, and enable particular behaviours of Agents, while constraining others.
- Attitudes to Structures (via Transactions) – The perceptions, experiences, beliefs, values, and goals of Agents motivate and shape their activities and interactions. These transaction experiences in turn shape and reinforce their perceptions, beliefs, values, goals, motivations, and strategies. The enduring nature of this iterative process creates and sustains structures.
- Structures to Attitudes (via Transactions) – Structures embody a particular set of perceptions, beliefs, values, and goals, because the "Agents" that created such structures were motivated by a particular set of attitudes. In doing so, however, those structures filter out other values, goals, and attitudes. In enabling certain behaviours and constraining others, structures also influence and reinforce certain perceptions, beliefs, values, and goals through their experiences in that structural setting.

In addition, Ricigliano (2012) does not consider his SAT Framework as part of a broader social-ecological system or how the social elements of his framework may be linked to the environment. Based on an analysis of his work, and drawing on the work of Berkes et al. (2003), it is proposed that social systems, as captured by the SAT Framework, are linked to environmental systems through the transactional dimension, as follows:

- (Social) Transactions to Ecological System Dynamics – Certain transactions in the social sphere may consume and/or transform environmental resources. The type, quantity, and rate of resource consumption and/or transformation in these transactions may alter the integrity of the individual resource and/or broader dynamics of the ecological system of which the resource is a part.
- Ecological System Dynamics to (Social) Transactions – The integrity of individual resource and/or broader dynamics of the ecological system of which the resource is a part may impact the quality and/or quantity of resources available for consumption in social transactions. The quality and/or quantity of resources available may impact the capacity of agents in those transactions or the outcomes of those transactions, which may have subsequent effects

throughout a social system on structures, attitudes, or other transactions, for example, in affecting the ability of transactions to sustain structures, or by resulting in different experiences that may alter attitudes.

Taking the SAT Framework and social-ecological systems together, the proposed conceptual framework considers the social side of social-ecological systems in further depth in terms of Structural, Attitudinal, and Transactional dimensions, and provides a more specific mechanism – through transactions – that connect social and environmental systems. It also provides specific mechanisms that connect Structures, Attitudes, and Transactions within a given social system. The final missing element in the conceptual framework involves conceptualizing mining operations and peacebuilding efforts as complex systems. In the following discussion, mining and peacebuilding are each examined in order to unpack their structural, attitudinal, and transactional elements and to consider the ways in which they rely on and impact the environment.

Mining as a Complex System

Mining concerns the extraction of specific substances, such as gold, from the earth. It is a physical and highly technical endeavour. As such it is highly dependent on a number of environmental resources, such as water, stable ground, and the minerals to be extracted. At the same time, mining has major impacts on the environment: through the depletion of resources such as water, production of waste and pollution, and transformation of landscapes (Rosa & Sanchez 2016). Mining operations also have a significant social dimension as the various technical activities require concerted efforts among a variety of agents such as investors, managers, and labourers, guided by a common set of goals, values, and ideas, and held together through various social structures, such as rules, contracts, and relationships.

On a structural dimension, mining relies on a variety structures to coordinate the various activities and transactions involved in creating and sustaining a mining operation, which can be conceptualized on three levels: operational management, financial management, and strategic management. At the operational management level, agents involved in mining operations are organized and bound by a variety of structures such as employment/service contracts or operating policies and standards, which stipulate performance expectations and other terms and conditions (Azapagic 2004; Botin 2009, 192–193, 226–227, 229–234; Dunning & Lundan 2008, 101). These operational management structures are shaped by broader financial management structures concerning the planning, financing, approvals, and ongoing regulatory requirements associated with the business venture as a whole (Azapagic 2004; Botin 2009, 225, 231, 233; Sloan 1983, 13). These financial management structures are shaped by broader strategic management structures concerning inward-facing global enterprise-wide corporate governance, outward-facing global market strategy and supply chain governance, and outward-facing global partnership, stakeholder relations, and strategy (Azapagic, 2004; Boege & Franks 2012; Botin 2009, 38–40, 45–47, 181, 188–189, 227; Chen et al. 2015; de la Vergne, 2014, p. 66–67; Ietto-Gillies 2012, 12; Nair et al. 2009; Poulton et al. 2013; Sloan 1983; UNCTAD n.d.).

Underlying the activities and structures involved in mining operations at the operational, financial, and strategic management levels are a set of assumptions, perceptions, values, or attitudes. Six key attitudinal aspects have been identified as relevant: purpose, role, interests, conduct, internal unity, and external clash. "Purpose" refers the general reason why a given structure or set of structures exist, which is often synonymous with the overarching objective or goal they seek to achieve. "Role" refers to how a given agent or structure understands itself in relation to the overarching objective, which is often synonymous with identity and/or how it believes it contributes to the overarching objective. "Interests" broadly reflects the values and/or priorities of a given agent or structure, which is often synonymous with what it believes is the most important in relation to achieving the overarching goal and could be a substantive item or condition to be achieved or avoided, a process-related consideration, a grievance to be addressed, or something else. "Conduct" refers to expectations about appropriate behaviour and/or process-related considerations that shape the way by which a given agent, structure, or set of structures can or should achieve their goals. "Internal unity" refers to the extent that members of a given structure or set of structures share the same attitudes (e.g. about their purpose, roles, interests, and conduct). "External clash" refers to the extent that external stakeholders (that are not necessarily part of common efforts to achieve a certain goal) share the same attitudes (e.g. purpose, roles, interests, and conduct). In particular, this examination will focus on A) the extent that attitudinal differences exist as part of mining operations, and between mining operations and external partners and stakeholders, and B) the extent that attitudes change (converge or diverge) through interactions among mining and peacebuilding structures and transactions.

On the transactional dimension, mining operations involve a variety of different activities at the operational, financial, and strategic management levels, which require various material and informational inputs, create outputs, and involve the exchange of information, materials, and other relationships.[1] At the operational level, this includes five general activities: mechanical construction and maintenance, ore extraction, ore processing, waste management, and operational monitoring (Botin 2009, 36; de la Vergne 2008; EC 2009). At the financial level, this includes five general activities: business planning, project financing and marketing, regulatory compliance, reporting and communications, and issue management (Botin 2009, 34). At the strategic level, this includes three general activities: corporate governance, market strategy, and stakeholder relations (Botin 2009, 34). Each of these activities can be thought of as involving four main transactions: *inputs, outputs, work,* and *exchange.* "Inputs" are pre-requisite things (information, materials, skills) that need to be obtained in order to begin performing a given activity; "outputs" are things (waste, finished products) that result from the activity, which include outputs that are both intended and unintended (e.g. failures, accidents, by-products, or other

[1] The activities differ at various stages of the "mine lifecycle" (Exploration, Project Planning and Approvals, Mine Development, Mine Operations, and Mine Closure; Botin 2009, 3; de la Vergne 2014; EC 2009). For the purposes of this conceptual framework, only the activities and transactions that occur at the "Mine Operations" stage will be considered.

adverse consequences); "work" are the actual tasks performed as part of the activity; and "exchange" are the relationships and interactions involved in performing those tasks. Each of these transactions can be thought of as intersecting with the social system, environmental system, or both.

As noted earlier, mining operations have a significant environmental dimension, primarily through the transactional dimension and at the operational level through the following mechanisms:

- Mining relies on resource inputs (e.g. minerals, water) into various operational activities, such as construction and maintenance, or ore extraction and processing;
- These resource inputs are potentially also inputs relied upon by other users, and their consumption in mining may alter the integrity of the resource, and by extension, consumption patterns.
- The outputs of mining operations may also affect the integrity of environmental resources, which may alter the integrity of resources relied upon by other users or the dynamics of the ecosystem as a whole.
- Mining is affected by broader ecosystem dynamics, such as the stability of the ground, which impacts the functioning of mining infrastructure and equipment, and by extension, the feasibility of mining activities;

However, it is important to emphasize that other structures and transactions (informed by a particular set of attitudes) at the operational, financial, and strategic management levels of mining operations may influence the way in which mining transactions at the operational level rely on and impact the environment. The overall quantity or rate in which a resource like water is consumed could be the result of a (structural) goal-setting exercise at the financial management level or the enterprise-wide (attitudinal) prioritization of profit over environmental sustainability. In this regard, the environmental effects associated with mining are more appropriately understood as an emergent property of the systemic dynamics of the mining enterprise as a whole.

Peacebuilding as a Complex System

Peacebuilding is a multidimensional process that seeks to transform societal structures in regions affected by conflict in ways that will support non-violent social interactions and prevent future violent relapses (Bruch et al. 2016; Lederach 1997). The goal of peacebuilding, broadly, is to achieve "peace," defined here as the absence of widespread conflict likely to endure on an ongoing basis (Paris 2004, 56). Peacebuilding involves a range of different agents in a variety of activities aimed at transforming the dynamics of conflict by addressing both the "root causes" of conflict as well as the "consequences" of conflict on society (Busumtwi-Sam 2004). Conceptually, "root causes" can be understood the original motivations that led to conflict, and could include "grievances," or the substantive, interpersonal, and/or attitudinal issues or needs around which collective (violent) action was originally motivated

and organized.[1] Root causes could also include "opportunities," or the enablers that made collective (violent) action possible.[2] These various root causes of conflict can be either internal to a given societal context or driven externally (e.g. spillover from a neighbouring country or politics driven by a regional power; Busumtwi-Sam 2004). In addition to addressing root causes, there are also a number of consequences of conflict on society that make of efforts to rebuild societies and create the foundations for a peaceful society more challenging.[3] Although peacebuilding is primarily concerned with social relations, scholars have begun to recognize the relevance of the environment in this work, for example, as a foundation for livelihoods disrupted by conflict, or as a source of revenue providing opportunity for conflict.

Peacebuilding scholars and practitioners have identified various "theories of change" that stipulate causal mechanisms by which peacebuilding activities are assumed to contribute to peace (Allen Nan 2010). In the discussion below, these mehcanisms have been reconceptualized in terms of whether they intend to target the root causes or consequences of conflict through structural, attitudinal, or transactional means in order to distinguish potential causal linkages between mining operations and peacebuilding efforts.

A significant part of peacebuilding is to create, transform, strengthen, or supplement the various rules, institutions, and other societal structures that determine how power, resources, programs, and services are distributed, how decisions are made, and how interests are represented as part of efforts to address the root causes and consequences of conflict (Ricigliano 2012, 35). A global cast of agents are involved such efforts,[4] which target a variety of different structures at the national, regional, and

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[1] Examples of grievances include procedural justice issues or inequalities (i.e. concerns about inadequate representation, participation, and/or say in relevant decision making institutions or processes), distributive justice issues or inequalities (i.e. concerns about inequitable distribution of power, resources, benefits, or costs), identity (i.e. restrictions on forms of self or group expression), structural violence (i.e. institutionalized forms of discrimination, delegitimization, repression, denial, along other bases), among others (Busumtwi-Sam 2004).

[2] Examples of opportunities include political will (i.e. willingness to accept the costs and consequences of collective action), organizational capacity (i.e. the administrative, financial, and/or technical means to plan, organize, and coordinate collective action), and/or resources (i.e. access and control of critical resources such as money, land, infrastructure, equipment, weapons, etc. to carry out collective action; Busumtwi-Sam 2004).

[3] These consequences include political consequences such as eroded capacity or legitimacy of governance institutions to deliver basic programs and services to citizens or maintain law and order. They could also include social consequences such as the breakdown of social institutions, social ties, and inter-group trust; widespread trauma and suffering and destroyed collective identities, culture, and differentiation; or destroyed livelihoods. They could include economic consequences such as the breakdown of local, regional, and national economies, ranging from the physical destruction and/or fundamental changes in access and control of key economic resources (e.g. infrastructure, land, capital, and other natural resources) necessary to support production and exchange; the loss of labour (e.g. from death or emigration), disruption of livelihoods and/or poverty; or proliferation of illicit economic activities (e.g. trafficking and black markets). They could include consequences for law and order and personal security. The various root causes and consequences may be linked to various degrees to the environment, for example, as a source of livelihoods, power, or opportunity.

[4] Agents could include national, regional, local, and foreign governments, as well as former combatant groups, International Organizations (such as the United Nations, World Bank), Regional Organizations (such as the Or-

local levels. Some of these efforts are part of a centrally-organized "top-down" effort, while other efforts may be part of a cumulative series of decentralized, largely isolated, "bottom-up" initiatives (Allan Nan 2010).[1] Another important element of peacebuilding efforts is aimed at transforming perceptions, ideologies, beliefs, and other attitudes held by various societal groups about themselves, towards others, and about peace as part of efforts to address the root causes and consequences of conflict (Ricigliano 2012, 35). Although these efforts involve similar agents, and follow similar top-down or bottom-up strategies as structural peacebuilding efforts, the emphasis is slightly different (Allan Nan 2010; Rustad et al. 2012).[2] The efforts, activities, exchanges, and other transactions that take place among key agents affected by conflict as part of peacebuilding efforts are themselves an important component of peacebuilding efforts by equipping societies with the skills, capacity, and relationships to address the root causes and consequences of conflict (Ricigliano 2012, 35). The same agents and top-down or bottom-up approaches are used for activities in the transactional dimension, but with a diferent emphasis on building specific capacities and relationships (Allan Nan 2010; Rustad et al. 2012).[3]

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ganization of American States or the African Union), international, foreign, and domestically-based NGOs working on various sectors or policy areas, collectives of domestic citizens, and now increasingly the private sector (de Conning 2008; Ricigliano 2003).

[1] Examples of peacebuilding efforts targeting societal structures aimed at addressing the root causes of conflict include the establishment of peace agreements (e.g. ceasefire, power sharing, peace process), the establishment of transitional justice institutions (e.g. Truth & Reconciliation, International Tribunal), the creation or amendment of governance structures (e.g. constitutional change, monitoring, peace inst.), or introduction of economic instruments (e.g. embargoes; Allen Nan 2010). All of these institutions embody a different set of attitudes and are intended to help to change societal goals, expectations, and priorities, and in doing so, guide activities. In doing so, the hope is that the change in priorities, and by extension the change in activities, will help to transform societal dynamics, and in doing so, either directly resolve grievances or create confidence that they will be resolved. Examples of structural peacebuilding efforts targeting the consequences of conflict include the creation, amendment, or strengthening of governance structures (e.g. power sharing, democratization, capacity building, policy reforms, security sector reform), creation of supplementary structures for direct provision of programs and services (e.g. humanitarian relief, development, reconciliation, security, peace-keeping/monitoring), or creation, amendment, or strengthening of media structures (Allan Nan 2010). Similarly, these institutions are intended to guide activities, and in doing so transform societal dynamics resulting from conflict that make pecebuilding more difficult.

[2] Examples of peaccebuilding efforts targeting societal attitudes aimed at addressing the root causes of conflict include the *implementation* of transitional justice processes (e.g. Truth & Reconciliation, International Tribunal); *implementation* of new/amended governance structures (e.g. Constitutional change, monitoring, peace inst.); Mutually hurting stalemate; engagement of elites or spoilers (e.g. grassroots mobilization, elite political engagement); and public engagement, and communications (Allan Nan 2010). Though some these activities overlap with structural peacebuilding activities, the point of emphasis is that the intent of these activities is to send a signal about changing societal dynamics to encourage a change in attitude. Examples of attitudinal peacebuilding efforts targeting the consequences of conflict include engagement of elites, spoilers (e.g. reconciliation, build trust); new, amended, strengthened media structures; supplementary structures for direct provision of security (e.g. peace-keeping, monitoring); individual change, public attitudes; common identities; trauma healing; culture of peace; building trust (e.g. community-based peacebuilding, building bridges among groups); reconciliation (Allan Nan 2010). Again, the point of emphasis is on targeting activities towards changing attitudes.

[3] Examples of peacebuilding efforts targeting transactional dimensions of society aimed at addressing root causes include the peace negotiations *process* (e.g. ceasefire, power sharing, peace process); transitional justice *process* (e.g. Truth & Reconciliation, International Tribunal); *process* of creating or amending governance structures (e.g. participation); *process* of engaging elites or spoilers (e.g. dialogue, governance structures); *process*

As noted above, peacebuilding is largely oriented towards transforming social systems. However, scholars have begun to recognize the relevance of the environment (Lujala & Rustad 2012; Jensen & Lonergan 2012; Unruh & Williams 2013; Weinthal et al. 2014; Young & Goldman 2013; Bruch et al. 2016). In these discussions, "the environment" is regarded as:

- A provision (e.g. minerals extracted through mining) that has social (economic) value and can be leveraged as an instrument (e.g. source of revenue, source of power) to achieve a number of social ends (e.g. to support peacebuilding and development efforts, or further conflict, or to maximize status as part of the transition) (Lujala & Rustad 2012);
- A provision (e.g. land, water) that sustains the livelihoods and well-being of many communities, which may be adversely impacted (e.g. through environmental degradation, over exploitation) by the activities associated with conflict and/or peacebuilding (Bruch et al. 2009);
- A policy area or forum for building trust and rebuilding social ties (Bruch et al. 2009; Conca et al. 2005);

The literature to date has been ad hoc, and has focused on only one of the above relationships (or an aspect of it), meaning that other relevant environmental linkages exist that have not yet been identified. Nevertheless, this serves as a starting point for identifying and tracking social-environmental linkages associated with peacebuilding and possible linkages with mining.

Results

To sum up the discussion thus far, to better capture the causal interconnections between mining and peacebuilding activities, the conceptual framework proposed for this examination consists of three key elements:

- Social-ecological system - mining and peacebuilding are conceptualized as occurring within the broader dynamics of a "social-ecological system" (Berkes et al. 2003).
- "SAT Framework" - Focusing on the "social" sphere in further depth, the dynamics of social systems are conceptualized in terms of Structural, Attitudinal, and Transactional dimensions, that interconnect with ecological systems through the transactional dimension (Ricigliano 2012).
- "Mining" and "Peacebuilding" as Systems - "Mining" and "peacebuilding" are conceptualized as systems in themselves, comprised of various Structural, Attitudinal, and Transactional elements.

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of multi-track diplomacy; and economic instruments (e.g. embargoes; Allan Nan 2010). The point of emphasis is that, just as important as the outcome of these activities, the process of bringing former combattants together to interact, build understanding, and build capacity is itself an important element in peacebuilding. Examples of transactional peacebuilding activities targeting the consequences of conflict include the *process* of creating or amending governance structures (e.g. participation), the *process* of engaging elites or spoilers (e.g. reconciliation, build trust); the *processes* of trauma healing, creating a culture of peace, building trust (e.g. community-based peacebuilding, building bridges among groups), and reconciliation; social service delivery (e.g. by government, third party); economic development support; reconstruction, restoring, and maintaining environmental integrity (Allan Nan 2010). Again the point of emphasis is that the act of bringing people together and building capacity *to do peacebuilding* is itself helpful.

Altogether, the framework enables a more complex perspective of the social and environmental dimensions of peacebuilding and how they may impact, and be impacted by each other both directly and indirectly, as illustrated below in Figure 2.

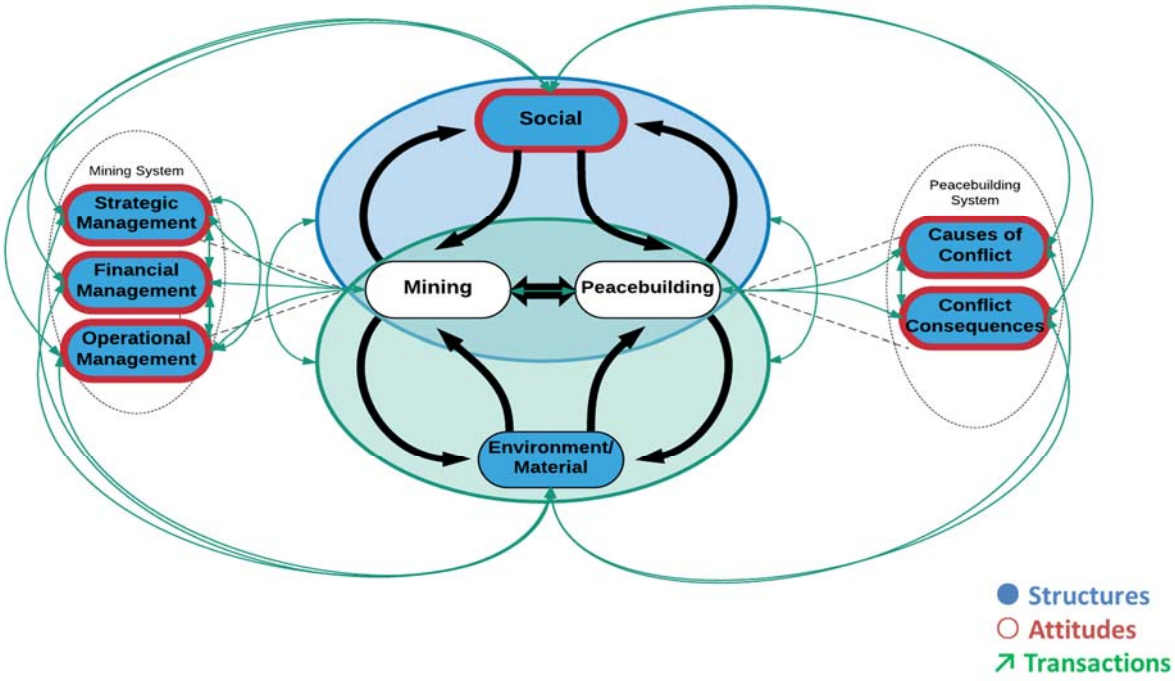

Figure 2. Conceptual Framework.

There appear to be four general pathways by which mining and peacebuilding activities could be interconnected: 1) directly (as part of "business for peace" initiatives), 2) indirectly through interactions with the social system and its dynamics (which can be further broken down into dynamics among Structures, Attitudes, and Transactions), 3) indirectly through interactions with the ecological system and its dynamics. Moreover, given the interdependence between the social and environmental systems, any/all of the above-mentioned causal pathways have subsequent interactions throughout the social-ecological system, providing a fourth general pathway.

Discussion and Conclusions

This paper has taken up an emerging policy issue, namely, the increasing involvement of the private sector in peacebuilding—Business for Peace. A key challenges in ongoing policy and planning discussions is the fact that much of the research and analysis to date has focused on a limited set of considerations, which are difficult to reconcile from one argument to the next, and have resulted in a number

of narrowly focused and largely ineffective policies.[1] As a first step towards overcoming this challenge, this paper presents a conceptual framework rooted in complex systems theory intended to better capture the various direct and indirect ways in which mining operations and peacebuilding activities may be interconnected. The framework conceptualizes mining and peacebuilding as occurring within the broader dynamics of a "social-ecological system." Focusing on the "social" side of this social-ecological system in further depth, social dynamics are conceptualized in terms of Structural, Attitudinal, and Transactional dimensions, and mechanisms are proposed for connections between each of these dimensions and for connections between social and ecological sides of the broader system. Finally, "mining" and "peacebuilding" are conceptualized as complex systems in themselves, which are comprised of various Structural, Attitudinal, and Transactional elements. All together, the framework provides a starting point for identifying linkages between mining and peacebuilding more systematically, and provides a more comprehensive view to inform policy and future-oriented analyses.

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[1] For example, peace agreements, bilateral, and multilateral foreign assistance arrangements have thus far not encompassed (and thus do not address) the activities of private enterprises (Bruch et al., 2016, p. 35; Grinspun & Shamise, 2010; McKenna, 2016). The activities of the private sector remain governed largely through voluntary initiatives that are narrow in scope in terms of the resources covered (e.g. the Kimberly Process only focuses on diamonds) or activities required (e.g. Extractive Industries Transparency Initiative focuses on transparency of payments; Dam de Jong, 2015, p. 366). These initiatives have been criticized for failing to address important aspects of resource governance that have been identified as relevant to societies recovering from conflict such as the distribution of resource benefits, sustainability and/or environmental protection, public participation, accountability, among others (Carbonnier et al., 2011; Dam de Jong, 2015, p. 418).

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The Science of Laws: Future Impact on Governance

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Abstract

This paper discusses the flaws and omissions of the traditional method of lawmaking, which is presently used by governments, and the new field of scientific lawmaking. The structure, function, and governmental role of the science of laws are presented. The advantage of scientific lawmaking, as compared to traditional lawmaking, is that it will bring the full resources of science to bear upon the solution of societal problems by means of laws. The history of success of all fields of science suggests that the expansion of science to encompass laws and lawmaking will also be successful. The discussion includes ongoing projects of the science of laws, future directions, and the projected impact of the science of laws.

Introduction and Background.

The scientific process ("scientific method") is the means by which reliable knowledge of the structure and mechanics of observable phenomena in the physical universe is derived. As knowledge grows, the scientific disciplines of engineering, which apply accumulated knowledge to the advancement of technology, are able to solve increasingly complex problems. The process of science requires high levels of scholarship, integrity, and quality, and the result of the dynamics of science is the optimistic scenario whereby knowledge grows, current problems are being solved by ever-improving means, and problems of the next higher order of complexity are in the process of being solved.

There is one major field of human endeavor that is the exception to the scenario of advances in scientific knowledge, technology, and problem-solving expertise: the laws of government. The laws of government may be counted among the most important works of humankind; they address the most significant problems of society and they have a direct effect upon the human rights, living standards, and quality of life standards of every person. However, in contrast with the experience of science, laws have been less than successful in their goal of solving (solving, mitigating, or preventing) societal problems. Despite the annual production of millions of laws by national and regional governments and the expenditure of substantial resources under the authority and direction of laws, serious problems of war, privation, abuses of human rights, and poverty, etc., remain unsolved.

Material and Methods

To determine what can be done to improve the performance of laws and thus enable governments to satisfy their public benefit obligations, an investigation into laws and the lawmaking process was conducted (Schrunk, 2005, 23–49). The investigation was focused on the federal and state governments

of the United States (See United States' Congress and California legislative processes). An investigation into the potential role of science in the creation and evaluation of laws was also conducted (Schrunk, 1997, 44–47; Schrunk, 2000, Schrunk, 2005, 61–91; Schrunk, 2008; Schrunk, 2010; Schrunk, 2011; Schrunk, 2012).

Results

The results of the investigations disclosed that the traditional method of lawmaking ("the legislative process") is seriously flawed and incapable of satisfying the problem-solving needs of government. The results also indicated that the performance of laws can be improved by expanding science to encompass laws and the lawmaking process.

The traditional method of lawmaking, which is used, in various forms, by all governments to create laws, is a relatively simple process (Schrunk, 2005). It begins when someone comes up with an idea for a law of government. The idea is transcribed into a written petition ("bill") which is then presented to a legislative assembly. After being evaluated by the legislature and, often, modified through debate and compromise, the final version of the bill is voted upon by the legislature. If the legislature / government approves the bill it is added to the government's body of enforceable laws. The next bill is presented to the legislature and the lawmaking process is then repeated. The traditional method thus operates as an open feedforward control system whose input consists of ideas and whose output is new laws as shown in Figure 1.

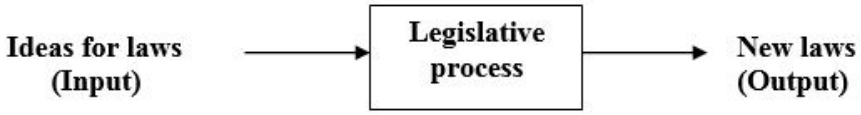

Figure 1. Traditional lawmaking. The traditional method of lawmaking is a simple feedforward control system whose output is a continuously growing body of laws. Note that this process can operate indefinitely without reference to societal problems.

Although the traditional method appears to be a reasonable means for creating laws of government through deliberation, debate, and compromise, it has the following fatal flaws and omissions:

- It does not require societal problems to be defined[1]
- It does not assign priorities to problems for solution
- It does not require laws to have a statement of purpose in terms of a measurable outcome

[1] It is impossible to solve a problem that has not been defined.

- It does not require law designers to have design expertise[1]
- It does not require the creation of a model for each law-design
- It does not require a full accounting of the multiple costs of laws
- It does not require a full accounting of the risks and side effects of laws
- It tolerates design defects and "intentional vagueness" in laws
- It tolerates the inclusion of "pork barrel" and other special interest provisions in laws
- It does not require law designers to have knowledge of the subject matter; it is primarily based upon ideology, anecdotes, and opinions
- It does not require a citation of references and data bases
- It does not require a competent and thorough quality assurance (QA) program that periodically evaluates the outcome of laws, or a regular mechanism for the repeal of laws that have been found to be less than useful to the citizenry
- It incorporates no regular, competent mechanism for improvement of the performance of laws

The aforementioned defects of the traditional method render it to be completely unacceptable as a problem-solving process of government. In fact, it is not a problem-solving process; its purpose, as depicted in Figure 1, is to make laws, not to solve problems. In addition, as noted, it is lacking or deficient in relevant knowledge, design expertise, ethics, and cost-risk analyses. The result is that the laws it creates are frequently defective, vague (often by design), unnecessary, or harmful. Also, since the traditional method does not evaluate the outcomes of laws, it fails to identify and repeal outmoded, ineffective, redundant, purposeless, and harmful laws whose continued enforcement wastes government resources to the detriment of the people. As legislatures enact more laws with each legislative session, the size, cost, and complexity of the bodies of laws increase but societal problems remain unsolved, and governments are compelled to enforce laws selectively in violation of the rule of law.

To solve the problem of the dysfunction and ineffectiveness of bodies of laws, a new science, the science of laws, was created by the author at the Science of Laws Institute in 1995 (www.scienceoflaws.org). Laws are designed as intended useful tools and they have a significant impact upon the physical universe, which is the domain of science; they are therefore eminently suited for inclusion within the purview of science. The promise of the science of laws is that it will bring the full resources and strengths of science, of knowledge, expertise, integrity, and quality to bear upon the solution of societal problems by means of laws. The science of laws has two co-equal branches: the creative science, or engineering discipline, of laws and the investigative science of laws.

Creative Science of Laws The creative science of laws develops, accumulates knowledge of, and applies engineering best practices and design methodologies to the solution of societal problems by

[1] There is no university curriculum that is dedicated to the field of law-design; there is no body of scholarship in law-design; no school of higher education currently offers a PhD degree in law-design engineering.

means of laws (Schrunk, 2000; Schrunk, 2005; Schrunk, 2011; Schrunk, 2012; Gottfried, 2017, 2–4; Madachy, 2017, 12–24). The engineering design process requires inputs from a wide range of scholarly fields such as sociology, law, statistics, business, and economics; it is the ultimate example of multi-disciplinary engineering[1]. By creating just and efficacious laws, the creative science of laws will enable governments to satisfy their problem-solving public-benefit obligations. One of the first steps for the engineering discipline of laws is to establish quality design (QD) standards (Schrunk, 1997, 44–47; Schrunk, 2005; Schrunk, 2010) that require law designers to observe knowledge-based best practices for the creation of each new law, such as:

- Identify/analyze a societal problem that needs to be solved
- State the priority of the problem and the goal of the law
- Create a model of the law based on relevant data and ethical codes
- Test and refine the model for maximum efficacy
- Document all sources, methodologies, and observations

When the final design of the prototype law ("bill") has been completed, it will be submitted to a legislative assembly for a vote of acceptance (enactment) or rejection. If the bill is enacted into law, it will be added to the government's enforceable body of laws and will then be subjected to periodic reviews of its performance by a quality assurance (QA) program.

In addition to creating new laws, the engineering discipline of laws will conduct a quality improvement (QI) program to enhance the structure and performance of existing laws following periodic QA evaluation. QI standards are the same as QD standards. By this means, the laws of government will be constantly upgraded and improved, by the engineering process[2], in their ability to satisfy the problem-solving purpose of government.

Investigative Science of Laws The purpose of the investigative branch of the science of laws is to derive reliable knowledge of 1) the mechanics ("cause and effect" mechanisms) of laws and 2) methodologies for the measurement and analysis of laws. It regards every law of government to be an incomplete experiment of human behavior[3]. Each law has a hypothesis (that it will produce a desired societal outcome) and that hypothesis is tested (i.e., the experiment is carried out) when the law is enforced. By measuring and analyzing the results of law enforcement, the investigative science of laws derives knowledge of the mechanics of each law, and of systems of laws, and the store of scientific

[1] To meet the future need for law design engineers, new college curricula to the PhD level will need to be developed. Law-design engineering will be closely allied to software and systems engineering disciplines.

[2] The Rule of Engineering: Change is always characterized by improvement.

[3] Traditional lawmaking is an incomplete experiment of human behavior because it does not measure, analyze, and record the results of the experiment, i.e., of law enforcement.

knowledge of the structure and function of laws thus grows over time. With this knowledge, governments can avoid the mistakes of the failed laws of the past, and law design engineers can create more effective and just laws in the future. Significantly, the investigative science of laws will be the basis of a comprehensive quality assurance (QA) program of laws.

Quality Assurance of Laws Unless a government measures the outcomes of its laws, it is "flying blind." That is, a government cannot know if its laws have accomplished anything of value for the public unless it utilizes a reliable process for assessing the outcomes of laws. Therefore, each law must undergo a periodic (e.g., every ten years) quality assurance (QA) evaluation to confirm that it is "necessary and proper" for the wellbeing of the public.

A major contribution of the investigative science of laws is that it will be the basis of a quality assurance program for laws. The QA program will employ empirical (i.e., scientific) methodologies to measure, analyze, and document the problem-solving outcome of each law, including its costs, burdens, and impact upon the human rights, living standards, and quality of life of the public (Schrunk, 2010).

A determination of the net benefit of each law will then be made (the net benefit of a law is the difference between its problem-solving benefit and the sum of its costs, risks, restrictions, and other burdens). If the QA program determines that the net benefit of a law is positive, the law will be referred to the legislature for affirmation and continued enforcement. All other laws will be recommended for repeal by the legislature. By leading to the repeal of non-productive laws (e.g., outmoded, ineffective, conflicting, duplicative, harmful, and unenforced laws) the QA program will more than pay for itself (Crosby, 1979) and the bodies of laws of government will then consist of the minimum number of laws that efficaciously satisfy the purpose of government, i.e., that are useful to the wellbeing of the public.

Policy Making versus Lawmaking The use of science for lawmaking will lead to a separation between "policy making" and "lawmaking." The role of legislators (members of a legislative assembly of government) will change from that of "lawmaker" to "trustee" (of the people), whose purpose is to 1) discuss the great issues of the day and formulate, through debate and deliberation, priorities and goals for government action, i.e., to "set policy," and 2) assure, through the enactment and repeal of laws and the maintenance of quality standards for laws, that the body of laws always and optimally serves the purpose of government[1].

However, in their roles as trustees of the people, legislators will not be lawmakers, for two reasons. First, the position of trustee will be a full-time position, and trustees will not have the time to design laws. Second, the requirements for being a qualified designer of laws (e.g., PhD in law-design engineering) are far beyond the typical general-knowledge background of popularly elected legislators.

[1] For democratic governments, the purpose of government is to secure the rights and liberty of the people, the citizenry (Schrunk, 2005, 109-113).

Thus, legislators will set policy, but will assign, by competitive bidding or other responsible method, the design of laws to qualified law-design institutions and engineers ("creative scientists").

The Scientific Control System of Laws The creative and investigative sciences of laws will act synergistically with the legislature to create a science-based feedback control system for the government's body of laws. By its incorporation of quality standards (QD, QA, and QI) for the creation, evaluation, and optimization of laws, the lawmaking process will be self-correcting in the direction of optimum outcomes in terms of the rights and liberty of the people (Figure 2).

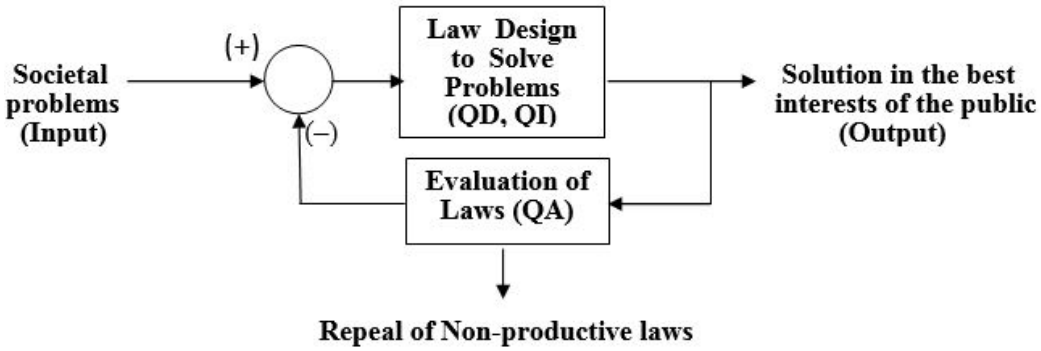

Figure 2. Scientific Lawmaking Science-derived quality programs for laws (QD, QA, and QI) will transform the lawmaking process into a problem-solving feedback control system that is self-correcting in the direction of optimum problem-solving outcomes for the public. (compare to Figure 1).

With each cycle of the scientific lawmaking process, the sophistication of engineering design and evaluation methods will improve, reliable knowledge of the mechanics of laws will increase, the size of the bodies of laws will be kept to a minimum, and the performance of laws will improve in terms of effective and just problem solution, cost-efficiency, and safety in the best interests, i.e., rights and liberty, of the public.

Status of the Science of Laws: Web Site The web site (www.scienceoflaws.org) of the Science of Laws Institute includes discussions of lawmaking, quality programs, and the creative and investigative sciences of laws, as well as the peer reviewed on-line *Journal of the Science of Laws*. It also includes a data base of abstracts of scientific abstracts of the mechanics of laws from the past two centuries up to year 2006. The data base comprises approximately 1800 abstracts.

Status: Annual Conferences The science of laws has held three annual scientific conferences at the University of California San Diego (UCSD) in conjunction with the systems engineering society (INCOSE) of San Diego, California. Presentations of scientific works related to the science of laws are given at the conferences and peer-reviewed papers are published in the Institute's on-line *Journal of the Science of Laws*. The fourth annual conference is scheduled for November, 2017.

Status: Ongoing Projects The Science of Laws Institute is engaged in a review of critical parameters (e.g., problem definition, purpose statement, cost and risk analyses, citation of references, name of law-designer…) of California Legislative Bills (year 2017). The goal of this effort is to identify the factors that should be included in quality design standards for laws. This work is scheduled for completion later in 2017 and the results will be presented at the annual science of laws conference. The published work may become the basis of an ISO 9000 standard for the design of laws generally.

Status: Future Projects The following Science of Laws projects are planned:

- Update the knowledge data base of scientific abstracts of the mechanics of laws
- Mine the data base to discover which laws or groups of laws tend to increase or decrease societal problems
- Expand the data base to include abstracts of outcomes research methodologies
- Expand the data base to include abstracts of engineering design methodologies that are applicable to law-design
- Develop a Systems Engineering Working Group dedicated to the advancement of the science of laws
- Begin experimentation with the creation and simulation of law-design models
- Coordinate with universities for the development of college degree programs, to the PhD level, for the science and engineering of laws

Projected Future Impact The science of laws will apply, for the first time, the full resources of science to the solution, by means of laws, of serious societal problems (war, poverty, privation, abuse of human rights…). It holds the promise, based on the record of success of all other fields of science, of improving the human condition by enabling governments to create and maintain a rule of law that always and optimally serves the safety and wellbeing of the public.

Conclusion

The traditional method of lawmaking, which is used as the lawmaking process of governments, is a prolific lawmaking process that increases the size and complexity of the bodies of laws of governments. However, the traditional method is flawed as a problem-solving process, and it has been less than successful in the solution of societal problems. A new science, the science of laws, has been established by the expansion of science to encompass laws of government and the lawmaking process. The new science of laws holds the promise of improving the performance of governments by bringing the full resources of science to bear upon the solution of societal problems by means of laws.

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Science of Laws Institute web site: www.scienceoflaws.org.

2. METHODS AND METHODOLOGY OF FUTURES RESEARCH

Critical Futures of Aging in Society – Enabling Futures of Intergenerational Knowledge Creation

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Abstract

Our relationship with younger and older generations in our lives can facilitate our need for personal care, material security as well as our search for identity and belonging. Yet as rising demographic dependency in the West is projected to increase economic pressure on the working age, it reinforces negative narratives such as "aging is a burden". In an attempt to re-frame such narratives, Sohail Inayatullah's Causal Layered Analysis was used to deconstruct a projected trend of rising demographic dependency in Canada revealing a rigid system of age specialization that is depicted through the metaphor of an "assembly line of aging". However, as changes in demography, lifestyle and lifespan continue to transform generational expectations, „the meandering river of aging" is described as an alternative metaphor that aims to challenge this status quo.

Introduction and Background

Understanding relationships between generations lies at the heart of society's contemporary dilemmas and is a phenomena that links a variety of fields and issues [Biggs, 2007]. While in the past, mapping life-stage characteristics has been the concern of generational studies, changes to lifespan and lifestyle have blurred generational roles creating a need for alternative approaches to understanding aging [Biggs, 2007].

Furthermore, in contrast to traditional societies where the death of an elder was similar to the burning down of a library [Helman, 2005, p. 56], today, the elder's role is changing as youth more readily access knowledge freely and absorb technology at a quicker rate. This is especially significant considering that our potential to develop ideas sustainably is influenced by how we use networks [Howkins, 2009], therefore connecting knowledge across generations becomes an important consideration for developing sustainable societies for the future.

Yet as rising demographic dependency in the West is projected to increase economic pressure on the working age, it reinforces negative narratives such as "aging is a burden". Therefore, this study

addresses the following inquiry: How might we enable futures of intergenerational knowledge creation through *re-framing* aging narratives?

Material and Methods

Literature that discusses 'Generations' was gathered from the domains of Sociology and Social Gerontology and an environmental scan captured trends and emerging issues from a variety of sources and applied it to a critical futures methodology. Critical futures is part of an emerging field in Social Foresight and is a methodology that was originally developed by Richard A. Slaughter. Critical futures studies recognizes that the present is a consequence of a dominant narrative or a "status quo" [Inayatullah, 2005]. Its objective is to "un-define the future" through challenging predictive approaches and moving past cultural assumptions often based on dominant industrial paradigms originating in the West [Inayatullah, 2005]. In doing so, it uncovers deeper layers about the future by questioning the nature of "time, rationality and agency [Inayatullah, 2005]".

A post-structural approach attempts to question trends and events that appear at the surface. Building on Slaughter's work, Inayatullah [2005] developed a tool called Causal Layered Analysis [CLA] that allows these deeper layers of cultural reality, world view and metaphor to emerge. Deconstruction, genealogy, distancing and re-ording knowledge are among the elements introduced by Inayatullah [2005] when conducting post-structural futures research. CLA links mythic and metaphorical dimension with other levels of analysis by acknowledging that "individuals, organizations and civilizations see the world from different positions—horizontal and vertical [Inayatullah, 2005, p. 6]". The four dimensions of the CLA -as proposed by Inayatullah [2005] are discussed more deeply below.

a) The Litany

The first layer is the litany which includes quantitative trends and issues as they appear in mainstream media such as news. Fisher [2003] developed the term "litany" which refers to the clichés and stereotypes we live in every day. Described by Slaughter as 'pop futurism', litany is the most visible form of reality and was later adapted as the first layer of CLA by Inayatullah [Ramos, 2003].

b) The Causes and System

Beneath the litany, social and systemic causes question the quantitative data presented by considering various economic, cultural, political and historical factors [Inayatullah, 2005]. It uses technical explanations and academic analysis to explore the role and interests of actors. It also draws relationships between the various factors to show complexity and contradictions.

c) The Worldviews

Beneath the social and systemic causes lies the worldviews revealing the deeper discourses that are reinforcing the system [Inayatullah, 2005]. For instance, one may explore various mental models that may lead to a re-framing of the issue such as economic, social or cultural.

d) The Metaphors and Myths

Finally, the deepest layer reveals metaphors or myths which represent the "unconscious, often emotive, dimensions of the problem [Inayatullah, 2005, p. 7]". It is concerned with evoking visual images, emotional responses and uses more open language. It is what Inayatullah refers to as the "root level of questioning [Inayatullah, 2005, p. 7]".

At each level of the CLA, solutions varying in complexity exist (Inayatullah, 2017). For example, while litany level solutions lead to simple short-term solutions, systemic and worldview changes are much more complex and long-term (Inayatullah, 2017). Metaphor or Myth solutions require new memories to be created and collective narratives to be told (Inayatullah, 2017).

Therefore, CLA seeks to integrate these four levels of understanding and solution finding. It is through the application of the CLA, that new and alternatives narratives can emerge considering that "the way in which one frames a problem changes the policy solution and the actors responsible for creating transformation (Milojevi I. and Inayatullah, 2015, p. 157)". CLA seeks to challenge conventional framings of issues and to reveal underlying assumptions in order to deepen the future and the solutions that will shape it (Milojevi I. and Inayatullah, 2015).

Results

Through the application of CLA, two metaphors were developed: 1) The assembly line of aging which represents the status quo and 2) The meandering river of aging which represents a forgotten yet emerging paradigm of aging. Therefore, the CLA was conducted twice. First it placed trends at the litany and de-constructed them down to a metaphor. Second it challenged the metaphor and moved back up the ladder to question the litany. In the first attempt, an assembly line metaphor was revealed to represent a dominant narrative or 'status quo'. Next, an emerging paradigm of aging is introduced through the meandering river, which is argued to open up a rigid system of age segregation. Figure 1 below summarizes this process.

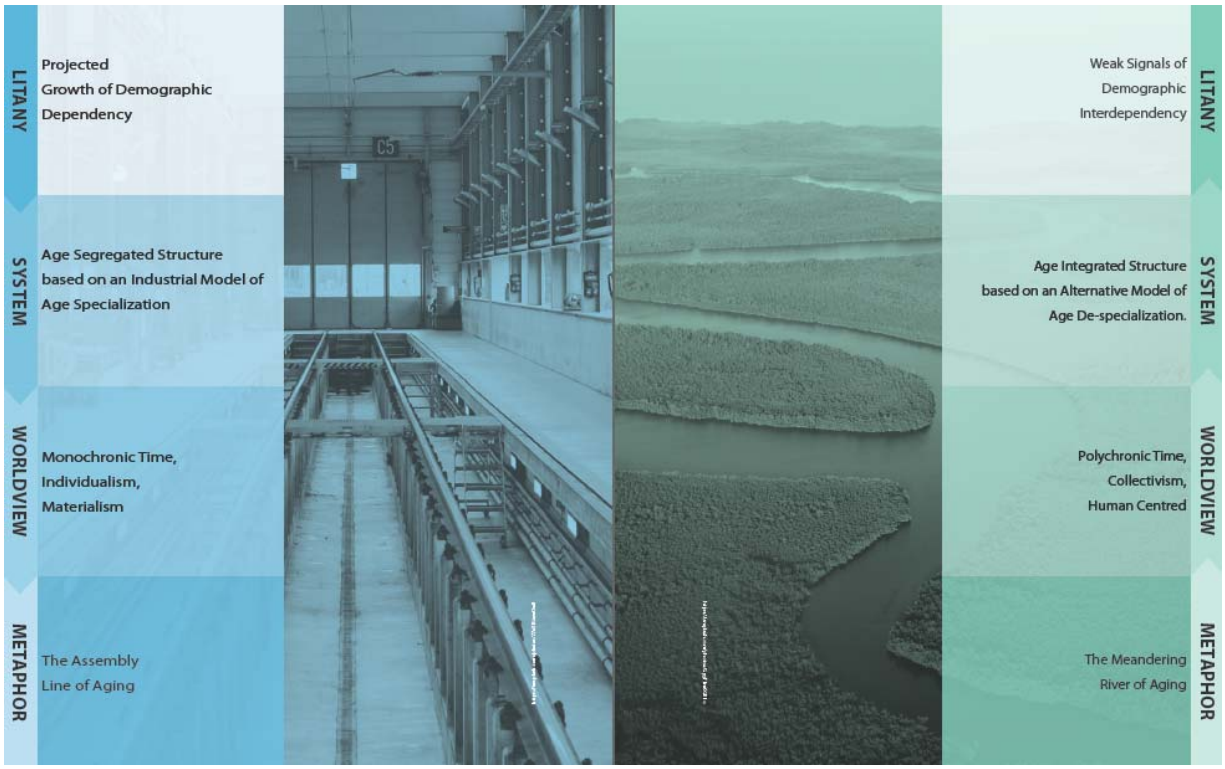


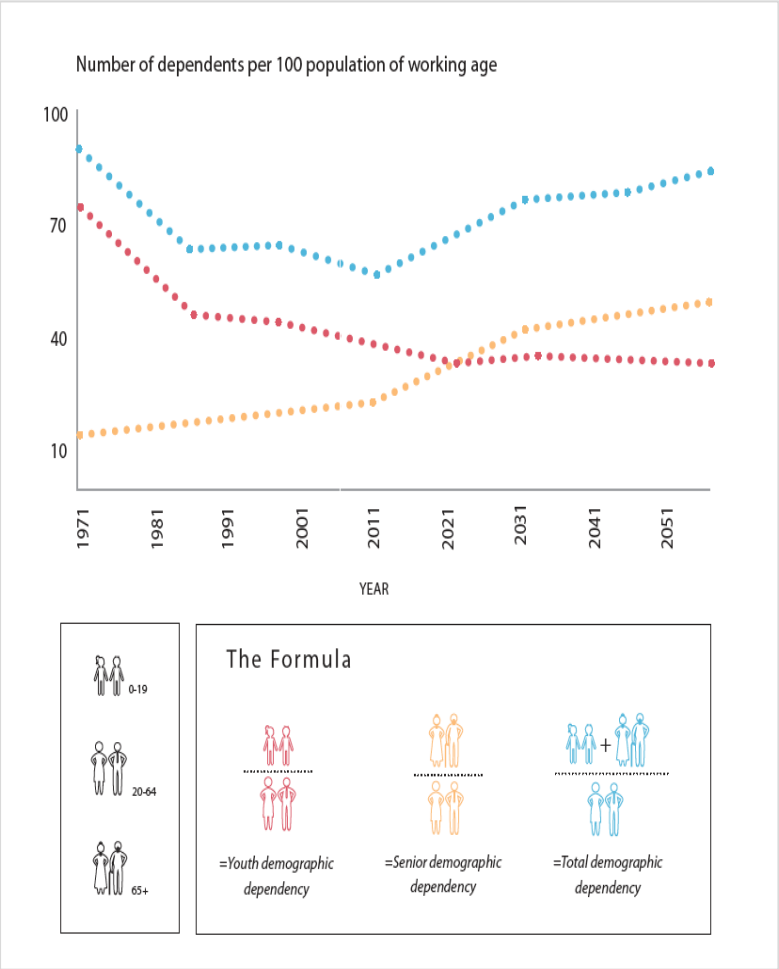
Figure 1.

A Status Quo

More objective, the assembly line of aging is based on a linear model of organization intended to regulate needs across the life course and to maintain social security in life stages where individuals are likely to need it most. However, it also limits the freedom to pursue alternative choices and reinforces stereotypes in the case the rules do not fit. The following section first begins by describing the litany or the quantified trends, then moves to reveal their systems, world views and metaphors.

Litany- Projected Rise of Demographic Dependency

An article in the Globe and Mail titled "Boom, Bust and Economic Headaches" published on Nov. 8th of 2015 highlighted how succession planning remains to be a significant challenge as the population continues to age and paints a dystopian scenario for the future. The demographic dependency ratio is an economic indicator that describes this socio-economic relationship between those typically not in the workforce referred to as dependents and the working age population [StatCan, 2011].



The demographic dependency ratio uses a formula to measure the pressure on a productive population through dividing the number of youth and seniors by the working age to generate the youth, senior and total demographic dependency per 100 working age persons. The data in Figure 2 reflects both past observations as well as future projections. While observed data reflects what is perceived to have taken place in the past, projected data reflects an estimate of what might happen in the future. As the baby-boom generation that followed World War II continues to retire, the data projects that there will be a decline in work force participation [StatCan, 2011].

Figure 2.

System and Causes - Age Segregated Social Structure

Nevertheless, it is important to note that the demographic dependency ratio does not include young people or seniors who are active in the workforce, nor working-age people who are inactive [StatCan, 2011]. Therefore, it is based on age rather than employment status reflecting a population age structure. This population structure is described as "age segregated" organizing life stages into generic units and following a linear chronology of: a) Education, b) Work, c) Leisure. While this age structure appears to be natural at the surface, it has only become common practice with the growth of bureaucratic and industrial systems [Riley and Riley, 2000; Kohli, 2007; Uhlenberg, 2000]. This evolution is part of a capitalist model which focuses on individuals as separate units and chronologizes life course stages [Kohli, 2007].

Worldview - Monochronic time, Individualism, Materialism

This "chronolization" of the life course [Kohli, 2007] represents a cultural model of time which is hugely influenced by intellectual and religious thought in the Western world for many centuries. The

anthropologist Edward T. Hall [1983] described this form of time as "monochronic". In this view, time considered as linear and tangible, dividing the life course into three chronological periods of pre-work, work and post-work [Helman, 2005]. This is linked to the overall aim of an industrial culture which is greater productivity in a shorter time frame and at a cheaper cost [Helman, 2005]. Furthermore, as time and work became more connected, watches and calendars became more commonly owned.

A Medical Anthropologist, Helman [2005] raises questions about the relationship between cultural concepts of time and human longevity by recognizing how the experience and meaning given to old age is different across cultures. In contemporary society, an emphasis is placed on youth, beauty and independence as well as on the ability to be productive [Helman, 2005]. Therefore, the elder's role is changing as youth more readily access knowledge freely and absorb technology at a quicker rate.

Metaphor - The Assembly Line of Aging

Similar to watches, factories represent important symbols of industrialization, emerging with modern economic and social systems based on standardized mass production and consumption. In the manufacturing process, assembly lines are used to increase production and efficiency. So what does all this have to do with the experience of aging? May the assembly line serve as a metaphor for the experience of an age segregated structure?

For the purposes of exploring this metaphor, let us consider the assembly of a car. Assume that the assembly steps are to install the engine, install the hood, and install the wheels and only one of these steps can be done at a time. Moving in a linear fashion similar to a factory's assembly line, what if we are to replace the assembly of a car with the assembly of the life course? The steps in the assembly line are to install education, install work, and install leisure and only one of these steps can be done at a time. Therefore, an age segregated structure mass produces age specific roles and activities [ex. education, work, leisure] within quantified durations [ex 0–19, 19–64, 65+] ready for consumption by individuals in society.

To take the assembly line of aging metaphor further one may compare between what is happening to the car industry today as a way to understand what is happening to the life course. An industry that is experiencing extreme disruption with the emergence of Uber, a biking culture, driverless cars and heightened awareness of climate change? Similarly, the life course is, too, experiencing disruption, as work becomes more autonomous, care becomes more distributed, and technology creates new forms of interaction.

2) An Emerging Paradigm

The Meandering River of Aging describes an image of the future where an emerging model of aging challenges the assembly line. More subjective, the process of aging is customizable and activities between age groups are more likely to become shared. Driven by a need to embrace both life and death,

it values free time for self, family and friends over the desire for materialism. This section first begins by describing the metaphor then moves up the CLA ladder to discuss the world views, systems and litany.

The Metaphor - The Meandering River of Aging

In their book Social identities Across the Life Course, Hockey and James [2003] describe the Life course to be "Less as the mechanical turning of a wheel and more as the unpredictable flow of a river [Hockey J. and James A., 2003, p. 5-6]." The mechanic turning of a wheel provides another reference to the assembly line metaphor while an unpredictable river provides an alternative metaphor to explore further. In contrast to an assembly line, rivers almost never flow in a linear fashion, instead they twist and turn along paths, moving unpredictably as they obtain nutrients by changing their course - called meandering it is how rivers renew themselves.

The Worldview - Polychronic Time, Collectivism, Human Centered

In contrast to how life is experienced in more monochronic societies, in more polychronic societies life is experienced as continuous, often wandering like the flow of a river [Helman, 2005]. Polychronic time is characterized as cyclical, intangible, and experienced as a "point" at which life activities converge [Hall, 1983]. Polychronic societies tend to emphasize the importance of people and the "completion of tasks only when the time is right" [Helman, 2005, p. 55]. This cyclical view of human experience is often expressed through concepts such as reincarnation in Asian religions [Helman, 2005].

The System- Age Integrated Social Structure

In agricultural or craft based communities, generations predominantly lived and learned together under one roof -in some parts of the world they still do. In these more traditional societies elders played an import role of care giving and children were expected to work in the field or to care for their younger siblings as "time devoted to work was considered as intrinsic to childhood as it is to adulthood [Helman, 2005, p. 55]". In these more traditional societies, the death of an elder is similar to the burning down of a library as "knowledge, skills, wisdom and mastery of local technology accumulate in later years of life making elders the repositories of inherited wisdom [Helman, 2005, p. 56]".

In contrast to how knowledge and experience is acquired today, in these societies experience is orally transferred from one generation to the next and elders are considered to be the "repositories of wisdom [Helman, 2005, p. 56]". However, although there are lessons to be learned from the past, moving forward in to the future, its important to recognize that knowledge and wisdom exists in different ways across age and that establishing grounds for which older and younger generations may equally learn from one another in a contemporary context is key. This is also made more complex, as

ones choice of vocation is liberated from ancestry and families have become more heterogeneous in nature.

The Litany - Emerging Weak Signals of Demographic Interdependency

The process of environmental scanning revealed weak signals indicating that age integration and opportunities for converging activities between old and young are slowly emerging. Weak signals included senior homes opening up in universities and schools opening up in senior homes, social media used for purposes of intergenerational engagement, the integration of economically active seniors into entrepreneurial practices as well as the rights of future generations being discussed in contexts of climate change. Figure 3 aims to visualize a framework for such emerging intergenerational networks.

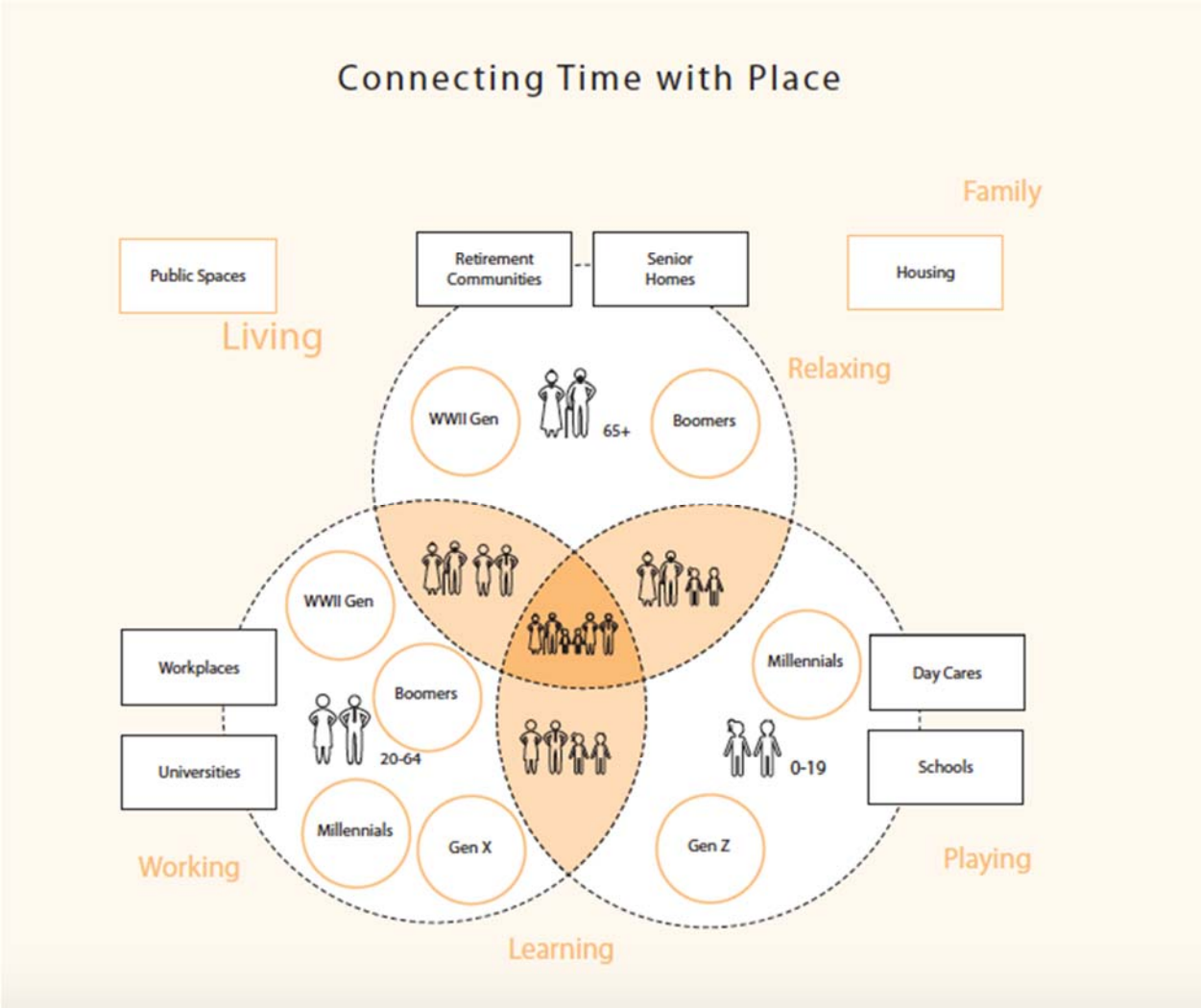


Figure 3.

Discussion and Conclusions

Both metaphors represent a tension between how we perceive and identify with aging internally or 'subjective aging' as opposed to how society imposes an externally constructed view of what aging implies for our lives or 'objective aging'. The assembly line of aging described an image of the future where an industrial model fails to adapt to the needs of its people. Viewing age groups as objective numbers, it is driven by the standardization of activities across life course stages. In contrast to this, more subjective, the meandering river of aging opens up the system creating opportunities for more choices to pursue alternative roles throughout the life course, however, it raises questions as to how this may preserve and secure different needs across the age spectrum. Creating opportunities for more meaningful contributions across the life course may lead to a pro-active aging narrative as well as increase knowledge sharing between generations.

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Future Dreams of Young People – Tools to Promote Young People's Civic Participation

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Abstract

Do we hear the voice of children and young when developing our society? The research project "Young people's images of the future 2067" focuses on bringing forth youth's dreams and hopes for the future, and based on those desires to construct proposals for policymakers. A participatory future camp method is used to challenge high school and vocational school students to ponder on future issues. Based on future camp material a survey with six different futures images is designed and respondents rate them according to probability and desirability. It is found out that the future camp method can be used both for encouraging futures thinking and gathering data of future related values and thoughts.

Introduction and Background

Challenges in Finnish society, such as population aging, globalization, climate change, and labor migration require reforming and diversifying the structures of the society (e.g. Dufva et al. 2017). According to Kettunen (2015, 167–168), future anticipation should be more citizen-oriented and more democratic by providing people a genuine opportunity to be included in the discussion on Finland's future, and thus help to find solutions for developing the society and maintaining good quality of life. How can especially young people's conceptions about the future prospects of Finland be observed and taken into account? In what ways can the society promote civic participation of young people? These questions in mind, a research project "Young people and their future images of 2067" was planned. The project is part of Finland's 100th anniversary festivities in the city of Hämeenlinna, where the focus of the celebration is on developing a good future for our children by bringing forth young people's views of possible and preferable futures.

The research aims to find out what kinds of desirable images of the future young people aged 16–19 years have related to housing, livelihoods and lifestyle. The target is also to study, what possible obstacles young people see in societal or private level when thinking about realization of different future images. Research seeks to encourage young people to actively think and express their viewpoints related to future and to learn to consider alternative future images. The participatory aspect is applied in different ways during three phases of the project. First, it is experimented how a tool called future camp can be applied to gather young people's views about the topics in question and to promote futures thinking in a participatory atmosphere. Second, a survey is conducted where young people are asked to evaluate six different future images that are created based on the material from the first phase. Teenagers are also challenged to ponder factors that might prevent desirable futures to come

true. After the research material is analysed and reported, a group of young people is invited to use these research results to pick up issues they see important and to get their views out in the open in a seminar, which is organised by Hämeenlinna in November 2017.

Material and Methods

The research material was collected in two phases. The first phase consisted of seven future camps, which were organized in late 2015 and early 2016 across Finland in high schools, vocational schools and in one adult education college. The purpose of future camps was to gather images of the future from young people. The images of the future provide a basis for understanding youth aspirations and hopes for the future, as they guide people's choices and are one of the reasons for future come true (Rubin 2000; Bell 1997; Masini 1993).

Future camp combines personal futures approach, scenario approach and future-oriented guidance approach. This framework has been created in FFRC as a participatory process together with academic researchers, career counsellors, entrepreneurs and students. Future camp is a tool created especially for young people to build stepping stones for unknown future, as well as to focus on individual capacities to approach the desired future. Future camp is meant to support teenagers in imagining their own possibilities along with reflecting individual thinking and decision making. (Ahvenainen et al. 2014 and 2015; Jokinen et al. 2015.) In this project future camp was developed further and tested to function also as an interaction based foresight method that is suitable for gathering research data.

The camp sites were chosen by geographic distribution of the school location and by different regional types, such as cities and rural areas. One of the camps was organized only for adolescents at risk of becoming marginalized. A total of 208 teenagers participated in the future camps, where they imagined and described their own dreams and expectations of future for example by writing, drawing, voting and building with Lego bricks. Each camp was identical and consisted of four activity points that had different content supporting participants' futures awareness. These activity points addressed thinking and values related to future, work and livelihood, housing, and Independence Day in 2067. After the tour of future camps was completed, the collected research material was organized and then analysed by using methods of classification and thematization.

Based on the analysis of future camp material, researchers constructed six positive future images depicting life in the 2050s. Writing the future descriptions was a delicate process, since the effects of used words were carefully considered. Every description had also three photographs attached, which were meant to inspire the reader but not to limit their thoughts or lead them in any particular direction. The future images focus on aspects of lifestyle, housing, and work. They were applied in an online survey that was constructed in the second phase of collecting the research material. The survey was sent to selected educational establishments in late 2016 and early 2017 and young people both in vocational schools and high schools evaluated the ready-made future images, reflected the desirability and probability perspectives of the images and then described their own dream future. The survey participant schools represented different parts of Finland and approximately 520 of all answers were

analysed for this project by using method of thematization. Among respondents there were about 270 males and 250 females. The data analysis from both phases was carried out on a grounded theory basis, in order to retain young people's own experiences and defined meanings in the research focus.

Results

According to the results of future camps, young people's images of the future are rather conservative and they are based on the ideal of welfare society and values of the surrounding society. The images of the future emphasize traditional views of happy family and good life. Among these young people, the dream is to live with family members in a detached house that is located near the city and its services in Finland, some country in Europe, the United States or in a sunny and warm destination abroad. The homes are preferably located close to nature and water. In these future images people commute by ecological car and also good public transport is very important.

High income is expected in young people's dreams based on camp results and over half of the participants considered international career attractive. Many emphasized interesting work content and a good working atmosphere as important criteria for a satisfied working life. Both paid labour and entrepreneurship were considered to be somewhat or fairly important as career criteria. Based on the camp data, young people see their own future in a very positive light, but national and global development is overshadowed by rising unemployment, increasing impacts of climate change and progressive numbers of refugees. This is based on the experience that personal future can be more easily influenced than Finland's or global development. Future camps were organized within a period of time, when unemployment numbers and refugee crises were actively discussed in the media and it may have had some impact on teenagers' outlooks of future prospects.

Fairly similar elements were emphasized in the survey results as in future camps. In the survey, every respondent assessed the desirability and probability perspectives of the future images and many of them also elaborated their thoughts in the open-ended questions attached in all of the future images. The results of average desirability and probability of the future images can be seen in figure 1. According to the results, the most desirable future image is number two, where people live spaciously in the waterfront. In this image, home is located in a convenient driving distance from hobbies, work and other services. The family members live with their pets in a big detached house with a lot of space and nature around them. The house is equipped with smart technology and adults' working life is very flexible. This futures image is also seen as the most probable amongst young people answering the survey questions (figure 1).

Figure 1. The desirability and probability of the future images.

In figure 1 the estimates of desirability are always greater than probability. Kuhmonen et al. (2014, 55) also found out in their study that the desirability of future images is greater than the probability and they state, that it is based on the possible obstacles or on the fact, that the images are not considered personally realistic. In this project the future image number three, where people live in a private community outside the society is seen the second most desirable but not very likely to be the future lifestyle. Many of the respondents think that this future image is unrealistic and feeling of social isolation as well as economic issues are the most commonly reported obstacles.

In the open-ended questions attached in each of the future images young people were asked to mention what they liked in the future image and what they found as possible obstacles for realization of the image. The thematization of the answers revealed that same themes could be seen both as attractive or unfavourable attributes depending what were the values and preferences of the respondents. For example, the future image number five Active metropolis, got numerous comments regarding living in the city centre and while for many young people it was a positive feature, there were equally many who expressed that they do not wish to live in that way in the future.

The findings of the future camp and survey material are encapsulated accordingly: the favourable image of the future for the participants includes significant relationships and a possibility for communality, a variety of housing options in different phases of life, easily achievable services and meaningful work tasks and sufficient income. In addition, possibility to live out ecological or international lifestyle is valued and smart technology is seen to be part of everyday life in many occasions in the future. Proposals for policy makers are made based on these notions.

Discussion and Conclusions

The views of the young people in this research resemble results gathered from the Finnish youth in other researches (e.g. Seppälä 2008; Myllyniemi 2016; Limnéll & Rantapelkonen 2017). According to previous research on young people's images of the future, the youth consider their own future more positively than the future of the society at large and this is argued to base in the notion that the youth feel they can affect their own future but not that much the future in national or global level (Eckersley 1999; Rubin 2000; Hicks & Holden 2007). The results of this research correlate with former research in this respect.

In the project, the focus was on positive images of the future only. This choice was motivated by former research observations that working with positive images of the future may encourage the sense of hope and possibilities regarding the future (Rubin 2000; Lombardo 2010). When young people's thinking is the subject of the research, it is to be taken into consideration that the choice of the research method may affect the results as the mindset of the youth is a complicated process and, during the years of youth the futures thinking is still developing and social relations and the surrounding society influence on it (Nurmi & Nuutinen 1987). Keeping this in mind, two methods, future camps and a survey, were used in order to reach youth's thoughts.

In this research the future camp is used as a method both in order to gather research material and to encourage young people to ponder on different aspects of possible futures. It is a good method to promote young people´s participation in the development of our society. Future camps can increase access to decision-making, as well as increase influence and voice of young people. It is also a good tool for young people helping them to focus on individual capacities to approach the desired future, imagining own possibilities and reflect individual thinking, as well as decision making patterns. Future camp is a suitable method for data gathering but also demanding for both organizers and participants when implemented in detail. Therefore, as new technology develops and becomes more consumer friendly, one way to facilitate camps could be to apply virtual reality elements in some form. Virtual reality could both lighten the practical activities of the camps as well as provide more imaginative ways for participants to explore the future images in different contexts. The development work with the future camp method continues in the FFRC.

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AXIOM Approach for Modeling and Analysis of Complex Systems

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Abstract

AXIOM is an approach for modeling and analysis of complex systems based on expert-sourced data. It proposes a systems modeling language and a computational process to extract information of higher analytical value from a model built using the language. AXIOM can be placed in the family of cross-impact analysis techniques, and it proposes solutions for several practical problems associated with systems modeling using the established cross-impact techniques. This paper presents the AXIOM modeling language primitives, outlines the computational process and shows how the evaluated AXIOM model can be used for analysis of the modeled system.

1. Introduction

This paper describes the AXIOM approach for complex systems modeling and analysis. Modeling is generally defined as creating an approximation of the real world or a portion of reality (Sokolowski and Banks, 2009, 3). Such approximations or *models* can then be used in simulation of the real system they represent. Simulation is done to improve understanding of the real system, test how the system behaves under different conditions, and study the effects of changes, thus supporting planning and decision-making. International Council on Systems Engineering (INCOSE) (2017) defines a *system* as a "collection of elements that together produce results not obtainable by the elements alone". Systems thinking entails understanding the parts of reality under analysis as a set of components, that are logically connected abstractions of some real world objects or phenomena (Checkland, 1999, 99).

Systems modeling is therefore a process of representing reality using a modeling language which defines the available types components, and the logical connections and relationships between them for building the representation. The process of trying to capture the essential aspects of a system or a problem domain can as such be a useful learning experience (Checkland, 1999). However, as the components and their relationships and connections are modeling inputs, the analysis part of system modeling and analysis must derive its added value from a process of performing some kind of evaluation or simulation on the model. This process aims at revealing the emergent properties of the system itself, which can be difficult to observe by just looking at the system components at the lowest level of aggregation (Checkland, 1999, 99–103). The emergent properties are *systemic*, reflecting how the components and their connections function as a system.

Modeling a system involves abstracting the real system components and aspects into the model components and drafting the structure of their relationships, using the constructs available in the modeling language. The modeling process relies on a theory of the system, which guides the framing of the

system, the inclusion or exclusion of components, and the aggregation level. Systems modeling does not necessarily go beyond this conceptual level representation of the system. In order to be able to perform evaluation of the model or use it for simulation, the relationships between the components should be valuated in some more formal logical or mathematical form. If such a form is not developed, the analysis that can be done on the basis of the system model remains more or less intuitive and heuristic: there is no transformation that can be done on the model to reveal the systemic "emergent properties".

The typical way of defining the relationships or connections between the components of the system model is to acquire a sufficient amount of quantitative data (Sokolowski and Banks, 2009) from statistics or empirical measurements on the modeled domain, and to derive a mathematical expression for the relationship on the basis of this available data. This data-driven approach obviously requires that the modeled components and relationships a) are quantifiable, and b) data about them is or can be made available for the modeling. The requirements of highly data-driven modeling can lead to omission of many important and interesting aspects of the system in modeling, or systems for which empirical data is not readily available not being subject to analysis with a systems modeling approach. For some systems, empirical data can be an impossibility: especially modeling employed in foresight and futures can deal with phenomena that do not yet exist and therefore can have no hard data available about them.

In lieu of empirical or statistical data, the system knowledge and understanding of knowledgeable people or *experts* of the modeled domain can be used in the process of formal valuation of the relationships between the model components. *Cross-impact analysis approaches* are a family of techniques to model systems based on expert-sourced information. The cross-impact approach goes beyond a conceptual-level model of a system, enabling, depending on the technique, some form of model evaluation or system simulation, aimed at extracting information about the emergent properties of the system. Tapping into expert-sourced data enables systems modeling in a theory-driven way, grounded in expert judgment and understanding: Cross-impact methods as modeling and analysis approaches fall in between empirical data-driven computational models and argumentative systems analysis, and they exhibit a high degree of disciplinary heterogeneity and focus on expert-sourced "soft" system knowledge (Weimer-Jehle, 2006). While a number of cross-impact techniques exist, there are barriers for adoption of the cross-impact approach, due to impracticalities in the modeling languages, intransparent documentation and lacking software implementations. AXIOM is a novel cross-impact approach, which proposes solutions for practical problems in existing cross-impact modeling techniques, with the aim of creating a clearly more feasible approach for systems modeling based on expert-sourced data. It also aims at providing output of more analytical value from the cross-impact modeling effort. AXIOM is transparently documented and implemented as free software, and is a ready-to-use tool for theory-driven systems modeling and simulation.

2. Cross-impact approaches

Cross-impact analysis has a long history in systems analysis and various foresight applications (Agami et al., 2010; Bañuls and Turoff, 2011; Bañuls et al., 2013; Blackman, 1973; Bloom, 1977; Brauers and Weber, 1988; Burns and Marcy, 1979; Choi et al., 2007; Dalkey, 1971; Godet et al., 1991; Godet, 1976; Godet et al., 1994; Gordon, 1969, 1994; Gordon and Hayward, 1968b; Ishikawa et al., 1980; Jackson and Lawton, 1976; Jeong and Kim, 1997; Kane, 1972; Kaya et al., 1979; Martino and Chen, 1978; Mitroff and Turoff, 1976; Nováky and Lóránt, 1978; Pagani, 2009; Thorleuchter et al., 2010; Turoff, 1971;Weimer-Jehle, 2006). The original motivation for the development of the approach was to complement the Delphi method by introducing analysis of interaction between elements of a given system (Godet et al., 1994; Gordon, 1969, 1994; Gordon and Hayward, 1968b). Recent research has focused mainly on application of the approach (Alizadeh et al., 2016; Blanning and Reinig, 1999; Chander et al., 2013; Choi et al., 2007; Gorane and Kant, 2013) and there has not been much methodological development. In spite of the methodological discussion, barriers exist for utilization of the cross-impact approach in modeling and research: many cross-impact techniques are not very transparent in their documentation and lack software tools and implementations.

Cross-impact analysis could be described as an analytical technique for studying a system, and particularly interaction within it. A system is seen to consist of several components, states, events and forces that are partially dependent on each other and therefore have influence on each other. The objects are modeled as system descriptors. System descriptors are referred to by different terms by authors of different cross-impact techniques. Gordon (1994) uses the term *event*, Godet et al. (1994) speak of *hypotheses*, and Honton et al. (1984) use the term *descriptor*. The influence the objects of the modeled system have on each other are given a model representation as impacts. Impacts can be represented as conditional probabilities (Godet et al., 1994; Gordon, 1994), references to probability adjusting functions (Honton et al., 1984; Luukkanen, 1994; Panula-Ontto, 2016), impact indices (Godet et al., 1994; Kane, 1972; Panula-Ontto and Piirainen, 2017), or simply a boolean indicator of interaction of some kind (Godet et al., 1994, 83).

The aim of cross-impact analysis is to extract information about the indirect and systemic interactions between the system components on the basis of the information on direct interactions. In a system with more than a few components, the indirect interactions can effectuate over a complex web of mediating components. Accounting for the effect of these interaction webs can reveal surprising and counter-intuitive relationships between the system components: seemingly unrelated components can be important for each other in a systemic way, and conversely an important direct impact of a component on another may be cancelled out or reversed by the systemic effects.

The inputs for cross-impact analysis include the system descriptors, their direct interactions and the valuations of properties for the descriptors and interactions. Typically this input data is provided by people with expertise considered relevant for the modeled system or topic. Technically one expert who supplies all the input data is enough to perform the analysis. Normally, however, there are several experts, and the facilitation of the expert process to supply the input data is of central importance for

the cross-impact modeling exercise. The expert inputs can be collected in a Delphi-like expert panel, via a questionnaire, or some combination of these. This paper presents a cross-impact modeling language and a computational technique for processing the built cross-impact model and extracting information from it; it does not propose a particular solution for the use of experts in the cross-impact modeling. However, the questions of expert selection, model building, facilitating expert group work in model valuation and other processual details are very important for the modeling undertaking. For discussion of these aspects of cross-impact modeling see e.g. Alizadeh et al. (2016); Blanning and Reinig (1999); Enzer (1971); Godet et al. (1991, 1994); Linstone and Turoff (1977); Seker (2015).

The existing cross-impact techniques vary greatly in terms of their inputs, computational process and outputs, but they can be grouped into three categories based on the analytical output they produce. The categories and the specific techniques in these categories are

1. Structural orientation
- MICMAC (Godet et al., 1991, 1994)
- ADVIAN (Linss and Fried, 2010)
- EXIT (Panula-Ontto and Piirainen, 2017)
- KSIM (Kane, 1972)

2. Morphological orientation
- Cross-impact balances approach (Weimer-Jehle, 2006)
- BASICS (Honton et al., 1984)
- JL-algorithm (Luukkanen, 1994)

3. Probability orientation
- Gordon's technique (Gordon and Hayward, 1968a; Gordon, 1994)
- SMIC (Godet et al., 1991, 1994)
- AXIOM

The **structurally oriented approaches** focus on the impact network structure, and derive their analytical added value from revealing the indirect impacts between system descriptors and relating them to the direct impacts in some way. The most used technique in this category appears to be the MICMAC (Godet et al., 1994) approach, which is a computational approach based on matrix multiplication, and a part of a larger analytical approach Godet calls “structural analysis". A derivative of MICMAC has been also proposed Linss and Fried (2010). The KSIM approach (Kane, 1972) is quite different from the other cross-impact approaches listed, but can, with reservation, be placed in the structurally oriented group of approaches. The structurally oriented techniques require fewer inputs than

the other approaches, and provide a faster and easier modeling process, but the analytical output is more abstract and less actionable.

The **morphological orientation** of cross-impact analysis enables identifying logical, probable or consistent states for the system. A system state can be understood to be the combination of particular states for the system components. It can also be thought of as a scenario. This utility of cross-impact analysis overlaps morphological analysis (see Ritchey, 2006). Some morphologically oriented cross-impact techniques deal with probabilities explicitly and some do not. Documented approaches in this category are the cross-impact balances approach (Weimer-Jehle, 2006), BASICS (Honton et al., 1984), and JL-algorithm (Luukkanen, 1994). BASICS and JL-algorithm could also be seen as probability-oriented techniques, but their implementations output only probabilities for system states, their added value being of the morphological type.

The **probability-oriented approaches** explicitly deal with probabilities and therefore require that the system descriptors or their possible states are assigned initial or a priori probabilities. Additionally, they require some expression of how the probabilities of the system descriptors are adjusted during the evaluation of the cross-impact model. This can mean defining a conditional probability matrix (Godet et al., 1994; Gordon, 1994) or referencing probability adjustment functions (Honton et al., 1984; Luukkanen, 1994; Panula-Ontto, 2016). The basic output of the model evaluation is a new set of probabilities for the system descriptors, the *a posteriori probabilities*, which are the probabilities when the emergent, systemic effects have been factored in. The modeling phase of the probability-oriented approach to cross-impact analysis is more difficult and time-consuming than in the other orientations, but this approach offers the greatest analytical possibilities. This approach is the most suited for simulation-type analysis with a cross-impact model, and can be used for testing effects of changes in or interventions to the system. The probability-oriented approaches can be also used for delivering similar analytical outputs as the structural approach and the morphological approach. The best-known techniques in this group are Gordon's method (Gordon, 1969; Gordon and Hayward, 1968a; Gordon, 1994) and SMIC (Godet et al., 1991; Godet, 1976; Godet et al., 1994). AXIOM is also in this category.

3. Advantages of the AXIOM approach

As stated in Section 2, AXIOM is a probability-oriented cross-impact approach, and the probability-oriented approaches in general have the greatest analytical possibilities among the different varieties of cross-impact methods. What are the advantages of AXIOM in comparison to other probability-oriented approaches? AXIOM combines the strengths of several documented cross-impact techniques in order to create a general systems modeling tool that is feasible, flexible and makes analytically powerful. The combination of the best features of various approaches makes AXIOM a recommendable method for use in crossimpact modeling. The advantages of AXIOM, in comparison to other probability-oriented cross-impact approaches, are the following:

1. Model valuation in AXIOM is relatively easy. For the probability-oriented cross-impact approaches, valuation refers to the task of assigning initial (a priori) probabilities for the system descriptors and defining conditional probabilities for them or expressing the interactions between the descriptors in some other way. The impact valuation phase in AXIOM is decisively easier when compared to cross-impact methods which represent interactions as conditional probabilities (such as Gordon's method or SMIC). The cognitive cost of providing a large number of conditional probabilities is very high for the expert valuators. The conditional probability valuations are needed for all ordered pairs of hypotheses in the model, even when the model valuators would conclude that there is no direct interaction between the hypotheses. For example, the conditional probability valuation P(A|B) = P(A) might violate the probability axioms, so no "default" conditional probability value exists: all interactions have to be valuated. The valuations have to comply with the probability axioms, and as the number of hypotheses grows, simply finding a compliant valuation solution might become difficult (at least without a help of a computer program specifically designed for this purpose). In this difficult valuation process, the qualitative-nature understanding of the experts about the interactions in the modeled system might get distorted in the attempt to find an acceptable valuation solution, changing the focus from modeling the system in the best way possible on the basis of expert knowledge into a sudoku-like number-placement exercise.

2. AXIOM is suited for cross-impact models with a large number of components. Cross-impact techniques which represent the interactions as conditional probabilities are not well suited for constructing system models with a large number of components. The cognitively expensive valuation phase heavily limits the practical number of components in the model. Godet et al. (1994, 149) actually recommend that the number of hypotheses should not exceed 6.

Modeling systems with such a small number of hypotheses is very limiting. In a system model with a handful of components represented by hypotheses, if those hypotheses are detailed and concrete, many relevant factors and driving forces are left outside the cross-impact model. Conversely, if the hypotheses are loaded with a lot of content so that each hypothesis represents many factors and driving forces simultaneously, the abstraction level of the hypotheses gets very high. This high abstraction level will make the model valuation difficult and ambiguous. The interpretation of results is likely to suffer from the high abstraction level and drawing concrete policy recommendations on the basis of the model might turn out difficult. Either way, practical and useful cross-impact modeling is very difficult if the nature of the cross-impact technique per se limits the number of model components.

As the object of interest in cross-impact modeling is the impact network of the modeled system, the limitations on the number of components in cross-impact models also limit the interestingness of the analysis. In a system model of few components, the impact chains cannot be very long. If the ability to investigate higher-order interactions, long impact chains and complex systemic effects is an important motivation to do cross-impact analysis, the cross-impact modeling technique should definitely support this aspiration.

3. AXIOM primitives have comparatively high modeling power. AXIOM statements have multiple possible values (called *options*), unlike Gordon's method or SMIC. It is easy to make the case that the multi-valued AXIOM statements are a better solution than separate boolean hypotheses for constructing useful and relevant cross-impact models. Boolean hypotheses can, to some degree, be used to model mutually exclusive system states akin to AXIOM options, but they are much less convenient and error-prone in modeling as they require the exclusiveness to be explicitly defined through conditional probabilities. Additionally, boolean hypotheses cannot model the exhaustiveness of AXIOM options: there is no mechanism to ensure that the probability distribution of a supposedly exclusive and exhaustive set of boolean hypotheses will remain valid during the model evaluation.

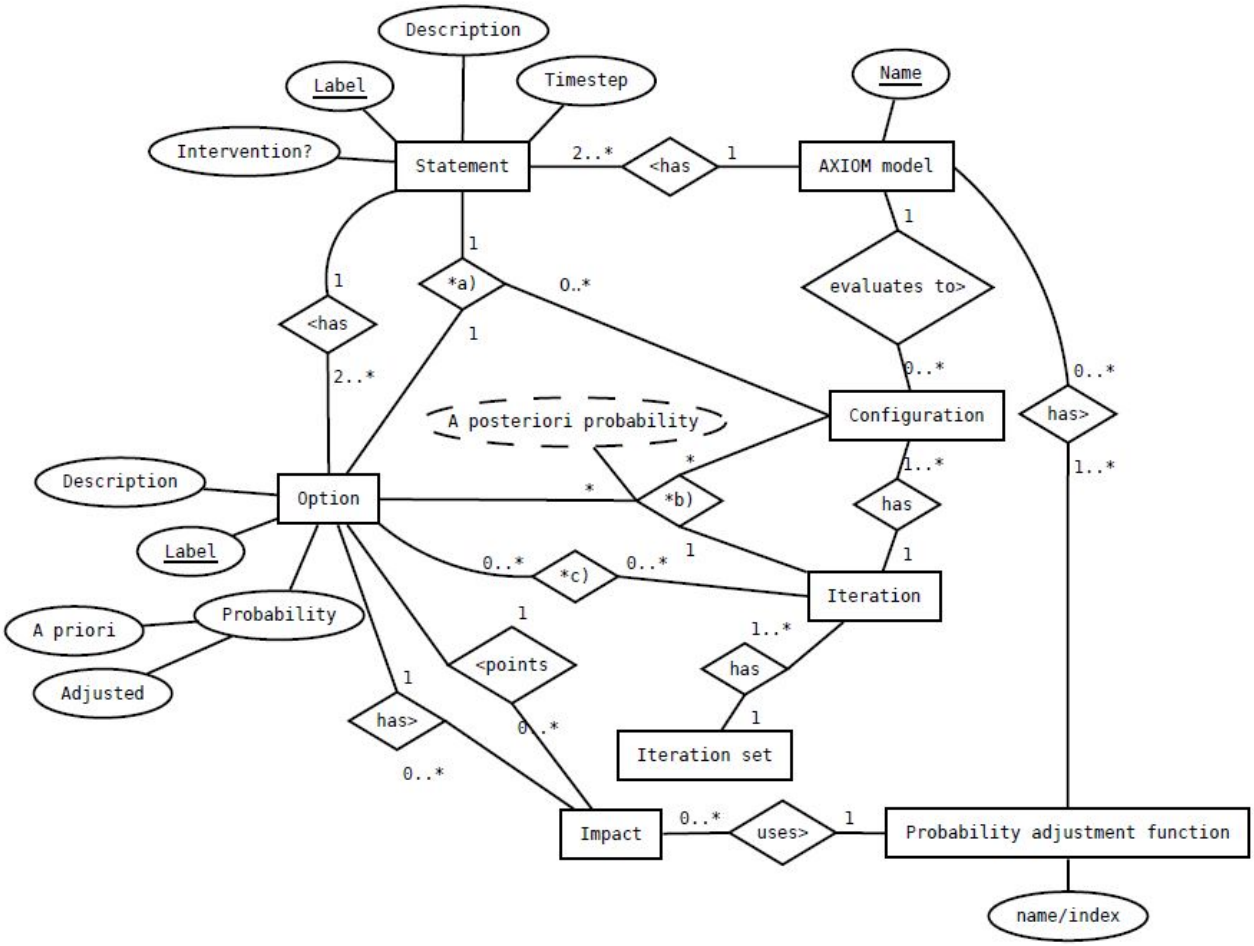
AXIOM also has a statement property called *timestep*. The timestep property makes it easy to model passage of time in the cross-impact model. Incorporating temporal aspect to cross-impact modeling is a feature of AXIOM that greatly increases its power to model real systems compared to methods that do not offer a mechanism to model time. Providing a way to model time makes it easier to construct models from the perspective of modeling interventions: today's decisions can be modeled to take their effect on the future states of the system in a very convenient and natural way instead of providing means to only model a system with a single temporal space where events happen and system states take place without any temporal structure.

4. AXIOM provides more analytical possibilities. In Gordon's method and Godet's SMIC method, especially the process of studying the effect of interventions and policy actions on the modeled system is, compared to AXIOM, cumbersome (although this might be more dependent on the implementation than the method). Modeling interventions requires changes to the cross-impact model and possibly redefinition of the conditional probabilities. The AXIOM method offers tools to design the simulation of interventions cleanly in the model building phase, and the focus of the analytical outputs is from the start in the effects of the different intervention sets, which makes it easy to extract practical policy recommendations. In addition to this, a number of further analytical outputs can be easily extracted on the basis of the AXIOM computation.

Above-stated strengths of the AXIOM approach, the freely available implementation, and the transparent documentation of the computation details make AXIOM a strong candidate for a general cross-impact modeling approach.

4. AXIOM modeling language, concepts and model evaluation

Any modeling approach has a modeling language associated with it, meaning a set of *modeling primitives* or building blocks to describe the characteristics of the real-world system that is being modeled. The building blocks for an AXIOM model are *statements* and their possible values called *options*, and *impacts* between the options. There are, however, a number of other important concepts that are also discussed in this section. Figure 1 presents an entity-relationship model of the important concepts of the AXIOM approach.



*a) Statement is evaluated to an option in a single configuration
*b) A configuration in an iteration has a single option for each statement in the model; the a posteriori probability of each option is the rate of occurrence of the option in configurations in the iteration.
*c) An iteration can have options as active interventions

Figure 1: ER model of the AXIOM concepts.

Statements represent system aspects or components that can have a state. They roughly correspond to what Gordon (1994) calls events, Godet et al. (1991) call hypotheses and Honton et al. (1984) call descriptors. AXIOM statements can have two to unlimited possible states (called options) whereas events or hypotheses in Gordon's or Godet et al.'s approaches only have a binary state (true or false) when evaluated or a state of being undetermined before evaluation. A statement should have a) a unique, identifying label b) a description detailing what they represent in the model c) a set of options d) a timestep value (explained in **timestep** definition), and e) a flag for whether the statement is to be treated as an intervention (explained in **intervention** definition). The options under a statement should be exclusive and exhaustive. Exclusiveness means that only one option can be evaluated to be the state of the statement (instead of more than one option being "true"). Exhaustiveness means that the options should cover the possible states of the component or aspect of the real system that corresponds to the AXIOM statement. This is rarely possible in practice. Selecting the most relevant possible states for an AXIOM statement is a part of framing of the model. Models in general can never

cover all parts and details of the modeled system. They should focus on covering the pertinent and essential parts, aspects and features of the modeled system, in order to be useful (if the model is as complex as the reality, its usefulness is questionable).

Options represent the different possible states a system component modeled as an AXIOM statement can have. Every option in an AXIOM model has a) one statement the fall under, b) identifying label, c) a description of what they represent, d) an immutable a priori probability e) a mutable, adjusted probability valuation, and f) a (possibly empty) set of impacts directed to other options in the model. The immutable a priori probability is the initial, expert-sourced probability valuation of an option. The a priori probability is interpreted as the probability of the option to become true, as estimated when no other information about the system or its state is available; the a priori probability valuation is given in a context where the states of the other statements are unknown. The mutable probability valuation might change during model evaluation, as impacts in the model are realized or take place. The set of a priori probabilities and the set of mutable probabilities under a statement both form a probability distribution, meaning that the sum of values in both sets of probabilities must equal 1 at all times. The AXIOM options are flexible and can model the possibilities of the modeled system in various ways. It is possible that the different options under a statement embody a very clear and atomic value or fact about the system, such as a number or a percentage, or a single boolean fact. It is also possible that the options represent a big group of connected details, or a mini-scenario. These different uses can be combined in the same model unproblematically.

Impacts are probability-changing influences between options. Impacts have an owning option and a target option. Impacts are realized when their owning option is evaluated to be the state of the statement it falls under; when an option is known to be true, its impacts ensue. Impacts, when realized, change the probability of their target option in some way. In AXIOM, the exact amount of probability adjustment is determined with probability adjustment functions (defined later). Any option *o* in an AXIOM model can have zero to $n_m - n_o$ impacts, where n_m is the number of options in the model and no is the number of options under the statement the option *o* falls under. This is because there can be no need to adjust the probability of options that are under the same statement as the owning option of the impacts; the owning option of an impact is already evaluated to be the state of its statement upon the time of realization of any impact.

An impact points to a probability adjustment function, that map the mutable, adjusted probability of the target option to a new adjusted probability value. The new probability value of the target option now reflects the valuation of the target option's probability when new information has become available (as the owning option is now known to be true). The probability adjustment functions have names, which can be indices: a set of names of probability adjustment functions could be {“ –3"," –2"," –1"," +1"," +2"," +3"}. Probability adjustment function "–3" could refer to a significant negative change in probability, while "–1" could refer to a slight negative change in probability. "+3" could refer to a significant positive change in probability. What is a significant positive change in probability means

different things in different contexts. A very improbable event or descriptor state might see its probability going from 0.00001 to 0.00100, making it a hundred times more probable but still having a very low probability. On the other hand, a probable event or descriptor state might have a probability of 0.8; Its probability cannot see a hundredfold increase. A strong positive change in its probability means a reduction in its uncertainty, and the adjustment must be no bigger than a part of the remaining 0.2 probability, that the probable descriptor will not be true. This kind of contextual probability adjustment is achieved by using probability adjustment functions: In AXIOM, the impact an option (when true) will have on the probability of some other option is expressed as a reference to (or as a name of) a probability adjustment function. This approach avoids the need to define a conditional probability matrix. The difficulties of using a conditional probability matrix in expressing the interactions in the cross-impact model has been discussed in Section 3. The probability adjustment function approach is an easier and more flexible way to express the cross-impact interactions.

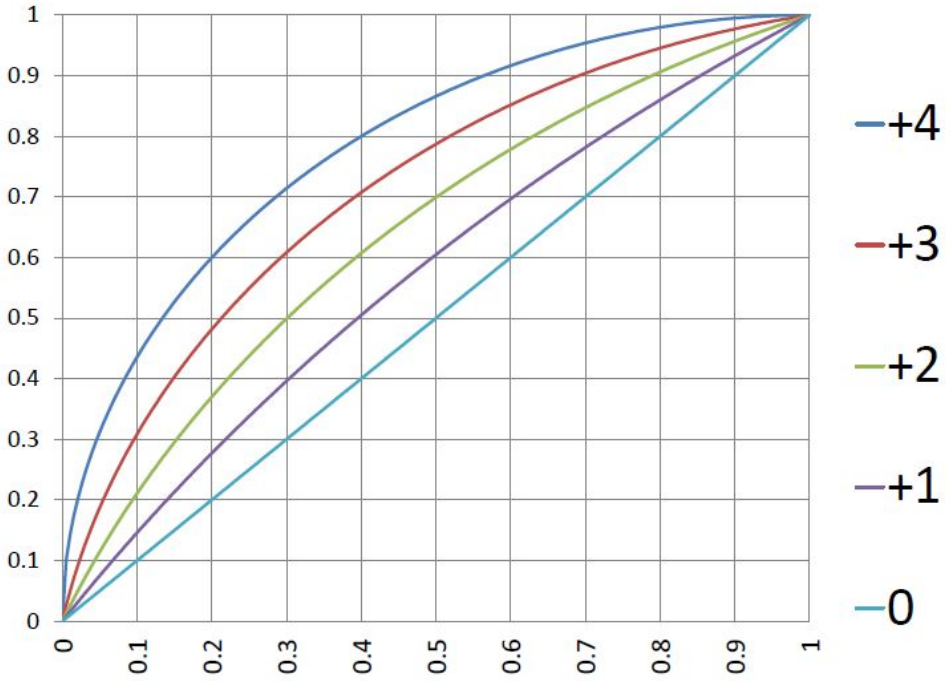


Figure 2: Examples of AXIOM probability adjustment functions

Probability adjustment functions map probability values into new, adjusted probability values. In AXIOM, the named probability adjustment functions are used to contextually change the probabilities of options. They can be freely defined by the analyst. The adjustment functions need to have a domain and range of [0, 1]. Figure 2 presents the graphs of four probability adjustment functions.

However, the probability adjustment functions should adjust probabilities in a way that is easy to understand and coherent from the perspective of the model valuators. For this reason, there are recommended properties the functions should have, in order for them to provide a clear and understandable way for the expert valuators to express interactions within the AXIOM model.

- They should be symmetric about the line $y = -x + 1$
- Should have the property $y(x_0) < y(x_1)$ when $x_0 < x_1$
- Should have the property $y(x) > x$ if the name of the function implies positive (probability-increasing) impact, and the property $y(x) < x$ if the name of the function implies negative (probability-decreasing) impact.

The probability adjustment functions in Figure 2 have this property. These recommendations can be disregarded by the modeler(s) if some functions not conforming to these requirements is seen as useful in the model valuation.

When the adjusted probability of an option of an AXIOM statement is changed according to the used probability-adjusting function, the probabilities of the other options under the impacted statement must be adjusted too. We can call the probability adjustment of the option that is the target of the impact *primary probability adjustment* and the probability adjustment of all the other options under the impacted statement *secondary probability adjustment*. The secondary probability adjustment is necessary because the probabilities of the options of a statement form a probability distribution and the sum of the probabilities of the options must always be equal to 1.

The primary and secondary probability adjustment are performed so that the probability of the impacted option is changed according to the probability adjustment function pointed by the impact, *(primary adjustment)* and the probabilities of the other options change so that their summed probability is equal to the complement of the new adjusted probability of the impacted option and the probability share each of these other options gets out of that summed probability is equal to their share of their summed probability before the probability adjustment *(secondary adjustment).* When the other options under the same statement as the impacted option is have their probabilities adjusted in this way, the total sum of the probabilities of all the statement's options remains equal to 1.

Timestep is a property of an AXIOM statement. It defines the temporal position of a statement in relation to other statements in the model. In model evaluation, the statements with the lowest timestep are evaluated before statements with a higher timestep value. Statements that have the same timestep value are evaluated in random order. In other words, in AXIOM model evaluation, statements are evaluated in groups of statements that share a timestep value. This makes it possible to simulate a system with temporal depth: events or descriptor states to take place in the near future can influence the descriptors that lie further in the future. A policy implemented in the next four years might have an impact of a particular economic scenario being true in the next four year period. Timesteps can be years, but they can also simply be ordinal numbers of the time categories (however they are defined in the actual model building), only their ordering as numbers is significant from the point of view of model evaluation.

Statement evaluation means assigning a state for an AXIOM statement, or setting one of the statement's options as its value. This is done probabilistically, with each option of the statement having a probability equal to its current adjusted (mutable) probability of being selected as the state of the

statement. When a statement is evaluated to a state (one of its options) all the impacts of the state option ensue or "take place".

The probabilities of the target options of the ensuing impacts are adjusted according to the probability adjustment functions associated with the ensuing impacts. After this, the statement is evaluated and has a known state.

Model evaluation means evaluating all of its statements. As explained in the **timestep** definition, the statements are evaluated in time categories, from lowest (earliest) to highest (latest), and statements in the same time category are evaluated in random order. During the model evaluation process, as more information about the state of the system becomes available, the probabilities of options in yet unevaluated statements are adjusted to reflect the effect of the newly available information. After evaluation of every statement, the model now has a state, as it now has a value for each of its statements. This combination of values is called a configuration: Model evaluation produces a configuration. For full details on the model evaluation, AXIOM algorithms pseudocode and a full example of an AXIOM model evaluation are presented in Panula-Ontto (2016).

Configuration is the result of the model evaluation. The information content of a configuration is a set of options, one option for each statement in the model. The options in the configuration are the options evaluated to be the states of each of the statements in a single model evaluation. A configuration can be understood as a scenario for the modeled system. As the model is evaluated multiple times, the resulting sets of configurations or iterations are used to derive a posteriori probabilities for the model options and other higher-order information. This is discussed in Section 5.

Intervention statements are treated in a special way in the model evaluation. Any statement can be flagged as an intervention statement in AXIOM model construction. They are not evaluated in the normal probabilistic way as non-intervention statements. In a single model evaluation, an intervention statement will have a predefined state; their state is determined when the model evaluation commences. Other details of the model evaluation are the same: the impacts of the predetermined options of the intervention statements take place when the intervention statement is taken up for evaluation. The states of the intervention statements change only between different iterations.

The function of intervention statements is that they can model policy actions, strategic options available to actors in the system or some other intervention-type aspect of the system. They provide an easy way to study the impacts and systemic effects of the different options available for the real-world component or aspect that the intervention statement represents.

Iteration is a list of configurations. A single model evaluation produces a configuration and several consecutive model evaluations produce an iteration. The utility of iterations is to be able to calculate the frequencies of different model options from a set of configurations with identical characteristics. Identical characteristics means same interventions, same model valuations and same model components. The frequence of occurrence of each option in an iteration is the a *posteriori* probability of that option.

The number of configurations in an iteration is not defined in the AXIOM method. The more model evaluations (and resulting configurations) the less the randomness of the Monte Carlo process effects the option frequencies. This is why a high number of configurations is recommended. For iterations that will be used for extracting final results to be analysed, at least 10^6 configurations are recommended. This recommendation is for calculating the a posteriori probabilities of individual options. If the idea is to compute a probability for a morphology or "partial scenario", i.e. the frequency of configurations that contain a specific set of options, the number of configurations should be even higher.

Iteration set is simply a set of iterations. The utility of an iteration set is to enable comparisons between the outputs of different model setups. The different model setups most commonly mean a different intervention combination (see intervention statements) but can also mean different a priori probability and impact valuations and inclusion and exclusion of different statements and options. When the model has flagged intervention statements, the AXIOM software implementation will automatically create an iteration set containing an iteration for each intervention combination derivable from the flagged intervention statements. This facility makes it straightforward to investigate how alternative policy actions modeled by the options of intervention statements affect the a posteriori probabilities of other model options.

The definitions of the concepts of the AXIOM approach outline the AXIOM modelling language and the computation process of AXIOM. The full description of the process is detailed in Panula-Ontto (2016), with pseudocode for the algorithms and a step-by-step computation example provided.

5. Output and analysis

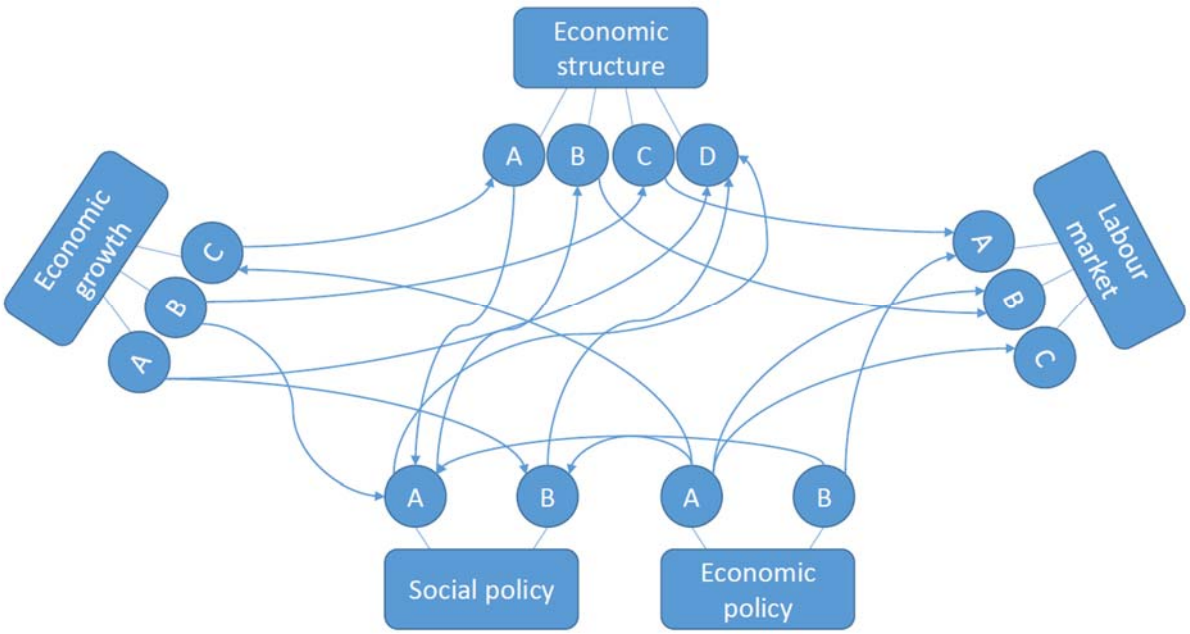


Figure 3: A conceptual system model.

Figure 3 presents a conceptual model of an economic system and a strategic decision-making problem framework. The (hypothetical) real system is modeled using AXIOM primitives: Statements, representing social policy, economic policy, economic growth, economic structure, and labour market aspects in the system; Options, describing possible states for the modeled system aspects, or *subscenarios* for the system aspects; and impacts, representing the influences that different subscenarios (AXIOM options), if realized, have on the likelihood of other subscenarios being realized. In the conceptual system model of Figure 3, economic policy subscenario A influences the probability of labour market subscenarios B and C, while economic policy subscenario B influences the probability of labour market subscenario A. The model valuations (a priori probabilities and impact valuations) are not presented in the conceptual model. For purposes of the example, let's assume an expert group has performed the model valuation and the model can be evaluated with the AXIOM computation process.

Statements "Social policy" and "Economic policy" represent policy interventions to the system. Both statements have two options. Assuming these two statements are aged as intervention statements, there are four possible combinations of interventions to investigate. Table 1 presents an example of the basic output of AXIOM. The table presents the a posteriori probabilities for the different model options of the conceptual system model presented in Figure 3. The second column displays the a priori probabilities. The third column presents the a posteriori probabilities in a case where no statement is treated as an intervention statement. These probabilities have the systemic interactions and higher-order impacts factored into them.

Table 1: AXIOM iteration set consisting of five iterations, one without active interventions and four iterations with different intervention combinations.

	a priori	no policy	SP_A + EP_A	SP_A + EP_B	SP_B + EP_A	SP_B + EP_B
Social policy A ($\mathbf{SP}_A$)	0.825	0.860	1	1	0	0
Social policy B ($\mathbf{SP}_B$)	0.175	0.140	0	0	1	1
Economic policy A ($\mathbf{EP}_A$)	0.258	0.260	1	0	1	0
Economic policy B ($\mathbf{EP}_B$)	0.742	0.740	0	1	0	1
Economic growth A ($\mathbf{G}_A$)	0.028	0.045	0.137	0.480	0.331	0.613
Economic growth B ($\mathbf{G}_B$)	0.715	0.717	0.425	0.041	0.581	0.192
Economic growth C ($\mathbf{G}_C$)	0.258	0.237	0.438	0.479	0.088	0.195
Economic structure A ($\mathbf{S}_A$)	0.144	0.176	0.357	0.438	0.027	0.469
Economic structure B ($\mathbf{S}_B$)	0.242	0.289	0.028	0.157	0.314	0.204
Economic structure C ($\mathbf{S}_C$)	0.152	0.185	0.118	0.046	0.413	0.232
Economic structure D ($\mathbf{S}_D$)	0.461	0.350	0.497	0.359	0.246	0.094
Labour market A ($\mathbf{L}_A$)	0.439	0.485	0.322	0.235	0.457	0.643
Labour market B ($\mathbf{L}_B$)	0.328	0.361	0.230	0.526	0.008	0.329
Labour market C ($\mathbf{L}_C$)	0.233	0.154	0.448	0.239	0.536	0.027

Columns 4–7 in Table 1 present the a posteriori probabilities of the model options under different intervention combinations. Column 4 presents the a posteriori probabilities assuming a combination

of social policy A and economic policy A; column 6 the a posteriori probabilities under a combination of social policy B and economic policy A. If the subscenario A for economic growth would be desirable, its probability would be maximized under a policy combination of social policy B and economic policy B (column 7). Similarly, if labour market subscenario B would be particularly undesirable, its probability would be minimized under social policy B combined with economic policy A (column 6).

A posteriori probabilities for individual options under different assumptions and policy combinations are easy to read from this output. The analyst may however be interested in more complex questions, such as what kind of policy mix would maximize (or minimize) the likelihood of a particular system morphology. Such morphologies in the case of the example model could be "Economic growth A" and "Labour market B" ($G_A \wedge L_B$) or "Economic growth B" and not "Labour market C" ($G_B \wedge \neg L_C$), or perhaps something more complicated such as $(G_B \vee G_C) \wedge (S_A \vee (S_B \wedge L_C))$. The AXIOM iteration object is suited for calculating probabilities of such morphologies and performing various frequent itemset mining operations that might be of use for the analyst.

Table 2: Using AXIOM iteration object to compute probabilities of system states as frequencies of morphologies.

Morphology	p	c_1	c_2	c_3	c_4	c_5	c_6	c_7	c_8	c_9	c_{10}	c_{11}	c_{12}	c_{13}	c_{14}	c_{15}	c_{16}	c_{17}	c_{18}	c_{19}	c_{20}
SP_A	0.80	1	0	1	1	0	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1
SP_B	0.20	0	1	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
EP_A	0.35	0	0	1	0	0	1	1	0	1	0	1	0	0	0	0	0	0	1	1	0
EP_B	0.65	1	1	0	1	1	0	0	1	0	1	0	1	1	1	1	1	1	0	0	1
G_A	0.25	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1
G_B	0.50	0	0	0	1	1	0	1	1	0	0	1	1	0	0	1	1	1	0	1	0
G_C	0.25	0	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	1	0	0
S_A	0.25	1	0	0	0	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0
S_B	0.25	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	1	1	0	0
S_C	0.30	0	1	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	1	0
S_D	0.20	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1
L_A	0.55	1	1	1	1	0	0	1	0	1	0	0	1	0	1	0	0	1	0	1	1
L_B	0.35	0	0	0	0	1	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0
L_C	0.10	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
$G_A \wedge L_B$	0.05	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
$G_B \wedge \neg L_C$	0.45	0	0	0	1	1	0	1	1	0	0	0	1	0	0	1	1	1	0	1	0
$(G_B \vee G_C) \wedge (S_A \vee (S_B \wedge L_C))$	0.25	0	0	0	0	1	0	1	0	0	0	1	0	0	0	1	0	0	1	0	0

Table 2 displays an iteration of 20 configurations, frequencies of different individual options within these 20 configurations, and frequencies of three example morphologies. 20 configurations is obviously insufficient to derive the a posteriori probabilities from the occurrence frequencies, but the principle is the same in an iteration of any number of configurations.

6. Software implementation

AXIOM is implemented as a Java program, and it can be downloaded from https://github.com/jmpaon/AXIOM. The GitHub page provides basic instructions for use and links to more resources on AXIOM.

7. Discussion

The AXIOM approach proposes a new modeling language and a computational process to extract information of higher added value from a system model built with that language. The rationale for a new probability-oriented or simulation-oriented cross-impact approach is illustrated in Section 3 by pointing out practical difficulties of modeling systems with the primitives available in Gordon's cross-impact approach and SMIC and proposing improvements, that have been incorporated into AXIOM approach. Section 4 discussed the AXIOM modeling language primitives, the computational process and how the evaluated AXIOM model can be used for analysis of the modeled system.

As a general systems modeling approach, the best fitness of AXIOM lies in high-level systems modeling where expert understanding of the system could be seen as the best source of information. For some modeling domains, the approach of using expert-sourced data is obviously not the best approach. For instance, technical systems with well-known limits and clearly measurable relationships and characteristics, the AXIOM modeling language, while a possible approach, is not a natural fit. Approaches like AXIOM can, however, offer tools to model systems from a very different perspective and attempt to incorporate aspects of the system that would be difficult or impossible to model using a more traditional datadriven approach. Combining theory-driven modeling and data-driven modeling in the same modeling framework provides interesting possibilities and warrants further experimentation, study and methodological development.

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Beyond Consistency: An Alternative Technique to Investigate Inconsistent CIB Scenarios

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Abstract

Despite the role that concept of consistency plays in qualitative scenario construction methods like Cross-impact balanced analysis (CIB), inconsistency investigation could be still important when it comes to discovering complex dynamics or biased expert opinions. However, for CIB method there is no way to investigate scenarios independent of their consistency qualities. This paper aims to propose an alternative technique to fill this gap. It utilizes inconsistency correction algorithms existing in CIB method to form a scenario network that can be analysed further to explore inconsistent scenarios.

Introduction and Background

Concept of "consistency" has been used widely as one of the central pillars of scenario planning process when it comes to define quality criteria for a good scenario construction practice. Consistency has mainly been defined along with the notions like plausibility that denotes "something makes sense and is coherent in itself" (Kosow 2015), and understood "as a safeguard against arbitrariness of scenarios. It is a substitute for empirical validation, which is not possible and not appropriate with respect to scenarios because their object is not accessible in the present and because they do not claim to be or to become true" (Kosow 2015).

More practically, consistency/plausibility stands at the heart of intuitive scenario construction techniques (Derbyshire & Wright 2016), and tries to keep the generated scenario narratives within the boundaries of being believable and reasonable. Thus, the outcome would be few plausibly formed scenario narratives. On the contrary, there exist so called "exploratory" scenario techniques that tend to explore the whole possibility space of the future, thus generate numerous possible scenarios (Davis, Bankes, & Egner 2007). In this family of methods exist both quantitative modeling approaches which suppose that mathematical heart of the models ensures the consistency, also qualitative-systematic methods (like cross-impact balanced analysis) that construct qualitative scenarios for the whole set of possibility space. Here, consistency check is crucial to divide scenarios based on their degree of plausibility.

Thus, it could be said that the concept of consistency still play a significant role in both type of scenario approaches, but its role differs from mainstream intuitive scenario narrative generation exercises to more formal-explorative methods. For the latter, what matters more is a kind of summarizing the possibility space into few number of scenarios due to practical reasons. Consistency together with

criteria like diversity, policy relevance or embedding surprises (Trutnevyte, Guivarch, Lempert, & Strachan 2016), are among tools that enables the researcher to extract subsets of scenarios for further analysis.

However, the concept of consistency has its rivals within the academic community too. Consistency testing has been criticized for assuming that the future would remain consistently within the boundaries of historical trends, thus ignore the possibility of surprising, and currently inconsistent situations (Postma & Liebl 2005). Accordingly, this group of literature call for recognizing the importance of inconsistency in the scenario construction process, as a chance to "examine complex interaction of existing dynamics, or unfolding of potential new dynamics" (Mahony 2014), and explore the possibility of co-occurrence of trends and counter trends, as characteristics of complexity of future (Mahony 2014). From this point of view, "presenting extreme or seemingly implausible future conditions intentionally, with an explanation of how they could in fact arise, can contribute to several of the major purposes of scenarios, e.g., shaking up habitual thinking and broadening expectations of what future developments are plausible" (Parson et al. 2007).

Besides what have been discussed above, the scenario methods that use the expert opinions as their basis, the inconsistency would mean more than potential complexity, but rather result of dissidence of opinions, biased views or wrong judgements. Meaning that consistency is primarily is a measure to show how well the scenario corresponds to the metal models of its generators (Weimer-Jehle 2006) and tells less about the trustworthiness of these mental models. It is especially the case when scenarios are resulted from a workshop with different participants, and the chance to reach a consensus and mutual understanding is less. Inconsistencies in this case are not a sign of implausibility per se, thus there seems to be a need for a further look into inconsistent scenarios and recycling them instead of discarding them altogether.

The purpose of this paper links directly to the discussion above. Cross-impact balanced (CIB) (Weimer-Jehle 2006) analysis is a qualitative method that generates large number of scenarios for all possibility space based on expert judgements on mutual impacts of the system drivers. Until now, in classical CIB studies only scenarios with highest degree of consistency have been taken into account (mainly very less than 1% of total generated scenarios). The scenario selection in this method is simply done through ranking scenarios based on their degree of consistency, and choose from the top of the list accordingly. Excluding some exceptions, studying inconsistent scenarios has not been part of CIB studies until now, and there is no method of scenario selection which is independent of consistency ranking to identify what inconsistent scenarios (among many) could also be selected for further inquiries.

So, the aim of this paper is to take a step towards introducing a technique that can distinguish between CIB generated scenarios based on a measure other than internal consistency, so that a chance for both looking at inconsistent scenarios as spaces for possible surprises, and possibility of twisted combinations of mental models of the expert is provided. As the goal of the paper is more to present the technique, only demonstrator examples are presented, and not a complete case study.

The paper will proceed as follows. Right after introduction a short and condensed description of CIB method is presented, because understanding the method and its terminology is necessary to grasp the technique this paper proposes. Later, the suggested technique is explained and accompanied by some example of its potential performance. And, finally a discussion of the usefulness of the method would be explained before the concluding remarks.

Cross-impact balanced analysis

Cross-Impact Balanced analysis (hereafter CIB) is a member of cross-impact analysis method family. The cross-impact analysis method was first introduced in the field of technology foresight to analyze the interdependence between important factors in the process of technology development, which links such process into the relevant underlying political, social and technological arenas (Gordon & Hayward 1968).

The very basic idea behind Cross Impact analysis method is to decide upon the mutual impact between the main factors concerning stability or change of a specific phenomenon. It is usually done through expert judgements which are gathered in a "cross-impact matrix". However, different members of this method family differ in the use of judgements and analysis algorithms (Gerhard Fuchs et al. 2008). In this sense, CIB is specifically designed to analyze qualitatively, and semi-quantitatively (Schweizer & Kriegler 2012) defined interaction networks.

These interdependencies can schematically be shown as a network of nodes and arrows (Gerhard Fuchs et al. 2008). While arrows showing direct linkages, nodes representing descriptors in CIB method. Descriptors are "the most important factors which have a significant direct or indirect influence on the object of the examination" (Weimer-Jehle 2006). Each descriptor has specific development variants, meaning that different possible development path of these descriptors, leading to different states in the target year of the analysis have to be taken into account. These can be ordinal (e.g., low, medium, and high currency exchange rate) or non-ordinal (e.g., government run by party A, party B, or party C) (Gerhard Fuchs et al. 2008). Descriptors and their variants are usually chosen based on expert judgement or literature research (Weimer-Jehle 2006).

While identifying system descriptors and their variants, next step is to form cross-impact matrix. It contains decision over mutual influences of descriptors which are gathered through expert judgements or literature (Weimer-Jehle 2006). To this end, experts are asked to answer this question for each pair of descriptors: "if the only piece of information about the system is that Descriptor X has the state x, will you evaluate this due to the direct influence of X on Y as a hint that Descriptor Y has the state y (promoting influence, positive points assessed) or as a hint that Descriptor Y has not the state y (restricting influence, negative points assessed)?" (Weimer-Jehle 2006) Usually a continuum of integers is used to capture expert judgements (+3 for highly promoting, -3 for highly restricting), however CIB algorithm does not exhibit this limitation (Weimer-Jehle 2006).

Following this step, CIB generates so called "consistent scenarios". Meaning that if we have sum of n for descriptor variations, 2^n configuration of these variations exist (scenarios). What CIB algorithm does is to check if for any given scenario all the consisting factors are internally consistent with each other (not contradicting) or not. To this end, as the descriptors are normally influenced by several others in a given scenario, all influences have to be combined. This is done simply by summing up the numbers in the matrix columns (see figure 1), this follows the principle of compensation and the result is called impact balances (Weimer-Jehle 2006). Then, because there is a double role for each descriptor: as source of influence and as target of influence being posed by other descriptors, there should be a match between these two. "Scenarios that do not contain contradictions between both perspectives are then accepted as valid" (Weimer-Jehle 2006) for the purpose of consistency check. Accordingly, the algorithm, compares the descriptor states of any randomly chosen scenario, with those descriptor states having the highest impact balances. When there is a mismatch, it means that "the combined influences of the given scenario promote another scenario different from itself and is therefore not self-consistent" (Schweizer & Kriegler 2012). Inconsistency scores are calculated from this difference. "It is defined as the maximum difference between the impact balance score for the target scenario state and the given scenario state that can be found across all descriptors" (Schweizer & Kriegler 2012). Consistent scenarios have the inconsistency score of 0.

	Pop			GDP				FFA			Mix				Int			EcP		EnP	
	M	L	H	H	M	VH	L	H	Co	L	HC	B	LC	VLC	H	M	L	G	R	G	R
Population																					
-Medium (8-12 billion)				-1	1	-1	1	-1	1	0	0	0	0	0	0	0	0	0	0	0	0
-Low (<8 billion)				0	0	0	0	1	0	-1	0	0	0	0	0	0	0	0	0	0	0
-High (>12 billion)				-1	1	-1	1	-2	1	1	0	0	0	0	0	0	0	0	0	0	0
GDP growth per capita																					
-High (2.0% - 2.6%)	1	1	-2					0	0	0	-1	0	1	0	-2	1	1	2	-2	0	0
-Medium (1.4% - 2.0%)	1	1	-2					0	0	0	1	0	0	-1	-1	1	0	-1	1	0	0
-Very High (>2.6%)	-1	3	-2					0	0	0	-2	0	1	1	-3	1	2	3	-3	0	0
-Low (<1.4%)	1	-2	1					0	0	0	2	0	-1	-1	1	-1	0	-2	2	0	0
Availability of fossil fuel																					
-High fossils	0	0	0	0	0	0	0				3	1	-2	-2	3	-1	-2	0	0	0	0
-Low oil/gas (High coal)	0	0	0	0	0	0	0				2	2	-2	-2	2	-1	-1	0	0	0	0
-Low fossils	0	0	0	0	0	0	0				-3	-3	3	3	-3	1	2	0	0	0	0
Energy structure																					
-C intensive (oil/coal => 50%)	0	0	0	0	0	0	0	-2	1	1					0	0	0	0	0	-3	3
-Balanced (30% < =oil/coal < 50%)	0	0	0	0	0	0	0	-1	1	0					0	0	0	0	0	2	-2
-Low C (6% <= oil/coal < 30%)	0	0	0	0	0	0	0	1	-1	0					0	0	0	0	0	2	-2
-Very low C (<6% oil/coal)	0	0	0	0	0	0	0	0	0	0					0	0	0	0	0	3	-3
Primary energy intensity																					
-High (>6.5 MJ/$)	0	0	0	0	0	0	0	-2	1	1	3	-1	-1	-1				0	0	0	0
-Medium (4.3-6.5 MJ/$)	0	0	0	0	0	0	0	-1	1	0	-2	2	1	-1				0	0	0	0
-Low (<4.3 MJ/$)	0	0	0	0	0	0	0	2	-1	-1	-3	1	1	1				0	0	0	0
Economic policy orientation																					
-Global	0	0	0	3	-1	1	-3	0	0	0	0	0	0	0	0	0	0			0	0
-Regional	0	0	0	-1	1	-1	1	0	0	0	2	1	-1	-2	2	-1	-1			0	0
Environmental policy orientation																					
-Global	0	0	0	0	0	0	0	0	0	0	-3	1	1	1	-2	1	1	0	0		
-Regional	0	0	0	0	0	0	0	0	0	0	3	-1	-1	-1	1	1	-2	0	0		
	v			v				v			v				v			v		v	
Balance:	1	1	-2	2	0	0	-2	-4	3	1	2	3	-1	-4	1	1	-2	2	-2	-3	3

Figure 1.cross-impact matrix. (Schweizer & Kriegler 2012)

An example is shown in figure 1. The chosen scenario in the picture (highlighted rows) is inconsistent, because for the descriptor "energy structure" (Mix abbreviation) the chosen variant "carbon intensive" (HC in the picture) is not receiving the highest impact comparing to its alternative state "balanced structure" (B in the picture).

Material and Methods

As explained in introduction, the aim of the paper is to introduce a technique in order to investigate the inconsistent CIB scenarios regardless of their consistency degree. Meaning that an alternative ranking of the scenarios is needed to decide upon the importance of scenarios. For this purpose, "succession analysis" -a side tool of CIB analysis- is suggested as a basis for the purpose of this paper.

Succession analysis and scenario network

There are two ways for identifying consistent scenarios in CIB. Either by enumeration of inconsistent scenarios, or by correcting the inconsistencies under certain algorithm, in order to generate consistent scenarios. The latter approach that needs more computational effort, is called succession analysis (Weimer-Jehle 2006). Taking the example of figure 1, succession is done through correcting the only inconsistency of the chosen scenario, meaning that one should change the descriptor state "C intensive energy structure" to the more supported state "Balanced structure" (Mix: HC to Mix:B in the matrix). The result of this correction is a new scenario which is called "successor". The successor could be a consistent or inconsistent scenario. In case that successor is inconsistent, the succession process could continue to either reach a consistent scenario or end up in a cycle of inconsistent scenarios (Weimer-Jehle 2006).

In classical CIB, succession analysis plays only a side role to provide more information about some specifically selected scenarios. But the idea in this paper is to perform a succession analysis for all possible CIB scenarios. The result could be presented in a network format, where each scenario is connected to its successor. For each CIB analysis, there could be a scenario network around each consistent scenario. The shape of the network depends on the cross-impact matrix structure and the succession algorithm (meaning what inconsistencies, and to what degree should be corrected in each step). Figure 2 shows a sample scenario network, to give an idea that how the distribution of scenarios around the fully consistent center could look like (graph is extracted from the matrix in Figure 1).

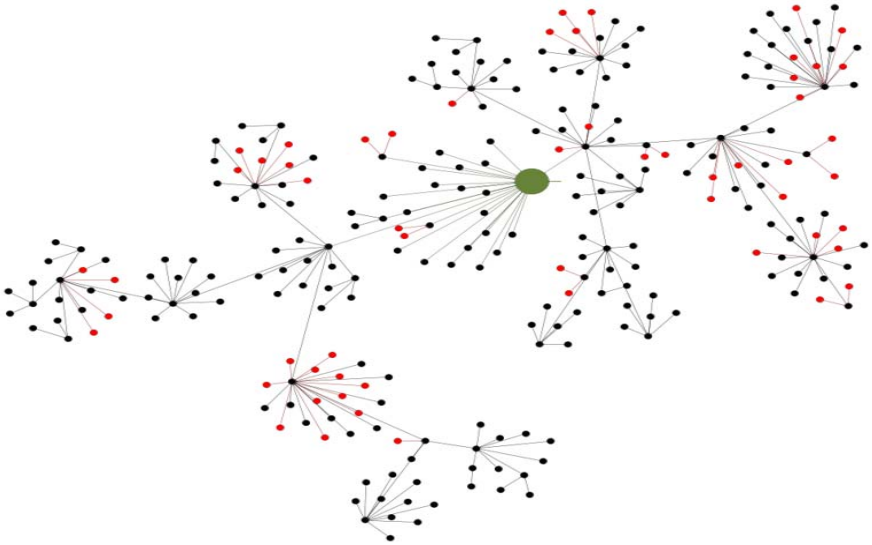

Figure 2. Succession network. The central node (bigger green) is a consistent scenario. Rest are inconsistent. Red nodes are scenarios containing "very low carbon intensive structures" assumption.

By having such network, the nodes (scenarios) have a new quality other than those they possess after the CIB analysis (like consistency value, number of inconsistencies, etc.) which is related to their network position. For example, the importance of each scenario could be assessed by considering the number of direct network connections (graph edges) it receives (identifying network hotspots), or in more advanced stage, by considering its connection and distance from the other network hotspots (e.g. eigenvector centrality in network analysis terms). This new assigned quality to the scenarios enables us to distinguish between scenarios by another criterion which is to some extent independent of consistency ranking of the scenarios. The weights assigned to the scenarios in the network is more a function of their position that is directly related to the structure of cross-impact matrix and succession algorithm.

As stated before the edges of the graph show a succession step, thus denotes a correction in the assumptions used to create the scenarios. Accordingly, the scenario network provides the researcher with two main types of information: network hotspots, and the most important corrections in the network (the edges that connects the network hotspots are representing the more important assumption corrections). In short, forming the network of successions, and using network characteristics is the alternative way of ranking scenarios.

In the next section few insights from an example would be presented. The cross-impact matrix for this example is presented in figure 1 and was adopted from (Schweizer & Kriegler 2012). The succession analysis for all scenarios of that matrix was performed.

Results

The demonstrator CIB study stated above was done based on IPCC scenarios in order to assess the consistency of its scenario narratives. There were 10 fully consistent scenarios resulted from this study. This section will try to show how employing the above presented technique could bring new

insights, besides the classical information resulting from CIB method (e.g. consistent scenarios, inconsistency degree of scenarios, etc.), especially regarding the inconsistent scenarios, which are 1718 scenarios out of the total 1728. For this purpose, a succession network for each of the 10 consistent scenarios was created and analyzed, however due to the nature of this paper, only some insights were selected for presenting the potentials of the technique.

A simple impression of the network could be extracted by looking into the network hotspots (the most referred successor scenarios). Table 1 shows 10 main hotspots and their respective CIB characteristics:

Table 1. Network Hotspots.

Rank	Scenario ID	Number of succesions leads to this scenario	Consistency value	Number of inconsistent assumptions
1	444	61	-6	3
2	16	44	-6	4
3	453	44	-6	1
4	447	37	-6	1
5	193	34	0	0
6	15	31	-6	4
7	1308	26	-4	2
8	192	25	0	0
9	157	21	-9	2
10	337	21	-2	1

As the table 1 shows, it is clear that there is an independence between the consistency as the main criterion of CIB and the network position of successor scenarios. 8 out of 10 fully consistent scenarios (highlighted in the table) are not among the most referred succession network destinations, and the rank 1 is a kind of implausible scenario (-6 consistency score) which is normally is not taken into account in normal CIB analysis. Also, there seems to be no relation between other CIB qualities like number of inconsistent assumptions or total inconsistency score with network qualities. The position of a scenario in a succession network more than anything could be understood as a result of the cross-impacts network, and the algorithm used to correct the inconsistencies. This means that, the importance of a network position is an indicator that shows that how easily an inconsistent scenario could be corrected under certain algorithm. Thus, the more a scenario is on the periphery of the network (there are lesser number of scenario that are resulted to them after correction), the harder to correct it, and this is regardless of its inconsistency degree. The farthest nodes could contain only with 1 slightly inconsistent assumption (-1 inconsistency) but the correction of this assumption might need several steps, while on the contrary a highly inconsistent, but closer to center scenario could be corrected in one go. In this sense, the network hotspots are worthy of a closer look, because they are results of more number of corrected assumptions, thus are specific cross-impact structures. This could provide a chance of re-assessing the scenario located at hotspots either simply regarding the

credibility of their impact judgements which were gathered before and reconsider them, or to go one step further and look at the paths under which a consistent scenario is resulted, and to pursue correction types and their frequency.

For instance the figure 3 shows the hotspots around scenario 453 (rank 3 in the table 1)[1]. The corrected assumptions for each step is also presented by abbreviations (figure 1 can help to understand) until we reach the consistent scenario no.1317. As the figure shows, high inconsistency of scenario 453 is rooted in an inconsistent assumption that does not fit plausibly with others. First thought would be to look whether the related scenario assumptions are well argued, whether there existed different neglected judgements for related cross-impacts (for example different opinions during the expert workshop) or even there might exist opposing theories or evidences in the scientific community for that particular impact judgement. For the example above, the inconsistency of scenario 453 is due to the assumption that carbon intensive structures are an obstacle against global environmental agreements, thus a global policy in this sense makes the scenario inconsistent (supplementary data for (Schweizer & Kriegler 2012)). However, one might argue against this, and points examples such as Paris agreement, that has been to some extent successful to include carbon intensive energy structures too, to meet the goals of the agreement.

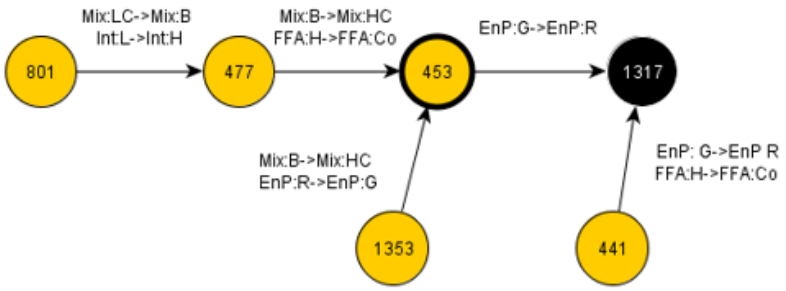

Figure 3.Succession network for main hotspots and related assumption corrections

This way by identifying some relatively more important assumptions, the possibility of a sort of sampling for an in depth reconsideration of cross-impact matrix could be provided. Judgements regarding these assumptions could be examined against broader body of evidence or literature.

Discussions

The succession network technique is a step towards investigation of inconsistent scenarios in CIB studies. It provides an opportunity to select handful of inconsistent scenarios out of many for further analysis, in order to discover potential misjudgments regarding the impact network or possibility of

[1] Out of the scenarios presented in the table 1, rank 1 and 2 fall in a circle of uncorrectable assumptions, thus were not considered.

surprising constellations of trends. It serves the primary purpose of this paper which was to pick scenarios from a quality different from consistency ranking. However, it can be argued that a succession network has more to say, if it is used in a way to reflect on present knowledge rather than discovering the future. To make this point, a typology of future knowledge orientation developed by (Grunwald 2014) could be employed.

Table 2.Major properties of the three modes of orientation (Grunwald 2014)

	Mode 1	Mode 2	Mode 3
Approach to the future	Predictive: one future	Look for a corridor of sensible futures	Open space of futures
spectrum of futures	Convergence as ideal	Bounded diversity	Unbounded divergence
Preferred methodology	Quantitative, model-based	Quantitative or qualitative; participatory	Narrative
Knowledge used	Causal and statistical knowledge, laws	Models, knowledge of stakeholders	Associative knowledge, arguments
Role of normative issues	Low	Depends on case	High
Orientation provided	Decision-support, optimization	Robust action strategies	Self-reflection and contemporary diagnostics

Grunwald presents three modes of orientation provided by future knowledge, which is summarized in table 2. Mode 1 is the one common in most of the modeling practices. There a single future is assumed which is being predicted through quantitative models that have a causal structure in their background. In mode 2 we have a limited diversity of futures or scenarios which are produced either by quantitative or qualitative methods. Here plausibility or sensibility is a measure to limit the whole possibility space in order to give robustness to our strategies. And finally mode 3 which is an open space of different futures in the format of narratives. In this mode a kind of relativism exist which gives no superiority to any future narrative. Instead Grunwald argues that mode 3 is a suitable place for self-reflection and a democratic dialogue about the assumptions we use to shape our future. This diversity lets us to become aware of our contemporary world and values (Grunwald 2014).

In this classification, CIB method in its classical approach is an example of mode 2 that goes from a relatively open space to a bounded convergence using the notion of consistency, which extracts handful of sensible futures through employing existing expert/stakeholder knowledge. In fact the succession network is a technique that can reverse the transition from mode 3 to mode 2 that takes place in a conventional CIB practice. It makes possible for the researcher to make use of large body of inconsistent futures constructed as a knowledge repository to provide what Grunwald calls a hermeneutic basis of the present (Grunwald 2014) to be used for better decision making. It means that we use the diversity that CIB generates in a way that brings us more clarity about ourselves and the discursive nature of our knowledge structures. In other words as Grunwald states: "if projections of future are interpreted in a way that makes clear why we aggregate certain current ingredients to specific futures

and argue dedicatedly about them, then we have learned something explicitly about ourselves which to date has only been an implicit part of societal reality" (Grunwald 2014).

This approach specifically matters for CIB, because the basic ingredients of the process-judgements- are highly discursive/value oriented components, thus the resulted consistent picture might be highly distorted consequently. Put it differently, the concept of consistency in CIB method could be understood as discursively constructed through agents and materials (experts and literature) presented within the process, thus a deconstruction could reveal something more about the nature of such shaping forces. This is where a succession network could play a role. It lets the researcher to turn the consistency from a final product of the method, to more procedural, being formed in stepwise correction process. And these processes are the hermeneutic materials for the self-reflection of the researcher.

As an example let's return to the case of IPCC scenario mentioned before. For the descriptor "energy structure" 4 variants has been designated. Primarily the study leaves the chance for the future energy systems to be "very low carbon intensive structures", however, when it comes to final products of CIB study, there is not such descriptor state among any of the 10 consistent scenarios (nor low carbon intensive structures). The question that can be posed here is, "how such consistent mental models (scenarios) are formed that do not contain this specific descriptor state?" The fact that a specific trend (here very low carbon intensive structures as an example) does not fit in the plausible pictures of future we make, could have different implications. "Is this element fundamentally non-retractable to the other elements of this mental model?" Or under certain, minimum adjustments of other elements is a plausible picture still assumable? These are the questions that could be answered through the succession network. Considering the case above, the respective succession network shows that scenarios containing the "very low carbon intensive structures" are totally at the periphery of the network (red nodes in figure 2). Meaning that there is no other scenario to be resulted towards them after the correction (no graph edge enters these nodes), or in other words, these scenarios are among the hardest correctable in the network. Regarding the second assumption (low carbon intensive structures), there are some scenarios at the absolute periphery, and the rest are at the second correctable position.

Connecting to what is discussed above, this example could show how the mental model behind this example did not consider any chance for plausible futures with very low carbon intensive energy structures, thus exclude them in the first place and look for the sensible pictures among others. This can have many reasons behind. This might be due to a disproportioned study design that did not consider relevant aspects for such futures to be presented plausibly, or might be due to kind of discursive, thus channelized mindset that cannot imagine future pictures outside of a certain range of carbon intensity. In any case, the succession network provides the opportunity to observe this process of correction and exclusion transparently to be able to derive conclusions regarding the relevant importance of different assumptions when it comes to construction of consistent pictures of the future. This results could be inspiring for the study conductors. For example, in order to pose new question to the scenario group

that stimulates their creativity in a different, less considered direction, or to add new voices with different point of views to the group, or to change the study design and add new elements and descriptors. This is the merit of scenario succession to provide a kind of mind map which already exist behind the CIB study transparently, that could be improved of better understood and justified.

Conclusion

CIB method is highly bound to the concept of consistency to ensure its final products are plausible. However, for the scenario methods generally and CIB specifically, the concept of consistency should be treated cautiously, because inconsistencies could be due to uncovered complexities or wrong and biased views. Succession analysis as a side tool of CIB method could help to generate succession networks to give CIB scenarios a new quality: their network position. This new quality helps us to investigate the inconsistent CIB scenarios to find out what are the more important (under this new quality). Important inconsistent scenarios could be re-assessed separately regarding their inconsistency sources, or in a network to know under which process the consistent scenarios are being made. The succession network acts as a tool for the researcher to explore more the existing knowledge, discourses and values shaping them. The result is a better awareness of the assumption set we develop to discover the future.

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Dismal Theory and Methodological Chaos in Scenario Planning

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Abstract

Managers utilizing scenario planning for strategy development may be surprised to learn that scholars in futures studies, an area responsible for research on foresight techniques, generally do not know why scenarios work. For more than a decade, scholars have prefaced their scientific communications by conspicuously bemoaning the lack of theory to support scenario methodology. This presents managers, scholars, and scenario planning facilitators with a paradox. Concern over insufficient theory and methodological chaos within the scenario planning literature is well known, but not so well known that the claim no longer requires frequent rendition (which the authors demonstrate); moreover, this gap in the literature has yet to be bridged despite repeated calls dating back to the 1970s. They conclude that although this concern is not unreasonable, it also serves a number of secondary, collateral functions. Ultimately, rehearsing the claim that there is insufficient theory to support scenario methodology acts as a readymade justification for adopting theory from outside of future studies and for developing one methodological typology after another; counter intuitively, both moves appear to deprive scenario planning of precisely the foundational theory and shared methodological toolkit scholars claim it desperately needs.

Introduction and Background

Managers utilizing scenarios to inform their decisions and facilitate strategic action may be surprised to learn that scholars in futures studies generally do not know why scenarios work. If a scholar were to examine the conduct of scientific inquiry within futures studies, then one of the most readily apparent patterns in the field would be revealed by observing that – for at least a decade now – scholars in futures studies have initiated their scientific communications (i.e., articles and books) by voicing concern over the paucity of theory needed to support scenario methodology. Oddly, it appears that there is no greater point of consensus in futures studies than the reality that there is no scholarly consensus with regard to the application of theory to support scenario methodology.

In this context, what strikes the authors is the consistently unresolved character of this now formulaic element of scientific account making in futures studies. After all, this gap in the literature has yet to be bridged despite repeated calls dating back to the 1970s. That said, rather than accept these claims as statements of fact or reject them as illegitimate or unrealistic portrayals of the field, the

authors remain neutral – at least provisionally – with regard to the veracity of these now commonplace accounts in futures studies. Thus, they inquire about the consequences of leaving this concern unresolved for so long, and, in so doing, foreground a number of covert or collateral functions that these claims appear to serve. Thus, the chief aim of this paper is to examine and understand – rather accept and repeat or reject and deny – the claim that scenario methodology lacks sufficient theory.

In what follows, the authors provide background literature framing what they referred to as an "unresolved" concern in futures studies. The authors conclude that while this unresolved concern is reasonable, it also serves a number of secondary functions. In exchange for voicing this concern scholars release themselves from responsibility to resolve it, even provisionally, thus freeing scholars to adopt theoretical commitments untethered from past research in futures studies. Alternatively, because of the repetitiveness of the concern over time, the authors speculate on the ritualized quality of the concern and consider whether or not voicing it has become a signal among members of the field actively publishing. Ultimately, rehearsing the claim that there is insufficient theory to support scenario methodology acts as a readymade justification for adopting theory from outside of future studies and for developing one methodological typology after another; counter intuitively, both moves appear to deprive scenario planning of precisely the foundational theory and shared methodological toolkit scholars claim it desperately needs.

Materials and Methods

This section utilizes intensive literature review as a methodology for systematically identifying evidence of (oft repeated) claims made in the futures studies literature. We contend that the origin of the claim (i.e., that scenario methodology lacks theory) hinges, in larger part, on an older and more general discussion in the history of futures studies regarding the appropriate use of systematic methods for forecasting. Editorial comments from Volume 1, Issue 1, of *Futures* frame the field for the reader as having deep-seated problems with methods, and, in this set-up, the implicit message is that the (specifically plural) futures concept will help to resolve methods problems. As of 1969, while the field "is at present in the formative stage," the origins of interest in the "futures [concept] has arisen because of the need for systematic methods of dealing with the enormous number of variables that must be taken into account when forecasting" (Editorial 1969, 2).

Overcoming uncertainty and establishing confidence in futures research and practice, the editor claimed, will only be possible if "forecasters" work "according to disciplined methods" and clearly communicate these systematic methods to outside constituencies, for example, "managers and government officials" who will "come to depend more and more on professional forecasts" (p. 3). Since then managers and government officials have come to depend on strategic planning and scenario methodology. Still, the aspirational title of the editorial (i.e., "Futures—Confidence from Chaos") seems never to have fully materialized, and this remains the case, despite the considerable growth of scenario planning as an offshoot of forecasting (Slaughter 2002). It appears that the problem with

methods was, in effect, inherited baggage, passed-on during the development of scenario planning from its origins in forecasting.

The foundational concern over "chaos" with regard to methodology dates back further than this inaugural editorial piece. The so-called father of scenario planning, Herman Kahn (1973, 146, as cited in in Aligica 2004, 80), openly claimed that "human societies are [so] complicated [that they are] beyond scientific generalization" during the early 1960s, hence, Kahn's early thinking was primarily shaped in the crucible of planning practices rather than founded in scientific theory to support the enterprise. This has had a lasting impact. It appears that with rare exception almost every major shift in the field of scenario planning amounts to a transition in practice that is not met with a corollary opportunity to develop theory to justify or, at minimum, explain that transition. Scenario planning, in academia and in practice, seems to be an applied field of research driven by practice, and, thus, tends to emphasize "who is doing what" whenever a survey history of the field is crafted. To this end, the authors review examples of the claims.

Results

In demonstrating our results, the authors would be remiss not to note that, in futures studies, the new century began with two separate scholarly assessments of scenario planning that characterize the field as overrun by "methodological chaos" (Martelli 2001) and bereft of theory (i.e., Chermack 2002). Both claims have now become formulaic. Also, please note that because of the repetitive nature of the claim under study, this section will also be repetitive -- too repetitive for some readers. The authors acknowledge this drawback; it is unavoidable given that they aim to demonstrate rather than merely state the repetitiveness.

Some scholars claim that the field was overrun by methodological chaos. Martelli's "Scenario building and scenario planning: State of the art and prospects of evolution," published in 2001 by *Futures Research Quarterly* (now *Futures*), contains the proverbial lightningrod statement on methodology in futures studies. After surveying scenario practitioner-facilitators and then hosting a panel-discussion among them, Martelli (2001) states that "methodological chaos" characterizes scenario planning in practice. The "methodological chaos" claim is perhaps the most well cited of its kind, picked-up by numerous authors. Problems associated with methodological chaos, Martelli (2001, 57) claims, "stem from the same identical theoretical and practical approach to the study of the future," that is to say, stem from this hybrid, practice-based research field. In 2005, Bradfield et al. (2005, 795) echoes and extends Martelli's claim, stating that the "literature reveals an abundance of different and at times contradictory definitions, characteristics, principles and methodological ideas about scenarios." Consider Bradfield et al.'s (2005, 795) claim in its full context: "Scenario Planning has been around for more than 30 years and during this period a multitude of techniques and methodologies have developed, resulting in what has been described as a 'methodological chaos' which is unlikely to disappear in the near future … This is reflected in the fact that literature reveals an abundance of different and at times contradictory definitions, characteristics, principles and methodological ideas about scenarios.

It has been suggested that a pressing need for the future of scenarios is amongst other things, to resolve the confusion over 'the definitions and methods of scenarios.'"

As we shall see, Bradfield et al. (2005) are not alone. The abundant repetitiveness of Martelli's concern regarding chaos echoes year after year in the futures studies literature. By 2013, for example, the concern is starting to appear as though it is a taken-for-granted matter of fact; according to Dusza (2013, p. 137): "Over the past 30 years, the methods of scenario planning were described so diversely that we may call it a "methodological chaos.""

Typologizing the scenario planning process is occasionally identified as a solution to the issue. Thus, academics have sought to wrangle the chaos by systematizing methods into various typologies, according to Gordon (2013, 88), who writes: "Since the rise of scenario planning as a mainstream planning tool, many academic authors have attempted to determine a classificatory system or "typology" of scenario work, to bring order to the methodological "chaos" of contested definitions and justifications perceived in the field."

Ramirez et al. (2015, 71) note that "several efforts" to resolve methodological concerns "have been undertaken:" "Because scenario planning developed as a practitioner-led domain in a great variety of settings, many different practices, methods, techniques and tools have been proposed and used. Social scientists have made scenario planning practices an object of study and have found that many of these practices contradict others in terms of both their ontological assumptions and their epistemological orientations, leading to what Martelli (2001) referred to as "methodological chaos". Several efforts to distinguish, compare, and classify the variety of scenario planning practices and their theoretical and philosophical underpinnings have been undertaken."

Bradfield et al. (2016, 60) state that "paucity of theory" is the source of confusion: "Scenario planning has been around for more than 50 years and during this period a multitude of techniques and methodologies have developed, resulting in what has been described by Martelli (2001) as *'methodological chaos'*. The literature reveals an abundance of different and at times contradictory definitions, characteristics, principles and methodological ideas about scenarios. The consequence, according to Khakee (1991), is that 'few techniques in futures studies have given rise to so much confusion as scenarios' … This 'confusion' results from the fact that there is a paucity of theory underpinning the use of scenarios as a means to consider the future, leading Chermack (2002) to conclude that 'the status of theory development in the area of scenario planning is dismal' … This is equally true of futures studies in general, which Miller (2006) contends, lacks a coherent and commonly accepted foundation when compared to other well-established academic disciplines."

No matter how often the concern over methodological chaos is repeated, the issue still boils down to a single passage by Martelli (2001, 63): "intuitive logic is strictly connected with the expert or group of experts who work on the scenario, the techniques are assembled in the most varied way, and consequently it is hard, if not impossible, to check the validity of the particular approach adopted from a scientific point-of-view. This difficulty is certainly compounded by the fact that most of the scenario studies concerned remain the property of a client company or governmental agency and are therefore

not subject to that "peer review" which is, in the long-run, the only method to ascertain the validity of a technique or set of techniques and the scientific reliability of a researcher (but this is generally true of all methods used in scenario building and planning)." Thus, if practice-based scenario work remains essentially private without a blind peer review system in place to shape practice, then the scenario method is unlikely to become more scientific and, therefore, less chaotic in form and function. It follows, therefore, that one of the greatest points of scholarly, academic consensus in futures studies with regard to the scenario method is that there is no consensus in futures studies with regard to the status of the scenario method, which the authors repeatedly demonstrated with quotations from extant, relevant literature.

Still other scholars claim that the field is bereft of theory. Shortly after Martelli's (2001) critique, Chermack (2002, 25) assessed the status of theory in scenario planning and concluded that it was "dismal." Chermack's review of major contributions to scenario planning revealed analytical emphasis on practical application at the expense of explicit theoretical considerations and moderate evidence that scholars even occasionally conflated "method and theory" (Chermack 2002, 26). In an inextricably related claim, Martelli (2001, 68) also characterizes Peter Schwartz's (1991) seminal text, *The Art of the Long View*, as theoretically "flimsy;" implicating that without theoretical support, Martelli (2001, 68) states, the approach cannot and "does not really tell [readers] much about how to build scenarios and use them in strategic planning." On balance, however, Bishop et al., (2007, 5), after an analysis of two dozen scenario techniques, concluded that: "As consultants and organizations have come to recognize the value of scenarios, they have also latched onto one scenario technique … as the default for all their scenario work. That technique is the Royal Dutch Shell/Global Business Network (GBN) matrix approach, created by Pierre Wack in the 1970s and popularized by Schwartz (1991) in the *Art of the Long View* and Van der Heijden (1996) in *Scenarios: The Art of Strategic Conversations*. In fact, Millett (2003, …) calls it the "gold standard of corporate scenario generation."" A decade later, Ramirez and Wilkinson (2014, 251) suggests that the technique put forth by Schwartz (i.e., the 2x2 matrix) may be a case of "mistaken identity;" although Schwartz worked as Shell's head of scenarios, the 2x2 matrix was far from Shell's only or standard planning methodology.

As a secondary element of methodological chaos, concern over the lack of theoretical support for scenario planning remained essentially dormant after being voiced by Chermack (2002). Recently, however, there is evidence of renewed scholarly interest in the underpinnings of scenario planning. Predictably, these scholars lament the state of theory in the field.

To begin, the authors provide Chermack's (2002, 26) original language: "This focus on practical application and development can certainly be appreciated as the refinement of these methods has, in some cases, produced agile organizations that seem to be able to anticipate change. One need only look at [Shell's] success with scenarios to see this impact. On the other hand, some scenario projects have resulted in remarkable failure and there has been little effort in searching for the cause. The greatest danger in this situation is atheoretical application."

Bradfield (2008) acknowledges Chermack's (2002, 26) concern over "atheoretical application," thus, linking the field's practice-orientation to method with its lack of theoretical undergirding; Bradfield (2008, 198-199) writes that: "according to Khakee (1991) … "few techniques in futures studies have given rise to so much confusion as scenarios" … This confusion may be explained by the fact that unlike other long-range forecasting methods there appears to be no solid theoretically based foundation underpinning scenario techniques. As a number of writers have noted, there is in fact "a paucity of systematic research" (Kuhn & Sniezek, 1995, …), leading Chermack (2002) to conclude that "the status of theory development in the area of scenario planning is dismal" … This is explained by the fact that the growth in popularity of scenarios has happened for practical reasons rather than theoretical ones, the consequence of which is that "theoretical research and sophisticated tools have been neglected in favour of multiple applications" (Godet, 1990 …)."

Bradfield et al. (2016, 60-61) return to essentially the same language in (February) 2016, stating: "[t]he consequence, according to Khakee (1991), is that 'few techniques in futures studies have given rise to so much confusion as scenarios' (…). This 'confusion' results from the fact that there is a paucity of theory underpinning the use of scenarios as a means to consider the future, leading Chermack (2002) to conclude that 'the status of theory development in the area of scenario planning is dismal' (…). This is equally true of futures studies in general, which Miller (2006) contends, lacks a coherent and commonly accepted foundation when compared to other well- established academic disciplines. Godet (1990) notes that the absence of a theoretical underpinning for scenario planning is because the growth in popularity of scenarios has happened for practical reasons rather than theoretical ones, and as a result 'theoretical research and sophisticated tools have been neglected in favour of multiple applications'."

However, this time, Bradfield et al. (2016, 60–61) provide further development of the issue, implicating a conflict of interest associated with practitioners and their retrospective accounts as well as a conflict of interest, echoing Martelli's (2001, 63) concern over a lack of peer review, with regard to objective judgment of the effectiveness of the scenario method; they write that: "[c]onfirmation of this comes, firstly, from Hodgkinson and Healey (2008, …) who note that most of the scenario literature comprises 'retrospective accounts of practising advocates . . . [and] individuals with significant vested interests in the phenomena of study'; and secondly Tetlock (2005), who suggests that 'Scenario consultants should not, of course, be the final judges of their own effectiveness. When pressed for proof, the consultants have thus far offered only anecdotes, invariably self-promoting ones'."

Apparently, methods in the field are based on practice rather than theory. Scholars and practitioners may encounter a sizable conflict of interest when their objective, empirical understanding of the effectiveness of scenarios and scenario methodology come into steady contact with their role as scholarly or professional advocates (or both) for scenario planning. Even as evidence of theoretical advancement accumulates.

Discussion and Conclusion

While the scenario method shapes contemporary strategic management practices in large organizations, managers undertaking scenario planning may be surprised to learn that scholars generally do not know why scenarios work. As has been demonstrated, scholars in futures studies, especially experts in scenario planning, routinely preface scientific communications by reiterating confusion, internal to the field, with regard to the absence of shared definitions, lack of theoretical underpinnings to support the scenario method, and vast discretion in the application of planning methods. This is the primary contribution of this article.

The net result, which plagues the field, are the twin problems of "dismal" theory (Chermack 2002) amid "methodological chaos" (Martelli 2001). While the conspicuous repetitiveness of these formulaic messages is apparent to even casual observers of the literature, few scholars characterize the phenomenon. To say again that scenario planning lacks sufficient theory and suffers from methodological chaos has become something of a norm in the production of scientific accounts in the scenario planning literature, which, in mass repetition, appear to contribute to the widely-acknowledged unresolved character of this "open" controversy. The field has not and perhaps cannot sustain an appreciable level of paradigmatic consistency that scholars such as Kuhn (1977) refer to as "normal science." In fact, it would not be an overstatement to suggest that one of the few points of scientific consensus in futures studies is that there is a lack of consensus with regard to theory and methodology in the scenario planning literature. This curiosity motivates both the review of the literature, which reveals it, and, in these concluding remarks, speculation with regard to the secondary or collateral function(s) that it serves in the field.

In the end, it seems as though the same tautological problem that plagues scholars attempting to resolve methodological chaos also plague scholars attempting to resolve, apply, and/or specify foundational theory to support the method. Thus, even efforts to resolve the lack of theory, by introducing theory, does not resolve the lack of theory and possibly fuels perceived chaos in the field. Thus, even efforts toward resolution, by contributing to the cacophony of voices, do not get scholars any closer to that resolution they claim they the field so desperately needs. If anything, such efforts may even begin to distance scholars from their goal (Spaniol & Rowland 2018).

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The Application of Causal Layered Analysis to Deconstruct the Present Conditions of Media and Politics in Iran

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Abstract

A significant phenomenon of media and politics in Iran is the fact that it extremely reflects the state will. Top-Down governmental approach to control media objectives, whether to inform or amuse, has been applied either through press censorship in the rising era of making centric modern state in an early nineteenth century or through social media filtering in recent years. Although media technology is transformed or the characteristics of governmental policy are changed, the necessity to conduct people with media along with education remains fixed. Questioning what conditions are making possible the continuity of this powerful governmental intervention in media and politics as well as what myths & discourses are justified, is the main goal of this article. Causal Layered Analysis (CLA), as a critical futures studies method, is considered an appropriate method to deconstruct the present status. In four different layers of analysis, first, we determine different aspects of Litany level, including the role of media in promoting enmity discourse concerning real and fictitious Iran's enemies. In the second layer, we specify different social causes for the current situation of media and politics including new actors emerged in recent years. In the third level, which is about the deep discourses related to the issue under the study, we review the revolutionary discourse which mainly emphasizes on creating alternative responses to the controversy between tradition and modernity in the contemporary history of Iran. Regarding the fourth layer of CLA, which is entitled to the level of metaphor or myth, we discover the narrative of "Educating the Public" as the deepest myth behind media politics in Iran.

Introduction and Background

Media and politics are tightly interconnected with each other in Iran. In the relative lack of any systematic form of identifying the proper politics like party engagement, media platforms represent every political objective proposed by diverse power sects which depend on the state institutions in a broad sense. They also play a focal role in the political determination. Despite the fact that left-right political conflicts and negotiations provide a rich diverse political sphere in Iran's contemporary era, the common trait here is the absence of ordinary people in political processes ended with a new decision for all. Instead of establishing an institutional condition for involvement, politicians on both sides fully expect media to inject political objectives into brains. Nevertheless, informal politics influence decision making behind the closed doors, particularly upon the advent of alternative media. The plural demands

have no other choice unless using the media stream out of different channels under the major limitations which stand still. As a result, no top-down and bottom-up interconnectedness might be possible without mediated relationship through media interventions.

To understand what causes create and facilitate the conditions of corrupted relationship between media and politics over the modern history of Iran, we have to go beyond the apparent level in which the mainstream media make an effort to inject political governmental objectives into the public, on one hand, and the alternative media resist top-down politics to pursue the growing demands of plural social strata in Iran on the other hand. Causal Layered Analysis (CLA) is one of the most credible frameworks to achieve this sight. In addition, we consider the plausibility of alternative critical futures which can be imagined to transform the situation from the status quo into the more desirable scenarios. We investigate driving factors stimulating more media diversity as well as multi-trajectory politics after the deconstruction of present connections between media and politics. We argue that educating people, instead of informing them, is the most preventive myth on the deepest layer of the relationship between media and politics.

Research Method: Causal layered analysis (CLA)

Causal layered analysis (CLA) is known as a critical futures research method which deepens the understandings about the futures changes. It has been invented by Sohail Inayatullah in a 1998 article for Futures that would come to be widely cited. According to Inayatullah (2004), CLA is based on the assumption that the way in which a problem is framed will have an impact on how a change in the issue will be pursued. While the theoretical underpinning of CLA is based on post-structuralism, the approach is layered, that is, it is a method of analysis which is inclusive of accounting for various streams of causality operating in unison upon an issue (Ramos 2003).

As he explains, causal layered analysis (CLA) consists of four dimensions. The litany or the day-to-day layer, the commonly accepted headlines of the way things are or should be. Solutions to problems are at this level usually short term. The second dimension is deeper, focused on the social, economic, political causes of the issue. The third dimension is the culture or worldview. This is the big picture, the paradigm that informs what we think is real or not real, the cognitive lenses we use to understand and shape the world. The fourth dimension is the myth or the metaphor – this is the deep unconscious story behind the issue (Ibid).

CLA seeks to integrate these four levels of understanding. Each level is true, and solutions need to be found at each level. Thus, policy solutions can be deeper. Litany interventions lead to short-term solutions, easy to grasp, packed with data. Systemic answers require interventions by efficiency experts. Governmental policies linked to a partnership with the private sector often results. Worldview change is much harder and longer term. It requires seeking solutions from outside the framework in which the solution has been defined. And myth solutions require deepest interventions, as this requires telling a new story, rewiring the brain and building new memories and the personal and collective body (Inayatullah 2008, 4–21).

CLA has been vastly utilized in many different studies in the previous literature. Different studies have used CLA as the main research framework, or as a participatory environment for conducting workshops. It has been applied in various case studies as a stand-alone method, or in combination with other futures methods like scenarios, futures wheel and backcasting. Some of the most important practices of CLA are packed and presented in the book, "The Causal Layered Analysis (CLA) Reader". According to Inayatullah (2004), Bangkok traffic futures (1993), the future of enrolments (1994), housing persons with disabilities (1995), and the future of United Nations (1996) are some of the initial practices of applying CLA in research frameworks and work-shops environment. In some recent studies, Lederwasch et.al (2001) apply CLA to create the future visions of mining and mineral industry in Australia, Lynda Shevellar (2011) reflects upon the usefulness of CLA as a means of responding to dilemmas within the current practice of community development, and Bishop and Dzidik (2014) utilize CLA as a qualitative methodology well suited for psychology and define a space for its adoption in the discipline.

Litany layer: contemporary power of the state

Regarding the relationship between media and politics in Iran, at the litany level, all the relevant news, documents and laws on the interconnections between politics and media sphere is of concern. In this sense, we scan many different documents, particularly all the relevant reinforced laws and legislations on media and media regulations in Iran. By scanning, collecting and conducting exploratory content analysis, we identify the crucial key elements with which the present relationship between media and politics in Iran is shaped and defined.

Media ownership is the first key element of the relationship between media and politics in Iran. Dividing all media platforms into three categories including press media, broadcast media, and digital media, it can be said that the majority of the mainstream in all three categories are owned by the state regime in Iran. State owned media can be defined as media which are financially and editorially controlled and administered by the states regimes and governments. Regarding this definition, radio and television broadcasting in Iran is completely owned and monopolized by the state regime, while digital media and press media are partly state owned, while some kinds of privately owned and alternative media are co-existing with the state owned ones as well.

For instance, according to the regulations related to the internet infrastructure, the access service provider (A.S.P) for internet connections is monopolized and owned by the state regime. Every governmental department or public sector which demands to provide its own ISP must request from the ministry of communication for a legal license and official permission (ASP Regulations 2008). Although the internet in Iran is under the strict control of the state regime and the control is being reinforced through different surveillance and filtering policies (Aryan & Aryan & Halderman 2013), there is a counter flow of unofficial and alternative media platforms which many Iranian users have access to it with the help of VPNs and anti-filters. For example, there are many different blogs and web pages

that are filtered by the force of government, but they are still producing different kinds of digital contents for their target audiences (e.g. private and personal blogs, podcasts, pages and groups on social media, etc.). State ownership is also found on other media forms: dozens of print and online press media fully supported by government budget are owned and administered by the state regime and Broadcasting is totally dominated by state according to Iran's constitution (Iran's Constitution 1979 The Statute of Islamic Radio and Television Broadcasting 1983).

Media control is the second element of the relationship between media and politics in Iran. Whether in the Islamic Republic of Iran state regime of in the previous imperial government in Pahlavi era, all different regimes and governments have always aimed to control and suppress media sphere in Iran by any means. Determining broadcasting media policies in a governmental supervision Council, press media license detention, visible and invisible ways of censorship, and filtering digital media contents on the internet are the general methods which Iran's state regime employs to control and dominate the entire media sphere. According to Iran's press law (1985), for instance, the publication of any publication, both in print or online news media, by actual and legal persons with Iranian capital requires obtaining a license from the Ministry of Culture and Islamic Guidance. Therefore, every commercial and private press is in a way under the control of the state regime. Press supervisory board is established to issue press license and investigate the required qualifications of the actual or legal person who has sought the license (article 11).

The influence of the state regime on media content production is the third element of the relationship between media and politics in Iran. Generally, the fundamental goal and mission of the state owned media platforms in Iran is to recreate and propagate the political and cultural discourses, which are desirable and advantageous for the state regime, particularly Islamic-based ones. Hence, it can be claimed that the state regime in Iran aims to use its own media and enforce private independent media platforms to promote and propagate the Islamic, traditional and ideological values and discourses. According to the article 9 of the radio and television broadcasting statute (1983), the main goal of radio and television broadcasting is to promote the Islamic culture. Preparing the social environment for public education and refinement, increasing people's moral virtues and accelerating the evolutionary path of Islamic revolution worldwide are the other indicated aims of the IRIB. The article 11 of the mentioned statute emphasizes on the international function of broadcasting and explains that radio and television broadcasting has to develop international relations and communications in the light of Islam and Islamic standards.

Thus, not only all different kinds of state owned media platforms are restricted by the state regime to produce media content inside the dominance Islamic discourse, but also private or citizen based ones are also limited to this constraints. The violation of these rules and norms is considered as the violation of the law and the violator media platform will be entitled to a vast spectrum of punishments and penalties. However, there has been always a counter media flow which attempts to appear as an alternative platform and bypass the state regime's restrictions. Accordingly, alternative media platform in Iran meaning those independent media that can bypass the control and censorship usually aim

to produce some alternative media contents. These alternative media try to provide their audiences with different modernist media content including secular, feminist, environmental, liberal, leftist, ethnic-based etc. They empower the audiences to choose their desired content among a colorful spectrum of contents. The layer of social causes unfolds this duality more.

Systematic causes: the Advent of New Actors

The state regime, as we mentioned before, has always been the key actor which determined the relationship between media and politics in Iran. After the Iranian revolution and from the first days of Islamic Republic of Iran establishment, the state regime attempted again to control and dominate the media sphere locally and globally. State ownership of the only broadcasting system in Iran, the publication of several state owned newspapers, press and online news media, and using different tools of suppression like censorship, filtering and license detention as well as pre-publication tools to ban like journalist deterrent are the manifestations of the state regime's attempt to dominate all kinds of media platforms in Iran. The state regime's dominance over the media sphere is also extended to the telecommunication technologies and infrastructures.

However, the state regime is not the only actor in the relationship between media and politics in Iran. In the different historical period, other actors have become influential and effective in determining this relationship by their roles and their original aims (Hajarian 1997). About ten years after the Islamic revolution in Iran, when the governmental economy and pro-socialist economic policies started to fail their promises and privatization of economy started to rise, the market became a crucial actor in media sphere in Iran. Commercial and private newspapers and publications started to emerge and they supposed to convey a more counter flow of content production in the media sphere.

In 1997, when the reformist political parties succeeded to win the presidential election, a powerful public demand emerged for a colorful media sphere. As many claims (Arjomand 2000 Khiabany & Serberny 2001) the reformist government aimed to relatively decrease the control and pressure on the civil society to allow the private press and media to be more independent and to discern more the freedom of speech. In this era, the civil society in Iran became an important actor in the relationship between media and politics. The civil society empowered to facilitate the publication of small and medium size newspapers and different kinds of publications. At the same time, the reducing state control over the media sphere caused the emergence of more independent media platforms striving to convey a voice to the voiceless. Although many relatively independent newspapers emerged in this era, trying to stand in a critical position in contrast with state owned media, many of these publications encountered license detention and became suspended by the state regime's judiciary which was generally in line with the supreme leader and previous president of Iran who generally have enough legal capability to dictate macro-policies of regime.

Technology has been another key actor. From 2005 till the present, the growth of telecommunication technologies, the rise of the internet and satellite television channels, and finally the emergence of social media platforms have changed the relationship between media and politics and affected the

crucial role of the state regime in determining the rules and regulations of media sphere. The wide access to and the huge range of opposing media content and comprehensive information on the internet made the digital and online media relatively uncontrollable by the state regime. Although the state regime highly attempts to control the digital media by different means of filtering, the emergence of VPNs and other proxies empowered Iranian people to use the digital media in the way they want and access to almost anything they want on the internet. Similarly, when the television and radio satellite receivers became accessible and popular in Iran, many media users started to consume these media platform's production instead of the state owned broadcasting programs Transmitted by IRIB or conventional state-owned press media. Despite the official legislations which ban the consumption of satellite channels in Iran, millions of Iranians watch foreign-based channels via illegal satellite dishes and receivers at their homes and regularly watch the satellite television channels (Barraclough 2001). These new are actors have a common characteristic: they are dissident due to the fact that they promote pro-western discourses as the official supported media content hyped up by the state is totally anti-western. The next layer is able to unfold this similarity among nonstate actors more.

Discoursive Layer: Traditionalism vs Modernism

The struggle between tradition and modernity was reached to its culmination when the Iranian revolution was achieved to final victory in 1978–9. Under the umbrella of a charismatic clergy, Ayatollah Rouhollah Khomeini, the new political regime was established: the Islamic Republic of Iran. As this new title vividly indicates, the challenges between modernist and traditionalist discourses entered a new phase in which both have had some sort of political power in various governing bodies. It resulted in an ongoing gap between different administrative structures as well as political recruitments in recent years (Bashiriyeh 2011, 106–156). Those who were traditionalists before becoming radical modernists after. The essential gap historically occurred at the beginning of the new regime when Mehdi Bazargan, one of the most prominent modernist figures, was forced to resign from the head of Iran's interim government as the result of burdensome pressure from traditionalists who play a significant role in political decision makings, particularly after Khomeini supports US Embassy takeover by one of the most radical Islamist groups, Muslim Student Followers of the Imam's Line.

According to Soltani (2005), modernists and traditionalists who were two wing of the victory and the supporters of Khomeini's leadership before the revolution were split into two different camps advocating different focal nodes: Islamic vs Republican. Islamists who gathered at Islamic Republican Party (IRP) on early years, utilized some discursive armament such as "clergy", "supreme leadership" and "religious jurisprudence" on their controversies against modernists who tended to institutionalize some modern concepts such as "citizenry", "legislation" and "freedom". This discursive duality has been lasting for the whole history of Iran's post-revolution era and crystallized on thereafter political controversies, particularly on presidential elections in which a pro-modernist candidate campaigned against a pro-traditionalist group of candidates (Tajik & Roozkhosh 2008 Jahangiri & Fattahi 2011 Mirzaei & Rabani-Khorasgani 2016 Nariman & Azizi 2016).

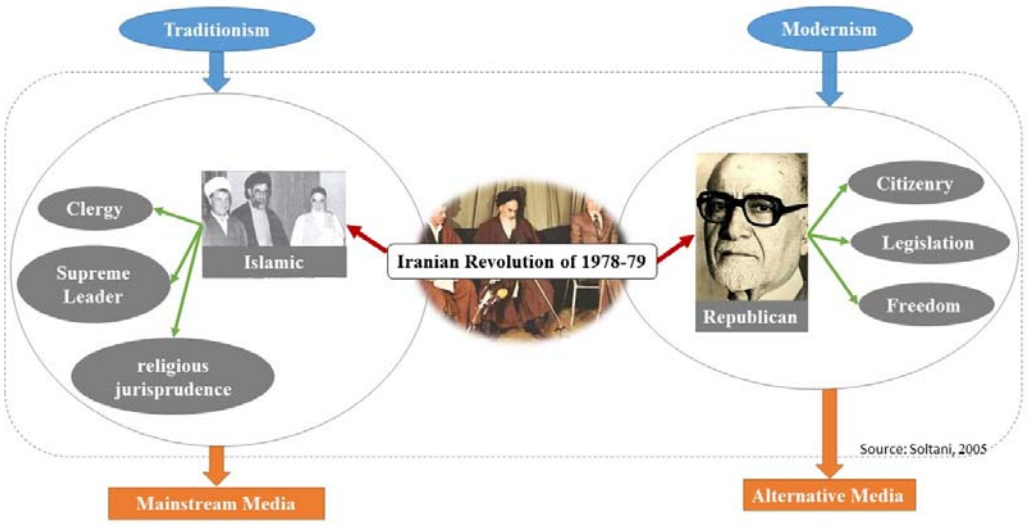

Figure 1. Worldview: Traditionalism Vs Modernism

Despite the fact that the traditionalist discourse is being hyped by the mainstream media as traditionalists have gained the upper hand on the political power, the alternative media have been strived highly to promote modernist discourses for a long time, declining the dominant traditionalist discourse. As the alternative press media have been conventionally played a vital role in the contemporary history of Iran, their highest peak coincides with the evolutionary periods that the rise against traditionalism becomes one of the essential axioms of social struggles to establish a more democratic political system given to different kinds of modern discourses. Dissent journalists were at least the leading figures of constitutional movement from 1905 to 1911, nationalization of Iran's oil industry movement in 1951, and the Iran's Revolution of 1979–80. Regardless of some various aspects and objectives, they share a firm belief to demolish the despotism as the main symbol of traditionalism. This notion is crystallized by the concept of "rule of law" during the constitutional age, "nationalization" by Mohammad Mossadegh, as an opposing prime minister who fought against the monarchy power, and "Republicanism" by national-religious factions supporting the Ayatollah Khomeini at the advent of the revolution. Iranian reformists then employed the power of alternative newspapers to expand rapidly a new version of modernist discourse relied on the notation of citizenry as the focal node, articulating other signs like legislation, political development, civil society, freedom, and reforms. Although it was dominated party from 1997 to 2005, the widespread closure of alternative newspapers in 2000 (Samii 2001) was just a link of the long chain of events indicated that Iran has a long run to be released from traditionalism.

Given to the fact that the Internet enormously has been developed all around the world, publishing becomes easier, and broadcasting comes out of state's monopoly, the alternative media also have been growing in the recent years. However, the pressure and constraint with which they are faced remain persistently as the discursive struggle which does not direct to a point of compromise or ultimate dominance. The rapid expansion of new ICT technologies provides a great opportunity to propagate the various modernist discourses by alternative media including feminist approaches, liberal

politics, environment advocacy perspectives, leftist criticism etc. In addition, it facilitates the media practice considering the substantial modality of digitality, virtuality, interactivity, hypersexuality, networking and simulating (Lister 2009) as well as the diversity of practitioners as different social strata which can participate actively in the Internet to generate media content through citizen journalism, telegram channels, advocacy group websites, activist hidden forums etc. On the other hand, surveillance technologies are developed simultaneously, hence, the traditional powerful institutions possess the more effective equipment to ban, block, filter or slow down different parts of the Internet. It also enhances the ability of security organizations dominated by traditionalists to track dissident activities, keep records of their deficiency, and to accuse them of what they believe or carry out in their ordinary life. Consequently, the new ICT technologies create a new open virtual space to listen to more various modernist voices by the alternative media, but also, they make it possible to suppress them by the apprehension of modern individuals with threatening to disclose their personal information or prosecution of modernist advocacy groups based on media evidence.

The metaphor: "To Educate the Public"

To unfold the deepest layer of causes, we have to go beyond the contemporary history of Iranian struggle between tradition and modernity to find an ultimate metaphor or myths. As the history of media in the conventional sense goes back to the 19th century when the first periodicals aspiring to imitate western newspapers were published (Bashir 2000), we should seek to find another prevailing literary genre with which some similar properties could accomplish. In pre-modern Persian literature, a couple of prominent travelounge have been written for the illiterate populace to be informed, amused, and educated. In other words, they are some educational written forms with which the composer attempts to familiarize the readers with social and moral thoughts by the application of travel anecdotes informative as well as storytelling tools attractive, though they are considered to be some pieces of prose literature nowadays. Thus, the travelogues combine the education of morality, social norms, wisdom etc. with lots of information derived from travel anecdotes that the composers observed or heard from somebody else.

The notion of totalitarianism is also embedded broadly in the Iranian's ancient literature as we can track it in written pieces of Saadi of Shiraz, one of the most prominent composers of Iran in the medieval age. For instance, he tells many of his travel anecdotes in "Gulistan", chapter 7, concerning the effects of education, but he quotes a viewpoint of the king that "he whose foundation is bad will not take instruction from the good; To educate unworthy persons is like throwing nuts on a cupola" (Gladwin & Ross 1865). The king actually rejects the possibility of pedagogy concurrent with the medieval notation of education as the morality and the ordinary way of life which is an intrinsic quality, as his preference is "to extirpate the race and offspring of these people and to dig up their roots and foundations". Consequently, the good (Saadi himself or generally "Dervishes") has to centralize his endeavor to educate the king by aphorism as he named the first chapter of his book as "the manner of king".

The combined thematic content of travelogues provides a foundational metaphor for media and politics contrary to the hypothetically so-called concept of "the 4th pillar of democracy" in the western history of media in the 19th century. At the advent of the modern era, Iranian intellectuals diverged the notion of education into pedagogy in order to engender a new modern manner in the populace. Now the wise king replaces with modernists who avow their commitments whether to educate all folks or to instruct the king how to establish a more modern society at the late of an early modern era in Qajar Dynasty (1789–1925). The first Iranian periodicals were published during this period of time when the most prominent chancellor of Iran, Mirza Taghi Khan Farahani known as Amir Kabir, founded the second official newspaper, "Vaghaye Etefaghie" translated to "events", with a key slogan: "the highly scramble of the majesty was busied with the education of peasants, merchants, tradespeople … as though he ordered the kingdom to publish that gazette…" (Vaghaye Etefaghie 1850). Simultaneously, he established the first Iranian modern school -Dar al-Fanun translated to "graduate school"- to educate new sciences including physics, mathematics, etc. confronted with traditional ones ("Maktabkhaneh" translated to "school") educating conventional religious expertise and knowledge to make a couple of students the clergies.

After the defeat of constitutionalism in progress, the authoritarian modernization (Atabaki & Zurcher 2004) under the personal conduct of new Shah of Iran since Reza Khan appointed as the legal monarch of Iran in 1925, transformed the romanticism considering to the substance of education regardless of its exigency into the new project of coercively injecting modern values and arrangements into all of social strata. What remains still nowadays is the compulsory education of children in new modern schools as well as severe censorship of press media. Albeit some technical achievements, the next political evolutions were highly concentrated on the revision of modernity as the authoritarian regime of Pahlavi could not be concerned to tolerate any opposition against its politics. To reach the highest peak in Iranian Revolution of 1979–8, Ayatollah Khomeini told that "Cinema is one of the civilization manifestation which has to serve to educate people" on his first public speech when he arrived in Iran after 14 years living in exile.

After an early short period of media freedom provided with the new revolutionary atmosphere, the new regime has just changed some marginal components of the focal metaphor around the essential functions of the media as an educational apparatus, albeit more enormously limitations. Along with the domination of Islamist discourses on the next years, it legitimates the basic role of clergies or representatives to educate all in different aspects of social life including the media practice, the pedagogical efforts in primary kindergartens, schools, universities or other forms of unofficial education, artistic activities, religious ceremonies etc. Thus, the imaginary will to education remains still a fixed powerful myth.

The alternative media are likewise organized to play the same role for education as the opponent modernist discourses take a subaltern position in civil sphere after the Iranian revolution. They attempt to fill the socio-political vacuum caused by the absence of any modernist response to any dilemma which comes from the incapacity of official governmental media to realize that a civil society moving

forward to the modern institutional orders could not be necessarily persuaded by media content derived from traditional solutions. In this state of affairs, alternative media complies with an immense responsibility to diffuse the modern viewpoints in terms of what fallacies the public affirms as the result of mainstream media practices. this task is intrinsically perceived as an educational performance even though it would be a concert, a foreign soap opera, a social media channel about the women's right to refute the compulsory vein, the sensational journalism, a TV series against the various minority stereotyping or any other media forms and contents not regularly admitted by the governmental media, totalitarian legislations, and traditional discourses. Thus, the contradictory dialectic between tradition and modernity, at least in media sphere has been capable of maintaining for almost two century since they confess to a common metaphor to educate the public by the media instead of the pedagogy.

Conclusions

In this article, we attempt to investigate the multiple layers of causes that make the current relationship between the media and politics in Iran. The particular interconnections of each layer have been established a long time ago and maintained rigorously. It is also worthwhile to identify which solutions might be highlighted for problems concerning each layer. However, any solution is not required to be simply practical given to the fact that different layers of analysis from apparent issues to the more deeply latent controversy or compromise take us into more abstract notions that we cannot translate into a specific policy or agenda. Despite the fact that offering a solution is highly problematic, we point out our rational resolution in table 1 as it also summarizes our findings in each layer of analysis.

Table 1. Four Layer of Analysis and Its Solutions

Layers	Results
Litany	Mainstream media vs alternative media, solution in increasing "freedom of speech"
Systematic causes	Semi-totalitarian regime has to be repulsed by the civil society, completed by the market, and disarmed by ICT technology advancement
Discourses/ worldview	Traditionalism vs Modernism- the historical empowerment to a compromise
Myth/ Metaphor	The prophecy of education should be thwarted by a modernist responsibility to education vis-a-vis

Despite the so-called colorful media sphere and diverse platforms and productions at the litany level, what is so fundamental here is the reality that the key actor which shapes the media sphere in Iran is still the state regime, though the influential role of new actors in the recent years is observable. Regarding the present conditions, the essential contradiction between traditionalism and modernism, discursively and objectively, will determine the short-term futures of the relationship between media

and politics in Iran. However, considering the long-term transformations, the myth of "education" remains unchanged unless the scenario of "diverse media" in which we anticipate more democratic state, more competitive media market with multi stakeholders especially on infrastructures and more powerful civil society overcomes the other plausible alternatives. We conclude simply that it might be the predominance of modernist discourse by some revolutionary transformation, to some extent free of state control or surveillance, whereas the narrative of education by media practice.

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3. FUTURES OF HEALTH AND WELL-BEING

Nursing and Technology Foresight in Futures of a Complex World

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Abstract

Medical technology is one of the foundations health care systems in the world. Patient care technology has become increasingly complex and medical technology has improved health care efficiency, quality safety and cost. However, it is shown in patient care centers that current technology alone is not enough. Up to now several tools were originally created for morbid monitoring e.g. pain scale and bedsores protection to help patients communicate about their pain. However, in spite of the importance and prevalence of pain, there are currently no clinically accepted tools to objectively monitor changes in pain level, requiring physicians to rely on patients' subjective assessment, or to simply guess, when patients cannot describe their pain. [1] This article aimed to provide the theoretic framework for improving patient safety system, and enhances the ability of health care professionals to coordinate care by providing a patient's health information. This framework is based on Morbid-Monitoring Systems include "Pain and Unconsciousness Scales-measurements" and "Thermal Wound Injury Prevention Sys-tem (TWIP)". The multi-methods approaches to monitor these processes are Morbid Motion Monitoring, Facial expressions and effective Thermal Radiation. This article identifies these novel technologies that change the practice of nursing, and explores issues on how these novel technologies are driving change in the nursing environment.

Keywords: Nursing informatics, Morbid monitoring, Pain scale, Bedsores, Thermal radiation.

Introduction

Computer technology gives us a tool which can be used to help us cope with the complexity and efficiency which is of-ten required in many areas of work. [2] Since the earliest days of technology adoption in health care, nursing informatics professionals have been at the forefront of leading change. Early pioneers included nurses who effectively combined the science of nursing with computer and information science to support the clinical workflow, adding value to the organization as they began their journey to join the digital revolution. [3] However, it has been difficult to find computer solutions that offer benefit to operational nurses, midwives and health visitors. Solutions are required that support patient-orientated developments in practice. [4] Therefore in the future, the nursing informatics systems committees must be able to sup-port quality morbid-monitoring. This document provides the

context for an examination of the issue of developing a nursing informatics strategy at the local level of patient care centers.

Morbid-Monitoring Systems

Morbid monitoring can be defined as "repeated or continuous observations or measurements of the patient, his or her physiological function, and the function of life support equipment, for the purpose of guiding management decisions, including when to make therapeutic interventions, and assessment of those interventions" (Hudson, 1985, p. 630). Morbid monitoring system is classified by target parameter, e.g. monitoring treatment for chronic pain [5], painful monitoring, [6] pain-management medication monitoring, [7] neurological monitoring which generally refers to electroencephalography, intracranial pressure, anesthesia and pain monitoring, coma monitoring, monitoring of wound, etc. However, up to now the goal of monitoring has been to measure the degree of injury and to prevent further injury, rather than to measure, [8] "pain scales measurements", "Unconsciousness scale measurements" or "Injury Prevention". Up to now several tools were originally created for patients such as the Brief Pain Inventory, PEG tool, Wong-Baker FACES Pain Rating Scale, 0–10 Numeric Pain Rating Scale, Pain Assessment in Advanced Dementia Scale (PAINAD) and etc. to help them communicate about their pain. However, in spite of the importance and prevalence of pain, there are currently no clinically accepted tools to objectively monitor changes in pain level, requiring physicians to rely on patients' subjective assessment, or to simply guess, when patients cannot describe their pain. [9]

The latest development in patient monitoring system can be used in Intensive Care Unit (ICU), Critical Care Unit (CCU), and Emergency Rooms of hospital. During treatment, the patient monitor is continuously monitoring the coma (a deep state of unconsciousness) patient to transmit the important information. [10] In 2011 Kansal and Dhillon have developed Advanced Coma Patient Monitoring System which is advanced product related to physical changes in body movement of the patient and gives Warning in form of alarm and display on the Liquid crystal display (LCD). It also passes a SMS to a person sitting at the distant place if there exists any movement in any body part of the patient. [11] In 2013 Sneha Chowdary and et al proposed the Wearable Motion sensor system, which is used to monitor the body movements such as eye blink movement and hand movement to detect the conscious state of an individual. This system will be helpful in assisting the doctor about the health condition of the unconscious patient and alerting the doctor whenever care is required. [12]

However, these methods did not address the management of coma patients injured by penetrating objects such as thermal radiation, pressure ulcer and stab wounds. Pressure ulcers occur because of soft tissue distortion, and incidence rates are on the rise in the healthcare arena (James G. Spahn, 215). The pressure ulcer prevention protocol consisted of preventive interventions stratified on risk level, with implementation of support surfaces and turning/repositioning residents. [13] In 2013 Matthew and Pompeo have trialed new pressure map-ping technology for patients with pressure ulcers. The

system contains thousands of sensors, which sensors display specific areas of pressure, and it provides live feedback to clinicians as they reposition patients. [14] However, for implementation of the system, the nursing staff needs to understand its ability to record data. [15] To overcome these significant problems, we have designed and developed an Morbid-Monitoring System, with a novel technique to optimize the "pain and Unconsciousness scale measurements" and the prevention of "Thermal Wound Injury" and "pressure ulcers". The goal of this study is to develop Clinical Decision Support Systems for, "pain, unconsciousness and wound prevention managements that could be used by health care professionals throughout the world.

Methods and Materials

I) Pain and Unconsciousness Scale Measurements

Two methods have described for the measurement of pain rate: Morbid mobility monitoring and Facial expressions and Micro expression.

Morbid mobility monitoring

Motion of morbid has been defined as the rate of pine and it is linked with various co-morbid conditions. The data which is generated by the hospital on the basis of video data recorder is separated frame by frame. The next set of function is about the visual differences between various frames. A variety of techniques can be used as a basis for comparison between frames. One of these techniques is called Texture analysis based on DNA Modeling. The method is based on the linear mapping and the one-to-one correspondences between point features extracted from the frames and on calculating similarities in pixel values. This correspondence is determined by comparing two strings constructed from pixel values of the frames. The method uses a table called the Quarter Code table, which is the set of characters and numbers. In this table every number between 0 and 255 is translated into a unique string of four letter alphabet. Letters A, C, G, T are chosen, since they are the same as used in DNA sequences. In this way it possible to utilize tools originally programmed to DNA sequences analysis. When all pixel values of frames (images) are converted to virtual DNA sequences, one can show the differences between two virtual DNA sequences. The comparison between two virtual DNA sequences is done by Chi-squared test, DNA Sequence Alignment Algorithms (Needleman Wunsch and Smith Waterman), Markov Chain and glm plot. The rate of similarity between frames is plotted as a graph and it's appearing in Monitor. The system is used to show and describe the displacement of the morbid on the bedside. The amount of ill transmitted to the morbid increase the motion ratio. In this manner Motion Ration is the ratio of the displacement of the morbid.

Facial expressions: interpretation of facial pain signals

Neuropsychological and neuroimaging evidence suggests that the human brain contains facial expression recognition detectors specialized for specific discrete emotions. [16] Emotional facial expressions represent facial displays of emotions which determine different patterns of muscular correlates, cognitive responses, and brain activation. [17] Behavioural/facial markers of pain refer to a variety of responses that typically accompany the experience of pain. They serve the purpose to communicate the inner state "pain" to others and thus play a crucial role in social interactions. [18] Methods designed to capture and measure this dynamic phenomenon have greatly improved our understanding of discrete muscle action associated with the various facial displays. [19] In this study, a novel facial expression recognition method is proposed. The technique is based on DNA Modelling of digital images and their statistical analysis. This method is executed by Chi-Squared test. Chi-Squared test is a statistical test method commonly used to compare observed data with data we would expect.

II) Prevention of Thermal Wound Injury and Pressure Ulcers

A pressure ulcer is a localized injury to the skin or underlying tissue, usually over a bony prominence, as a result of unrelieved pressure. [20] Pressure ulcers are caused by unrelieved pressure, applied with great force over a short period (or with less force over a longer period), that disrupts blood supply to the capillary network, impeding blood flow and depriving tissues of oxygen and nutrients. This external pressure must be greater than arterial capillary pressure to lead to inflow impairment and resultant local ischemia and tissue damage. [21] In 2015 Chaves and et al presented a study that suggested a relationship between the temperature and area of pressure ulcers and proposed thermography as an adjunctive method for the evaluation of healing processes. [22] In 2016 Bennett and colleagues began an examination of at-risk older adult patient data (pressure and thermal) to identify patterns that may related to pressure ulcer development. The results of this study suggested that a relationship may exist between the sleeping behavior of patient and the long term temperature distribution of the feet. [23] However, before of these studies in 2013 Matthew Q. and Pompeo have trialed new pressure mapping technology for patients with pressure ulcers. In this technique, the device (The MAP System, Wellsense Inc, Nashville, TN) is a thin mat placed on a mattress that has a color monitor attached. The mat contains thousands of sensors, and is secured to the top of the mattress with straps. These sensors measure pressures through a sensing area measuring 1945 mm x 805 mm. The sensors display specific areas of pressure, and the system provides live feedback to clinicians as they reposition patients. The monitor acts as an educational tool for staff, patients, and family by indicating where the pressure points are located. It can also assist clinicians in optimal surface selection and detection of malfunctioning mattresses. Other features include a bed alarm that can be set to sound at the desired interval to alert for turning. [24]

III) Hospital Application Integration

Hospital Application Integration (HAI) is an integration framework composed of a collection of technologies and services to integrate a set of hospital computer applications. Hospital Computer Applications (HCA) is computer software used to integrate a set of hospital computer applications.

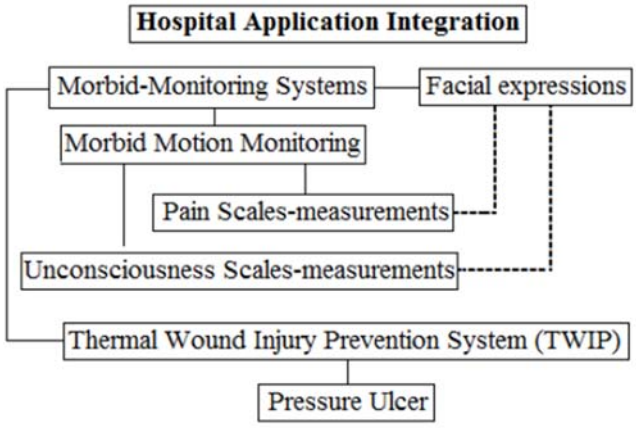

Figure 1. Flowchart of the multimethod.

Conclusion

With the help of this system nurses can monitor the pain and unconsciousness scales with help of motion detection techniques and facial expressions. Nurses can also identify and prevent risk factors associated with hospital-acquired pre-existing pressure. Consequently, the system can enhance the ability of health care professionals to coordinate care by providing a patient's health information.

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Exploring the Missing Dimensions of Transition through 'Sustainable Wellbeing'

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Abstract

Rising material consumption and associated greenhouse gas emissions (GHG) are becoming an entrenched stumbling block in the quest for low carbon transition worldwide. Consumption performs various functions in human wellbeing but the relationships are neither static nor inevitable and consumption can be damaging. The '*double dividend*' of enhanced wellbeing and reduced material consumption and emissions has been identified as an approach to address this challenge. Rather than the global expansion of increasing consumption as the means of achieving wellbeing, this could be implemented through enabling balanced multidimensional human wellbeing. Multiple independent lines of theory and evidence support a multidimensional concept of wellbeing, from the macro development perspective to the micro individual perspective. Changing the focus away from consumption could be facilitated by pursuing a more balanced '*sustainable wellbeing*' that places a higher priority on other life domains. The advantage of such an approach is in the potential win-win of lowering the emissions trajectory while actually enhancing human wellbeing. Offering 'the good life' or indeed a more balanced life, is a more enticing policy prospect than measures which give a perception of sacrifice or loss.

Keywords: Climate change, consumption, low carbon transition, sustainable, multidimensional wellbeing, wellbeing pathways.

1. Introduction

The Paris agreement of December 2015, under the United Nations Framework Convention on Climate Change (UNFCCC), set in train an international commitment for all nations to achieve significant global reductions in greenhouse gas (GHG) emissions throughout the 21st century. Low carbon development is now a global goal, with a necessity to continually re-invent and ramp up measures to reduce emissions as the cuts deepen. Against a backdrop of growing global population and affluence, the related trend of increasing material consumption and associated emissions is a continual drag on efforts at mitigation and low carbon transition. While global resources continue to be increasingly exploited, and natural systems under intensifying pressure, meeting the requirements of global human wellbeing through material consumption will become ever more challenging. The flip-side is that there is a recognition that there is also a fundamental link between human development and sustainable development (O'Mahony and Dufour, 2015; Anand and Sen, 2000). Consequently, there is a potential opportunity to renew development efforts as described by Jackson and Marks (1999) that advance

both of these interdependent goals in tandem, a critical issue in low carbon transition (Victor *et al.*, 2014).

The approaches in the field of sustainable consumption and production (SCP) have relied predominantly on efficiency and consumer behaviour. While these are useful tools, they do not appear sufficient to address the systemic challenges according to the Intergovernmental Panel on Climate Change (IPCC) fifth assessment report (Fleurbaey *et al.*, 2014). In countries and contexts where '*over-consumption*' is problematic, shifting from a priority on consumption to a priority on multidimensional wellbeing could prove key to unlocking the double dividend. Achieving wellbeing is predominantly a concern for more affluent populations where basic needs are already met and over-consumption continues. However, it also has relevance even for those in less affluent countries and those in poverty. The ability to be happy and contented with life is a central criterion of psychological adaptation and positive mental health (Lyubomirski et al., 2005). The middle classes and elites in developing countries are also in the process of developing high consumption lifestyles (Fleurbaey *et al.*, 2014:308), and global inequality of consumption affects the ability of those in poverty to meet their basic human needs.

Despite the growing problems of over-consumption and the related cultural phenomenon of 'consumerism,' the potential significance of a multidimensional '*sustainable wellbeing*' has yet to surface in thinking on the low carbon transition, or the related policy discussions, to any notable degree. Transition studies remain dominated by modelling derived scenario approaches, leading to a continued narrow policy focus on the three 'T's'; technology, tax and emissions trading (O'Mahony and Kirby, 2018). However, in addition to the high-level discussion in the IPCC Assessment Report 5 (Fleurbaey et al., 2014), there are early signs of experimentation with elaborating the concept, the first shoots of a new research field. Helne and Hirvillami (2015) have begun sketching a multidimensional and relational sustainable wellbeing and Rogers et al. (2011) explored transitions to social sustainability. The New Zealand Department of Conservation moved from the ecologists position of looking at the supply of ecosystem services, and the economists at demand, to a social science perspective (Roberts et al., 2015). This embraced what is driving demand as seen through the lens of the rapidly expanding wellbeing literature. Following this, Schleicher et al. (2017) placed the natural environment as a constituent of wellbeing, while Wingate et al. (2014) critiqued the 'double dividend' sociologically[1]. Kate Raworth's doughnut economics (Raworth, 2017), probably the most high-profile in the public consciousness, gave framing to discussions of development within social and environmental boundaries.

After the introduction in section 1.0 this paper is structured as follows; section 2.0 places consumption in context in the climate change challenge, section 3.0 discusses the different functions of consumption and section 4.0 reviews sustainable consumption and production. Section 5.0 discusses

[1] Suggesting that the double dividend could be described as a 'sales technique,' as it reproduces the economic doctrine of the rational individual rather than challenging more fundamentally.

how the focus can be changed through three broadbrush approaches; shifting behaviour, shifting consumption structure and shifting the priority on life domains towards balanced multidimensional wellbeing pathways or 'sustainable wellbeing'. Section 6.0 offers concluding remarks to synthesise the outcomes of the paper and its implications.

2. The place of consumption in the climate problem

It is recognised that the physical consumption of material resources and related GHG emissions show strong historical trends, driven primarily by economic development in industrialised and emerging countries (Fleurbaey et al., 2014). As resource use has grown more slowly than Gross Domestic Product (GDP), some decoupling by '*dematerialisation*[1]' has occurred, but this efficiency has been overwhelmed by growth in demand, leading to an inexorable rise in material consumption and associated GHG emissions. Two of the defining issues of resource consumption; are global social inequality arising from income disparity and the purchasing patterns in affluent lifestyles, and secondly, that there are different levels of consumption for countries at similar levels of development and income. A defining condition of climate change mitigation is that it will be extremely difficult and expensive to sufficiently reduce emissions through mitigation alone, without considering the underlying development path including consumption. An increasingly strong focus on consumption is now beginning to emerge globally. In IPCC Fifth Assessment Report, Fleurbaey *et al*. (2014: 290) highlight the centrality of these issues in mitigation by stating that; "…*overcoming under-consumption and reversing over-consumption, while maintaining and advancing human well-being, are fundamental dimensions of sustainable development, and are equally critical to resolving the climate problem*." The challenge of unsustainable consumption patterns place climate goals at risk. 'Consumerism' has been identified as a growing global cultural paradigm since the IPCC third assessment report (Toth et al., 2001). While the consumption of those in poverty is driven mainly by meeting basic human needs, it is increasingly common across cultures that people seek meaning, contentment and acceptance in consumption. The spread of consumerism means that a large share of goods and services produced are 'luxuries' that only the wealthy can afford, while those in poverty are deprived of even basic goods and services (Khor, 2011:23). While the relationship between income and wellbeing has been investigated for a number of decades, and a positive relationship is dubious beyond a certain point, the relationship of consumption to wellbeing has not been studied to any great degree. Recent efforst show that the impacts of consumption on life satisfaction are diverse; across individuals, levels of development and types of consumption, including negative impacts with some categories (Dumludag, D., 2015; Zhang, J. and Xiong,

[1] Where the system becomes more efficient in generating GDP with less material resource inputs.

Y., 2015; Noll and Weick, 2015; Gokdemir, 2015). In societies that are more strongly tied to consumerism[1] (Toth et al., 2001; Assadourian, 2010; Fleurbaey *et al.*, 2014) other dimensions of wellbeing can be ignored or demoted to the detriment of overall individual wellbeing.

3. The different functions of consumption

The place of 'needs' in understanding consumption as a driver of climate change took prominence in the IPCC Special Report on Emission Scenarios (SRES) (Nakicenovic *et al.*, 2000), using Maslow´s hierarchy of needs (Maslow, 1943) where choices are only possible once basic human needs have been met such as; food, shelter, health care, safety and education. The needs approach has proven controversial, but if we accept that consumption can indeed be problematic, or indeed that wellbeing is acknowledged as multidimensional (McGillivray, 2007; Stiglitz et al. 2009; Huppert, *et al.* 2005) then a critique of the place of consumption is patently necessary. In a large multi-country study in 2011, Tay and Diener (2011) examined the association of needs fulfillment and subjective wellbeing (SWB), finding that needs are indeed universal, with life evaluation most associated with fulfilling basic needs, and positive feelings associated with social and respect needs. Once people's basic needs are met, factors such as luxury consumption, status and comparisons are more significant in determining subjective well-being in countries with higher levels of development (Layard, 2005; Veenhoven, 1998). However, Kasser (2002) also showed that materialism has a cost in terms of individual well-being. As material commodities are poor satisfiers of social and psychological needs, materialism can directly hinder wellbeing. Just as GDP can hide many issues (O'Mahony *et al.*, 2018), as can SWB and life satidsfaction. Within the complex systemic interactions that determine multidimensional human wellbeing, even fine data from happiness studies can obscure underlying phenomena that may have significant affects on how human wellbeing is evolving.

Aside from meeting basic needs, it must be recognised that consumption can perform various functions; assisting in the creation of meaning (McCracken, 1990) and social positioning in the long understood sociological phenomenon of conspicuous consumption (Veblen, 1899). Gronow and Warde (2001) point to factors in inconspicuous consumption of convenience, habit and responses to social norms and institutional contexts. In a seminal text, Jackson (2005a) has placed an important emphasis on sacred aspects of money, consumption and material goods as embodying meaning, cautioning simplistic assumptions about the contribution of material goods to our wellbeing. Conclusions from this strand of literature point to both push and pull factors, that both cause and restrict individual and collective human wellbeing at the same time. This points once more to complexity, which makes interpretations more challenging. However, Gruber *et al.* (2011) provided an important contribution by clarifying that in the examples of both food and happiness, we can have too much, at the wrong time,

[1] A cultural paradigm noted in wealthier countries that is spreading globally, where people seek meaning, contentment and acceptance in consumption.

of the wrong type or pursue in the wrong way. The different functions of consumption and its implications have led to much research on steering consumption towards a more sustainable path.

4. Sustainable Consumption and Production

The transition towards sustainable development has often been described by two different types of decoupling; dematerialisation and immaterialisation. Dematerialisation involves the decoupling of material resource consumption (including fossil fuels) and environmental impact (including climate change) from economic growth (Fleurbaey et al. 2014:304). Much of the focus occurs on the production side through efficiency in production and 'eco-efficiency' to reduce the environmental impact of activities. Sustainable consumption and production (SCP) arrived on the international policy agenda through UN Conference on Environment and Development (UNCED) in 1992, with the key aim on the consumption side to foster the diffusion of sustainable consumer behavior through raising awareness of the impacts of consumption choices. While efficiency on the production side has improved, it has been overwhelmed by absolute growth in consumption demand and emissions have continued to increase. A new perspective on consumption patterns is therefore essential to enable sustainable development according to Tukker et al. (2008). This moves attention more towards the second type of decoupling by *immaterialisation*, where human wellbeing is decoupled from economic growth or from material consumption. Moving towards immaterialisation recognises that consumption, or its proxy income, cannot be described as more than contributory dimensions of human wellbeing[1]. This is a position in-line with what is accepted in theory and evidence from multiple independent lines of enquiry, from the multidimensional concepts of wellbeing in development studies, economic performance and social progress (McGillivray, 2007; Stiglitz et al. 2009, Sen, 1999; Nusbaum, 2005) to sustainable development (Halsnæs et al. 2014) and human health and psychology (Hupper et al. 2005; Naci and Ionnadis, 2015; Keyes and Ryff 1999).

5. Changing the focus

Demand for consumer goods is not a simple consequence of income levels, populations at the same income levels consume different bundles of resources, emit widely varying amounts of greenhouse gases with varying levels of 'wellbeing'. Production side changes can contribute but are insufficient to the challenge, and as stated by Tukker *et al.* (2008), the focus must now be directed towards the consumption or 'demand side'. The question that arises then is how can demand for material consumption be reduced, and how can this be achieved while human wellbeing is maintained or improved?

[1] The importance of income and consumption is indisputable, particularly for those in poverty and recognising problems with inequality, but they are neither the sole means nor the ends of human wellbeing as noted by Sen (1999). They are necessary but not sufficient for a *sustainable wellbeing*.

5.1 Shifting behaviour placed in context

In seeking to understand the intractable elements of changing consumer behaviour, the IPCC fifth assessment report offered systemic transdisciplinary conclusions (Fleurbaey et al., 2014). In contrast to rigid neoclassical assumptions on the rational choice of individuals, and utility maximisation measured in market prices and opportunity costs, this allows some of the sticking points to be more fully understood. Research in psychology, sociology, and marketing science shows that consumer behavior is far more complicated than just a rational response to price signals (Mont and Plepys, 2005). Consumption is influenced by a range of economic, informational, psychological, sociological, and cultural factors that operate at different levels or spheres in society – including the individual, the family, the locality, the market, and the work place (Thøgersen, 2010). There are structural issues beyond the individual, family or community, which lead to consumer lock-in to unsustainable patterns from product availability and cultural norms and beliefs to working conditions that favour a 'work-and-spend' lifestyle (Sanne, 2002). The capacity of a 'green consumer' to enable sustainable consumption appears limited when recognising not only the structural factors, but the 'value-action' gap between 'green' attitudes and consumption patterns and lifestyles (Barr, 2006; Young et al. 2010; De Barcellos et al., 2011) and the disabling influence of specific factors such as habit and cost (Young et al. 2010)[1]. The strength of the political economy factors and the inadequate attention to them by policy, is an important cause of the lack progress towards sustainable consumption patterns according to Fleurbaey *et al*. (2014: 308).

5.2 Shifting consumption structure

Pogutz and Micale (2011) suggest that demand can be shifted to lower impact consumption through environmentally friendly products and services and green shopping. There is an important distinction to be made here in that lowering material demand does not necessarily mean lowering expenditures, or indeed incomes, as highlighted by Pogutz and Micale. Consumption expenditures can theoretically be shifted towards consumption bundles that are inherently less emissions intensive, and from material consumption to services and experiential goods. All three of the strands; lower emissions alternative goods, shifting the structure of consumption and seeking quality over quantity, could lead to lower emissions intensity of consumption in general as human wellbeing is dematerialised. By aligning consumption expenditures with consumption bundles of lower emissions intensity, where they are associated with higher wellbeing, a win-win approach of co-benefits and synergies can be pursued, as one of the gateways to the '*double-dividend*'. Value change in society is often described as a prerequisite towards higher concern for the environment and changes in lifestyle and behaviours (Gilg *et al*. 2005),

[1] Young *et al*. (39) note factors including; habit, high transactions costs, availability, affordability, and non-green criteria such as quality, size, brand, and discounts.

but there are also self-interest motivations for making such changes where they enhance individual wellbeing.

5.3 Shifting the priority of life domains towards multidimensional 'sustainable wellbeing'

An alternative approach to reducing the impacts of consumption is to seek an absolute reduction in material consumption levels on the demand side. It is frequently connected with lifestyle and behaviour change but has failed to gain much traction. In research on '*low carbon transition and the good life*' that sought "*to initiate a discussion surrounding the notion that reductions in greenhouse gas emissions always entail sacrifices*" the Swedish Environmental Protection Agency (SEPA) became frontrunners in a field that is set to take on great importance as transition deepens globally, and consumption moves to centre stage. They noted that a perception exists that moving to less materially intensive lifestyles is one of cost and loss and the sacrifice of quality of life (SEPA, 2012:71). However, this perception is peculiar when acknowledging the preceding evidence that not all types of consumption are equal and some are damaging, to the individual, to society and to the environment. The perception is common-place but evidently skewed, suggesting social and cultural lock-in is at play. It is likely linked to perceptions of 'the good life' as represented by pervasive consumer advertising (Fleurbaey et al. (2014: 308). Wellbeing is multidimensional and cannot be fully met through consumption, which can actually compete with other life domains that are potentially more beneficial. Jackson (2005b) described the *´ double dividend'* as an approach of reduced consumption and improved wellbeing. This is described by SEPA (2012) as the '*third way,*' focussing on human welfare and change that is beneficial to quality of life, while also reducing emissions at source. SEPA point out that "*very little research has examined the actual relationship between reduced emissions and quality of life, and our review of the research that has been done does not point to any clear-cut link.*" A growing if nascent literature has sought to explain and explore this concept as a promising double, triple or even quadruple dividend (Brown and Kasser, 2005; Gowdy 2005; Jackson 2005a, Princen, 2005: Dolan, et al. 2006; Marks, et al. 2006; Kasser, 2009; Welsch, 2009; Alexander, 2012), but there remain significant gaps in knowledge in how this is conceived and implemented as per SEPA (2012). The approach of alternative lifestyles have been enumerated as 'sufficiency'[1] (Muller, 2009), 'voluntary simplicity' (Huneke, 2005) and ecologically concious or frugal lifestyles (Pepper et al., 2009). Such lifestyles are useful but may be limited in what they can achieve in the general population, at least in the short term without radical value change. Where they play into a perception of an austere narrative of reduction of 'quality of life,' they may not have a wide appeal, which would require long-term value change in society itself. It could therefore be argued that the key to achieving sustainable consumption patterns is not through addressing individual consumption behaviour, which is a viable supporting measure, but through beginning with a balance of overall human wellbeing. Rather than purusing

[1] A 'sufficient life' is associated with moderation and prudence.

'degrowth' as a development paradigm this could bypass 'reduce consumption' for 'increase wellbeing,' as part of a holistic approach to immaterialisation.

A promising approach to improved human wellbeing that balances the different life domains is offered by '*wellbeing pathways*' of Henderson and Knight (2012) and Huta and Ryan (2010) and '*full-life*' or *'integrated pathways*' of Waterman (1993) Seligman *et al*. (2004) Peterson *et al*., (2005) and Huppert and So (2009). Among the life domains, the social and relational feature prominently, with the key to wellbeing in achievement of balance and not necessarily 'more' as proposed by Delle Fave *et al*. (2011). While wellbeing needs to be defined individually and by different cultures[1], to at least some degree, the eight dimensions of wellbeing in development of Stiglitz *et al*. (2009)[2], the ten central capabilities of Nussbaum (2005), and the six dimension model of psychological wellbeing of Keyes and Ryff (1999) show some overlap. In defining wellbeing pathways, the 2011 study of Delle Fave *et al*. (2011), of seven different countries[3], outlined eleven different life domains from wellbeing research (i.e. Work, Family, Standard of Living, Interpersonal Relationships, Health, Personal Growth, Spirituality/Religion, Society issues, Community issues, Leisure, and Life in general). They found concordance with what citizens referred to when they speak of wellbeing and happiness. Interestingly, balance, family, health and interpersonal relationships were once more ranked highest, and Henderson and Knight (2012) have recommended such a categorisation of life domains for future wellbeing research. This literature could establish the seeds of sustainable wellbeing for immaterialisation that addresses over-consumption. In Fig. 1, the contrast of approaches to wellbeing that place a priority on consumption, verses balanced wellbeing pathways, are adapted from Delle Fave *et al*. (2011). They are illustrated with reference to a social and environmental sustainability threshold. For the purposes of illustration, the 'standard of living' domain of Delle Fave *et al*. (2011) is replaced with 'consumption.' While Stiglitz *et al*. (2009), Nussbaum (2005) and others (Kjell, 2011; Helne and Hirvilammi, 2015: Alexander, 2012) have noted the importance of the 'environment,' 'nature' and 'other species,' much of applied wellbeing research has tended not to include such categories. It would be useful to include a suitable category in the domains of Delle Fave *et al*. (2011) for alignment with development studies and sustainability literature as detailed in Fig. 1.

[1] Recognising the importance of freedom and the cultural context as described in the capability approach of Amartya Sen (30).
[2] The eight dimensions of Stiglitz *et al*. (18) are listed as; i) Material living standards (income, consumption and wealth); ii) Health; iii) Education; iv) Personal activities including work; v) Political voice and governance; vi) Social connections and relationships; vii) Environment (present and future conditions); viii) Insecurity, of an economic as well as a physical nature.
[3] Australia, Croatia, Germany, Italy, Portugal, Spain, and South Africa.

Figure. 1 Contrasting approaches to wellbeing through a priority on consumption and balanced well-being pathways adapted from Delle Fave et al. (63)

Where the '*sustainable wellbeing pathways*' approach (O'Mahony, 2016) becomes promising in transition, is when it is recognised that societies that are directed towards multidimensional wellbeing could causally be linked to lower material consumption and emissions. It is known that the life domains most beneficial for wellbeing are not income or consumption as previously discussed (Layard et al. 2012; Delle Fave et al. 2011), but are domains such as the social and relational. With potential policy synergies and win-wins, the 'double-dividend' becomes a highly desirable pursuit in its function to reduce emissions. In line with a lower emissions development path, it can also be used to facilitate and empower citizens in all nations to pursue 'the good life'. Ironically, it may also help spur the process of values change in society towards sustainability, the holy grail of SCP research, by re-establishing more direct links of human wellbeing to environmental wellbeing and the natural world.

6. Conclusion

The issue of material consumption patterns has been prominent since the debate on intergovernmental treaties on climate change accelerated in the 1990's. Increasing material consumption levels have continued to drive GHG emissions, placing a significant barrier in the pathway of global low carbon transition, and achieving equality and sustainable development. While acknowledging the role of income and consumption in reducing poverty, their role in delivering human wellbeing can be questioned. Income has been the usual proxy for consumption but the literature does not provide an endorsement of its role as more than a contributor to wellbeing. Recent studies that seek to explore the relationship of consumption to wellbeing document a heterogeneous picture, where some consumption bundles contribute more to wellbeing than others, and some categories can even be damaging

particularly in 'over-consumption'. From development studies to health, and from psychology to well-being science, a multidimensional model of wellbeing is now accepted, both by a long philosophical tradition and emerging empirical results. Development pathways that balance high levels of wellbeing and low emissions are a largely unexplored in modern history. Economic development and industrialisation have inherently involved higher consumption growth as the pathway to 'the good life,' status and national prestige. The field of sustainable consumption and production has sought to address this paradox, where the response that has emerged has centred on approaches such as production and eco-efficiency on the production side and the 'green consumer' and behaviour on the consumption side. While efficiency has improved, material consumption and emissions have continued to increase. A more fundamental focus looks at immaterialisation through decoupling income or consumption from human wellbeing. A focus on multidimensional wellbeing, with consumption as only one of the contributors to this, is supported by both theory and evidence. However, important conclusions by the Swedish Environmental Protection Agency (2012) have highlighted two defining characteristics. Firstly, little is known about the links between emissions and wellbeing, or the potential for the 'double dividend,' as there has been very little esearch. Secondly, the current approaches to transition are insufficient, and the neglected issue of consumption can be neglected no more if there is to be a low carbon transition, a point echoed recently by the Intergovernmental Panel on Climate Change (Fleurbaey et al. 2014: 290).

A more fundamental change involves a shift in the priority on life domains and a focus on balanced *multidimensional wellbeing pathways* or '*sustainable wellbeing*' (O'Mahony, 2016). This could lead to higher levels of wellbeing while reducing emissions, the essence of Jackson's '*double dividend*' (2005b). Balanced wellbeing would address all of the dimensions of human wellbeing, rather than relying on income and material consumption as the route to living 'the good life'. Recent research in wellbeing science and psychology has outlined '*wellbeing pathways*' as a unifying conception that allows a '*full-life*' '*flourishing*' concept to emerge in individuals and society. While debates on 'degrowth' have made important contributions on development within limits, for some the concept lacks intuitive appeal which could hamper its uptake. 'Sustainable wellbeing' could overcome such negative associations while also focussing clearly on outcomes and solutions, on win-win approaches within the environmental and social boundaries of development. This could facilitate the emergence of synergies and win-win outcomes, particularly the coincidence of an advancement of human wellbeing, in parallel to low carbon transition and environmental protection.

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4. RESILIENT FUTURES: FOOD AND WATER SAFETY

The Cogitaire 5 Model: Thinking our way into the future

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Abstract

Current research identifies the impact of new technologies on a range of global occupations and the changing nature of work itself, as many employers eliminate full-time jobs in favour of casual or contract jobs in the gig economy. Unfortunately, the education/training system is not keeping pace with the changes occurring in the labour market. This paper puts forward the proposition that, rather than delivering vocationally specific courses, we should be assisting students, jobseekers and employees to develop cross-sector capabilities, and then offering them short, just-in-time vocational programs for the work they are about to undertake. The author has developed the *Cogitaire 5 Model*, which consists of five thinking capabilities which she believes will prepare people for the varied types of work and personal decisions which they need to make in the modern, chaotic world. These capabilities include Futures Thinking, Systems Thinking, Complexity Thinking, Entrepreneurial Thinking and Design Thinking. This paper will discuss some of the tools and techniques which relate to each capability as well as the personal attributes which people can develop by learning these methods.

Introduction and Background

Global labour markets are undergoing change caused by the introduction of new technologies and changes to the structure of work involving a continuing decline in full-time jobs, and a rise in the gig economy. This means that traditional vocationally specific courses are becoming less useful for those who find themselves having to make many personal and professional decisions in a constantly changing world. This paper examines factors impacting on the ability of the education/training sector to effectively meet the varied needs of these individuals. This include discussion of the three Aristotelian categories of learning, the concept of neuroplasticity as it relates to learning, and the increasing irrelevance of mainstream factory models of education. In their place, the author presents a different model of learning which assists individuals to develop a range of cross-sector capabilities designed to help them make more sophisticated, informed decisions about their future. This *Cogitaire*[1] *5* model

[1] The word "Cogitaire" is the Latin word for "thinking"

consists of five thinking capabilities – *Futures Thinking, Systems Thinking, Complexity Thinking, Entrepreneurial Thinking* and *Design Thinking*; and is designed to assist people to build their creative and critical thinking capacity. The paper will identify some of the tools and techniques which people can learn, and discuss the personal capabilities which can be developed through practice of these techniques.

New technologies

Frey and Osborne (2013) examined occupational categories in the American labour market with the intent of estimating the statistical probability of each occupation being eliminated due to the introduction of new technologies. Overall, they estimated that 47% of jobs in the U.S. were at high risk of disappearing over the next two decades (2013, 38). That work has now been extrapolated into the European labour market (van Dijk & Edzes 2016) and the Australian labour market (Durrent-Whyte et al 2015). The Australian research indicates that 40%, or five million, jobs are at high risk of being eliminated by 2030 (Durrent-Whyte et al 2015, 92).

Whilst there is some debate as to the accuracy of the conclusions drawn by these studies (Ciriani & Perin 2015), it is certain that, even if specific jobs are not eliminated entirely, most jobs will be changed to a greater or lesser extent by the introduction of new technologies (Autor 2015, 9).

The gig economy

The gig economy is also known as the sharing, on-demand or portfolio economy.

These terms indicate that these types of less traditional ways of working involve undertaking several jobs concurrently, sometimes in completely different occupations and even industry sectors. If individuals are to maximise their ability to take advantage of this type of work, then the education/training and employment sectors need to assist them to gain the capabilities necessary to navigate the more chaotic employment conditions they face.

The rise in independent workers without the safety net of protection provided by Government regulation supported by an active labour movement is now putting that economic security at risk for many workers. Services such as Airbnb and Uber have been under the spotlight for some time (Rahman 2016), and issues of labour underutilisation are now also becoming topics of research (Mayer 2014). Not only can this type of employment place workers into economic difficulties, it also poses a number of other risks for those in work or seeking work, as they grapple with changes in their own identity, purpose and meaning of life which, in the past, have often been associated with their occupations. This has left many people struggling with a range of life decisions, not just career ones. Once again, the education/training system is ill equipped to effectively prepare students to make informed, sophisticated choices.

Material and Methods

Whilst there are many pockets of innovation in education/training organisations, in the main the education sector still works on a traditional nineteenth century factory model (Gilham & Tomkins 2016), in which students proceed in lock-step fashion, with teachers using convergent methods of teaching which "usually corresponds to the default option in classrooms and is taught in interactions between teachers and students" (Bonnardel & Didier 2016, 86). In using these convergent methods, teachers accustom students to seek the "one right answer". This method of teaching makes it difficult for students to learn critical or creative thinking, but rather they accept that there is always a correct process to be followed to find that "one right answer". Bonnardel and Didier identify the difficulty in teaching creativity when convergent teaching practices are used.

In many education/training organisations, a curriculum or competency driven approach also now appears to be more important than meeting the specific needs of learners. It often appears as if the entire teaching process is subsumed into the need to develop timetables and to program the delivery of siloed subjects or competencies. The problems in taking a curriculum driven approach have been the subject of research in a range of settings, including population health care training in which "such curriculum-driven structure may limit the development of problem representations that incorporate the necessary complexity and context to support adequate clinical solution development" (Merahn 2015, 126). The difficulties in using a curriculum driven approach to problem-based learning is also examined in the context of medical training with the conclusion that a more integrated approach is needed for effective problem-based learning to occur (Amoako-Sakyi & Amonoo-Kuofi 2015). Given the complexity of preparing people for the emerging labour market and the life decisions that this entails, this would seem to indicate that a different approach is needed by the education/training system.

Aristotle's three types of learning

If we are to consider what different approaches may be useful in assisting people to gain the capabilities that they are likely to need in the changing labour market, then an examination of Aristotle's three types of learning may be useful.

Aristotle (384-322BC) "allows for reconsidering and reintegrating ways of knowing: 'traditional, practical, tacit, emotional, experiential, intuitive, etc., marginalised and considered insufficient by modernist [and postmodernist] thinking'" (Eikeland 2012, 20-21).

The three famous virtues defined by Aristotle are:

- episteme – scientific knowledge or theory, which is "universal, invariable, and context independent" (Harper & Maher 2017, p. 3). This is the type of knowledge which is highly valued and taught in both secondary levels of high school (that is, for students aged twelve to eighteen) as well as in higher education institutions such as universities.
- techne – "denotes production, namely art, workmanship, or skill (the 'know how'). It describes the endeavor of using technical rationality to produce a certain outcome" (Ermenc, Vujisić &

Spasenović 2015, 3). This is the type of knowledge which is taught in competency based Technical and Vocational Education & Training (TVET) institutions.

- phronesis – "is most often translated as 'practical wisdom' or prudence, and denotes the ability or character trait of being able to use one's collective knowledge in a different way, in order to produce the most optimal outcome of a specific situation. A phronetic practitioner is able to draw on their knowledge, recognize what is needed in that situation, and deal with it effectively. This ability requires a high level of perception and flexibility, in combination with an understanding of which epistemic and technical knowledge to apply for the best outcome" (2015, 3).

It is this phronetic component which appears to be missing in the way people learn in our modern education and training institutions, as well as in modern workplaces. Whilst students are well prepared with theory and skill sets, they very often are not able to translate that learning effectively into their professional and private lives. Nor are they able to develop an ethical framework by which to guide their lives (Chen 2015). Without these capabilities, the author believes that we are losing our capacity for creative and critical thinking and ethical decision making. This is demonstrated by the willingness of so many to blindly believe anything they see or read on social media. Whilst this is indicative of all generations, it is a particular issue for the Generation Z group, born between 2005 and 2014 (Rickes 2016, 25), whose upbringing has been described as "oversimple, overslowed [and] overprotected" (Strauss & Howe 1997, 299).

Neuroscience and neuroplasticity

If we accept that existing mainstream education and training institutions are not adequately preparing students to deal with the complexities of the global labour market, then different forms of education need to be developed, and this means that different styles of teaching and learning may also be needed. Neuroscience shows that "[t]he brain is a network of neural networks. Hence, some form of network theory is required to explain how learning and memory work" (Tryon 2016, 277). One of the newer areas of research into teaching and learning is that of neuroplasticity, which is the study of how the brain forms new neural pathways, often after a traumatic event of some sort. For hundreds of years, scientists believed that humans brains were fully formed by adolescence and that no change was possible.

We have known for a long time that "practice makes perfect"; that is, the more often we repeat what we have learnt, the more sub-conscious, and automatic, that learning becomes. In neuroplastic terms, we deepen those existing neural pathways which have been formed by the learning. In other words, "the more that you do something, the more it will ultimately form a more indelible relationship between neurons and neural networks" (Gustafson 2017, 22). Whilst this has been seen as a positive aspect of learning, the other side of the neuroplastic coin is that, the deeper those neural pathways

become, the less likely we are to form new neural pathways by learning alternative ways of doing that thing we have learnt, or of doing a new thing instead. This can result in rigid thinking processes which have difficulty in accepting new information. This is known as cognitive dissonance, and the result is often the rejection of that new information.

If we are to successfully prepare individuals to make informed, sophisticated decisions about their futures, then we need to stop relying simply on traditional ways of helping them to learn, and be willing to examine new learning structures. The rest of this paper will put forward one new model of assisting those learners to develop a range of cross-sector capabilities: the *Cogitaire 5* model.

Discussion and Conclusions

The *Cogitaire 5* model (see Figure 2 below) is built around five thinking capabilities which could be useful in preparing people for the varied types of work and personal decisions which they need to make in the modern, chaotic world of the gig economy, as well as in dealing with complex organisational issues. These include *Futures Thinking, Systems Thinking, Complexity Thinking, Entrepreneurial Thinking* and *Design Thinking.*

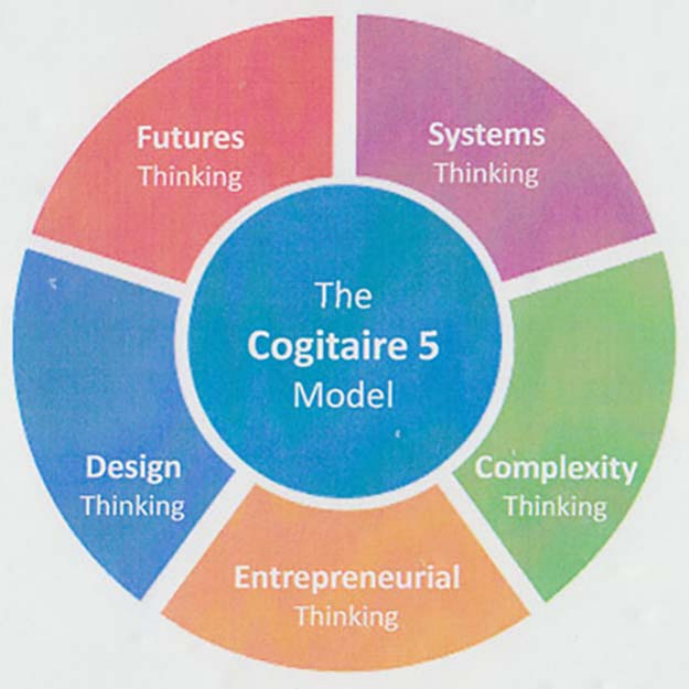

Figure 1 - Cogitaire 5 model

The thinking capabilities have been chosen in a particular order for reasons which will be defined as each capability is described. The model is designed to assist people to develop their overarching ability to think creatively and critically; and includes a range of tools and techniques which relate to each capability. The practice of these methods can also assist individuals to develop personal attributes which are vital if they are to be able to make informed, sophisticated decisions about their education and employment options, as well as the wide range of other important personal decisions which will

affect their futures. There are many tools and techniques which relate to each of these thinking capabilities. However, as there is insufficient room in this article to describe each of these, the focus will be on the ones the author considers most relevant in a range of conditions. The intent is that the selection of tools and techniques being taught is based on the particular needs of the learner or group of learners.

To test the efficacy of the model, the author consulted widely with employers, workers, educators, those seeking work, and the community agencies which work with all of these groups. As well, a workshop was conducted with the Board and staff of a not-for-profit working to improve education and employment outcomes for regional residents.

Futures thinking

Lewis Carroll has been quoted as saying "If you don't know where you're going, any road will get you there" (Carroll n.d.). This is the reason that *Futures Thinking* is the first capability to be examined in the *Cogitaire 5* model. Without having thought deeply about where the future may take us if we make no changes, and what possibilities may be realised if we have a process to work towards them, then we might as well simply "float along" and see where the road takes us. Voros' (2003) Futures Cone is a useful tool to explore probable, possible and preferred futures, from the pedestrian business-as-usual scenario to the most outrageous "what if" possibilities. This exercise takes courage to really think about what could be; creativity, imagination and curiosity to develop a wide range of options; and vision to see the potential.

Change is very difficult for most people (Kegan & Lahey 2009) and, unless there is a compelling reason, it is often easier to maintain the status quo. Inayatullah's (2003) Futures Triangle and Causal Layered Analysis, along with Wilber's (2001) Integral Theory are useful tools for individuals to reflect deeply, and critically, on their current and preferred future situations, and will often surface the key values which drive the person.

Having undertaken the reflective work required to gain insights into what is holding us back and the imperatives to change, the individual can then use scenarios (Slaughter 1996b) to build narratives of what the future might hold. Scenarios require creative thinking and imagination to bring the stories to life, and are an excellent tool for testing our assumptions about the future.

Having reflected deeply, examined why we need to change, and identified the probable, possible and preferred futures through the use of strategic foresight tools and techniques, we are then ready to move onto the next phase.

Systems thinking

Having examined a range of possible futures and selected the preferred future, it is then necessary to gain a deeper understanding of the system within which the individual is situated. The specific system will depend on the nature of the issue which has prompted the investigation in the first place. If the

desired future relates to an education/training/employment career based future, then the system will be the one in which those sectors, as well as the individual's own networks, are nested. If the issue is an organisational problem or opportunity, then the system may include suppliers, customers, etc. If a life decision is being made, then friends, family, social contacts, club membership, personal viewpoints, etc. will form the system. Until the system itself is understood, then it is not possible to identify where the drivers and barriers for change are located. Meadows defines a system as:

> *a set of things – people, cells, molecules, or whatever – interconnected in such a way that they produce their own pattern of behaviour over time. The system may be buffeted, constricted, triggered, or driven by outside forces. But the system's response to these forces is characteristic of itself, and that response is seldom simple in the real world (2008, 2).*

In trying to understand the system relating to our current and preferred future, it is vital to understand that that system is open to outside influence, and to gain insights into what those influences might be and whether they are benign or malignant. Often it is useful to visually map the system to identify how its parts are connected. This can be a very useful exercise as it assists the individual to develop their ability to think logically, conceptually and in a structured manner.

Furthermore, we must understand the mental models through which we make sense of that system and the world in general. Are we leaders or followers? What does leadership and followership mean to us? Have our experiences been positive or negative? Is the system cooperative or competitive and what does this mean for the interactions and communication between the parts of the system? What is the compelling vision for the future which will drive us towards change? What are the characteristics of the system which will facilitate that change, and which ones will be impediments? Until we understand these things, we are unlikely to be successful in moving towards our preferred future.

Complexity thinking

The problem with systems thinking is that, the minute we try to represent a system visually, we simplify it out of reality. Systems are highly complex things which "for their inner dynamic and emergent nature … have to deal with emerging, unexpected and unknown possibilities of interactions that may lead to conditions of complexity" (Badinelli et al, 2012, 507). This is why, having examined systems thinking, we must then consider complexity thinking in the development of the *Cogitaire 5* model. The process of doing this can help the individual to develop their personal capabilities in change tolerance, problem solving, decision making and critical thinking.

Chaos and ambiguity seem to be more prevalent today than previously, with the world being described as volatile, uncertain, complex and non-linear (Davis 2015, 2). In trying to understand the system, we also need to consider the memes which drive it. Waddock et al define memes as "cultural expressions that shape how things are perceived" (2015, 1004). The use of tools such as Spiral Dynamics© (Beck & Cowen 2014) can assist the individual to gain some insights into these areas, from both a group and personal perspective.

Entrepreneurial thinking

Amongst the many other quotes attributed to Albert Einstein, he has been reputed to have said "Insanity: doing the same thing over and over again and expecting different results" (c. 1930) and "We can't solve problems by using the same kind of thinking we used when we created them" (n.d.). Once the preferred future has been identified and the system, in all its complexity is understood, then the individual is ready to make the changes necessary to achieve their goals. This cannot be done in the mindset which has been used in the past – an entrepreneurial mindset will be required if new opportunities are to be identified and realised.

Paul and Seward examine six qualities which have been identified as forming entrepreneurial thinking, "questioning, improvising, being open to risk, being ready to fail, working collectively, and being self-driven. These are qualities of a mind-set that helps individuals be innovative, creative, and resourceful in the way that they solve problems" (2016, 325).

If the individual is to develop their personal capabilities for lateral thinking, risk tolerance, novel and adaptive thinking, as well as their curiosity, imagination and creative thinking capacity, then educators/trainers need to use exercises which will allow them to practice these skills.

Design thinking

The final component of the *Cogitaire 5* model is Design Thinking. Bringing an entrepreneurial mindset to the system in order to move towards the desired future, means that we have to try to redesign those parts of the system which are holding us back from making the necessary changes. Alternatively, if the system is completely dysfunctional, then we may need to attempt to design a completely new system which is supportive of the preferred future.

Design thinking can be very useful as it "can be applied very generally in numerous fields, serving as a tool that systematically prevents its applicants from using traditional means of problem solving" (Fischer 2015, 174). Vande Zande (2007) proposed that the use of design thinking can help individuals develop their critical thinking capabilities and it is these, along with creative thinking, which will be vital in achieving our desired future.

Brown and Kuratko (2015) describe a process which can be applied to assist the individual to understand and redesign the issue or system in question. This includes problem definition, research, prototyping, feedback, iterations, acquired knowledge, intuition and proof of concept.

The use of this process, along with other Design Thinking tools and techniques such as empathy mapping or persona mapping (Piu 2011) can be useful when working with individuals who are seeking to make significant changes in their lives, whether this relates to their careers, their organisational futures or their personal lives.

Conclusion

The *Cogitaire 5* model started out as the author's response to the inability of the education/training system to keep pace with the technological and structural changes occurring in the global labour market. However, the research undertaken during the development of the model has shown that it has wider applicability. Like the *Cogitaire* 5 model, there are other learning models being promulgated as useful alternatives to the offerings of the mainstream education and training systems. The *Cogitaire 5* model is still in the early stages of development and needs further testing to establish its validity and reliability. The author is working with other reseachers who are developing alternative concepts to further develop the model's usefulness for today's complex world.

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Particularities of the Future-Oriented Educational Practices in Different Regions: Comparative Analysis Based on the Experience of Russia and Finland

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Abstract

The paper is focused on the methodological issues related to the particularities of the comparative analysis of the future-oriented educational practices in different regions. In the research, the concept of "educational foresight-event" (EFE) is developed as a comparative analysis model. The future-oriented educational experience in Finland and Russia is considered on this basis.

Introduction and Background

Particularities of the generated educational models and methods, concepts and tools to develop futures/foresight thinking and futures/foresight literacy as a part of the modern worldview are considered by different educational and scientific groups in the world.

The idea of this comparative research came from the analysis based on the experience of educational projects “Open Foresight-laboratory” in Russian regions. The educational technology “open foresight-laboratory” was developed by research and pedagogical teams in cooperation of Tomsk State University with high schools and colleges of West Siberia (Tomsk, 2012-2017) and Arctic area (Yamal, 2017).

During the implementation of these programs for different regions, we formulated a hypothesis about the dependence of future-oriented educational programs on regional and territorial features. This hypothesis is focused on the key ussies: regional content of the future-oriented education and the circle of regional groups acting as participants of the future-oriented educational programs (stakeholders who are interested in territory development):

- Visioning (V): What kind of visions of the future are there on this territory? How do the visions of the future in the region influence future-oriented educational practices?
- Communities (C): What kind of territory groups are there who are interested in future-oriented educational practices?
- Education (E): Who are agents and what kind of approaches, programs, projects for future-oriented educational practices do they need?

The main purpose of this study is to perform a comparative analysis of the particularities of the future-oriented educational practices in different regions. Therefore, methodological issues and tools need to be discussed. Thus, we have two main research tasks: 1. to develop an analytical model for a comparative analysis of the future-oriented educational practices in different regions and 2. Based thereon to study particularities of the future-oriented educational practice in Russia and Finland.

Material and Methods

Several types of research materials and methods from theoretical and practical educational and psychological to philosophical and methodological researches were used for the comparative analysis of the future-oriented educational practices in different regions.

One type of the research materials relates to the educational practices of the programs based on the new educational technology "Open Foresight-Laboratory for Students". This educational project was developed by research and pedagogical teams in cooperation of Tomsk State University, region administrations, high schools and colleges. Different models of this educational technology were implemented in West Siberia (Tomsk) and in the Arctic area (Yamal) within 2012-2017.

The educational technology "open foresight-laboratory" is based on the Educational Foresight-methodology and moves participants' thinking from an uncertain vision of their futures to more positive and constructive versions, from a focus on new key technologies to the question about their effects and impacts on changes in economic, social-cultural, educational, professional levels of social life. In "open foresight-laboratory" programs students analyse how these changes influence the exploration of worldviews and myths that underlie possible, probable and preferred future, rethinking versions about their educational and professional futures. Finally, they create new versions of their choice of educational scenarios as well as of the visions of the futures of the region.

Model 1. Open foresight-laboratory of high school students "Key Technologies and Professions of the Future: Educational Foresight + 20" (2012–2017, Russia, Tomsk State University & high schools)

- 2012 (1): 5 experts, 70 high school students, 12 teachers from Seversk gymnasium/high school (Tomsk region)
- 2013 (1): 12 experts, 150 high school students, 34 teachers from 11 regions of Russia and Tomsk
- 2014 (2): 17 experts, 290 high school students, 41 teachers from Tomsk region and 10 regions of Russia
- 2015 (2): 16 experts, 310 high school students, 46 teachers from Tomsk region and 13 regions of Russia
- 2016 (2): 22 experts, 305 high school students, 46 teachers from Tomsk region and 10 regions of Russia
- 2017 (2): 10 experts, 145 high school students, 21 teachers from Tomsk region and 13 regions of Russia

Model 2. Open foresight-laboratory for students for the regional development "Arctic Generations & Arctic Skills + 20" (2017, Russia, Tomsk State University & high schools' and colleges' of Yamal, Yamalo-Nenets Autonomous District, Arctic area)

- March 2017: 18 experts, 60 high school and college students (10 groups), 20 teachers from 6 towns of Yamal
- April 2017: 23 experts, 60 high school and college students (6 groups), 21 teachers from 5 towns of Yamal
- November 2017: 12 experts, 60 students (6 groups) and 10 teachers from 5 medical college of Yamal

An example of future-oriented educational program: Model 2. Open foresight-laboratory for students for the regional development "Arctic Generations & Arctic Skills + 20" (February-March 2017, Yamal, Yamalo-Nenets Autonomous District, for high schools & colleges, head of the program team – Tatiana Yakubovskaya)

The program was held for 3 days (or 3 stages), and the prior preparation stage took 1 month. Participants: 18 experts, 60 high school and college students, 20 teachers from 6 towns of Yamal.
Structure of the educational program:

1. Key Technologies for Arctic Lifestyle +20: Threats and Opportunities

- Digitalization. IT
- Robotics
- New materials. 3- and 4-D printing
- Power Engineering
- Biotechnology

2. Arctic Lifestyle & Arctic Generations +20 (versions)

3. Arctic Skills + 20: Top - 15 Professions for Arctic Generation and My Priorities for My Personal Educational Programs (versions)

The materials for analysis:

- Programs (for different models)
- Students' Foresight-essays (from preparation/distance stage)
- Presentations from the work teams of "Open Foresight-laboratory" (3-10 teams)
- Questionnaires, interviews
- Video materials, comics and others.

The second type of research materials is based on the philosophical, psychological and methodological analysis of the future-oriented educational practices in the world. The development of the analytical model for comparative analysis requires to consider why practical use of the concepts of the future in modern education generates a number of serious problems as well as new educational and pedagogical tasks.

On the one hand, the accumulated global future-oriented education experience allows to hypothesize: what areas of educational activities meet conditions for understanding the concept of time in education and what opportunities to work with the future there are in the context of personalisation. Firstly, the concept of time is included into the idea of individualized education program (IEP) as the format of personalisation in education.

This means that different types of pedagogical activity are aimed at understanding personal resources and constraints of a personal educational path with respect to various vectors of time "present - future - past".

Secondly, the concept of time and the future corresponds to the organization of various educational co-creative events as the backbone units of teaching practice of personalisation. In the analysis of contemporary practices of personalisation attention is paid to the experience in developing special educational events to understand future trends. With the help of this type of educational events self-determination and understanding of the development of specific educational route involving various resources to implement this educational program can be identified.

Thirdly, to work with the concepts of time and future is fundamentally important in different pedagogical formats for project types of learning activities.

But, on the other hand, analysis of the situation in modern education shows that the issue of the future is a major historical challenge for educational practice. The idea of education originally has a timeless character. And education as a social institute focused on broadcasting of "eternal values", cultural norms and activities without an idea of time.

However, such global educational trends and practices of personalisation of education, project-based approach, widespread foresight-literacy and future-thinking development pay attention to the concept of time in education and the issues how we can and must work with the concept of the future in education.

Thesis 1. The future as a challenge for western education. When discussing future work in education practices, a fundamental revision of educational ideas is required.

The idea of western education initially confronts the idea of time and is based on a fundamentally timeless nature of the goals of education. The history of the idea of education in western culture from antiquity to modern times is still related to the history of the social institute of education oriented to showing "eternal values", norms of culture and activities.

In the pedagogical language, the term of “time” is used more as an empirical phenomenon, and not as a philosophical category: usually the “future” is considered as the term "tomorrow", in which the results of our "today" efforts are manifested for the development and preservation of the "past", in the forms of cultural norms and traditions. Accordingly, the term “future” in such pedagogical logic is a continuation of the “past” through its retention in the “present”.

The forward-looking scenarios of the development in education which describe education of the future consider mainly new unique opportunities and implications for educational practices only in terms of technological innovations. However, the time perspective should be considered as the deep historical challenge for education, since the idea of time in education changes ontological foundations of the western paradigm of education.

In the context of time concept, questions about new approaches and opportunities to work with different vectors of time in educational practice including the future of the educational community as a whole open up new areas of research and development.

Thesis 2. The trend of personalisation of education is commensurable with the question of the introduction of the category of time into educational theory and practice. On this basis, a new paradigm of education can be created: today, the experience of future-oriented education is an interesting promising approach to this task.

Introduction of the category of time in the concept of education requires rethinking of the underlying principles and the development of new conceptual solutions for the elaboration of the theory and practice of educational activities.

The main hypothesis is that the practice of education personalisation commensurate with the category of time and allows to work with the foresight-culture in the field of education. The idea of time enhances anthropological principles of education personalisation concept because the idea of human self-determination is related to the idea of time. The idea of time emphasizes the value of human personality through the projection of his subjectivity in different time dimensions and their co-scaling in the individual history of a person.

Thesis 3. The cultural-historical theory (L. Vygotsky) creates a foundation for the introduction of the concept of time and the future into the pedagogical practices It also provides for the opportunities to reconsider the idea of education: the main ideas are the “zone of proximal development”, thinking and speaking as verbal tools to guide thinking and actions. Vygotsky's research in the field of psychology of adolescence plays a special role in the organization of work with the concept of time and the future. Some of the most important research areas in the context of personalisation and future-oriented education are as follows:

1. In the context of cultural-historical theory the concepts of time and the future are considered to constitute the child's independence from the immediate situation at present, the possibility of free action by "the sketch of the future" [1]: mechanisms of the sign mediation, planning function of speech, symbolic operations, pilot actions, etc.
2. The investigation of conditions for the formation of subjectivity. L.Vygotsky's positions about the social nature of the individual, the mastery of behaviour and projective action introduces the concept of time and the future in determining activity of human nature: “human element is not a given. It is revealed in "step" of the human formation - an effort to build actions and re-creation, re-creation of the act of acquisition of subjectivity” [3]. The psychology of adolescence with valuable modes of time and the concept of the future are strengthened by the fact that the teenager "comes to one of the most decisive moments of life - to the choice of vocation and profession" [2, 220].

3. The research of the conditions and processes of formation of conceptual thinking / theoretical thinking: "The language of thinking is the language of freedom"[2, 202]. The position of the intellectualization of mental functions (memory, volitional action, imagination, etc.) in the transitional age of teenagers and the formation of conceptual thinking allow us to consider the connection of the concept of time and the future and the concept of freedom from ongoing activities and the work with intention.
4. The research of the development of a new way of thinking which is "based mainly on speech or any other system of signs" [2, 221]. The future has a significant feature, it always stays in signs, knowledge of the future exists in different types of text format. In accordance with the basic ideas of the cultural-historical theory an important challenge for education and a specific pedagogical task is to work with texts and information about the future: search, analysis and evaluation, selection, creation. So, new opportunities for pedagogical actions with different texts about the future in the formats of educational foresight-events arise including: organization of team format evets, analysis of personal resources and development versions of the individual educational program, designing educational routes, etc.

The third type of the research materials relates to the future studies and foresight researches and their use in the modern educational practice.

The formation of a new educational content based on the analysis of contemporary culture knowledge about the future and foresight-culture is becoming the key challenge for educational practice. Today, the area of future studies is a special area of activity and culture that is beginning to have a noticeable impact on the modern education. This primarily occurs through the preparation of experts within university programs in the field of research methodology where Futures studies (and Foresight) take a special place.

Compared to other approaches to the study of the s, the methodology of foresight is aimed at gaining knowledge about the future as the basis for making strategic management decisions. The most important criterion for evaluating the foresight methodology is the quality and reliability of knowledge of the future for making decisions at different levels: national strategic program development, corporate strategy, education policy and others.

On the one hand, in the modern western society foresight-knowledge has become a part of western culture and social institutions. On the other hand, the formation of a new educational content based on the modern foresight-culture requires radical re-thinking of the idea of education. Only within the framework of the introduction of time category into education we can talk about the development of future thinking and literacy in educational practices. The formation of modern culture of future-knowledge and future thinking and the pedagogical working with a time perspective becomes very important in educational theory and practice.

Thus, an analytical model for a comparative analysis of the future-oriented educational practice in Russia and Finland was developed on the basis of different types of research materials.

Results

1. The concept and analytical model of "Educational Foresight-Event" (EFE, Figure 1 and 2) as an analytical model for the comparative analysis of the future-oriented educational practice in different regions is based on the analyses of the regional content of economic, social-cultural, educational, professional levels of social life and the regional groups or stakeholders who are interested in the development of the territory:

- Visioning (V): What kind of visions of the future are there on this territory? How do the visions of the future in the region influence future-oriented educational practices?
- Communities (C): What kind of territorial groups are there who are interested in future-oriented educational practices?
- Education (E): Who are the agents and what kind of approaches, programs, projects for future-oriented educational practices do they need?

1.1. The concept of "Educational Foresight-Event" (EFE) includes three main types of regional features as the dependence of future-oriented educational programs on territorial particularities:

- Visioning (V): Rethinking of visions about the Future (versions about one's own and regional futures): youth versions about their own future and future of the territory
- Communities (C): Participation of the future-oriented communities in the EFE: groups interested in Future-oriented educational practices
- Education (E): Educational formats EFE: agents, approaches, programs, projects for Future-oriented educational practices

1.2. The concept of "Educational Foresight-Event" (EFE) as a comparative analytical model of the future-oriented educational practice is the series of regular future-oriented educational events according the educational technology "open foresight-laboratory". It goes beyond "futures" as isolated lessons through the empirical, interpretive, critical, and action learning modes of futures studies.

- The educational foresight-event (EFE) allows to:
- establish links between the future, past and present,
- teach skills for personal and social transformation,
- lead to a meaningful change and development for individuals and groups within their learning environment in connection with the issues of future image formation,
- move thinking from the focus on new technologies to the question of effects and impacts on economic, social-cultural, educational, professional changes,
- explore the worldviews and myths that underlie possible, probable and preferred futures
- achieve versions of one's own choice of educational scenarios and profession in line with the possibilities of desired presents and futures,
- rethink versions about one's own futures (educational, professional) and futures of the territory: from uncertain visions about one's own futures to more positive and constructive versions.

1.3. The concept of "Educational Foresight-Event" (EFE) develops significant focus within the future-oriented education by examination and adopting of the following ideas:

- Ideas from Psychology: fundamental models from Vygotsky's Cultural-historical / Sociocultural Theory
- Ideas from Futures studies: methods of educational foresight and narrative foresight (S.Inayatullah) approaches,
- Ideas from Philosophy: theory of extreme events and problems with probability, randomness (concept of Black Swan, N. Taleb),
- Ideas from training technologies for social innovation: "transformative action" model (Transformative Action Institute, TAI)

<table>
<tr><th colspan="2">The concept of Education Foresight-Event (EFE) as a comparative analytical model of the future-oriented educational practice is based on the following ideas:</th></tr>
<tr><td rowspan="6">Ideas from Philosophy: Theory of extreme events (concept of Black Swan) (N. Taleb)
Issues: extreme event, problems with probability, randomness, human error, the philosophy of knowledge and so on.

Ideas from Psychology: Vygotsky's Cultural-historical Theory: "zone of proximal development", thinking and speaking as verbal tools to guide thinking and actions, and other ideas.

Ideas from Futures studies: Educational foresight and Narrative foresight pedagogy (CLA) (S. Inayatullah):

Analysis: new technologies; impacts on economic, social-cultural, educational, changes of competencies and professions; possible, probable and preferred futures; versions of one's own choice of educational scenarios and professions, possibilities of desired presents and futures.

Ideas from training technologies for social innovation:

Transformative Action Institute (TAI): transforming action as a model for personal and social change</td><td>Education (E): Educational formats EFE</td></tr>
<tr><td>Educational Foresight-Events (EFE) as a series of regular future-oriented educational event according to the educational technology "open foresight-laboratory"
EFE goes beyond "futures" as isolated lessons through the empirical, interpretive, critical, and action learning modes of futures studies.</td></tr>
<tr><td>Communities (C): Participation of Future-oriented communities in the EFE</td></tr>
<tr><td>Students' and future-oriented communities' participation in transformining action through education foresight and narrative foresight:
✓ analysis of the issues from a focus on new technologies to the question of effects and impacts on economic, social-cultural, educational, changes of competencies and professions,
✓ to an exploration of the worldviews and myths that underlie possible, probable and preferred futures
✓ and, finally, towards versions of their own choice of educational scenarios and professions in line with the possibilities of desired presents and futures</td></tr>
<tr><td>Visioning (V): Rethinking visions about Future</td></tr>
<tr><td>Rethinking versions about one's own futures (educational, professional) and futures of the territory: from uncertain visions about one's own futures to more positive and constructive versions.</td></tr>
</table>

Figure 1. The concept of "Educational Foresight-Event" (EFE) as a comparative analytical model of the future-oriented educational practice

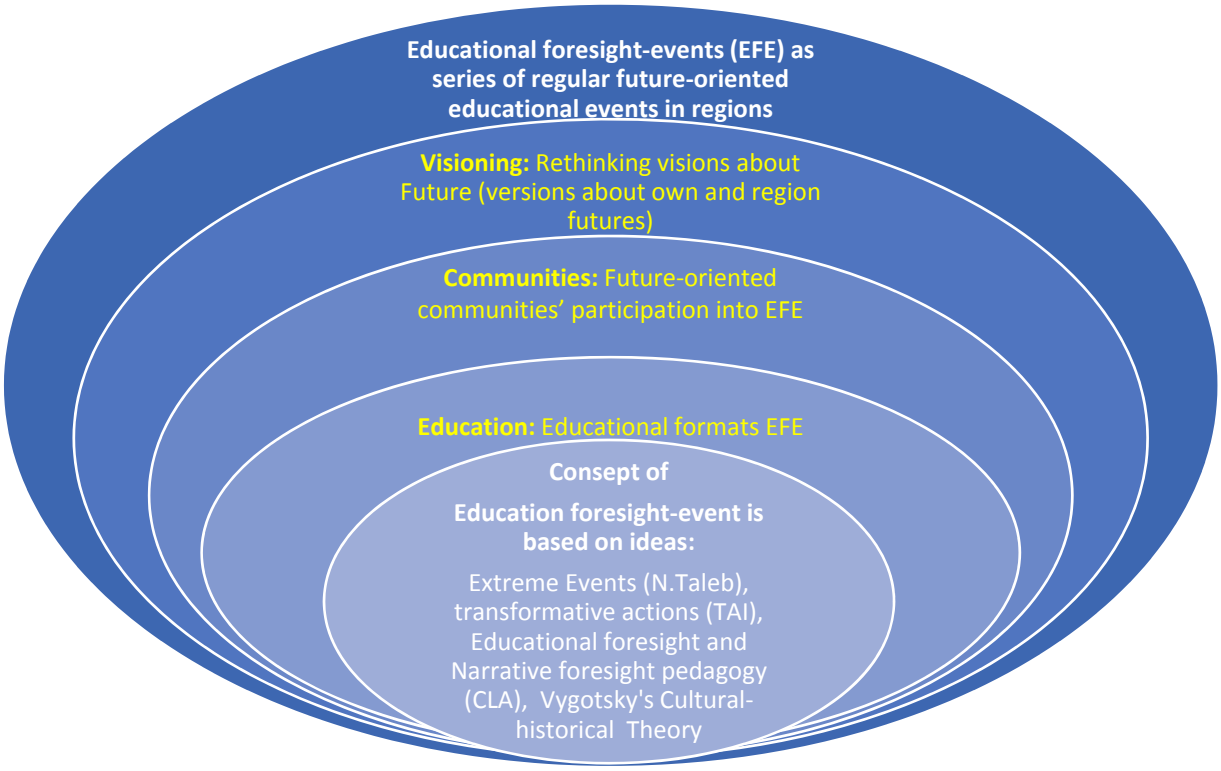


Figure 2.The concept of "Educational Foresight-Event"(EFE) for the comparative analysis of the future-oriented educational practice in different regions.

2. Based on the analytical model "Educational Foresight-Event" (EFE) the particularities of the future-oriented educational practice in Russia and Finland have been studied.

2.1. Particularities of the future-oriented educational practice in different types of regions: West Siberia – Arctic area was studied based on the developed analytical model Educational Foresight-Event (EFE).

Case 1. Tomsk, West Siberia – Scientific-education centre and Siberian Technological-Innovation region of West Siberia (600 000 peoples, 294,6 km^2, 6 universities)

Model 1. Open foresight-laboratory of high school students (2012–2017, Russia, Tomsk State University & high schools)

Case 2. Yamal, Arctic area, Yamalo-Nenets Autonomus District – Russia's strategic oil and gas region (600 000 peoples, 769 250,0 km^2, region without universities)

Model 2. Open foresight-laboratory for students for regional development (2017, Russia, Tomsk State University & high schools and colleges of Yamal, Yamalo-Nenets Autonomus District, Arctic area)

Case 1. Tomsk, West Siberia (600 000 peoples, 294,6 km^2, 6 universities) Scientific-education centre Siberian Technological-Innovation region	Case 2. Yamal, Arctic area (600 000 peoples, 769 250,0 km^2, region without universities) Yamalo-Nenets Autonomus District Russia's strategic oil and gas region
E: Educational Policy: agents, approaches, programs, projects for Future-oriented educational practices	
University groups: educational projects for the schools oriented at high-technological professions and competencies	Industrial groups: profession-oriented educational projects for the needs of industrial, HR-programs
C: Future-oriented communities: groups interested in Future-oriented educational practices	
High-technological scientific and entrepreneurial communities University communities Regional and city administration for innovation and economic development Parents groups	Technological groups of oil and gas industry Town communities Parents groups
V: Visions about Future: Youth versions about their own futures and futures of the territory	
"Futures through education" in Tomsk or Russian and international universities Visions about one's own futures are positive and constructive	"Futures through migration" from the territory for living and studying at other regions of Russia Visions about one's own futures is uncertain

Figure 3.Some results of the comparative analysis of the future-oriented educational practice in different regions of Russia based on the concept of "Educational Foresight-Event" (EFE)

2.2. Particularities of the future-oriented educational practice in different countries: Finland and Russia

In the Finnish education policy and educational practice, the use of futures studies and foresight is considered as an important task since 2000. In modern Russia, we can talk about the education policy in the area of "futures/foresight literacy" only after 2010.

At the same time, in Finland and Russia there are educational practices where educational models and methods, concepts and tools for the development of futures/foresight thinking as a part of a worldview are generated. The issue of "futures in education" is one of the insufficiently studied and difficult to approach issues: what problems and opportunities of using the concepts of time and the future in the formation of the "futures/foresight literacy" concepts and the futures thinking development there are for the modern theory and practice of education in Finland and Russia.

A special place in this issue is devoted to the analysis of education modernization in Finland in 2015-2016. Thematic area L7: Participation, influence and building a sustainable future was introduced into the new Finland state educational program for secondary and high school. The main content of the

thematic areas is the following: "During basic training, students reflect / think through the relationship between past, present and future, as well as various options for the future".

Russian examples of the experience in the use of the foresight-culture in educational practice are presented by both high school level and university education as well as by training programs for school teachers and university professors.

The analysis of pedagogical experience of Russia and Finland in the development of future-thinking, especially in the development of individual educational programs and the organization of educational and professional orientation for high school students.

FINLAND	RUSSIA
E: Educational Policy: agents, approaches, programs, projects for Future-oriented educational practices	
Finnish National Agency for Education since 2003 - Educational foresight http://www.ammattinetti.fi/artikkelit/detail/25_artikkeli;?link=true - Curriculum reform (since 2014-2016) http://www.oph.fi/download/158389_general_aspects_of_basic_education_curriculum_reform.pdf *Future-oriented curriculum process and competence (L7): Participation and influence, building the sustainable future.*	**Agency for Strategic Initiatives** (the autonomous non-profit organization established by the Government of Russia) **since 2013** Some new educational projects: - Atlas of emerging jobs http://atlas100.ru/en/future/ - Global Education Foresight https://asi.ru/eng/staffing/globaleduintegration/ - New model of the system of additional education of children https://asi.ru/eng/social/education/ , *e.g. Youth and Education industrial camp "School Technopark", Network of interactive scientific and entertainment centers of children and youth "Innopark" and so on.*
C: Future-oriented communities: groups interested in Future-oriented educational practices	
- Finland Futures Research Centre, Finland Futures Academy, the Finland National Foresight Network - High – technological scientific and entrepreneurial communities - University communities - Regional authorities or innovation and economic development - Parents groups	- Foresight Groups (Skolkovo) - High – technological scientific and entrepreneurial communities - Universities communities - Regional administrations for innovation and economic development - Parents groups
V: Visions about Future: youth versions about their own futures and the futures of the territory	
The development of future-thinking, especially in the development of individual educational programs and the organization of educational and professional orientation for high school students	

Figure 4.Some results of the comparative analysis of the future-oriented educational practices in different regions: Russia and Finland (based on the concept of "Educational Foresight-Event", EFE)

Discussion and Conclusions

The concept and analytical model of "educational foresight-event" (EFE) is a methodological tool which allows to analyse the hypothesis that "future-oriented educational practice depends on particularities of the region". It also helps to consider the cases related to the particularities of the future-oriented educational practice in different regions. This model integrates, on the one hand, regional key aspects of different types of regions and, on the other hand, feathers of the future-oriented educational theoretical and practical views.

In this connection, the main conclusion is that the process of developing and forming future-oriented educational programs includes a comparative regional analysis as a specific character of the future-oriented education.

This comparative analytical model needs further development and discussions. Additionally, we plan to continue the research of the comparative analysis of the future-oriented educational experience in Finland and Russia and to consider the particularities of the generated educational models and methods, concepts and tools to develop futures/foresight thinking and futures/foresight literacy.

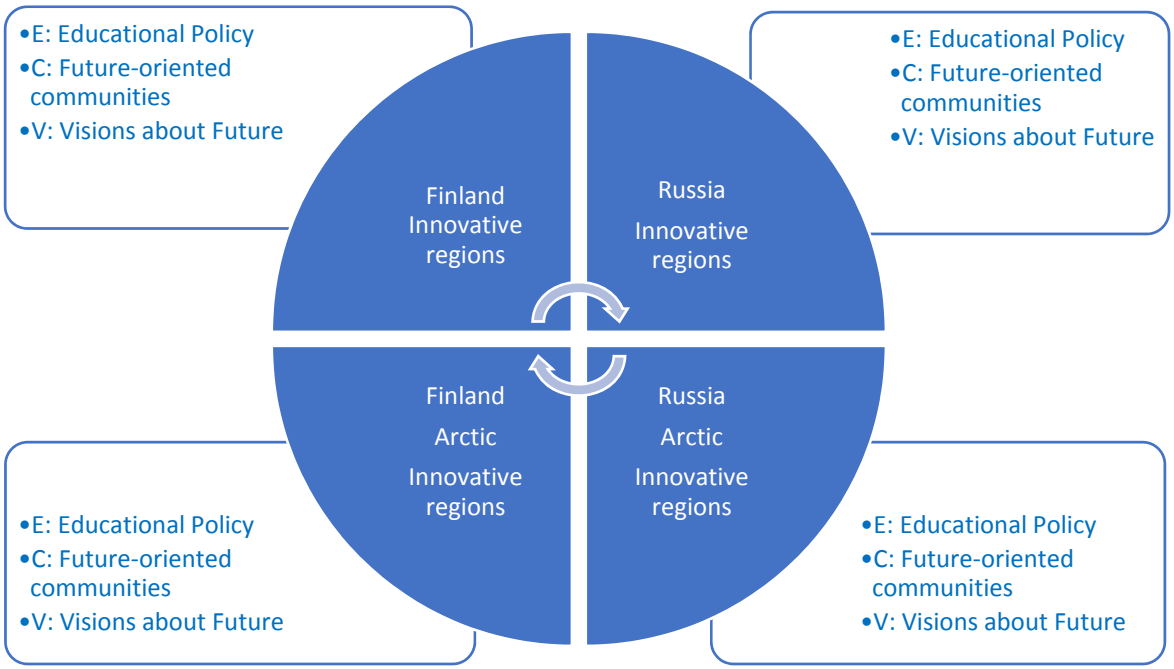
Thus, in the future research related to the hypothesis that "future-oriented educational practice depends on particularities of the region" we plan to study different types of regions in Finland and Russia to elaborate versions of the comparative analysis of the future-oriented educational practice as follows:

Case 1. Finland: Innovative region VS Arctic Innovative regions.

Case 2. Russia: Tomsk, Innovative region, Siberia VS Yamal, Arctic Innovative region.

Case 3. Finland (Innovative region) VS Russia (Tomsk, Innovative region, Siberia).

Case 4. Finland (Arctic Innovative regions) VS Russia (Yamal, Arctic Innovative region).



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5. RESILIENT FUTURES: FOOD AND WATER SAFETY

Institutional Interventions for preparing the Indian farmer to face an uncertain future

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Abstract

India, with a population of 1.31 billion, has about 50% dependent on the agriculture sector and more than 85% of farmers are small holder farmers. Agriculture is largely rain fed in India and faces a complex uncertain future due to climate change which is manifested in terms of erratic monsoon, freak weather conditions like frost, hail storm and catastrophes like floods and droughts. Small holder farmers are disproportionately affected due to their low financial and adaptive capacity.

However, Government of India has accorded top priority for addressing climate change and has formulated the National Action Plan on Climate Change (NAPCC) in 2008 that established 8 National Missions. NAPCC is further scaled down through State/Provincial Action Plans on Climate Change (SAPCC) for each of the 29 States and 7 Union Territories. The Government has established the National Adaptation Fund for Climate Change (NAFCC) which is a pioneering step to address climate change adaptation needs of the farmers. India's only Development Financial Institution for agriculture, the National Bank for Agriculture & Rural Development (NABARD) is the only National Implementing Entity for implanting projects funds under the Adaptation Fund as well as the Green Climate Fund. NABARD is taking up projects and programmes aimed at building climate resilient agriculture and supporting adaptation & mitigation projects related to plantation, horticulture, forestry, land development, watershed development, micro irrigation, solar power, hydel power, etc. that help the small and marginal farmers. The good practices are being mainstreamed for sustainable development in the region.

Introduction & Background

Agriculture in India

1.0 India is a very large country, covering about 2.4 per cent of the world's land surface area with the second largest population in the world, being home to approximately 1.31 billion people in 2010, or 15 per cent of the world's population. India's agriculture has always been dependent on monsoons. Nev-

ertheless, today India ranks second worldwide in farm output. Agriculture and allied sectors like forestry and fisheries accounted for 13.7% of the GDP (gross domestic product) in 2013, about 50% of the workforce. Agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India.

1.1 India is the world's largest producer of many fresh fruits and vegetables, milk, major spices, select fibrous crops such as jute, staples such as millets and castor oil seed. India is the second largest producer of wheat and rice, the world's major food crop. India has been maintaining its position as the world's second or third largest producer of several dry fruits, agriculture-based textile raw materials, roots and tuber crops, pulses, farmed fish, eggs, coconut, sugarcane and numerous vegetables. India ranked in the world's five largest producers of over 80% of agricultural produce items, including many cash crops such as coffee and cotton, in 2010.[India is one of the world's five largest producers of livestock and poultry meat, with one of the fastest growth rates, as of 2011.

1.2 India exported $39 billion worth of agricultural products in 2013, making it the seventh largest agricultural exporter worldwide and the sixth largest net exporter. Most of its agriculture exports serve developing and least developed nations. Indian agricultural/horticultural and processed foods are exported to more than 100 countries, primarily in the Middle East, Southeast Asia, SAARC countries, the EU and the United States. Any change in monsoon trends drastically affects agriculture. Any increase in temperature affect Indian agriculture. India exported $39 billion worth of agricultural products in 2013, making it the seventh largest agricultural exporter worldwide, and the sixth largest net exporter. This represents explosive growth, as in 2003 net export were about $5 billion. India is the fastest growing exporter of agricultural products over a 10-year period, its $39 billion of net exports is more than double the combined exports of the European Union (EU-28). It has become one of the world's largest supplier of rice, cotton, sugar and wheat. India exported around 2 million metric tonnes of wheat and 2.1 million metric tonnes of rice in 2011 to Africa, Nepal, Bangladesh and other regions around the world.

Changing scenario in Indian agriculture

2.0 Recent studies done at the Indian Agricultural Research Institute indicate the possibility of a loss of between 4 and 5 million tons in wheat production in the future with every rise of 1 degree Celsius temperature throughout the growing period. Rice production is slated to decrease by almost a tonne/hectare if the temperature rises by 2 degree celsius. In Rajasthan, a 2 degree rise in temperature was estimated to reduce production of pearl millet by 10 to 15 percent. If maximum and minimum temperatures rise by 3 and 3.5 degrees respectively, then soya bean yields in M.P will decline by 5 percent compared to 1998. Agriculture will be affected in the coastal regions of Gujarat and Maharashtra, as fertile areas are vulnerable to inundation and salinization.

2.1 The major impacts of climate change will be on rain fed or un-irrigated crops, which are cultivated on nearly 60 percent of cropland. A temperature rise by 0.5oC in winter temperature is pro-

jected to reduce rain fed wheat yield by 0.45 tonnes per hectare. Possibly there might be some improvement in yields of chickpeas, winter maize, sorghum and millets and coconut on the west coast and less loss in potatoes, mustard and vegetables in north-western India due to reduced frost damage. Increased droughts and floods are likely to increase production variability.

Climate change and Indian agriculture

3.0 Climate change is one of the most critical global challenges of our times. Recent events have emphatically demonstrated our growing vulnerability to climate change. Climate change impacts will range from affecting agriculture – further endangering food security – to sea-level rise and the accelerated erosion of coastal zones, increasing intensity of natural disasters, species extinction, and the spread of vector-borne diseases. Climate change has become real and tangible, affecting people's lives worldwide. It is a major challenge for agriculture, food security and rural livelihoods. As indicated in Intergovernmental Panel on Climate Change (IPCC) in its Fifth Assessment Report released in March 2014, poor, marginalized, and rural communities are likely to be hit hardest by climate change impacts. For these vulnerable groups, climate change acts as a "risk multiplier" worsening existing social, economic, political, and environmental stresses.

3.1 The impacts of climate change are global, but countries like India are more vulnerable in view of the high population depending on agriculture, which in turn is dependent on the seasonal monsoons. India is confronted with the challenge of sustaining rapid economic growth amidst the increasing global threat of climate change. India has already shown its commitment to help address the global climate challenge and Government of India accorded top priority for addressing climate change related concerns. India is highly vulnerable to various natural hazards such as droughts, floods, heat waves and cyclones. Climate change is altering the environment affecting agriculture, water availability, and sea-levels. It is increasing the intensity of natural disasters, the rate of species extinction and the spread of vector-borne diseases. Those most vulnerable to climate change are the world's poor as they are often directly reliant on natural resources to meet their basic needs. They also have the fewest resources to cope with climate-related shocks.

3.2 This paper tries to examine how the Indian farmers is being supported by Institutions in India to prepare themselves for an uncertain future, the dangers of climate change.

Materials and Methods

4.0 The author makes a review of the existing institutions both from the Governments side as well as the Non-Governmental side to understand the measures taken by them to achieve the objective. The paper is based mostly on secondary information and information obtained through personal interviews with a few officials of Institutions like Government of India, Indian Council of Agricultural Research, National Bank for Agriculture & Rural Development (NABARD) and a few other Non-Governmental Organisations.

The Results

5.0 The review reveals that the Governments of India as well as the Research Institutions under the Indian Council of Agricultural Research are fully geared up to tackle the situation and has taken several measures to help the farmers in India to prepare himself to face the problems of climate change. The measures taken by institutions like National Bank for Agriculture & Rural Development and various Non- Governmental Organisations across the country have also been studied and presented here.

Adaptation by Indian farmers to climate change

5.1 In view of drastic environmental changes taking place it is necessary for farmers to adapt to changing situation as soon as possible. Fortunately India was an early adopter of the climate change adaptation strategies. As more than 85 % of the farmers in India are small farmers with 5 ac or less of land and lack resources of various kinds, they need to be supported to face the vagaries of the climatic changes that are taking place. Indian farmers are made ready to cope with the current climatic risks by providing value-added weather services to farmers so that the farmers can adapt to climate changes to some degree by shifting planting dates, choosing varieties with different growth duration, or changing crop rotations. An early warning system helps to monitor changes in pest and disease outbreaks. The overall pest control strategy should be based on integrated pest management because it takes care of multiple pests in a given climatic scenario. Developing short-duration crop varieties that can mature before the peak heat phase set in. Farmers are educated to select genotype in crops that have a higher per day yield potential to counter yield loss from heat-induced reduction in growing periods.

Interventions by Government of India

5.2 Government of India has already shown its commitment to help address the global climate challenge and Government of India accorded top priority for addressing climate change related concerns. India has signed the United Nations Framework Convention on Climate Change (UNFCCC), and has acceded to the Kyoto Protocol in 2002. The Government formulated the National Action Plan on Climate Change (NAPCC) on June, 2008 that established 8 National Missions to reduce the vulnerability to the impacts of climate change through adaptation and mitigation measures.

India's National Action Plan on Climate Change

5.3 The action plan designed by the Government of India outlines a number of steps to simultaneously advance India's development and climate change-related objectives. The National Action Plan on Climate Change (NAPCC) encompasses a range of measures. It focuses on eight missions, which are as follows:

- National Solar Mission
- National Mission for Enhanced Energy Efficiency

- National Mission on Sustainable Habitat
- National Water Mission
- National Mission for Sustaining the Himalayan Ecosystem
- Green India Mission
- National Mission for Sustainable Agriculture
- National Mission on Strategic Knowledge for Climate Change

5.4 The NAPCC is further scaled down through State / Provincial Action Plan on Climate Change (SAPCC) for each of the 29 States and 7 Union Territories. The National Adaptation Fund on Climate Change (NAFCC) has been established by the Government of India. In addition to the above, the Govt. of India has also set up in August 2015 the National Adaptation Fund on Climate Change (NAFCC) to meet the cost of adaptation to climate change for the State and Union Territories of India that are particularly vulnerable to the adverse effects of climate change for which the National Bank for Agriculture & Rural Development (NABARD) in India, the Development Financial Institution for Agriculture, which has been accredited globally as a National Implementing Entity (NIE) in July 2012 and is the only NIE for India for implanting projects funder under the Adaptation Fund. In 2011, efforts continued to take the discourse and planning on climate change to the state level. Ten states prepared draft action plans for climate change which are currently under review. The Plans address a range of concerns including, assessing community vulnerabilities, mapping climate change affects across states, understanding the impact of economic activities on the environment, and proposing strategies to respond to climate change.

Indian Council of Agricultural Research

5.5 The Indian Council of Agricultural Research (ICAR) is an autonomous organisation under the Department of Agricultural Research and Education (DARE), Ministry of Agriculture and Farmers Welfare, Government of India. It was **established in 1929** as a registered society in pursuance of the report of the Royal Commission on Agriculture. The Council is the apex body for co-ordinating, guiding and managing research and education in agriculture including horticulture, fisheries and animal sciences in the entire country. With 101 Research Institutes and **71 agricultural universities** spread across the country this is one of the largest national agricultural systems in the world. The ICAR has played a pioneering role in ushering Green Revolution during the 1960s and subsequent developments in agriculture in India through its research and technology development that has **enabled the country to increase the production of food grains by 5 times, horticultural crops by 9.5 times, fish by 12.5 times, milk 7.8 times** and **eggs 39 times** since 1951 to 2014, thus making a visible impact on the national food and nutritional security.

Strategic Research

5.6 Adaptation to climate variability and climate change requires long term strategic research in the area of Natural Resource Management, Crops, Pests and disease dynamics, Livestock, Fisheries & Energy Efficiency. Focused programmes are taken up on different commodities on adaptation and mitigation. The strategic research is being carried out involving 21 Research Institutes of the Indian Council of Agricultural Research (ICAR) out of which seven are core institutes where state of the art research infrastructure and equipments are installed for climate change research on irrigated crops, rainfed crops, horticulture, livestock, fisheries and energy efficiency. The following Institutes have been identified for thematic research across crops and agro-climatic zones are:

1. Indian Veterinary Research Institute (IVRI), Izatnagar
2. Central Inland Fisheries Research Institute (CIFRI), Barrackpore
3. Central Institute for Brackish Water Aquaculture (CIBA), Chennai
4. National Institute for Abiotic Stress Management (NIASM), Baramati, Pune
5. Central Rice Research Institute (CRRI), Cuttack
6. Directorate of Rice Research (DRR), Hyderabad
7. Indian Institute of Pulses Research (IIPR), Kanpur
8. Indian Institute of Vegetable Research (IIVR), Varanasi
9. ICAR Research Complex for Eastern Region, Ranchi
10. NRC on Plant Biotechnology, New Delhi
11. National Centre for Integrated Pest Management (NCIPM), New Delhi
12. National Research Centre for Agro Forestry (NRCAF), Jhansi
13. Directorate of Water Management, Bhubhaneshwar
14. Project Directorate for Farming System Research (PDFSR), Modipuram

Technology Demonstration

5.7 An integrated package of proven technologies are demonstrated in one village in each district by Krishi Vigyan Kendra (Agriculture Knowledge Centres) or other Research Centres for adaptation and mitigation of the crop and livestock production systems to climate variability based on the available technologies. Agricultural Science Centres known as Krishi Vigyan Kendras are innovative institutions for taking technology from the laboratory to the field and imparting vocational training to the practicing farmers, and field level extension functionaries at the field level. The KVKs have been established under the aiegies of the Indian Council of Agricultural Research by various sponsors. At present there are 660 KVKs in India, largely promoted by the State Agricultural Universities (SAU) and Central Agricultural University (CAU), some of them directly under the ICAR, a few of them by NGOs, and some of them by the State Governments, and very few number by other educational institutions. On-farm testing to assess the location specificity of agricultural technologies under various farming systems.

- Frontline demonstrations to establish production potential of technologies on the farmers' fields
- Capacity development of farmers and extension personnel to update their knowledge and skills on modern agricultural technologies
- To work as Knowledge and Resource Centre of agricultural technologies for supporting initiatives of public, private and voluntary sectors in improving the agricultural economy of the district.
- Provide farm advisories using ICT and other media means on varied subjects of interest to farmers.

(ii) The All India Coordinated Research Project (AICRP) for Dryland Agriculture was launched in India in 1970 with the assistance of Canadian International Development Agency (CIDA) and has now a network of 25 centres spread across arid, semi-arid, sub-humid and per-humid rainfed agro ecologies and works with the following mandate :

- Optimize the use of natural resources, i.e., rainfall, land and water, and minimize soil and water loss and degradation of environment
- Evolve simple technologies to substantially increase crop productivity and profitability
- Increase stability of crop production over years by providing improvements in natural resources management, crop management systems and alternate crop production technologies matching weather aberrations
- Develop alternate and sustainable land use systems
- Evaluate and study transferability of improved dryland technologies to farmers' fields
- (iii) Besides the 100 KVKs and 25 centres of the AICRP the following Core Institutes under the ICAR have been identified for Technology Transfer as indicated below:

1. Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad
2. Indian Agricultural Research Institute (IARI), New Delhi
3. Indian Institute of Horticultural Research (IIHR), Bangalore
4. National Dairy Research Institute (NDRI), Karnal
5. Central Marine Fisheries Research Institute (CMFRI), Cochin
6. Central Institute of Agricultural Engineering (CIAE), Bhopal
7. ICAR-Research Complex for NEH Region, Barapani, Shillong

National Initiative on Climate Resilient Agriculture

5.8 The Ministry of Agriculture Government of India, through the Indian Council of Agricultural Research (ICAR), launched the National Initiative on Climate Resilient Agriculture (NICRA) in 2011 with funding from Government of India with the following objectives:

- To enhance the resilience of Indian agriculture covering crops, livestock and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies.

- To demonstrate site specific technology packages on farmers' fields for adapting to current climate risks.
- To enhance the capacity of scientists and other stakeholders in climate resilient agricultural research and its application.
- The mega project of NICRA has three major objectives of strategic research, technology demonstrations and capacity building. The interventions under NICRA consist of four modules – natural resource management, improving soil health, crop production and livestock and is aimed making the farmers self-reliant.

Key Features of NICRA

- Critical assessment of different crops/zones in the country for vulnerability to climatic stresses and extreme events, in particular, intra seasonal variability of rainfall
- Installation of the state-of-the-art equipment like flux towers for measurement of greenhouse gases in large field areas to understand the impact of management practices and contribute data on emissions as national responsibility.
- Rapid and large scale screening of crop germplasm including wild relatives for drought and heat tolerance through phenomics platforms for quick identification of promising lines and early development and release of heat/drought tolerant varieties.
- Comprehensive field evaluation of new and emerging approaches of paddy cultivation like aerobic rice and SRI for their contribution to reduce the GHG emissions and water saving.
- Special attention to livestock and fishery sectors including aquaculture which have not received enough attention in climate change research in the past. In particular, the documentation of adaptive traits in indigenous breeds is the most useful step.
- Thorough understanding of crop-pest/pathogen relationship and emergence of new biotypes due to climate change.
- Simultaneous up-scaling of the outputs both through KVKs and the National Mission on Sustainable Agriculture for wider adoption by the farmers
- Integrated simulation modeling for research, development and policy support

India Meteorological Department

5.9 The India Meteorological Department (IMD), also referred to as the *Met Department*, is an agency of the Ministry of Earth Sciences of the Government of India. It is the principal agency responsible for meteorological observations, weather forecasting and seismology. IMD is headquartered in New Delhi and has 127 district agromet units to collect weather data on a real time basis and provide it to the IMD regional stations and operates hundreds of observation stations across India and Antarctica. IMD is also one of the six Regional Specialized Meteorological Centres of the World Meteorological Organization. It has the responsibility for forecasting, naming and distribution of warnings for tropical cyclones in the Northern Indian Ocean region, including the Malacca Straits, the Bay of Bengal, the Arabian Sea and the Persian Gulf. The agro-meteorology advisory service (AMAS) is an old program, in practice by the Indian Meteorological Department (IMD), since 1945. Initially, AMAS was provided at the national level only and was extended to the states in 1976. The IMD started organizing one-day farmer awareness program in different agro-climates zones of the country to educate farmers

on weather and climate information and their role in farm management. The Met department is working with all states on how weather-sensitive information can be sent to farmers. The IMD already generates forecasts, which are sent to these units, which have agro-meteorologists and experts to gauge the effect of impending weather phenomenon on crops and agricultural activities. Advisories are then prepared and issued.

The "Science Express" by the Ministry of Railways

5.10 The Ministry of Railways of Government of India has flagged off a "Science Express" that will spend seven months traveling across the country and raising awareness among the public who largely are farmers. A collaborative effort by the Ministries of Railways, Environment and Science and Technology, the Science Express Climate Action Special has already begun its journey of 19,000 km covering 68 stations across 20 states across India with 16 coaches and will end it on September 8, 2017. The Government of India felt with every passing year it has become increasingly clear that there is an urgent need to address the challenges posed by climate change in the world and one of the main ways to do so is by educating the public which comprise the farmers in all the rural areas, of its implications and urging them to make better choices for themselves and the planet.

NABARD's interventions towards Adaptation to Climate Change

6.0 National Bank for Agriculture & Rural Development (NABARD) is set up as an apex Development Financial Institution (DFI) in India established on 12 July 1982 by an Act of the Parliament with a mandate for facilitating credit flow for promotion and development of agriculture, small-scale industries, cottage and village industries, handicrafts and other rural crafts. It also has the mandate to support all other allied economic activities in rural areas, promote integrated and sustainable rural development and secure prosperity of rural areas. In discharging its role as a facilitator for rural prosperity in India, the activities of NABARD can be broadly grouped into three broad categories:

1. Credit related
2. Developmental
3. Supervisory

6.1 NABARD has already taken various initiatives in addressing the challenges posed by Climate Change particularly in the areas of agriculture and rural livelihood sectors. In this direction NABARD aims to channelize national, international and private finances for adaptation and mitigation activities in India.

NABARD and Adaptation Fund of UNFCC

6.2 The Ministry of Environment, Forest & Climate Change, Govt. of India is the National Designated Authority (NDA) for proposals under the Adaptation Fund set up under the Kyoto Protocol of the

United Nations Framework Convention on Climate Change (UNFCCC) established in 2001 and officially launched in 2007 at CoP 7 in Marrakesh, Morocco which aims to finance concrete projects and programmes that help vulnerable communities in developing countries that are Parties to the Kyoto Protocol to adapt to climate change. NABARD in the capacity of NIE can access Adaptation Fund from AFB for implementation of feasible climate adaptation projects posed by eligible Executive Entities such as NGOs, Central/State Government Departments, Research Institutions, and Technical Institutions etc. So far 6 projects have been sanctioned under Adaptation Fund Board. In this direction, NABARD aims to channelize national, international and private finances for adaptation and mitigation activities in India.

NABARD accredited as National Implementing Entity by UNFCC

6.3 The National Bank for Agriculture & Rural Development (NABARD) in India has been accredited globally as a National Implementing Entity (NIE) in July 2012 and is the only NIE for India for implanting projects funder under the Adaptation Fund set up under the Kyoto Protocol of the UNFCCC. The NIE bears full responsibility for the overall management of the projects and programmes financed by the Adaptation Fund and have all financial, monitoring, and reporting responsibilities NABARD has also been accredited as NIE for implementation of projects under the Green Climate Fund as an implementing entity for undertaking climate change related projects in India.

NABARD and Green Climate Fund

6.4 NABARD as the accredited agency is the National Implementing Entity for projects under the Green Climate Fund and is eligible to submit large size projects having outlay of more than USD 250 million. The Green Climate Fund, head quartered in Songdo, Incheon City, Republic of Korea, has been designated as an operating entity of the financial mechanism of the UNFCCC. The decision to set up the Green Climate fund (GCF) was taken at COP 16 in Cancun on December 2010 and the GCF was operationalized in COP 17 in Durban in 2011. The Fund aims to promote a paradigm shift towards low emission and climate-resilient development pathways by providing support to developing countries to limit or reduce their greenhouse gas emissions and to adapt to the impacts of climate change, taking into account the needs of those developing countries particularly vulnerable to the adverse effects of climate change.

NABARD and National Adaptation Fund

6.5 The National Adaptation Fund for Climate Change (NAFCC) was established in August, 2015 by the Government of India with a budget provision of Rs.350 crores for the year 2015-16 and 2016-17, with an estimated requirement of Rs. 181.5 crores for financial year 2017-18 for NAFCC. The projects under NAFCC prioritizes the needs that builds climate resilience in the areas identified under the

SAPCC (State Action Plan on Climate Change) and the relevant Missions under NAPCC (National Action Plan on Climate Change). Considering the existing arrangement with NABARD as National Implementing Entity (NIE) for Adaptation Fund (AF) under Kyoto Protocol and its presence across the country, NABARD has been designated as National Implementing Entity (NIE) for implementation of adaptation projects under NAFCC by Govt. of India. Under this arrangement, NABARD would perform roles in facilitating identification of project ideas/concepts from State Action Plan for Climate Change (SAPCC), project formulation, appraisal, sanction, disbursement of fund, monitoring & evaluation and capacity building of stakeholders including State Governments.

Pilot Projects of NABARD on Climate Change

Climate Change Adaptation (CCA) project

6.6 NABARD had implemented a Climate Change Adaptation (CCA) project with a fund support of US$ 3.5 million in 72 villages in the 3 states of Maharashtra, Madhya Pradesh and Andhra Pradesh covering an area of 44,772 ha with the objective to improve the adaptive capacities of rural communities to respond to the effects of emerging climate changes by regenerating the eco-systems they live in, diversifying livelihood sources in order to reduce risks, and adopting new agricultural and renewable energy technologies. The project is directly benefitting 71,541 people. Besides watershed development, WOTR is introducing new elements such as agro-meteorology for tracking weather patterns at the village level leading to generation of advisories to farmers on what steps to take in emergency conditions. This is also linked to water budgeting, crop planning, adaptive and sustainable agronomic practices and irrigation management. Added to this, WOTR integrates biodiversity concerns in all its activities and encourages alternate energy to meet some of rural energy requirements.

Role of Non-Governmental Organisations

7.0 Adaptation plans are largely state driven and top-down in approach, while climate change is locally experienced and can only be effectively addressed by engaging local groups and institutions. All adaptation is local, and that local agencies, especially Non-Governmental organisations (NGOs) serving the rural communities, being closest to the problem, are best suited to creating adaptive capacities within communities. There are different areas in which NGOs can help communities adapt to climate change. Technology, investments, policy and regulations alone will not be able to provide the solution. A multi-stakeholder engagement of all concerned parties, on a sustained basis, starting at the community, regional and national levels, is required. Enlisting the active cooperation of local groups, communities, local institutions and stakeholders, building up their capacities and empowering them as active participants in decision making processes are a foundational pre-condition for efficient and effective adaptation measures. This is because the effects of climate change are experienced locally by communities, local institutions and stakeholders and they are best suited to addressing them. India

has about 500 NGOs across India which are implementing watershed projects and Tribal Development projects funded by NABARD leading to effective adaptation by the local farmers against climate change effects. To give a flavor of these NGOs, salient features of a few major NGOs operating across the country are indicated below.

The Tata Trusts

7.1 The Tata trusts are the unsung heroes of an extraordinary saga of philanthropy that has enriched India and its citizens in myriad ways. It was formed by merging two principal Trusts operating under Tata Trusts' umbrella, the Sir Dorabji Tata Trust and Allied Trusts (SDTT) & the Sir Ratan Tata Trust and Allied Trusts (SRTT) which was set up in 1919 which was established with a corpus of Rs. 8 million, to further Sir Ratan Tata's vision of building a self-sufficient nation. The Tata Trusts are common for all the Tata group companies. All developmental activities by the Group companies are carried out through the Tata Trusts. As such all group companies pool their CSR funds into the Tata Trust for implementing any developmental activity. The Tata Trust operations broadly cover areas of natural resource management and rural livelihoods; urban poverty and livelihoods; education; health; civil society, governance and human rights; and media, art, and culture.

M. S. Swaminathan Research Foundation (MSSRF)

7.2 The M. S. Swaminathan Research Foundation (MSSRF) was established in 1988 as a not-for-profit trust, envisioned and founded by Professor M. S. Swaminathan the doyen of 'Green Revolution' of India with proceeds from the First World Food Prize that he received in 1987. The Foundation aims to accelerate use of modern science for agricultural and rural development for development and dissemination of technology to improve lives and livelihoods of tribal and rural communities. These efforts have been undertaken in a participatory manner and in partnership with other knowledge-based institutions, public and private sector organisations and local communities. From a small beginning, across the years, the Foundation has made its impact felt in various dimensions making a difference to the lives of over 600,000 individuals, impacting livelihood of 100,000 farmers and fisherfolk every day with influence that spreads across 18 countries. MSSRF is carrying out research and development focusing on major thematic areas. MSSRF has been associated with the following project in India which in connection with climate change adaptation.

1. International Training Programme on Plant Genetic Resources
2. Rice – Saviour of Food Security in an era of Climate Change: Prof M S Swaminathan
3. Contextualizing Climate Change discussions to Tamil Nadu State
4. Community afforestation efforts in Odisha
5. Training for Scientists on Agrobiodiversity Conservation and Climate Change Adaptation
6. Seasonal Climate Information for Ensuring Agricultural Sustainability and Food Security of Small Holder Rainfed Farmers

Watershed Organsiation Trust (WOTR)

7.3. Watershed Organsiation Trust (WOTR) is a not-for-profit NGO founded in 1993 and launched in Maharashtra, India by Fr. Hermann Bacher, founder and its Chairman of WOTR. It is currently operating in 7 Indian states of Maharashtra, Telangana, Seemaandhra, Madhya Pradesh, Rajasthan, Jharkhand and Odisha. WOTR is recognised widely as a premier institution in the field of and Climate Change Adaptation through its unique participatory Watershed Development process. Its unique strength lies in its on-field experience and in a systemic, participatory approach. WOTR's mandate is address climate change adversites and reduce poverty through mobilising the self-help capacities of individuals and communities to regenerate the eco-spaces or watersheds they live in, harvest rain water wherever it falls, use it productively, undertake sustainable livelihoods and do whatever else it takes to get them out of poverty. Since its inception in 1993 WOTR has been in the forefront of mobilizing vulnerable communities in semi-arid and resource fragile regions to help themselves out of poverty by harvesting rainwater wherever it falls and regenerating the ecosystems they live in. WOTR believes that the well-being and economic sufficiency of agrarian communities, is directly related to the productivity, quality, quantity and range of services that the Ecosystems they live in can provide. WOTR's concept of Watershed and Ecosystems Management in the context of Climate Change builds upon its extensive work and expertise in Watershed Development in organising communities to sustainably manage the ecosystems they live in, and bringing about an optimal equilibrium in the eco-space between natural resources, man and animals. WOTR roots itself in Ecosystems Management as a means to reduce risks, mitigate the impact of extreme meteorological events, increase productivity, conserve biodiversity, improve the quality of life and stabilise and enhance nature based livelihoods.

Climate Change Adaptation (CCA) Project by WOTR

7.3.2. WOTR is implementing a Climate Change Adaptation project in 72 villages in the 3 states of Maharashtra, Madhya Pradesh and Andhra Pradesh covering an area of 44,772 ha and directly benefitting 71,541 people with the objective to improve the adaptive capacities of rural communities to respond to the effects of emerging climate changes by regenerating the eco-systems they live in, diversifying livelihood sources in order to reduce risks, and adopting new agricultural and renewable energy technologies. Besides watershed development, WOTR is has introduced new elements in the project such as agro-metereology for tracking weather patterns at the village level leading to generation of advisories to farmers on what steps to take in emergency conditions. This is also linked to water budgeting, crop planning, adaptive and sustainable agronomic practices and irrigation management. Added to this, WOTR integrates biodiversity concerns in all its activities and encourages alternate energy to meet some of rural energy requirements. Advanced project management and GIS-based systems are also being deployed so as to track progress, capture results and identify impacts.

WOTR Centre for Resilience Studies (W-CReS)

7.3.3 Realising that there is an urgent need for developing and implementing a science-and-evidence based risk mitigation and adaptation strategy and that there exists considerable knowledge gaps in understanding vulnerability especially that resulting from climate change, socio-economic impacts and identifying suitable pathways to build resilience WOTR felt the need for imparting education, raising awareness, training and capacity building for effective implementation of resilience enhancing interventions and therefore established WOTR Centre for Resilience Studies (W-CReS). W-CReS proposes to bridge some of the gaps between science, policy and practice and promote multi-stakeholder collaborative networks at all levels.

BAIF Development Research Foundation

7.4 BAIF Development Research Foundation (formerly registered as the Bharatiya Agro Industries Foundation (BAIF), is a reputed voluntary organisation based in Maharshtra state, established in 1967 by Dr. Manibhai Desai, a disciple of Mahatma Gandhi considered as the Father of the nation, at Urulikanchan, near Pune to promote sustainable livelihood in Rural India. BAIF is committed to provide sustainable livelihood to the rural poor through climate-resilient agriculture, management of natural resources, livestock development, watershed development and agri-horti-forestry as major income generation activities. BAIF has evolved innovative models of micro-enterprises to ensure inclusive development through dairy husbandry, goat production, agri-horti-forestry and sustainable agricultural production for food security and poverty alleviation. Formation of Producers' Groups, Empowerment of women and environmental sustainability cut across all these programmes. With a flexible and innovative approach to address individual needs of families, BAIF is now able to provide services to over 5 million small and marginal landless families spread over one lakh villages in backward regions of 16 states in the country. Apart from 4500 staff engaged by BAIF, there are thousands of field volunteers and para-veterinarians who are engaged in mentoring the needy beneficiaries at the grassroot level. Over the last few decades BAIF has been working on various approaches and programmes that have shown encouraging potential in countering agrarian distress. These holistic approaches encompass three key thrust areas:

1. sustainable management of natural resources;
2. diversifying farming systems; and
3. building social capital and cohesion.

Professional Assistance for Development Action (PRADAN)

7.5 PRADAN is a voluntary organisation registered under the Societies Registration Act of India. Established in Delhi in 1983, PRADAN was pioneered by a group of young professionals, all of whom were inspired by the conviction that individuals with knowledge resources and empathy for the marginalised must work with communities at the grassroots in order to help them overcome poverty.

PRADAN has over 350 highly Motivated and skilled Professionals who are working in the remote villages of India, immersing themselves directly with target communities. And work with over 374,008 families in 5,766 villages across 7 of the poorest states in the country. A majority of the families that PRADAN works with belong to the Schedule Tribes and Schedule Castes. Pradan intervention focus on the following broad areas of livelihood viz., Forest based Livelihood, Natural Resource Management based Livelihood Development, Livestock based Livelihood Development.

PRADAN follows a four-pronged approach to achieve its goals:

- Promoting and nurturing Self-Help Groups (SHGs) of poor women and strengthening them as organisations to leverage institutional finances for members' livelihoods.
- Developing and introducing locally suitable economic activities to increase productivity and incomes among SHG members; building synergic collaboration with a wide variety of stakeholders.
- Mobilising finances for livelihood assets and infrastructure from government bodies, donors, banks, and other financial institutions.
- Setting up mechanisms to sustain the livelihood gains made by the poor communities.

Self-Reliant Initiatives through Joint ActioN (SRIJAN)

7.6 Self-Reliant Initiatives through Joint Action (SRIJAN) is a multi-state NGO established in 1979 and working in 5 states of India. It is a grassroot implementation and support agency committed to promote sustainable and self-reliant models of rural development through interventions in:

- Agriculture & Horticulture
- Natural Resource Management
- Dairy & Livestock

SRIJAN works in close to 750 villages, with over 2000 SHGs and almost 40,000 families and have deliberately chosen to work with the socio-economically disadvantaged, particularly women, sociall and tribal people, as they need empowerment the most. SRIJAN is engaged in the following broad themes: Community Institution Building, Agriculture, Horticulture, Livestock and Natural Resource Management. They primarily work with women and provide livelihood support through the concept of Self Help Groups, constituting of and managed by women. SRIJAN works with the SHG members, motivating them, educating them about the latest techniques and best practices; assisting them with procurement of inputs, production cycle and finding the best price for their produce. They also help them get access to finance through bank linkages. Once SHGs are deemed satisfactory, they are clustered into village level bodies and after an incubation period, further coalesced into federations. Once federations are self-sustaining, SRIJAN plans a retreat from daily management but continues to provide support and consultation.

Gesellschaft fur Internationale Zusammernabeit (GiZ)

7.7 The Gesellschaft fur Internationale Zusammernabeit (GiZ), a German Government Technical service agency is supporting NABARD for the Climate Proofing component, to assess their Indo-German Watershed Development Programme (IGWDP) in regards to observed and projected climatic changes. The Indo-German development project of Ministry of Environment and Forests (MoEF) and Deutsche Gesellschaft fur Internationale Zusammernabeit (GiZ) "Adaptation to Climate Change in Rural Areas of India" aims to contribute to improving the livelihoods and adaptive capacities of vulnerable rural communities in India. It also aims to develop concrete pilot experiences on adaptation measures together with the Indian state development programmes and supports the up-scaling of successful technical and financial adaptation approaches. For the Climate Proofing component, GiZ is supporting NABARD to assess their Indo-German Watershed Development Programme (IGWDP) in regards to observed and projected climatic changes.

Kreditanstalt für Wiederaufbau (KfW)

7.8 The Kreditanstalt für Wiederaufbau (KfW) is a corporation under the Government of Germany and functions are those of a promotional bank for the domestic economy and a development bank for the developing countries. The National Bank for Agriculture and Rural Development (NABARD), KfW development bank and GiZ are collectively implementing the Umbrella Programme for Natural Resource Management (UPNRM), the aim of which is to promote environmentally sustainable growth by encouraging private investments that are pro-poor. The UPNRM Project helps for Climate Proofing with Key Features like Sustainable Natural Resources conservation and resource based livelihood planning Community involvement in planning, implementation, resources management and monitoring, environment sustainability.

United Nations Development Programme and intervention for Climate Change

7.9 UNDP's climate change work falls into four main areas:

- Helping people to adapt make poor people less vulnerable on all fronts. This includes striving to ensure they have access to basic energy services
- Assisting developing countries to have the knowledge and skills they need
- Help to make carbon finance work for the poor
- Energizing and climate-proofing the Millennium Development Goals (MDGs)

The UNDP Climate Change Adaptation programme is addressing a crucial dimension of these vulnerabilities by supporting specific activities to enhance climate change induced risk management capacities (adaptation, disaster mitigation and risk reduction) in districts across flood-prone areas of Odisha and drought-prone areas of Madhya Pradesh. The project, in partnership with the Australian

Agency for International Development, aims to address a crucial dimension of vulnerabilities by supporting specific activities to enhance climate change induced risk management capacities (adaptation, disaster mitigation and risk reduction) in districts flood-prone areas of Odisha and drought-prone areas of Madhya Pradesh. The project aims to build the resilience of poor women and men to climate change and enhance disaster risk capabilities in West Nimar district (Madhya Pradesh) and Puri district (Odisha) through integrated water management and incorporation of climate change adaptation in the state Disaster Management Plan to be achieved through:

- Developing models of community-based management of water resources. This will involve participatory vulnerability assessment and strengthening of communities
- Integrating water management and climate change risk concerns into disaster management planning at district and gram panchayat levels
- Informing state-level policy and planning process on climate change and disaster risk management on adaptive water management practices like rain water harvesting, sustainable drainage system, plantations, etc.

World Bank interventions for climate change adaptation

7.10 The World Bank has signed a series of agreements with India to boost climate change mitigation projects with a focus on dealing with cyclone disasters. The bank approved US$104 million in credit for the first phase of the National Cyclone Risk Mitigation (NCRMP) programme, which started in 2010, to help the states of Odisha and Andhra Pradesh respond to cyclones more effectively. The scheme has helped Odisha and Andhra Pradesh construct a combined 128 shelters, 550-km of evacuation roads and 11 bridges, benefitting an estimated 400,000 people. The bank also signed deals with Goa, Gujarat, Karnataka, Kerala, Maharashtra, and West Bengal governments to start the second phase of the NCRMP scheme. The new deals will see the World Bank channel US $308 million in credit to help the six states develop early warning dissemination systems, build cyclone risk mitigation infrastructure and provide technical assistance for multi-hazard risk management.

7.10.1 Another World Bank project focusses on climate resilient farming project that the Maharashtra state government is taking up in over 5,000 villages in drought-affected areas within Vidarbha and Marathwada regions of the State which have been affected by consistent drought years for last three years. Under this project, water conservation and changes in agriculture patterns to boost productivity and to make these villages more resilient towards changes in climate will be introduced.

7.10.2 A Grant Agreement for World Bank assistance of US$ 8 million for Sustainable Livelihoods and Adaptation to Climate Change (SLACC) Project has been signed between the Government of India and the World Bank. The grant project is funded through the Special Climate Change Fund of US$ 8 million. The SLACC project will help community institutions of the rural poor, particularly women farmers, to foster improved resilience in the production system in collaboration with government. Climatic hazards that affect the availability of natural resources, adversely affect the livelihoods of the

poor by impacting production, affecting incomes and preventing building up of assets. The project aims to improve adaptive capacity of the rural poor engaged in farm-based livelihoods to cope with climate variability and change in Bihar and Madhya Pradesh and scale up the demonstrated best practices and lessons into the Government of India's National Rural Livelihoods Mission. National Rural Livelihoods Mission is the implementing agency.

Discussion and conclusion

8.0 India has reasons to be concerned about the impacts of climate change. Its large population depends on climate-sensitive sectors like agriculture and forestry for livelihoods. Any adverse impact on water availability due to recession of glaciers, decrease in rainfall and increased flooding in certain pockets would threaten food security, cause die back of natural ecosystems including species that sustain the livelihoods of rural households, and adversely impact the coastal system due to sea level rise and increased frequency of extreme events. In addition to these impacts, achievement of vital national development goals related to other systems such as habitats, health, energy demand, and infrastructure investments would be adversely affected.

8.1 The integrated approach that India follows to combat climate change offers opportunities for India to meet its INDC and sustainable development goal targets using best practices in the local context and to scale impact. The major environmental challenge India faces-the nexus of natural resource and environmental degradation with poverty. Adaptation to climate change in India requires integrated solutions that simultaneously address livelihood improvements, environmental sustainability, as well as growth issues. Proactive measures for adaptation to climate variability and change can substantially reduce many of the adverse impacts, and thus contribute to livelihood security of the vulnerable rural population. While climate change will affect the nation's economy as a whole, its impact will be more severely felt by the poor who also have the least adaptive capacity.

8.2 All these are results of conscious steps taken by various institutions in India like the Government of India, the State Governments, the Research Institutions like the Indian Council of Agricultural Research and its constituent Research centers, State Agricultural Universities, the district level Krishi Vigyan Kendras (Agricultural Knowledge Centers) established by the State Agricultural Universities or Non-Governmental Organizations of repute who have the capability in terms of land, technical and professional manpower, Development Financial Institutions like National Bank for Agriculture & Rural Development (NABARD), International organizations of German origin like the GiZ, KfW, etc., and other international organisaions like the World Bank,,United Naions Development Fund (UNDP), Non-Governmental Organizations, etc. This paper attempts to present the efforts taken by many of these institutions which are helping the farmers in India face the brunt of the climate changes and increase the efficiency of the adaptive capabilities.

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Global Water Ecosystem – Past, Present, Future?

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Abstract

Water resources at the globe are among the critical elements of life conditions not only for biological processes but for industry as well. It is not only the water consumption for different kind of purposes but also the destroying of water reserves by many ways. This paper is based on the research project Circle, financed by European Regional Development Fund. The project will focus on opportunities for energy recycling, nutrients re-use, water reserves recycling and reducing of water use as well as opportunities for technology development. The geographical focus is on the global issues although the web survey results are based on the Finnish perspectives. In this paper we will present trends affecting the future of water service business in the long run, actors forming the water ecosystem as well as preliminary scenarios and visionary concepts concerning the future in water business. The data for this paper has been collected by a web-survey sent to actors in water ecosystem, but also from student work in Laurea UAS in spring 2017. Circle is an ongoing project until end November 2018.

Introduction and Background

Water resources at the globe are among the critical elements of life conditions for all biological processes. Three tensions will impact on the global future: *East –west –tension* has its background in the times of the cold war, when the weapon competition between US and former Soviet Union created the roots for the continuous economic growth. Today, this tension is a bit weak and the world is still looking for the new poles strong enough to generate growth again. During the last decades e.g. USA and China have been in the so called non-military war from the first position as an economic leader in the world or today perhaps USA and North Korea are even more in a traditional debate concerning war and nuclear weapons, too. *North-south –tension* has been defined as a polarization between rich and pure parts of the world. In the history, the rich north has used (and is still using) the resources of the poor south, e.g. in the form of cheap labor but also by exploiting the natural resources under the market prices. Also, during last two three years the increasing volume of immigrated people from south to north Europe is a sign of this tension. *Human –nature –tension* means the relationship of human beings and the globe as an ecosystem. Human beings have been used natural resources on the planet Tellus more than the nature can renew them. If all people in the world would live like north-Americans, we would need five globes. Even if people would live like we Finns, we would need four globes (Meristö 2013).

Water reserves on the globe are limited. It is not only the water consumption for different kind of purposes but also the destroying of water reserves by many even illegal ways is essential for the future development of whole mankind and the globe as a whole. Water reserves on the globe are 90% in the

seas, but also other reserves like polar ice, ground water or water in the air. Water reserves are distributed unequally between the countries in the world. North part of the globe has the best reserves. Still, water is needed everywhere and almost for every action both in natural and in manmade work. Quality requirements for drinking water are very high in order to avoid health problems and diseases. Ten percent (10%) from the world population is without safety water, and 30 % without basic sanitation. Waste water in the global context will be purified only in 20% of the cases, and 80% remain as it is (Katko 2017). Water services are a big business. Investment needs in the global context in 2017 are all together 150 billion dollars, but in the reality investments will reach only 45 billion dollars. Because of the poor infrastructure 30% of drinking water will be lost before reaching a consumer, in developing countries the share is even bigger, approximately 40-50% (Hukka 2017).

Water is the new oil! This is a sentence the futurists have repeated during the last decades since 1980´s. This means that the war of the clean water is as possible as the wars and conflicts because of oil have been since the first oil crisis in 1973. On energy side the renewables are coming, i.e. windmills, bioenergy from waste or solar energy. On water side, the recycling is still in the very beginning. In Singapore they do have the concept of *new water,* based on recycling through the process not only for other purposes but also for drinking water, which is unusual in the case of recycling water. In industry side recycling of all materials and alternative stuff is more familiar, even water recycling e.g. in the form of closed circulation in pulp and paper industry, the concept developed decades ago in Finland.

Material and Methods

In this paper we will focus on global water ecosystem, especially on how to exploit the nutrients and energy from the water on agricultural side, how to avoid pollution to the water in all sectors in the future and how to decrease the water consumption not only at institutional level including business, government and other institutes but also at consumer or citizen level especially concerning the everyday living in different type of residential areas. This paper is based on our ongoing research project CIRCLE, financed by ERDF, i.e. European Regional Development Fund. Häme University of Applied Sciences acts as a coordinator and the other partners are Laurea University of Applied Sciences (UAS) with its FuturesLab CoFi, the Association for Water and Environment of Western Uusimaa (LUVY), Aalto University and Sykli Environmental School of Finland. The web survey results consist of the Finnish perspectives but they are relevant also in the global context.

The Circle project focuses on opportunities for energy recycling, nutrients re-use, water reserves recycling and reducing of water use as well as opportunities for technology development. In this context also financial mechanisms, legislation, educational needs and ecosystem actors with the best practices will be analyzed. Laurea's research group has got support and contribution in data collection and analysis from two student groups from Laurea UAS, namely business students from Hyvinkää campus and MBA students in futures research field from Tikkurila campus, both in spring 2017.

Data collection for the study includes futures workshops with ecosystem actors to produce visionary knowledge, web-surveys to actors and experts to collect trends and impacts on this field and complementary interviews among key actors from water business and from water research side. The web-survey sent in winter/spring 2017 to the actors of the water ecosystem will form the main data for this paper. Also, alternative scenarios for the water related businesses were created in spring 2017 by six groups of students in Laurea MBA program (Student reports 2017). Examples of these students´ work will be presented at the end of this paper in the conclusion part.

This Circle project started in September 2016 and it will continue until August 2018. Theoretical background lies on one hand on the futures research paradigm and its methodology, including megatrends, PESTE analysis, scenario approach as well as visionary concept design. Visionary concept design (Kokkonen et al. 2005) is a methodology developed by FuturesLab CoFi in co-operation with the former University of Arts and the former University of Technology, both today better known as a part of Aalto University in Finland. Visionary concept design starts from the future and its alternative development paths and focuses on needs and opportunities risen from alternative scenarios. Scenarios will serve as wind tunnels to test ideas and concepts, but also as and ideation source to design visionary concepts, i.e. future-oriented concepts that are based on the future needs identified in different scenarios (Leppimäki et al. 2008; Laitinen & Meristö 2016).

On the other hand, cluster analysis and ecosystem theory are a part of the methodological concept in which actors and factors will be combined and described into a systemic view to the water ecosystem and its sustainable future alternatives. (Meristö & Laitinen 2017). Analysis and synthesis of the knowledge collected and created will be processed with the help of scenario methodology tool kit.

Web Survey Results: Actors and Factors Shaping the Future in Water Business

The main aim of our web-survey was to identify actors and factors influencing on the future of the water service business sector in the long run. Also, the estimates for the state of the art were asked, too. The surveys consisted of six parts including (1) background information of the recipient, (2) estimating the change factors affecting to the future, (3) estimating the key actors in the field, (4) key indicators to follow, (5) vision for the water sector and (6) opportunity for the open feedback. The survey was sent to the different actors in the water business and related actors from public and private sectors as well as from NGOs. The survey was open from March 8th to the end of April 2017. All together 54 replies were got broadly from various categories in business, government, education, and so on. According to the web-survey results, the recipients considered the future with the time frame variating from the less than one year up to 20 years. The most common horizon among the recipients was 20 years to the future, which is very easy to understand in the field of water service business with heavy investments to the infrastructure.

The change factors to the future were estimated by scale almost/fully agreed or disagreed with the statements presented in the survey (Figure 1). Altogether 15 statements from different perspectives

were presented: three of them were political by nature, three economic, three social, three technological and three ecological according to PESTE analysis (Meristö 1983). Time frame to the future reached the next 20 years, i.e. one generation ahead until 2037.

The most disagreed statements were number 2 and 8, which were not believed among the replies:

- (2) Reform of the Regional Administration in Finland will break the monopoly of municipalities.
- (8) Water Crisis will cause a collapse in trust index of citizens concerning municipalities´ Water Services.

The most agreed trends on the other hand were statements number 4, 5, 6, 11, 12 ja 14:

- (4) Weak economic situation in municipalities will bring totally new fees and taxes on the water services (e.g. rainwater fee)
- (5) Citizens´ willingness to pay extra for clean water with good quality.
- (6) Public-Private Partnership models will provide new business opportunities for agile actors.
- (11) Digital follow up services and products will enable real-time pricing of water (analogy from energy sector, stock exchange electricity)
- (12) Technologies enabling Recycling of energy and nutrients will come to water service branch slowly.
- (14) Extreme weather phenomena will make more difficult the control of floodwater significantly in Finland, too.

The actors answering the survey would be surprised, if the reform of regional administration would break the monopoly of municipalities, and also the trust of consumers to the water services will be strong in the future, too. Changes were expected to the action models in the field and also to the pricing policy. Consumers will be willing to pay for the high-quality water, but also the municipalities will probably need to develop new type of fees for their services to fulfill the financial gap in their economy. Climate change will cause extreme weather phenomena more often, which will complicate the control of floodwater in Finland, too. The water service sector is conservative. This means, that the new technologies will be slowly adopted in this field. Digital advices and services will become more general among consumers, and this will enable e.g. real-time pricing even in the near future.

	Totally agree (value: 4)	Agree (value: 3)	Disagree (value: 2)	Totally disagree (value: 1)
1. Difference of the legislation in foreign countries will form limitations for the Finnish companies and their business opportunities (avg: 2,32)				
2. Reform of the Regional Administration in Finland will break the monopoly of municipalities (avg: 2,09)				
3. EU directives and harmonization will obstruct regional development. (avg: 2,25)				
4. Weak economic situation in municipalities will bring totally new fees and taxes on the water services (e.g. rainwater fee) (avg: 3,02)				
5. Citizens´ willingness to pay extra for clean water with good quality (avg: 2,89)				
6. Public-Private Partnership models will provide new business opportunities for agile actors. (avg: 3,15)				
7. The loading of Water Services in Rural residential areas will significantly decrease because of the Urbanization development (avg: 2,45)				
8. Water Crisis will cause a collapse in trust index of citizens concerning municipalities´ Water Services. (avg: 2,07)				
9. Urbanization will put speed to the automatization of agriculture and its water services (avg: 2,40)				
10. Growing demand for energy-efficiency will move water services towards local solutions (e.g. logistics) (avg: 2,53)				
11. Digital follow up services and products will enable real-time pricing of water (avg: 2,96)				
12. Technologies enabling Recycling of energy and nutrients will come to water service branch slowly (avg: 2,96)				
13 Lack of (clean) water is a fact in international context and that will rise the water prices (avg: 2,89)				
14. Extreme weather phenomena will make more difficult the control of floodwater significantly in Finland, too (avg: 2,96)				
15. The growing awareness of people can be recognized in everyday life concerning water consumption. (avg: 2,76)				

Figure 1.Estimations (N=54) concerning the future statements in the water business service sector.

According to the web-survey the key actors in the water service field come from water treatment plants, but also from the group of decision-makers at national level (Figure 2). Private companies as well as by authorities controlling and regulating the sector have an important role in the field, too. The lowest position of the actors was given to the residential associations, agricultural actors as well as active citizens. Nor did education or lobbying organizations play any important role in this field.

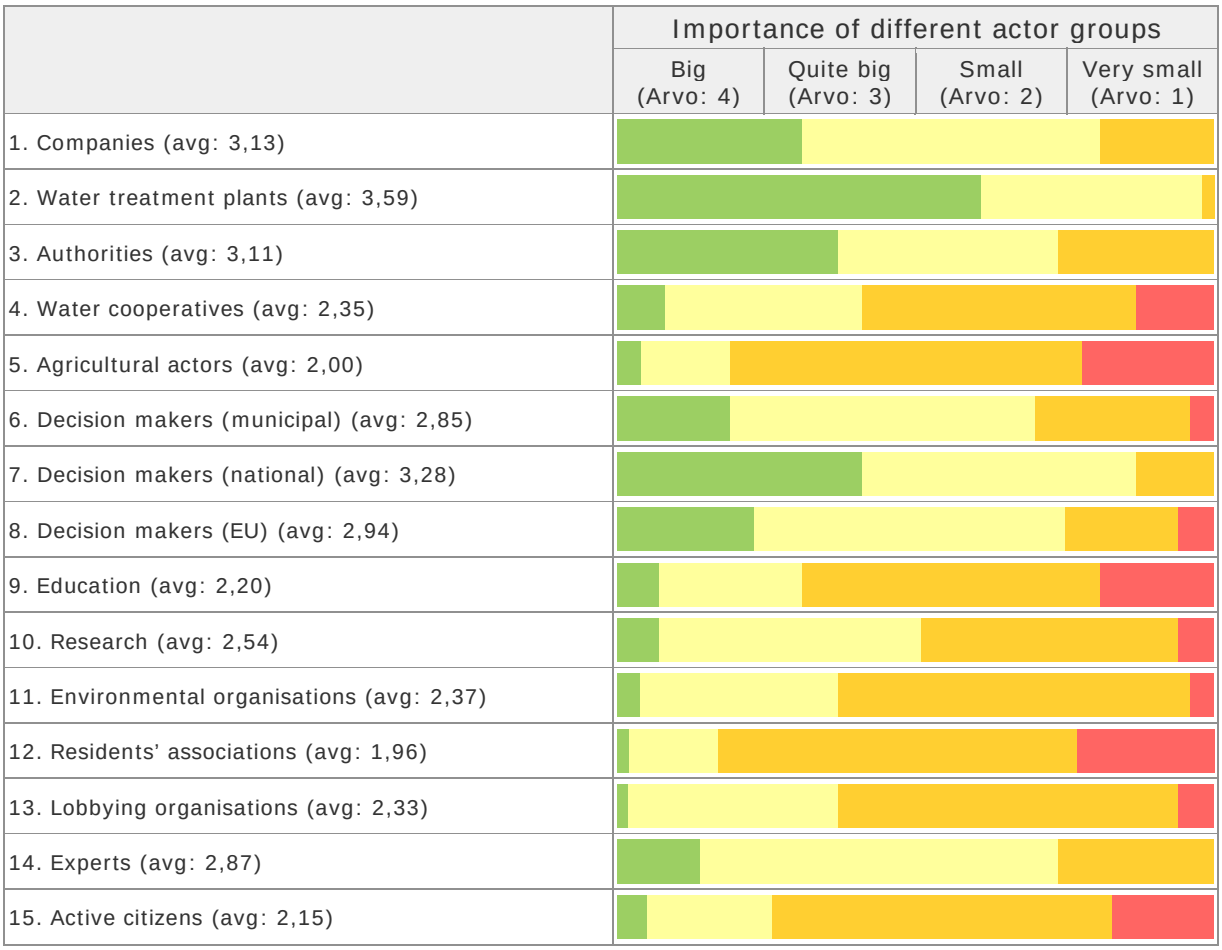

Figure 2.Estimations (N=54) concerning the role of different actors in the water ecosystem field.

The actors in the water ecosystem face critical phenomena and factors in the future, as our survey results show. The water ecosystem consists of many different actors with different roles. Theoretically, in the ecosystem there are first the actors in the middle, playing the main role in the field and then there are related and supporting actors, forming the multidisciplinary service and industry network around the key actors. Furthermore, the main actors in the water ecosystem context need also so called enablers, which usually are actors from public sector, but also from the third sector like different associations and other NGOs as well as from the financing sector. Each actor has its specific role in the ecosystem dynamics and their significance can vary from time to time in the "save the water" project, depending on the conditions in the real world.

In our web-survey, we also asked what kind of innovation water business cluster would need in the future. Most of the respondents saw that the technological innovations are the most needed ones. More specifically, technological innovations could be related e.g. to IoT-based solutions, real-time monitoring systems and automation. However, quite many of the respondents saw that also business and social innovations are needed. Business innovations could relate e.g. to financing models, co-operation models and procurement processes whereas social innovations could relate to financial solutions on poor countries.

Results: New Service and Product Concepts for Water Sector Companies

As an example scenarios and visionary concepts in each scenario will be presented for an illustrative state owned airline company diversifying its business to the water business sector (Student report Anttila et al 2017). First, PESTE factors were identified and their significance was estimated. The most significant factors are as follows:

- (P) Rainwater belongs to the state, End of state owned companies
- (E) For mid-class consumers air ticket prices too high, Increasing costs of air plane vehicles
- (S) Clean water a priviledge only for a few people, Tourism – an unethical activity
- (T) Copying water for household use a new opportunity, Water zipping possible
- (E) Clean water the most valuable asset for marketing in tourism, unexpected natural phenomena more common in future.

Copying water is a revolutionary concept, where copying is analogically compared to copying data files, i.e. from water it can be produced more water without more resources. *Water zipping is also a radical concept*, which comes from file zipping meaning that the requirements for the space are less than in normal case.

Second, four alternative scenarios were built from different assumptions, where scenario axes consist of two dimensions, i.e. drivers for the future, which are Water technology (innovations in this field or not) and Water reserves (lack or enough). In scenario alternatives there is on one hand enough water or not and on the other hand technology is advanced or not. Based on these assumptions scenario alternatives are the next four:

Scenario 1. ZIP-water and a flying water bottle. This scenario assumes that the technology develops so radically that the packing and copying of water is possible. As a consequence, transporting water by airplanes is efficient and the global water resources will be distributed more evenly.

Scenario 2. Water mine. In this scenario there is serious lack of pure water because of contamination. Technological development enables airplanes to collect water from the clouds and the airline companies become remarkable players in water business.

Scenario 3. Water war. This scenario assumes that remarkable share of water resources are contaminated and there is not much technological development in water supply field. The ownership of the water resources is fragmented which weakens global water supply. The scarce water resources lead water wars and water becomes a luxury product with a high price.

Scenario 4. Social water –common good with water. In this scenario it is assumed that there are very dry areas in the globe and the technology has not managed to solve the problem. The difficult situation in the dry area in leads to the increased amount of refuses. Also, social corporate responsibility and end social entrepreneurship becomes more general.

Each of these scenarios will include a wide range of opportunities for new products and services as well as for new business models. Scenario 1 will rise up innovations for water transportation with removable zip-water and water-express opportunities. Scenario 2 includes the revolutionary concept for

the future with a flying water mine in the sky. Scenario 3 will focus on army flights and red-cross hospital flights but also on water business as usual, if possible in uncertain environment. Scenario 4 will grow with network-based business model and with a daughter company as a social entrepreneurial firm.

As a conclusion we will present a summary of the work prepared by all our student groups in spring 2017, focusing on different themes concerning global water reserves (Table 1).

Table 1. Visionary concepts and innovations (based on Student reports 2017).

Theme	Visionary concepts (examples)
Local water from business perspective	Business unit for humanitarian aid Cleaning pill Utilizing water received from snow Filtered water for new markets
Water business in airline company	Zip water Cloud catcher / Water hoover Speculative trading with water resources Cooperation with charities
Rain management	Weather manipulation Cooperation with insurance companies Transferring rains Brand: "More sun"
Recreational use of water	Water park at home Spiritual water retreats Natural water parks Branded organic water
Water purification in traveling	Utilizing nanotechnology in packaging Possibility to manipulate the taste of water Purifying packages
Ecological tourism	Virtual lake tourism Importing water from space Green card lotteries to Finland to find pure water experiences

The themes of student groups and the visionary concepts developed were related to the opportunities concerning local water, water business in airline company, rain management, recreational use of water, water purification in traveling and ecological tourism.

Discussion and Conclusions

Ecosystem, including all the actors from core actors to enablers is similar in other countries, although our survey results consider only Finnish actors. Especially research community co-operation in Circle project shows that Finnish practices are appreciated e.g. in Brazil and Kenya. Changing factors are partly country related (e.g. issues concerning legislation, administration and regional development) but many of them are universal like the growing awareness of people concerning water consumption.

Scenarios developed for an illustrative airline company can be generalized almost everywhere. Market in this case is global, covering especially the areas with scarce water resources. Visionary concepts

themselves are "useful" in every company working in this field, regardless of the home country. Some of the visionary concepts mentioned in this paper are quite radical ones. According to Rush & Marshall (2015), in the water related businesses there is a tendency for the system to encourage incremental rather than more radical innovations. However, the future-orientation and the long timeframe explains the radical features of some concepts introduced in this paper.

In theory, this paper relies on the methods proved in practice, and the results and their significance are fruitful mostly for practioners or practice-oriented researchers. The Circle project is an ongoing project. These results are preliminary ones. The research work will continue together with the whole project team in order to clarify and complete the ecosystem with real water business actors with their roles and positions in it, but also to co-create generic scenarios for the water business sector in cooperation with the real actors in joint futures workshop facilitated by the futures researchers of our team. Water business sector is a challenging field, where the traditional attitudes will meet the future challenges. The changes in the mindset are necessary at all levels in the ecosystem. We wish our joint effort in the Circle project will bring the actors more close to the shared vision of the desirable future.

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6. FUTURES OF ENERGY

Understanding Smart Energy Transition: Insights to the Future Energy Technologies and Their Market Disruption in Finland

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Abstract

This research paper presents the first outcomes of Academy funded project Smart Energy Transition, which studies how and in what ways Finland could benefit from the disruption occurring in the energy sector. To get a comprehensive set of expert opinions and alternative views on the occurring transition in the Finnish energy sector, a two-round Delphi survey with concluding workshop has been organized in spring 2016, resulting in this paper as one of the summarizing outcomes.

Introduction and Background

International consensus on the climate change prevention and general acknowledgment of the need for future energy solutions has challenged the traditional energy system for instance through the uptake of wind power systems in Sweden and Denmark. As Finland is also facing this energy system disruption, the Academy of Finland funded project Smart Energy Transition (SET) is studying how and in what ways Finland could benefit from this disruption, or alternatively from this expected transition in the energy sector.

To get expert opinions and alternative views on the future energy system and on the role of different technologies in it, a two-round Delphi survey with concluding workshop was organized in spring 2016. Energy technologies were selected from both nationally promising ones (such as demand response) and currently marginal ones (such as solar photovoltaics), and were further developed into seven technology themes that were considered in the second round of the survey and in the workshop.

This paper introduces how survey respondents see the role and significance of the selected technology themes in Finland, and how different energy technologies are seen to be linked to each other.

Development of Delphi Study for Smart Energy Transition Project

'Smart energy transition – realizing its potential for sustainable growth for Finland's second century'[1] (SET) is a project funded by Strategic Research Council (SRC) for the years 2015-2020. Main research objective of this research project is to tackle the ongoing global disruption of energy markets by creating pathways for Finland to profit from this disruption. As generally required in SRC-funded projects, SET comprises a cross-disciplinary research consortium with academic partners from

- a management studies department at a business school;
- a political science unit;
- a design department;
- an engineering department working particularly with solar and wind power production technology;
- a building technology research unit;
- an institution for economic research;
- an environmental policy research unit, which has allowed conducting of research with technology, business, learning and policy point of views.

One key ingredient of the technology-related SET research is a two-round Delphi survey, conducted in spring 2016 with a concluding workshop, to generate exploratory future scenarios about disruptive changes in the Finnish energy system. While the main responsibility of the Delphi survey was with the authors of this paper from engineering and design departments, also all other academic partners and multiple non-academic partners contributed to the formulation of the survey.

Planning of the Delphi study started already when drafting the project application. Key technologies, such as new forms of intermittent power production by solar and wind, were mentioned in the application. However, much of the content of the survey remained open at the time of submitting the application. After positive funding decision in autumn 2015, the partners thus needed to re-assemble visions of smart energy and relevant research foci. After establishing first ideas of the content, the planning of the Delphi survey followed guidelines given in previous research (e.g. Gordon 2000; Riikonen & Tapio 2009). Accordingly, a few knowledgeable and willing respondents were selected to help in creating background understanding of the issue through interviews. It was thus the SET-project partners and the few interviewed external actors who had the opportunity to draw in technologies, trends, observations and emerging knowledge pools to the energy vision created for the Delphi study. Fig. 1 lists key steps in developing a Delphi study in the SET project and introduces documentation that has been formed during the development of Delphi study process.

[1] www.smartenergytransition.fi

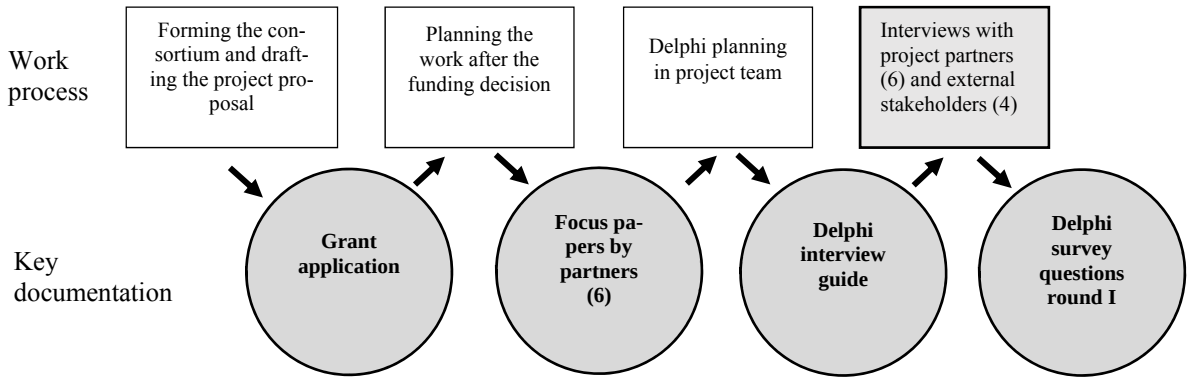

Figure 1.Key steps and related documentation produced during the preparation of Delphi survey (available in www.smartenergytransition.fi).

Based on the results to more general questions in the first round of Delphi survey, the second round was focused to the selected key technologies being possibly part of the disruption in the energy sector:

- solar photovoltaics (PV);
- solar heat, heat pumps and storages;
- wind power;
- biomass-based energy system;
- energy efficiency in buildings;
- production of peak and reserve power;
- digitalization and automating of demand response (DR).

This division was also applied in the concluding workshop, where views were gathered for each technology with separately prepared work process (Marttila et al. 2017).

Main Results of Delphi Survey

The Delphi survey comprises both numerical data obtained with two-round questionnaire and key insights from workshop discussions by 40 experts. That data is used as comparative source of information in the study of alternative solutions for the Finnish energy sector actors. The first main results of the Delphi survey are described in this section.

One of the main influencing factors to the obtained results is the background of survey respondents. As Fig. 2 illustrates, knowledge of respondents was strongly focused to solar PV systems and least to the energy efficiency of buildings. Distribution of respondents' main area of activity was more even across the academia, industry and public sector (including non-governmental organizations).

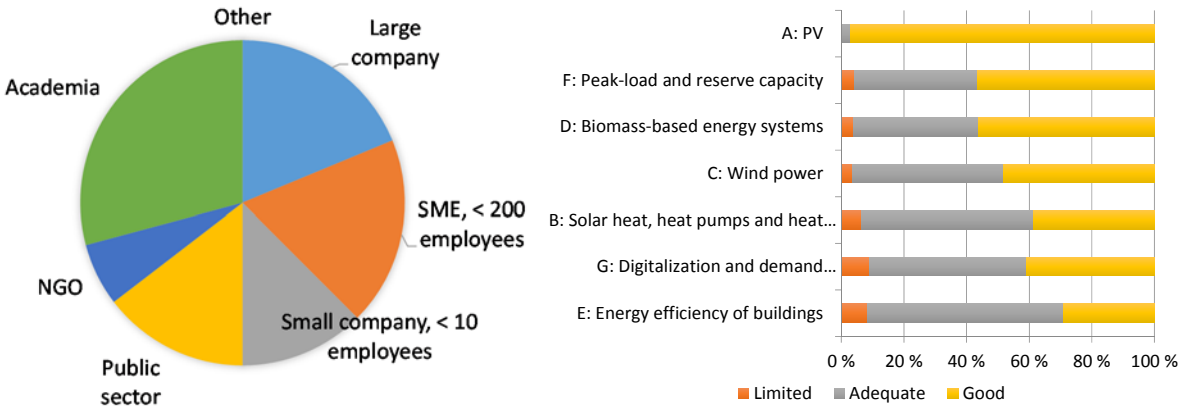

Figure 2.Background of Delphi survey respondents.

The second round of Delphi survey provided overall views on the significance and export potential of different energy technologies for Finland in year 2030. Compared to today's situation, heat pump, wind power and automated demand response systems are expected to be a more significant part of Finnish energy system in 2030. When these qualitative results are compared with the estimated values (or significance) given in the Finnish Energy and Climate Strategy for year 2030, especially the role of wind energy systems seems more prominent by respondents than by policy-related scenario (TEM 2017). Otherwise, expected upcoming of automated demand response and use of heat pumps as a part of district heating systems are in line with results illustrated in Fig. 3.

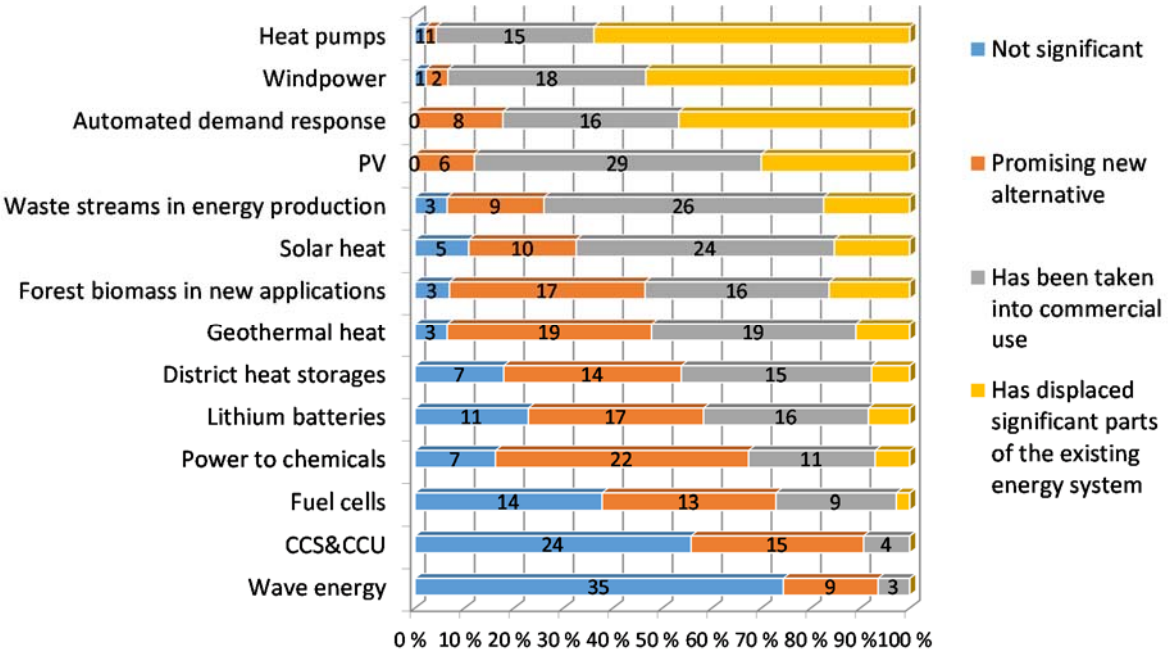

Figure 3.Expected importance of different energy technologies in Finland in 2030.

Survey results for the expected export potential of different technologies is illustrated in Fig. 4. It clearly illustrates how automated DR systems and new applications of forest biomass (such as materials and fuels) are seen to provide openings for new export activities, which are also expected in the Finnish Energy and Climate Strategy.

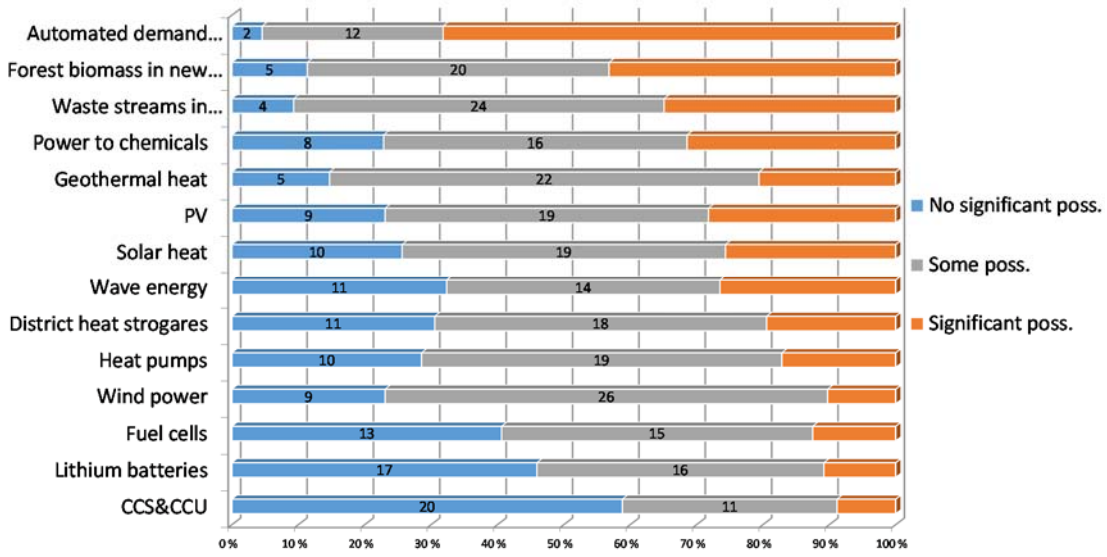

Figure 4.Expected export potential of different energy technologies in Finland in 2030.

Technology-specific Findings Obtained with Survey and Workshop

The summarizing workshop was organised right after the second round of Delphi survey in spring 2016. It followed the above presented listing of technologies, which can be thematically summarized under four topics titled as

- Disruptive electricity production methods: wind and solar PV;
- Balancing of demand and production: management of peak power demand, automated DR;
- New usage possibilities of renewable resources: biomass-based energy system;
- Changes in the energy consumption: energy efficiency in buildings, decentralized heating solutions.

This section summarizes technology-specific findings obtained from the survey and workshop data for wind power, solar photovoltaics, biomass-based energy system and automated demand response, which relate to the production and demand of electricity in Finland in 2030.

Wind Power

Wind power can be considered the main disruptive source in Nordic countries, since building of wind energy capacity especially to Sweden and Denmark has led to the decrease of electricity prices in Nordic market region below 40 €/MWh (ET 2017)[1]. As a comparison, published values of levelized cost of electricity (LCOE) in the latest Nordic projects have been around 45 €/MWh (Norwea 2016), demonstrating the effect of subsidy schemes (such as electricity certificates, investment grants and feed-in tariffs) on having the present capacity in Nordic countries. At the end of 2016, installed wind power capacity in Finland was around 1500 MW with annual production of 3 TWh, which was 3.6 % of annual electricity of 85 TWh in 2016 (ET 2017). According to (TEM 2017), Finnish government objective is to have 8 TWh of annual production capacity in 2030 that is below 10 % of expected electricity consumption at that time (i.e., 93 TWh for year 2030 "with additional measures" scenario).

As Fig. 5 illustrates, Delphi respondents expert over 10 % share for wind power in Finland with a notable share of offshore farms. This is one of the very interesting outcomes, as the present number of offshore windfarms in Finland very limited, and their LCOE tends to be higher than for onshore farms. On other other hand, the most expected share of 10-20 % is in line with the research findings of (Zakeri et al. 2015), where the maximum level of economically viable wind integration is 18.7 %. Acceptance of wind power is also expected to increase, which is also needed for seeing further increase in the onshore wind power capacity.

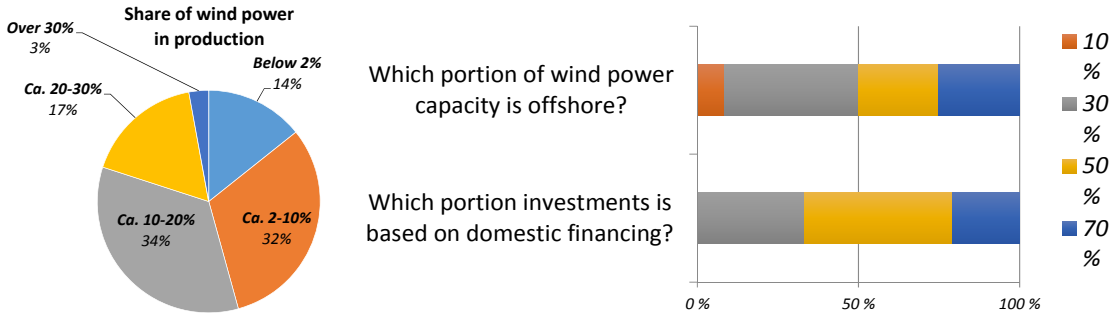

Figure 5.Delphi results concerning wind power systems.

Solar Photovoltaic Systems

Capacity of grid-connected solar PV systems has strongly increased in Finland during the last three years, as the installed capacity was 8 MW_p at the end of 2015, and it has tripled being 27 MW_p at the end of 2016 (Energiauutiset 2017). This increase has mainly happened without specific subsidy schemes, as solar PV systems do not receive feed-in tariffs in Finland, and even the investment-grant

[1] Please note that this average price does not represent as such the hourly fluctuation of electricity prices in the Nordic electricity market area.

supported payback time of a solar PV system is still close to ten years in Finland. If the annual production of grid-connected solar PV systems in Finland is estimated with the ratio of 800 kWh/kW$_p$, the present annual production is around 0.02 TWh. Compared to this, solar PV systems are projected to produce 0.2 TWh/a already in 2020 and 0.7 TWh in 2030 (TEM 2017), corresponding capacities of 250 and 875 MW$_p$, respectively.

Figure 6.Strong increase in the Finnish solar PV capacity is mainly contributed by residential and utility-scale plants built for the compensation of own electricity consumption (YLE 2016).

According to the Delphi study data, materialization of solar PV system is expected to happen especially in buildings that is logical continuation to their present installation for the compensation of own electricity consumption. This trend is closely related to the possible uptake of battery energy storages and electric vehicles that can work as direct storage for surplus electricity production. Share of the solar PV in electricity production is expected to be quite significant compared with values projected in the Finnish Energy and Climate Scenario, being in the range of several percentage units and hence in the range of several terawatt hours already in 2030.

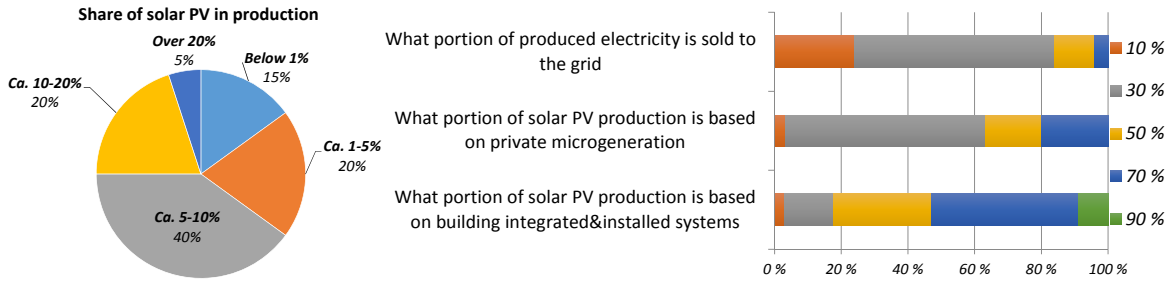

Figure 7.Delphi results concerning solar photovoltaic systems.

Biomass-based Energy System

Biomass originating from forests, waste and process side streams can be considered as the "cornerstone" of Finnish energy system through their use in combined heat and power (CHP) plants and as an ingredient for bio-based fuels. Principal examples of biomass-based energy system in Finland are the new Äänekoski bioproduct mill and widening use of biofuels in traffic sector to reach the 39 % emission decrease target set for sectors outside the emission trading system: as Fig. 8 illustrates, this target seems unreachable with existing policy measures for traffic sector.

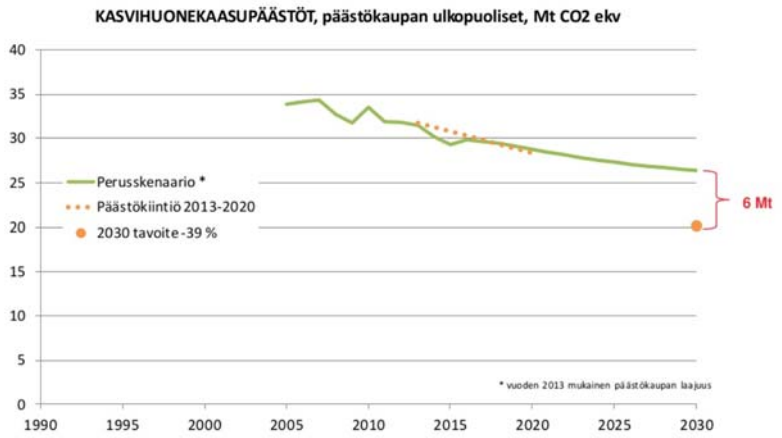

Figure 8.Target level set by European Union for the reduction of greenhouse gases outside the emission trading system against the trendline based on existing policy measures (Kuuva 2016).

Delphi respondents have mixed views on the role of biomass in Finnish energy system: they recognize its significance as a renewable energy source, but they would like to see more added value in them with ensured carbon neutrality. This question arises especially with possibly upcoming Kaidi biorefinery in Kemi that will produce biofuel with wood-based biomass, such as energy wood, harvesting remains and leftover bark from the forest industry (Kaidi 2017).

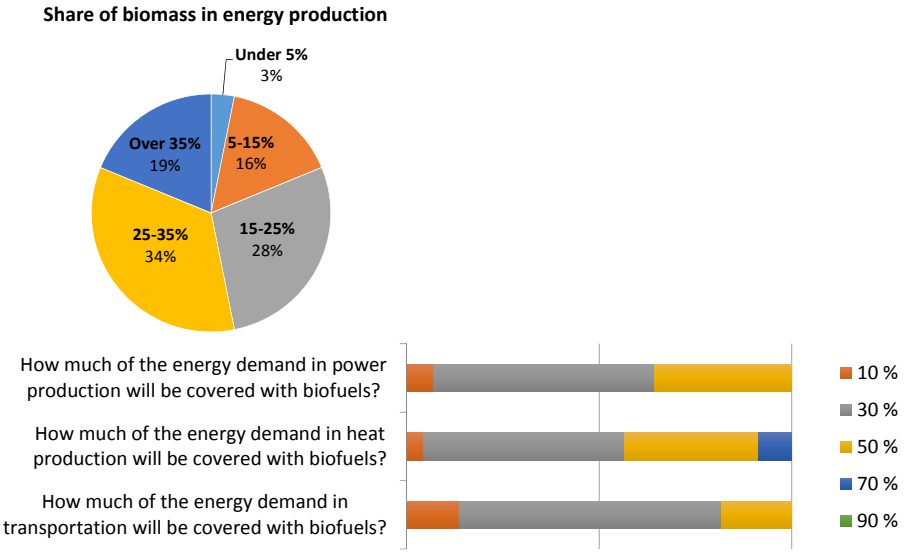

Figure 9.Delphi results concerning biomass-based energy system.

Automated Demand Response Systems

Traditionally the balance between supply and demand in the energy system is achieved by regulating the output power of generators. However, in the future, growing share of the electricity production will be based on intermittent generation (i.e. wind and solar), of which power output is variable and regulating possibilities are limited. Hence, there is an increasing need for novel solutions for regulating the system energy demand. In Finland, automated DR is closely related to the use of automated meter reading for electricity consumption and digital services for showing the customer's electricity consumption even in the real time.

As already noted in Fig. 4, automated DR systems are expected to have notable export potential in the near future and also significance in the Finnish energy system. To give more detailed view on the development needs of DR systems, Fig. 10 illustrates the significance of different factors in automated DR: open data access with communication between systems and real-time interaction with customers were considered most important in the answers to this question.

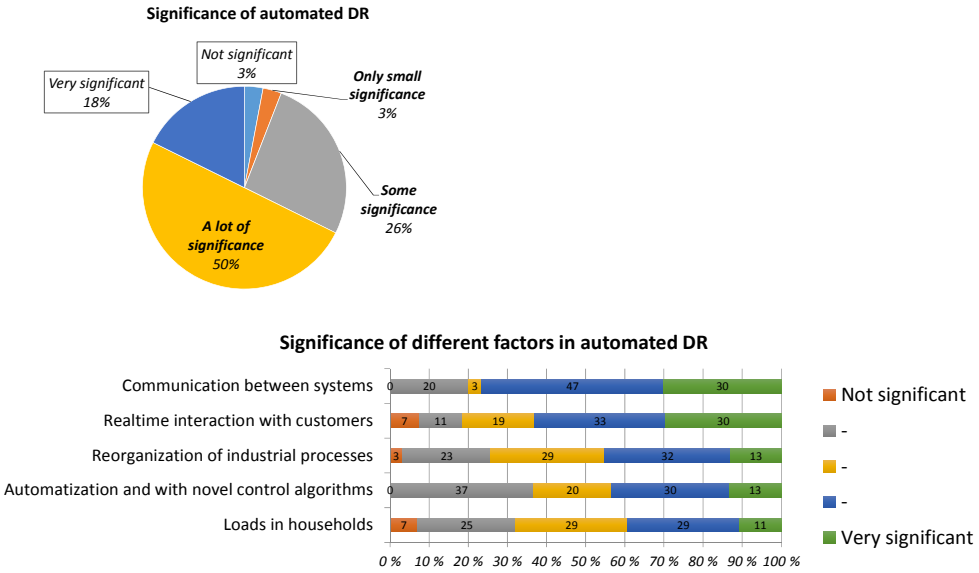

Figure 10.Delphi results concerning automated DR systems.

Discussion and Conclusions

Conducted Delphi study has provided views and opinions on the future development of Finnish energy system. Especially the role of digital services and renewable energy sources are expected to increase by Delphi respondents. Based on the obtained data, electricity markets can be seen to develop as a market place for demand availability with higher price volatility between different hours. One of the interesting comparison between themes is whether digitalization and related services or wood in different forms will work as key exportable in year 2030? Hopefully both, as all solutions are needed in limiting the amount of greenhouse gases.

Another interesting question relates to the uptake of storage solutions: as there will be more wind power and solar PV systems, will there also be significantly more battery energy storage systems (like Tesla Powerwall 2) in Finland or will electric vehicles become useable also as grid-connected energy storages? As Smart Energy Transition project is forecasted to continue up to year 2021, these questions will be reviewed in another Delphi study by authors.

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Energy security analysis and future recommendations – Four categories: R&D expenditure, education expenditure, rule of law and democracy

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Abstract

This paper sheds the light on an important aspect of the energy system: Energy Security. Energy security is a global issue that directs policy makers to vote decisions in. The promise for a more secure energy system is meant to provide societies with a better life. As energy security is a multidimensional concept, this paper investigates the relationship between four different parameters with energy security in a global holistic view. All countries with reliable data are compared in regards to their energy security based on these four parameters (R&D, education, rule of law and democracy). The results show clearly that there is a substantial difference between countries in their energy security level. It also, provides conclusions to policy makers of how energy security can be enhanced.

Introduction and Background

Energy security is a global concern (Ang et al. 2015) for different fields of science, national energy policies (Franki and Višković 2015) and politics, international relations (Kirchner and Berk 2010), policymakers (Turton and Barreto 2006; Winzer 2012), and as a national security issue (Dyer and Trombetta 2013).

There are many reasons for this interest: increased energy prices (Vivoda 2010), the global energy supply crisis, climate change, growing dependence of industrialised economies on energy as an engine for economic growth, major disruptions in oil markets related to military upheavals, political conflicts, social development (Augutis et al. 2011), complex global markets and the threats to the energy system. Although the energy security concept is an important concept, countries differ in their level of energy security. The reason is the different aspects and standpoints of energy security (Narula and Reddy 2015).

Being able to study and analyse the energy security level of countries is a strong tool that allows making proper recommendations for decision makers (Turton and Barreto 2006; Winzer 2012). Once decisions consider the energy security of the country, they are closer to be more sustainable decisions (Andrews and Shabani 2014). When sustainable decisions are taken for a country, the promise of development and prosperity can be achieved (Maslow 1943).

As the concept of energy security has many dimensions to be addressed (Yergin 2006), in this research, energy security is analysed based on four parameters, of which two are related to the Literacy dimension and the other two to the Policy dimension.

The four parameters to be addressed are:

1. Research and Development (R&D) expenditures
2. Education expenditures
3. Democracy index
4. Rule of law.

As found in previous research (Azzuni and Breyer 2017), these parameters have a strong relation to energy security. R&D expenditures affect energy security; R&D expenditures on renewable energy technologies enhance energy security (Lovins 1979; Franki and Višković 2015; Schellnhuber et al. 2016), by providing environmental friendly options. Furthermore, R&D expenditures allows for better understanding of the energy systems and thus gives an opportunity for efficiency gain and therefore achieving energy security (WEC 2015). Increasing efficiency makes the energy system more secure (Lovins 1976; IEA 2007; Brown et al. 2014; Augutis et al. 2015) and provides a double-win for the climate traits (Refaat 2009). Also, in the area of societal behavior, R&D expenditures highlights the possibilities for energy conservation and energy demand reduction (Hughes 2009) by users giving away some of the services that are derived from their energy use (Rutherford et al. 2007). This energy conservation has a substantial impact on energy security in which it allows for better use of the resources.

When it comes to education expenditures, education is important to spread awareness about energy security. Awareness and education result in informed members in the society which means to use and run the energy system securely (Balmer 2015). In addition, expenditures on education helps individuals to attain certain attitudes when using the energy system. In general terms, individuals with higher levels of education are more likely to have responsible attitudes in regards to energy security (Knox-Hayes et al. 2013). Also, energy literacy gives homeowners more control over their own energy security (Hossain et al. 2016), e.g. rooftop PV systems.

Further, as democracy is enhanced, so is energy security. Once citizens have their demands achieved, their needs covered and their will listened to, the energy system is considered more secure. More informed societies can shape their energy system by making a societal pressure on their governments to act based on the citizens' will. In such situations, energy security is clearly seen as the responsibility of the state (Barrett et al. 2010) that represents individuals whose will is supported by the right information. The stronger a democratic system, decisions are made with more coherence with citizens' daily needs (Johnson and Boersma 2015).

For the last parameter, the rule of law is important to ensure energy security. The more corruption in the system, the less secure it becomes. For example, Nicholas Stern clearly pointed out that "The existence of climate change is the largest and widest ranging market failure ever seen." (Stern et al. 2006). Further, when the rule of law is applied selectively by responsible personals to attain their own benefits (Bruusgaard 2006), the energy security is deteriorated. An example of such a corruption that

deteriorates energy security is the nuclear waste buried in some African countries. Regulations prevent nuclear waste to be buried in the country but because of the corruption, some people in high positions manipulated the regulations for a huge payment to allow this waste. For this, the better the rule of law the better for the energy security, whereas the more corrupt the system is the more deterioration of energy security can be observed (Onamics 2005).

Material and Methods

Each of the parameters is plotted and compared to GDP PPP for each country. Then countries around the world are divided into four groups. Countries with high GDP PPP and score high at the same time in a certain parameter are considered to have achieved energy security. Vice versa, countries with low GDP PPP and having low achievement in a parameter are considered to lack energy security. Countries in between the two ends are considered to be in a transition mode. The division into four categories is based on a 50% split. 50% of the GDP PPP makes the vertical dividing line and 50% of the maximum value of each indicator makes the horizontal dividing line.

GDP PPP of Singapore was taken to be 100% and all countries are shown as a percentage of Singapore GDP PPP. The energy security parameters are all in a percentage form. Internet endings are used in circles to represent each country. Countries with no data for any of the parameter were excluded from being represented.

Results

The data for R&D expenditures in each country was obtained from the World Bank database (WB 2014). The result of plotting each countries' R&D expenditures (vertical access) against the GDP PPP (horizontal axis) in each country resulted in Figure 1.

The data for education expenditures in each country was obtained from the World Bank database (WB 2015a). The result of plotting each countries education expenditure (vertical axis) against the GDP PPP (horizontal axis) in each country resulted in Figure 2.

The data for the democracy index in each country was obtained from The Economist Intelligence Unit (EIU 2016). The result of plotting each countries democracy index (vertical axis) against the GDP PPP (horizontal axis) in each country resulted in Figure 3.

The data for the Rule of law in each country was obtained from World Bank worldwide governance indicators (WB 2015b). The result of plotting each countries rule of law indicator (vertical axis) against the GDP PPP (horizontal axis) in each country resulted in Figure 4.

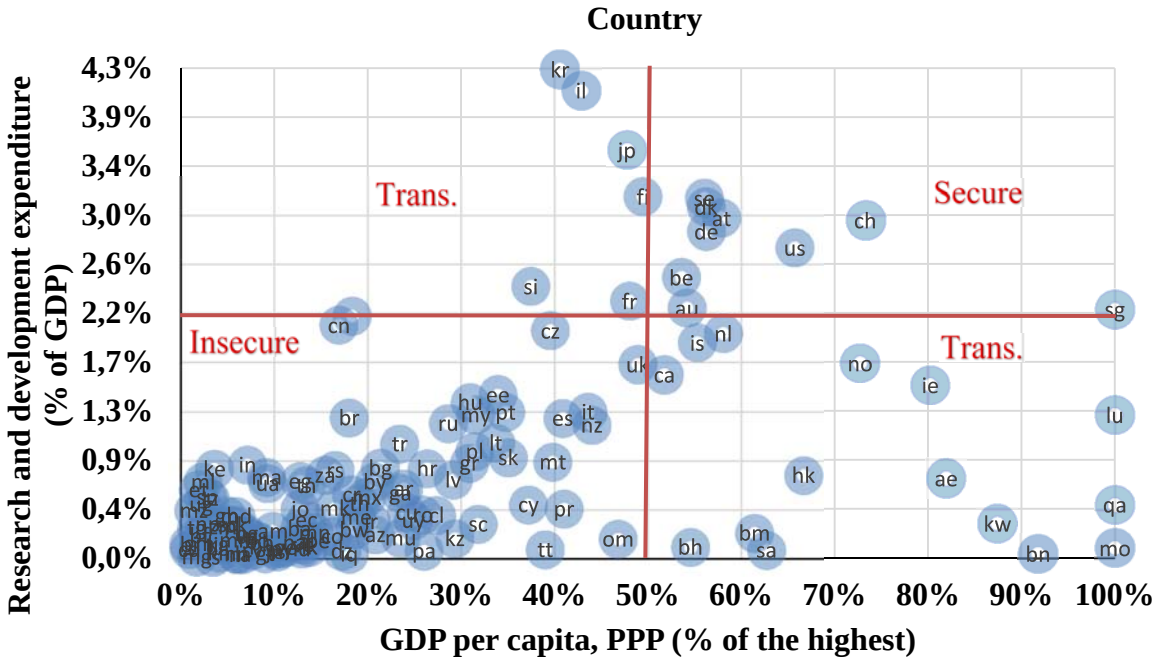

Fig. 1: Research and development expenditures as a percentage of GDP, 2014 or latest, versus GDP PPP normalized to Singapore GDP PPP.

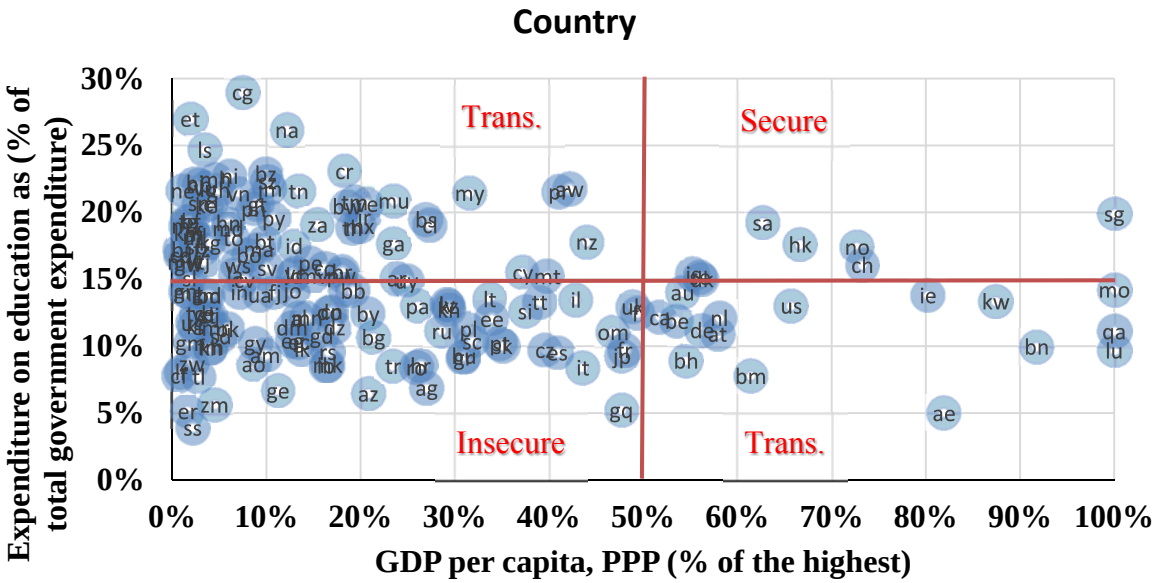

Fig. 2: Education expenditures as a percentage of total government expenditure, 2014 or latest, versus GDP PPP normalized to Singapore GDP PPP.

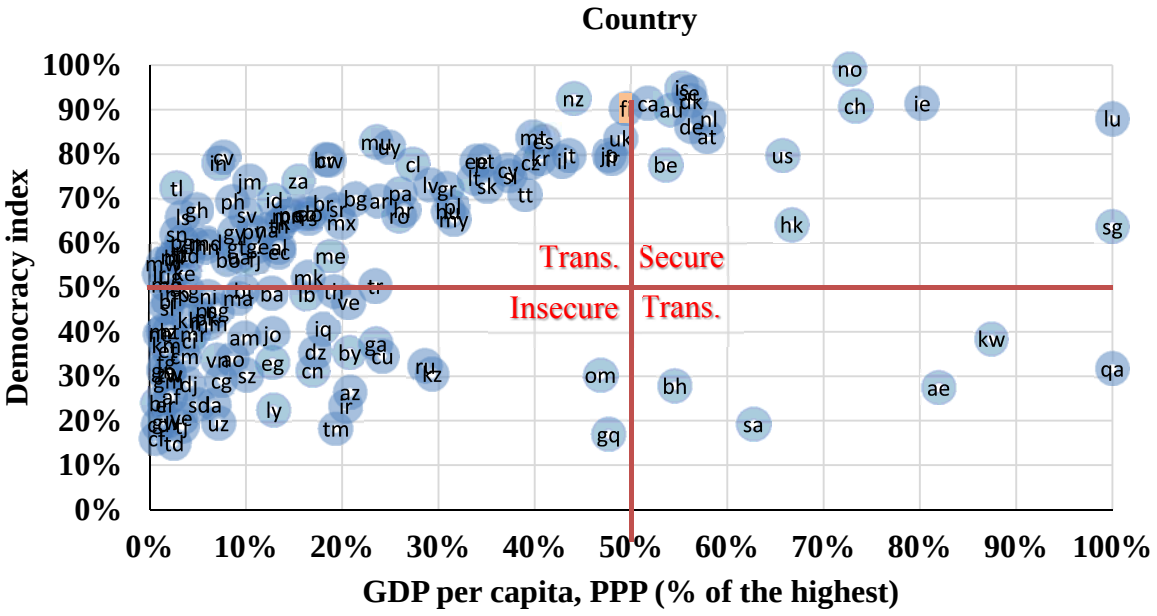

Fig. 3: Democracy index (percentage), versus GDP PPP normalized to Singapore GDP PPP.

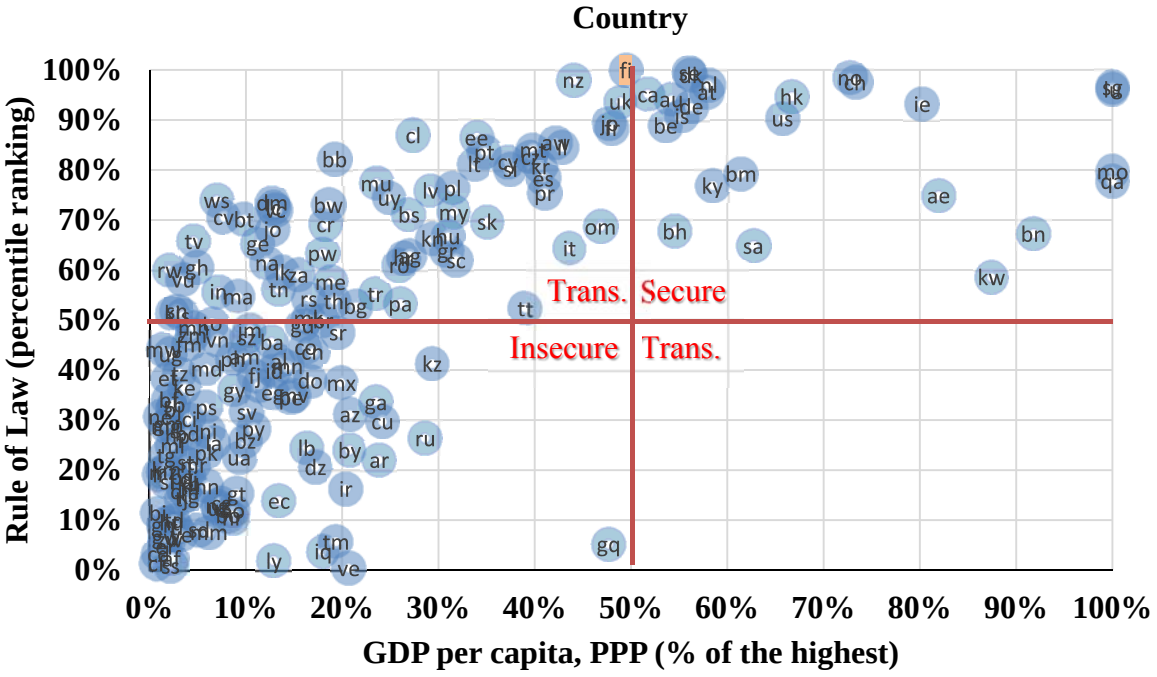

Fig. 4: Rule of law (percentile ranking) versus GDP PPP normalized to Singapore GDP PPP.

Discussion and Conclusions

The results in the previous section showed clearly how countries performed in regards to energy security. Many countries fell in the insecure area and many in the transition area. The discussion for each of the parameters and the countries performance is presented in this section.

1. It is noticed from Figure 1 that countries need to spend more on R&D. Most of the countries in the world do not spend enough on R&D to reach the transition area. Most of the countries lay in the insecure area. The reason for this categorization is the combined fact of low R&D expenditures and low GDP PPP levels in these countries. Examples of countries are France and Kyrgyzstan. These countries in this area need to improve their situation by one of two ways, either by increasing the R&D expenditure and thus move to the upper left side. Then the more R&D expenditures should be directed to invest in economic production that increase the GDP PPP. In this way the country can reach the secure zone. The second path is to increase the GDP PPP by other means e.g. natural resources export. Then, the public and private sector start allocating more money to R&D activities. On the other notice, many countries are already on the transition side with a high enough GDP PPP. They need to spend more on R&D that they can achieve a higher level of energy security. Examples for countries that should spend more on R&D are Qatar and Luxemburg.
2. When it comes to expenditures on education, it is noticed that many countries are already in the transition quarters, where they spend enough on education. However, it seems that expenditures on education in their cases need longer time to drive economic growth. There can be many reasons for this observation; first, the countries face corruption and thus the money spent on education does not reach its final destination. Second, the expenditures on education are tunnelled to non-productive activities. Third, the education system needs more infrastructure to become a reliable education system, in this case, even the expenditures on education are high in comparison to other countries in the world as a percentage of GDP PPP, there is still need for more investment on education in absolute values. On the other side of the transition zone, many countries need to start spending more on education immediately, in order to reach the secure area, e.g. United Arab Emirates.
3. The noticeable result from the democracy index is that, if the GDP PPP is high, it is not a guarantee for a high democracy level. For example, Saudi Arabia and Qatar have high GDP PPP but their democracy index is not high. This result shows the failure of countries in this zone to utilize their high GDP to root the democracy practice. On the other side, countries on the upper transition area have achieved high a democracy index but still they need to implement that democratic practice to achieve higher GDP PPP. This can be applied by for example allowing citizens to choose governmental projects in a more direct way. The last category are the countries in the insecure zone. These countries suffer from poverty and low democracy. This mixture makes it a real challenge. Although increasing the wealth of the society without democ-

racy is possible sometimes, the challenge comes after that to shift the regime into a democratic one. The easier path is to establish a full democratic approach in the country that allows for better representation of citizens' will. As the collective intelligence leads for creative solutions, a higher democracy level can drive the economic growth.

4. What was seen in the democracy index can be seen in the rule of law with one difference. There is no country in the world for which the GDP PPP is high and having low levels of rule of law. Law in these countries is applied more than countries with less GDP PPP. It can be concluded that high GDP PPP is a guarantee for rule of law, because any country with such big wealth will do its best to keep that level, thus the law is applied. For the countries in the transition upper left zone, there is a sub-relation between GDP PPP and rule of law. It seems that the rule of law is increased, if GDP PPP increases and vice versa. This brings us back to the previous conclusion; increasing GDP PPP drives for more ruling of law, most likely in that way that ruling of law is a precondition for a continuous GDP PPP growth. The last area in the rule of law paradigm is the insecure zone. For these countries in the insecure zone, the path out to security is first by achieving a higher rule of law to reach the transition area. Then the rational relationship will take place to drive these countries to the secure zone.

The conclusion of this research emphasizes the need of many countries to invest more in their education system and spend more on research and development in order to achieve higher levels of energy security. More democratic rule with higher rule of law enhance energy security. The recommendations for countries in the insecure zone are to apply changes on their respective systems in order to reach the secure zone. This can be done by increasing the GDP that will result in enhancing energy security parameters. Alternatively, to enhance the parameters in which on its turn will increase the GDP. The second option is longer and not guaranteed because many countries can get stuck in the transition zone for longer period.

Acknowledgements

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Synergies and Trade-off Analyses of Key Energy Consumption Variables and Key Drivers of Energy Consumption in the EU-28 Countries

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Abstract

This paper includes synergy and trade-off analyses of key energy consumption variables and key drivers of energy consumption in the EU-28 countries. Key driver variables are in the trade-off and synergy analyses: population, value added and urban population. Energy consumption variables are energy intensity and final electricity consumption per capita. Synergy and trade-off analyses cover the years 1995-2014. These analyses reveal many interesting aspects of energy efficiency improvements in the European Union.

Introduction and Background

The energy intensity of industry in developed countries has steadily declined in most countries in the world since the oil price shocks of the 1970s. The production of energy-intensive industrial commodities has grown dramatically and is expected to continue growing as population and per capita income increase – especially in the developing countries. Energy use represents the largest source of GHG emissions in industries. Energy efficiency improvements are linked to global climate change politics. Historically, industrial energy-efficiency improvement rates have typically been around 1%/year.

Also in service sector, energy-efficiency has improved during last decades. Still, there exists large potentials to further reduce energy use and GHG emissions in most sectors and economies. Challenges to improve energy efficiency and save energy are still big and remarkable. There is strong needs to monitor progress in energy savings and energy efficiency.

Energy efficiency can be studied at different levels and in different spatial, temporal and functional scales. In this paper our focus is national country-level scale. Efficient energy use means that we typically aim to minimizing the amount of energy used for a given, constant energy service. In this article we present some energy efficiency analyses using trade-off analyses (see, e.g. Kaivo-oja et al. 2014) and synergy analyses (see, e.g. Luukkanen et al. 2012).

In this paper the concepts of trade-off and synergy are important. As we know, the concept of synergy refers to a nonlinear relationship between two or more elements/variables whereby they generate a combined outcome that is more or less than the sum of their parts taken separately. This happens due to their capacity to work together (positive synergy) or against each other (negative synergy). The idea of a synergy is one of the core concepts within systems theory in that it forms the foundation to the idea of emergence and the concept of a system as being more than the sum of its parts. For complexity theory, measurements of synergy are one critical foundation of theoretical and empirical

development. Trade-off relationship refers to mote linear relationship between elements and variables. (see e.g. Johnson 2007, Hausmann et al. 2014)

Material and Methods

This section describes the data sources and methods of study. In Table 1 data sources of the study are reported.

Table 1. Data sources of the study.

Data	Sources
Population (number, first of January)	Word Bank Database 2016, Web: http://databank.worldbank.org/data/reports.aspx?source=2&series=SP.URB.TOTL&country=
Value added (Value added, gross, in current prices, million euros)	Eurostat Database 2016, Web: http://ec.europa.eu/eurostat/statistics-explained/index.php/National_accounts_and_GDP
Urban population (number)	Word Bank Database 2016, Web: http://databank.worldbank.org/data/reports.aspx?source=2&series=SP.URB.TOTL&country=
Energy intensity, (toe/MEuro)	Eurostat, DG Economic and Financial Affrairs, May 2015, Web: http://ec.europa.eu/energy/sites/ener/files/documents/PocketBook_ENERGY_2015%20PDF%20final.pdf
Energy consumption per capita, (kgoe/cap)	Eurostat, DG Economic and Financial Affrairs, May 2015, Web: http://ec.europa.eu/energy/sites/ener/files/documents/PocketBook_ENERGY_2015%20PDF%20final.pdf
Final electricity consumption per capita, (kWh/cap)	Eurostat, DG Economic and Financial Affrairs, May 2015, Web: http://ec.europa.eu/energy/sites/ener/files/documents/PocketBook_ENERGY_2015%20PDF%20final.pdf
Primary energy intensity, (toe/MEuro, 2010)	Eurostat, DG Economic and Financial Affrairs, May 2015, Web: http://ec.europa.eu/energy/sites/ener/files/documents/PocketBook_ENERGY_2015%20PDF%20final.pdf

The methodology of this study is based on synergy analysis and trade-off analyses of data. Methodologically, the analysis is based on a new assessment tool developed for the analysis of synergies and trade-offs between selected development trends. Understanding trade-offs and synergies is needed in smart management and decision-making (see .e.g. Luukkanen et al. 2012; Kaivo-oja et al. 2014). The synergy tool is developed to analyze the synergy between two different trends, but it can be used to analyze simultaneously the synergy between many variables (see Mainali, Luukkanen, Silveira & Kaivo-oja 2016, Luukkanen et al. 2012; see also Rothman 1976).

In Figure 1 we have presented 3 basic forms of synergy between two variables.

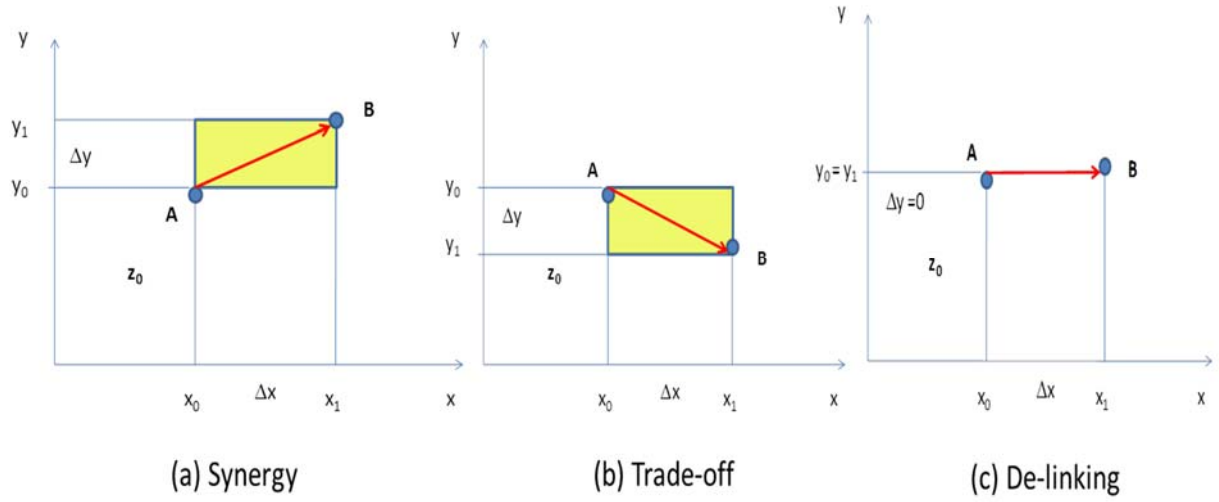

Figure 1. Alternatives of synergy level between two variables, x and y.

Maximum synergy can be obtained when relative changes Δx and Δy are equal. In case the change in y i.e. Δy is larger than changes in x i.e. Δx, the quotient must be inverted to estimate potential synergy ratio. Therefore, potential synergy/trade-off between two variables can be measured between -1 to +1. Negative sign indicates trade-off between two variables. In this study we calculate conventional index number of synergy and average long-run synergy index (Luukkanen et al. 2012).

Synergy method allows us to present explorative analysis of the relationships between key variables (in this case drivers of energy consumption and two energy consumption variables). It allow also critical analysis on long-run dynamics of economies (Ahern 2011, Cortina-Borja et al. 2009, de Roo 2012). There is always possibilities to create win-win policies from trade-offs. Empirical verification of trade-offs is, of course, important also for sustainability analyses and sustainability politics (see Rothman 1976, Southwood 1978, Wunder 2001, Mirc 2012, Howe et al. 2014, Jia 2014, Kaivo-oja et al. 2014, Mainali et al. 2016). For example, smart adaption to on-going economic growth and urban population trends may be impossible without detailed trade-off analyses (Kaivo-oja et al. 2014, Puuhacai & Zuidema 2017).

The synergy methodology provides essential information for future-oriented policy-planners and decision-makers. Synergy method is a new powerful tool for sustainability analyses. We remind us readers that the evaluation of synergy/trade-off proposed on this paper indicates only possible (potential) causality but, does not infer a causal relationship between the variables. In this article we apply stablised synergy analysis, which means that we calculated smoothed trends of synergies. This calculation methodology filters out strong cycles of synergy.

Results

Synergy analyses and trade-off analyses between key drivers and energy intensity

First, we present synergy analyses and trade-off analyses between energy intensity and key drivers, population, value added and urban population. First synergy analysis is presented in Fig. 2. The results are quite clear, because there is negative synergy between energy intensity and value added almost in all EU-28 countries. There are only two exceptions, Luxembourg and Austria. This result indicates that energy intensity has mostly negative synergy with value added. This result is reasonable. Biggest negative synergy levels (over -0,50) are observed in Sweden and United Kingdom.

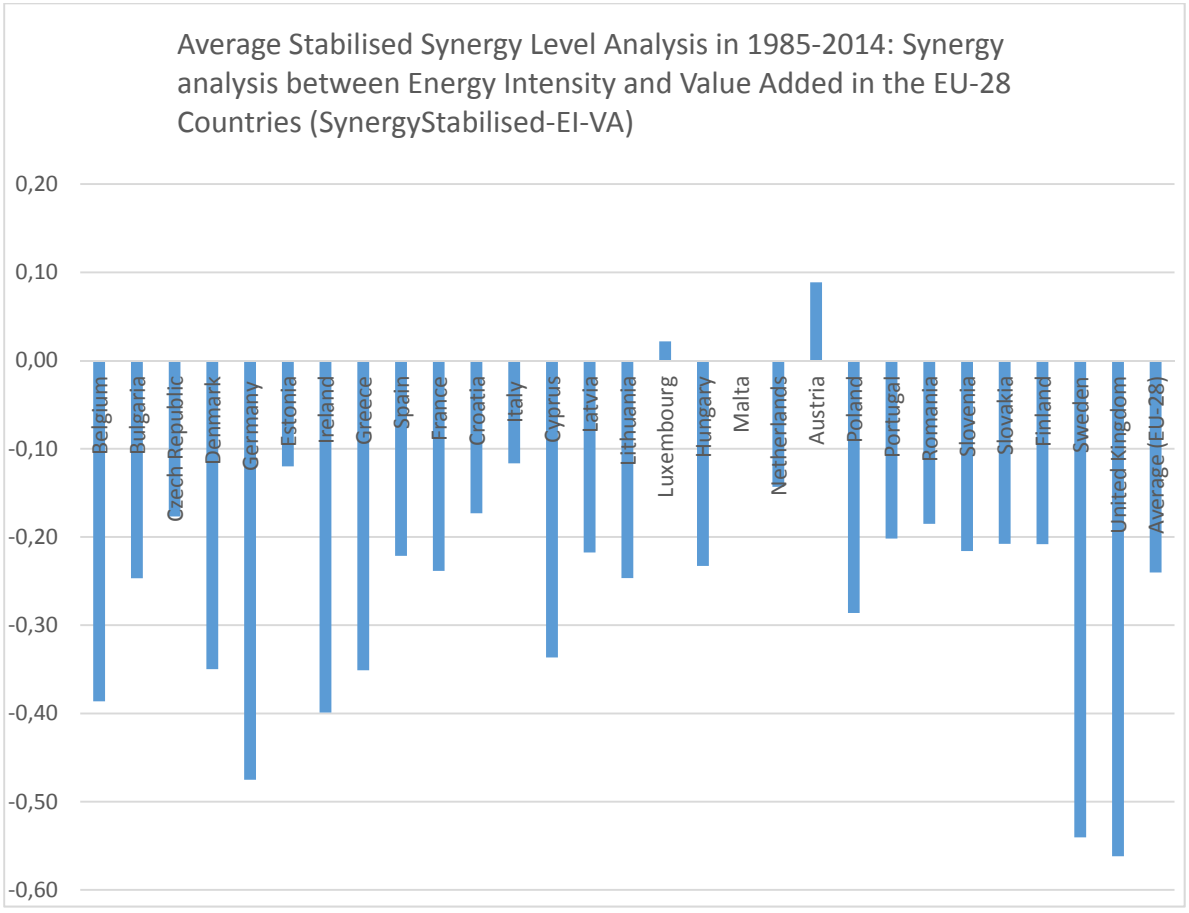

Figure 2. Average stabilised synergy level analysis in 1985-2014: Synergy analysis between energy intensity and value added in the EU-28 countries.

In Fig. 3 trade-off curve between energy intensity and value added in the EU-28 countries is outlined. We can observe negative trade-off curve. This result is consistent with the synergy analysis presented above. In general, the higher is value-added, the lower is energy intensity.

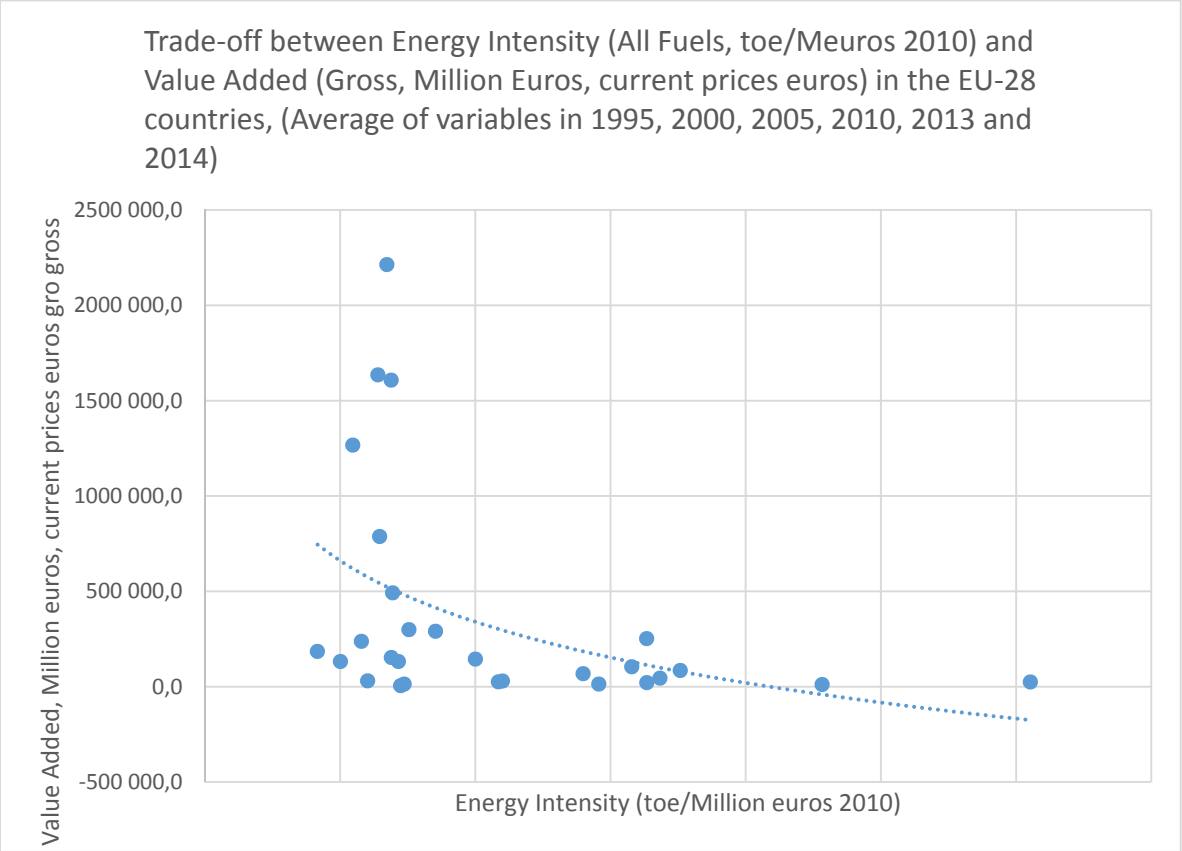

Figure 3. Trade-off analysis between energy intensity and value added in the EU-28 countries. Average stabilised synergy level analysis in 1985-2014.

Second synergy analysis is presented in Fig. 4. The results are not quite clear, because there is both negative and positive synergies between energy intensity and population in EU-28 countries. Negative synergies were identified in Bulgaria, Czech Republic, Denmark, Ireland, Greece, Spain, France, Italy, Cyprus, Luxembourg, the Netherlands, Austria, Slovenia, Finland, Sweden, and the United Kingdom. Positive synergies were identified in Bulgaria, Germany, Estonia, Croatia, Latvia, Lithuania, Hungary, Poland, Romania and Slovakia. If we think normatively, we would like to see negative synergy between population and energy intensity, but this is not the case in the EU-28. There are still quite many countries, which have positive synergy between population and energy intensity. This is an important observation for policy-makers.

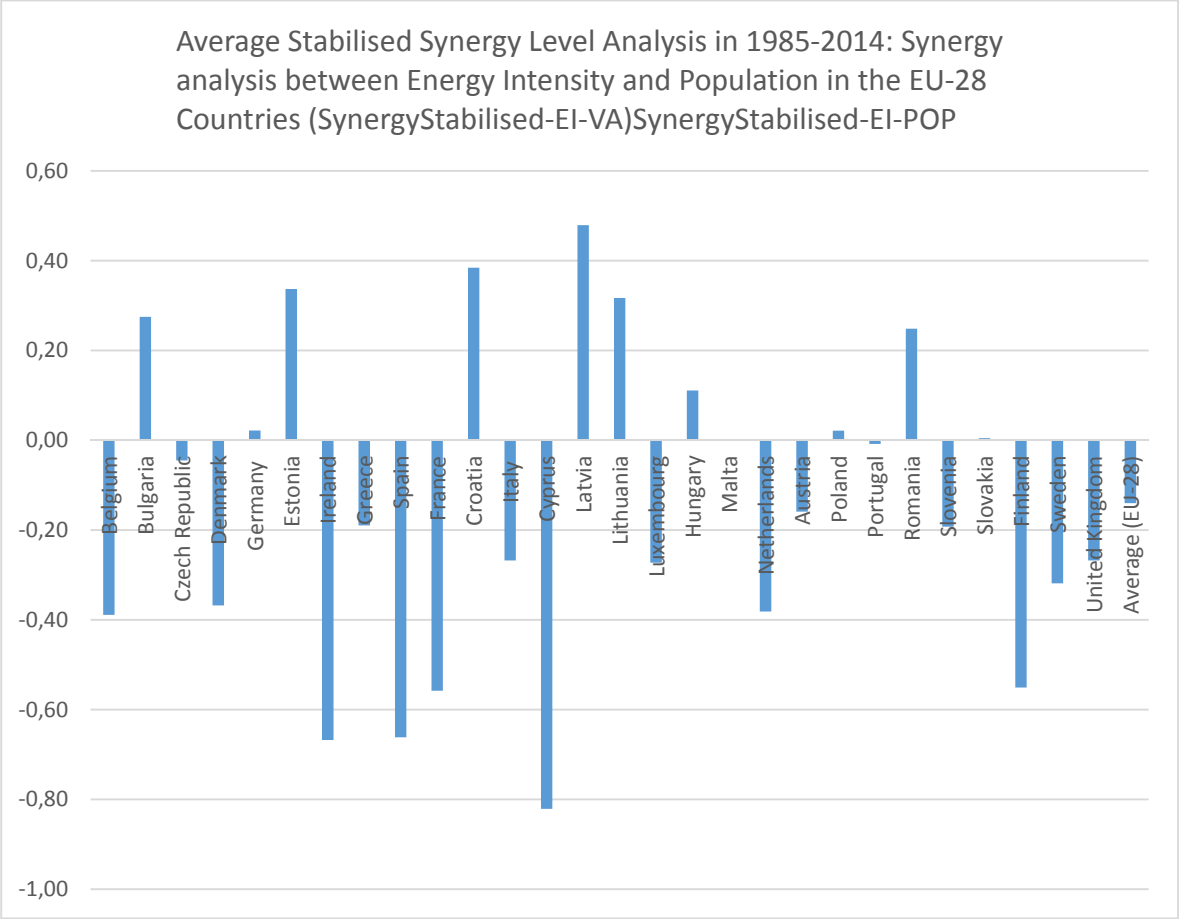

Figure 4. Average stabilised synergy level analysis in 1985-2014: Synergy analysis between energy intensity and population in the EU-28 countries.

In Fig. 5 trade-off curve between energy intensity and population in the EU-28 countries is outlined. We can observe negative trade-off curve. This result is consistent with the synergy analysis presented above. In general, the lower is population, the higher is energy intensity.

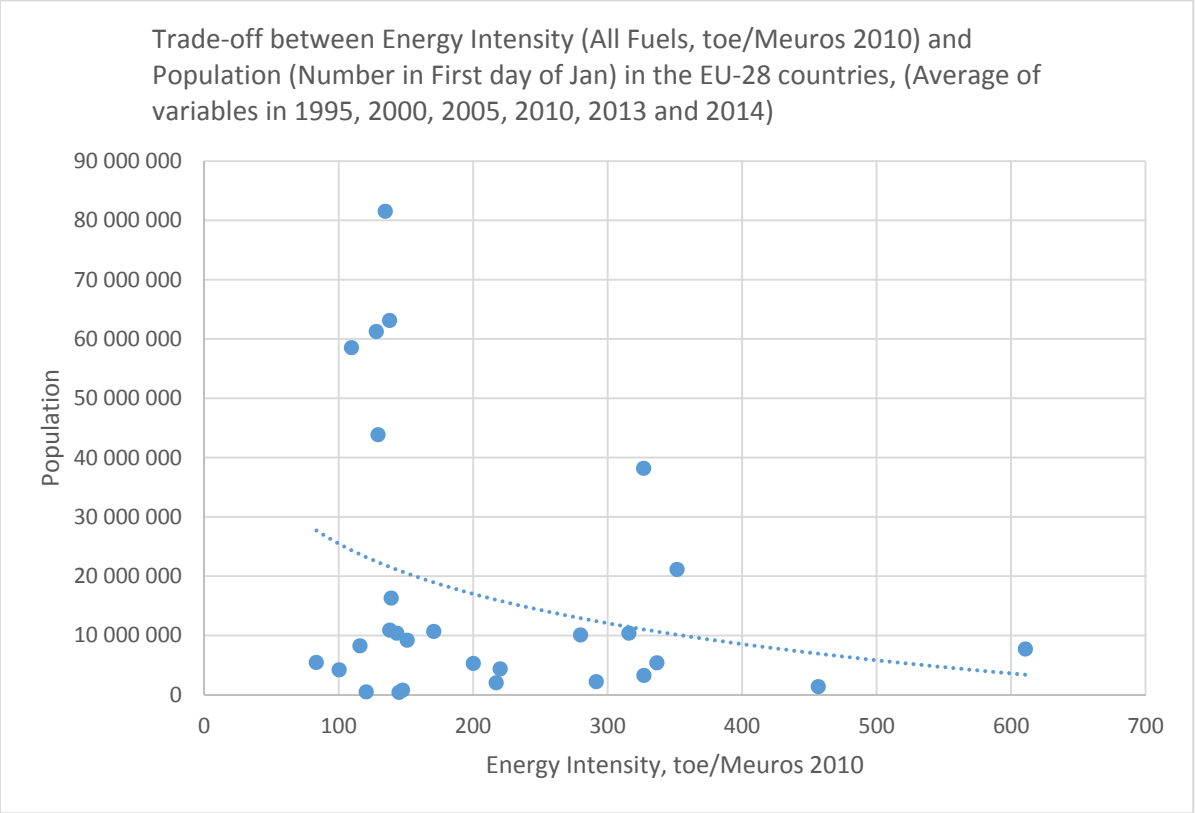

Figure 5. Trade-off analysis between energy intensity and population in the EU-28 countries. Average stabilised synergy level analysis in 1985-2014.

Third synergy analysis is presented in Fig. 6. The results are not quite clear, because there is both negative and negative synergies between energy intensity and urban population in EU-28 countries. Positive synergies were identified in Bulgaria, Estonia, Latvia, Lithuania, Poland, Romania and Slovakia. In other EU-28 countries synergy between energy intensity and urban population was negative. If we think normatively, we would like to see negative synergy between urban population and energy intensity, but this is not the case in the EU-28. There are still some countries (7 EU-member countries) which have positive synergy between urban population and energy intensity.

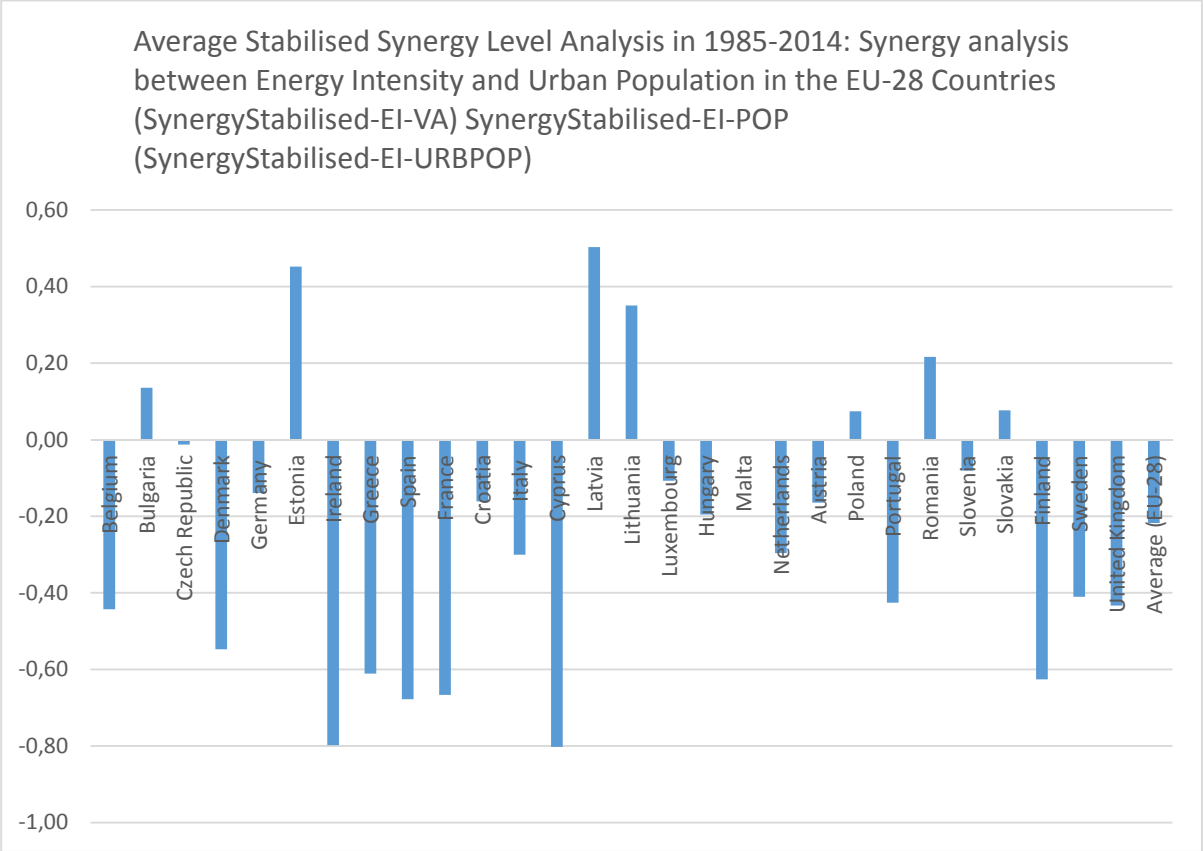

Figure 6. Average stabilised synergy level analysis in 1985-2014: Synergy analysis between energy intensity and urban population in the EU-28 countries.

In Fig. 7 trade-off curve between energy intensity and urban population in the EU-28 countries is outlined. We can observe negative trade-off curve. This result is consistent with the synergy analysis presented above. In general, the lower is urban population, the higher is energy intensity.

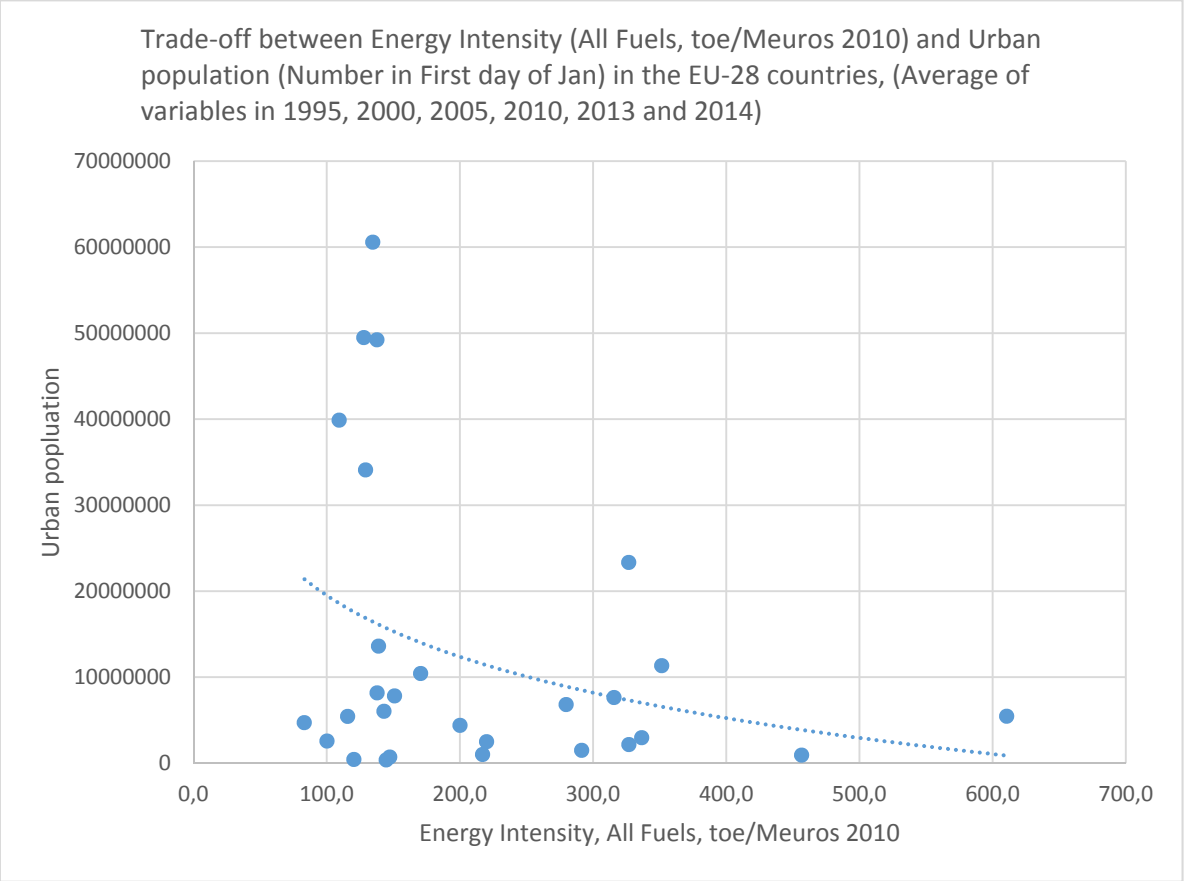

Figure 7. Trade-off analysis between energy intensity and urban population in the EU-28 countries. Average stabilised synergy level analysis in 1985-2014.

Synergy analyses and trade-off analyses between key drivers and energy consumption per capita

Secondly, we present synergy analyses and trade-off analyses between energy consumption per capita and key drivers: population, value added and urban population. Fourth synergy analysis is presented in Fig. 8. The results are quite clear, because there is negative synergy between energy consumption per capita and value added almost in all EU-28 countries. There are only two exceptions, Luxembourg and Austria. This result indicates that energy consumption per capita has mostly negative synergy with value added. This result is reasonable. Biggest negative synergy levels (over -0,50) are observed in Sweden and United Kingdom.

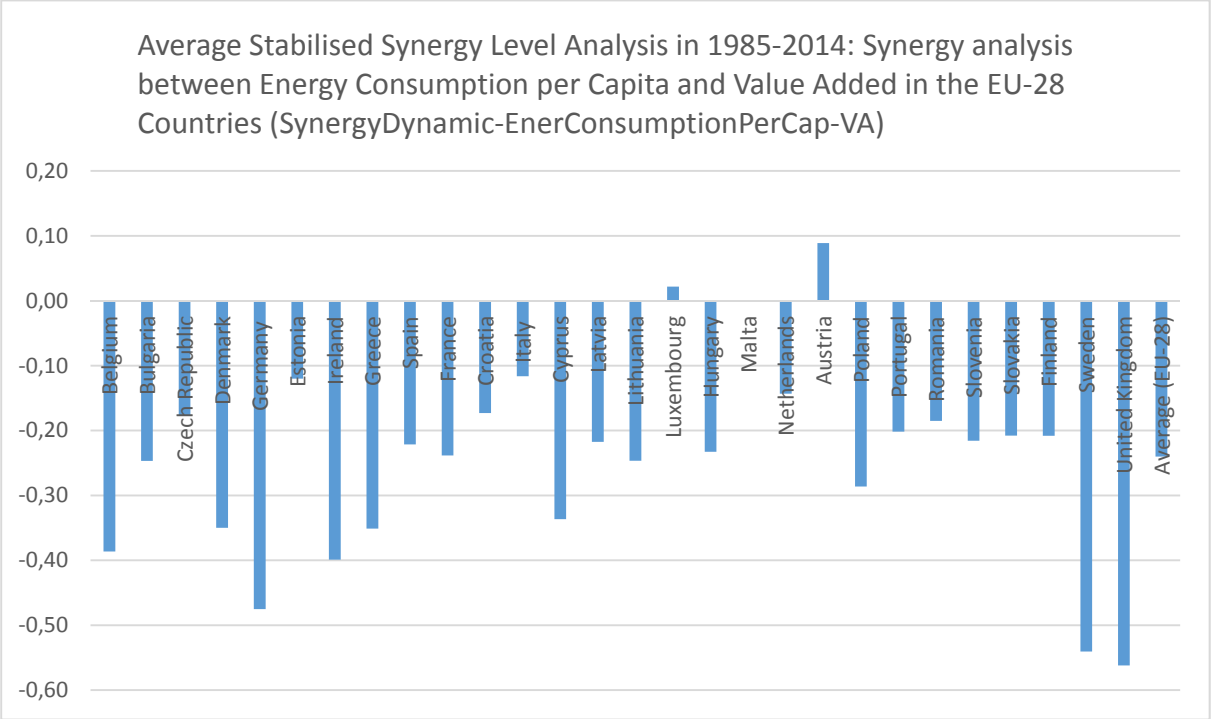

Figure 8. Average stabilised synergy level analysis in 1985-2014: Synergy analysis between average energy consumption per capita and average value added in the EU-28 countries.

In Fig. 9 trade-off curve between energy consumption per capita and value added in the EU-28 countries is outlined. We can observe negative trade-off curve. This result is consistent with the synergy analysis presented above. In general, the higher is value-added, the lower is energy consumption per capita.

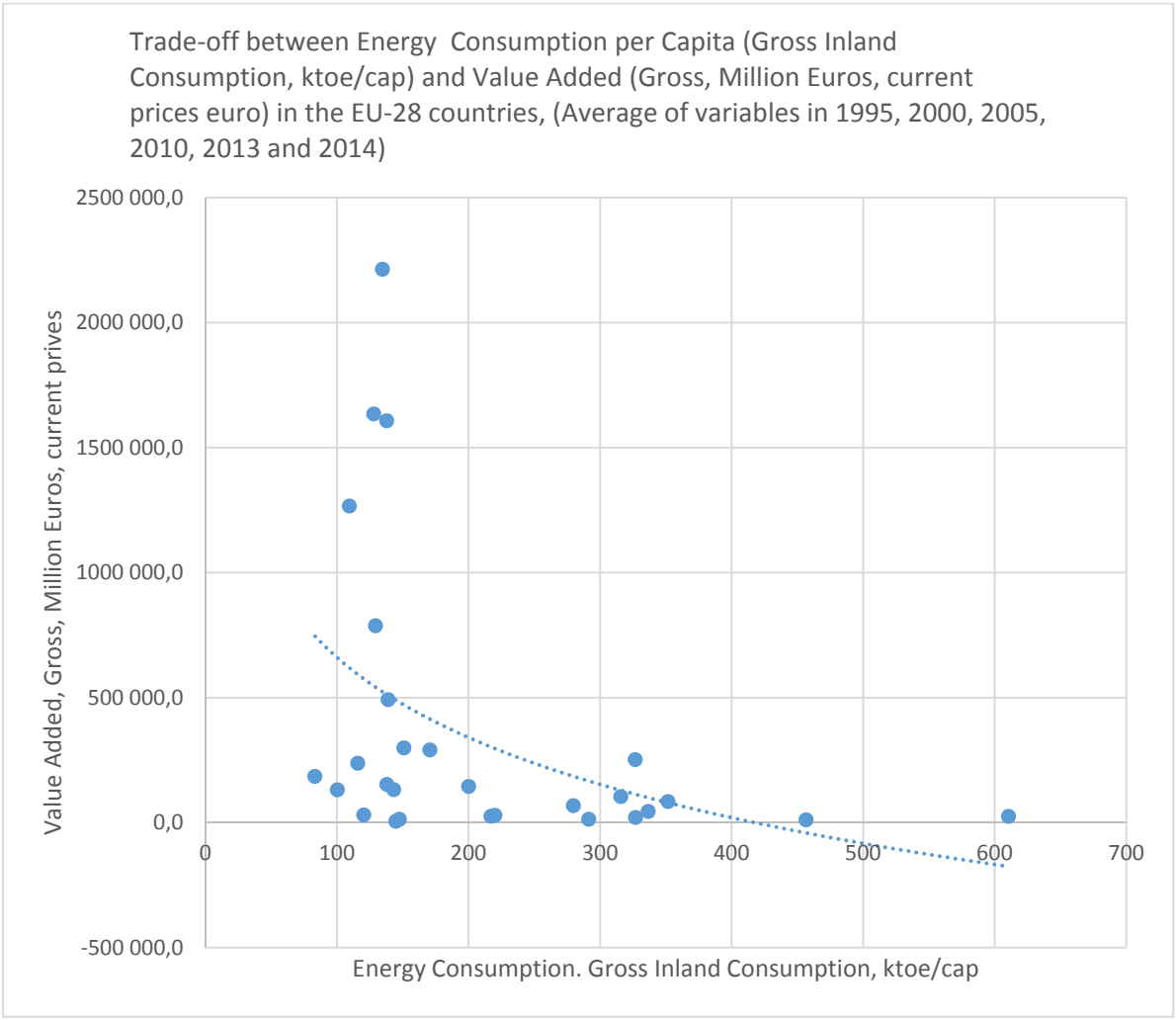

Figure 9. Trade-off analysis between energy consumption per capita and value added in the EU-28 countries. Average stabilised synergy level analysis in 1985-2014.

Fifth synergy analysis is presented in Fig. 10. The results are not quite clear, because there is both negative and negative synergies between energy consumption per capita and population in EU-28 countries. Positive synergies between energy consumption per capita and population were identified in Bulgaria, Germany, Estonia, Croatia, Latvia, Lithuania, Hungary, Poland and Romania. In other EU-28 countries synergy between energy consumption per capita and population was negative. If we think normatively, we would like to see negative synergy between energy consumption per capita and population, but this is not the case in the EU-28. There are still some countries which have positive synergy between energy consumption per capita and population.

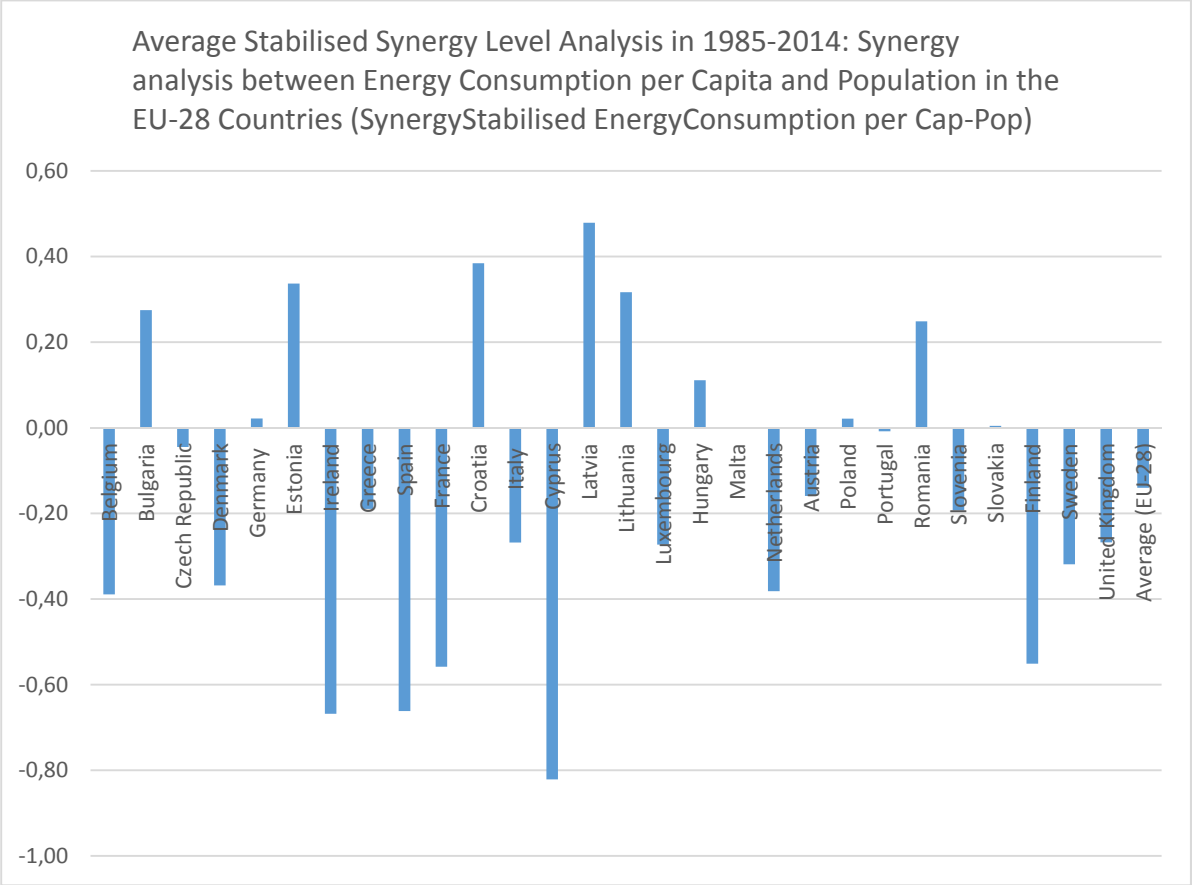

Figure 10. Average stabilised synergy level analysis in 1985-2014: Synergy analysis between average energy consumption per capita and average population in the EU-28 countries.

In Fig. 11 trade-off curve between energy consumption per capita and population in the EU-28 countries is outlined. We can observe negative trade-off curve. This result is consistent with the synergy analysis presented above. In general, the higher is population, the lower is energy consumption per capita.

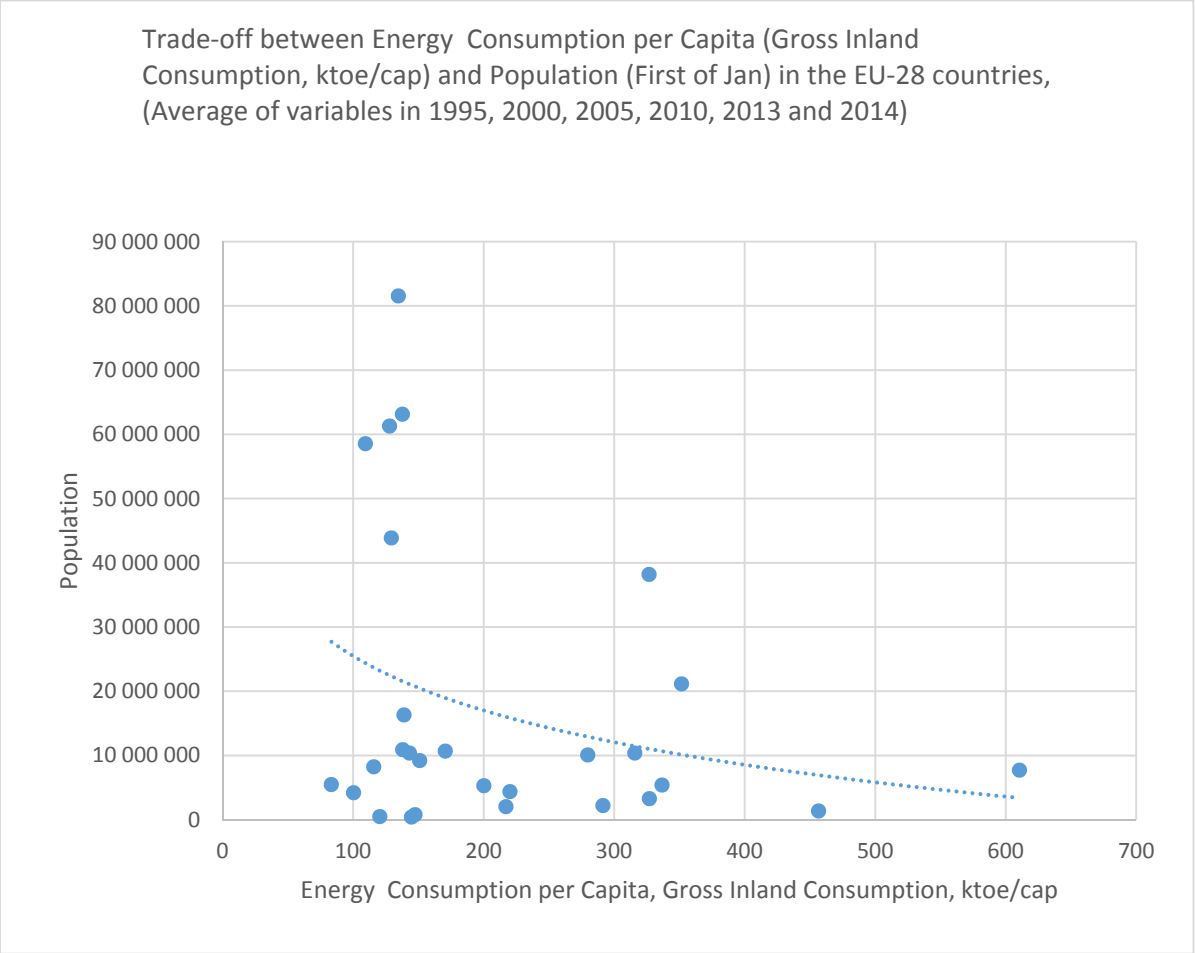

Figure 11. Trade-off analysis between energy consumption per capita and population in the EU-28 countries. Average stabilised synergy level analysis in 1985-2014.

Sixth synergy analysis is presented in Fig. 12. The results are not quite clear, because there is both negative and negative synergies between energy consumption per capita and urban population in EU-28 countries. Positive synergies between energy consumption per capita and urban population were identified in Bulgaria, Estonia, Latvia, Lithuania, Poland and Romania and Slovakia (7 EU-member countries). In other EU-28 countries (21 EU-member countries) synergy between energy consumption per capita and urban population was negative. In Czech Republic synergy was close to zero level. If we think normatively, we would like to see negative synergy between energy consumption per capita and urban population, but this is not the case in the EU-28. There are still some countries which have positive synergy between energy consumption per capita and population. Baltic countries, Bulgaria, Poland and Romania are having positive synergy between energy consumption per capita and urban population.

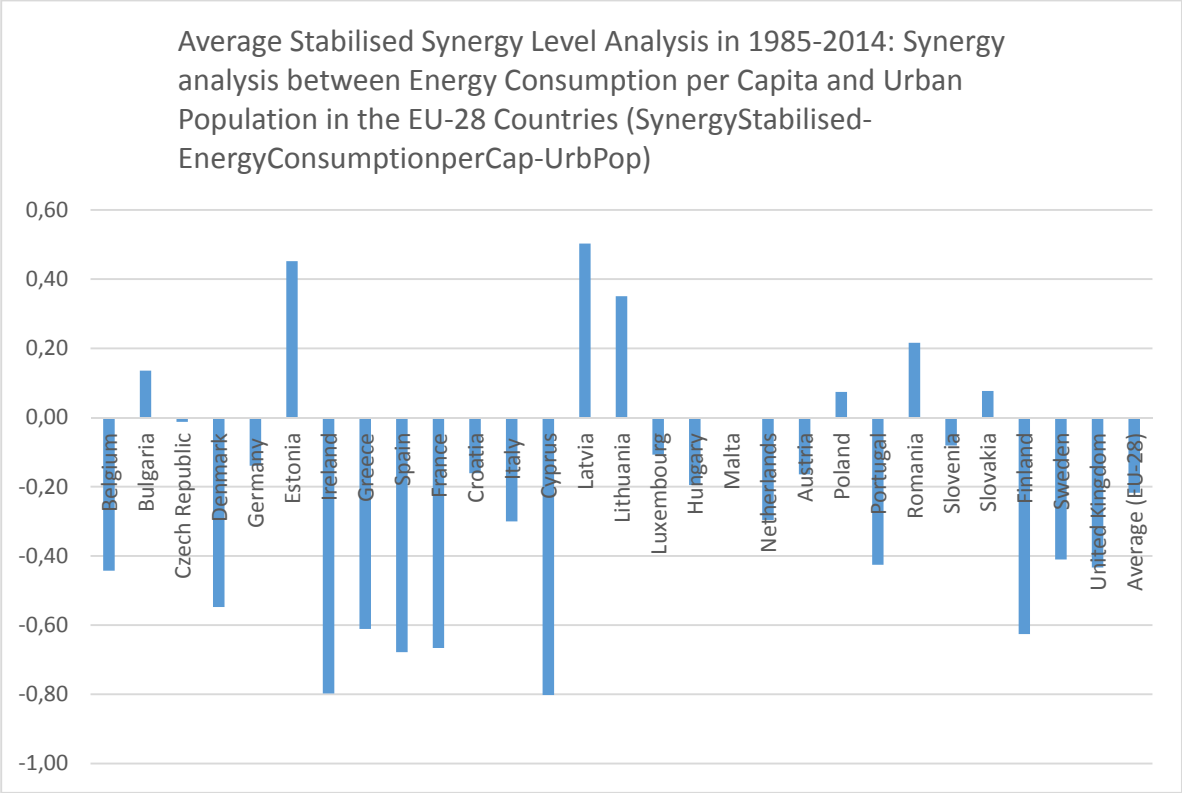

Figure 12. Average stabilised synergy level analysis in 1985-2014: Synergy analysis between average energy consumption per capita and average urban population in the EU-28 countries.

In Fig. 13 trade-off curve between energy consumption per capita and urban population in the EU-28 countries is outlined. We can observe negative trade-off curve. This result is consistent with the synergy analysis presented above. In general, the higher is urban population, the lower is energy consumption per capita.

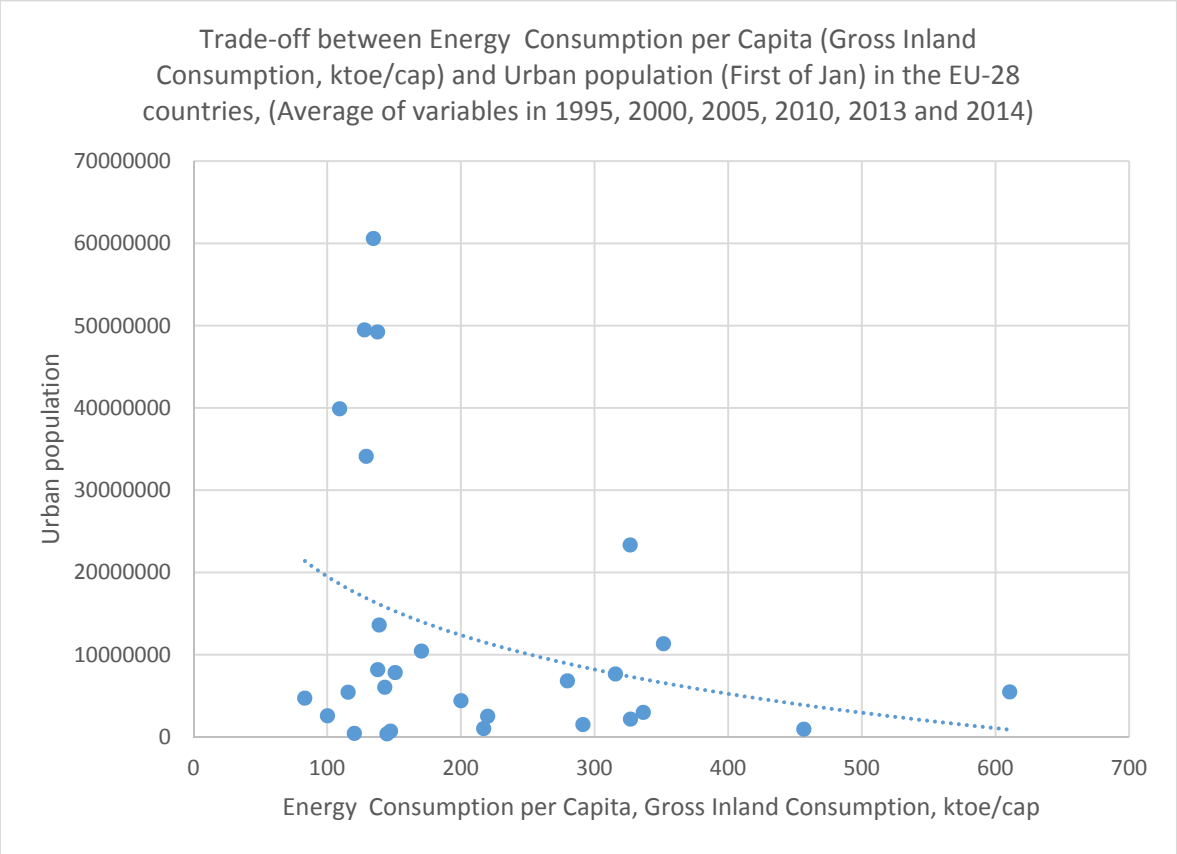

Figure 13. Trade-off analysis between energy consumption per capita and urban population in the EU-28 countries. Average stabilised synergy level analysis in 1995-2014.

Synergy analyses and trade-off analyses between key drivers and final electricity consumption per capita

Thirdly, we present synergy analyses and trade-off analyses between final electricity consumption per capita and key drivers: population, value added and urban population. Seventh synergy analysis is presented in Fig. 14. The results are quite clear, because there are mostly negative synergies between final electricity consumption per capita and value added in EU-28 countries. Positive synergies between final electricity consumption per capita and value added were identified in Luxembourg and Austria. In other EU-28 countries synergy between final electricity consumption per capita and value added was negative. If we think normatively, we would like to see negative synergy between final electricity consumption per capita and value added. There are still two countries (Luxembourg and Austria), which have positive synergy between final electricity consumption per capita and value added, but majority of EU-28 countries have negative synergy between final electricity consumption per capita and value added.

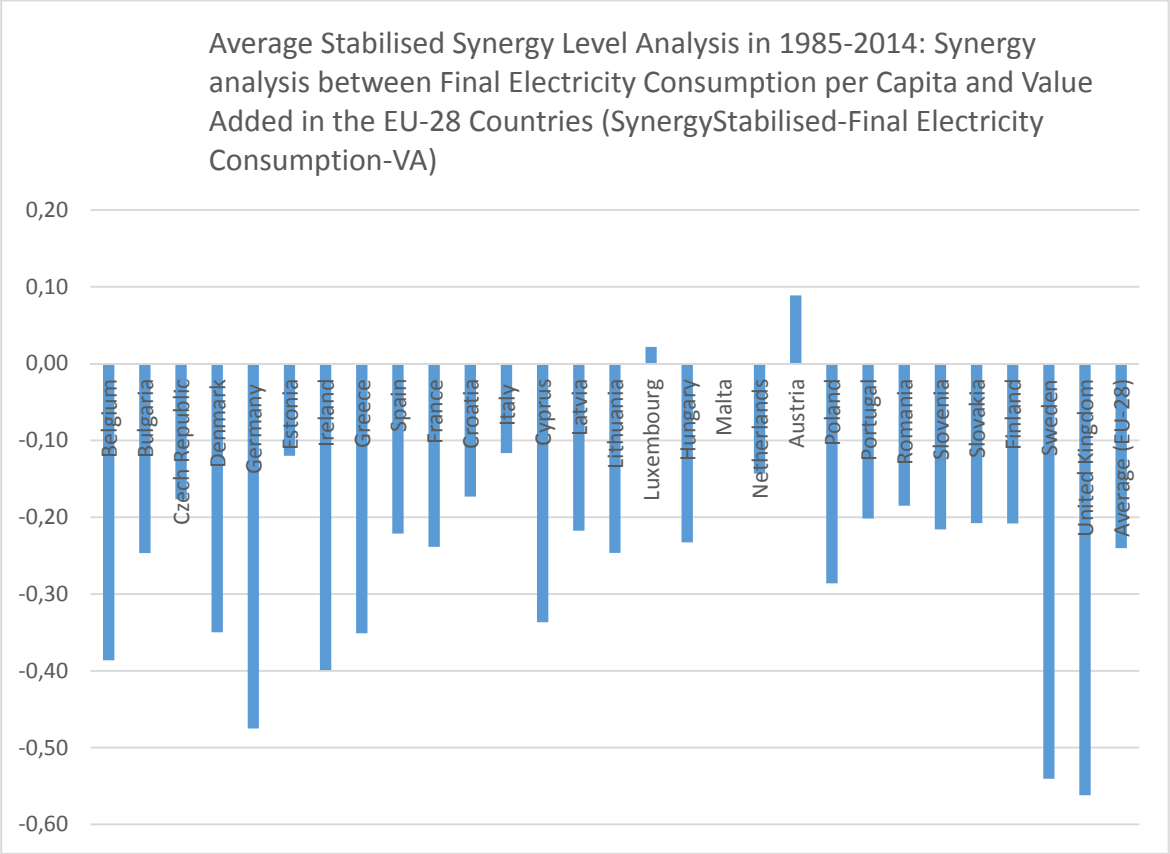

Figure 14. Average stabilised synergy level analysis in 1985-2014: Synergy analysis between final electricity consumption per capita and average value added in the EU-28 countries.

In Fig. 15 trade-off curve between final electricity consumption per capita and average value added in the EU-28 countries is outlined. We can observe negative trade-off curve. This result is consistent with the synergy analysis presented above. In general, the higher is value added, the lower is final electricity consumption per capita in the EU-28 region.

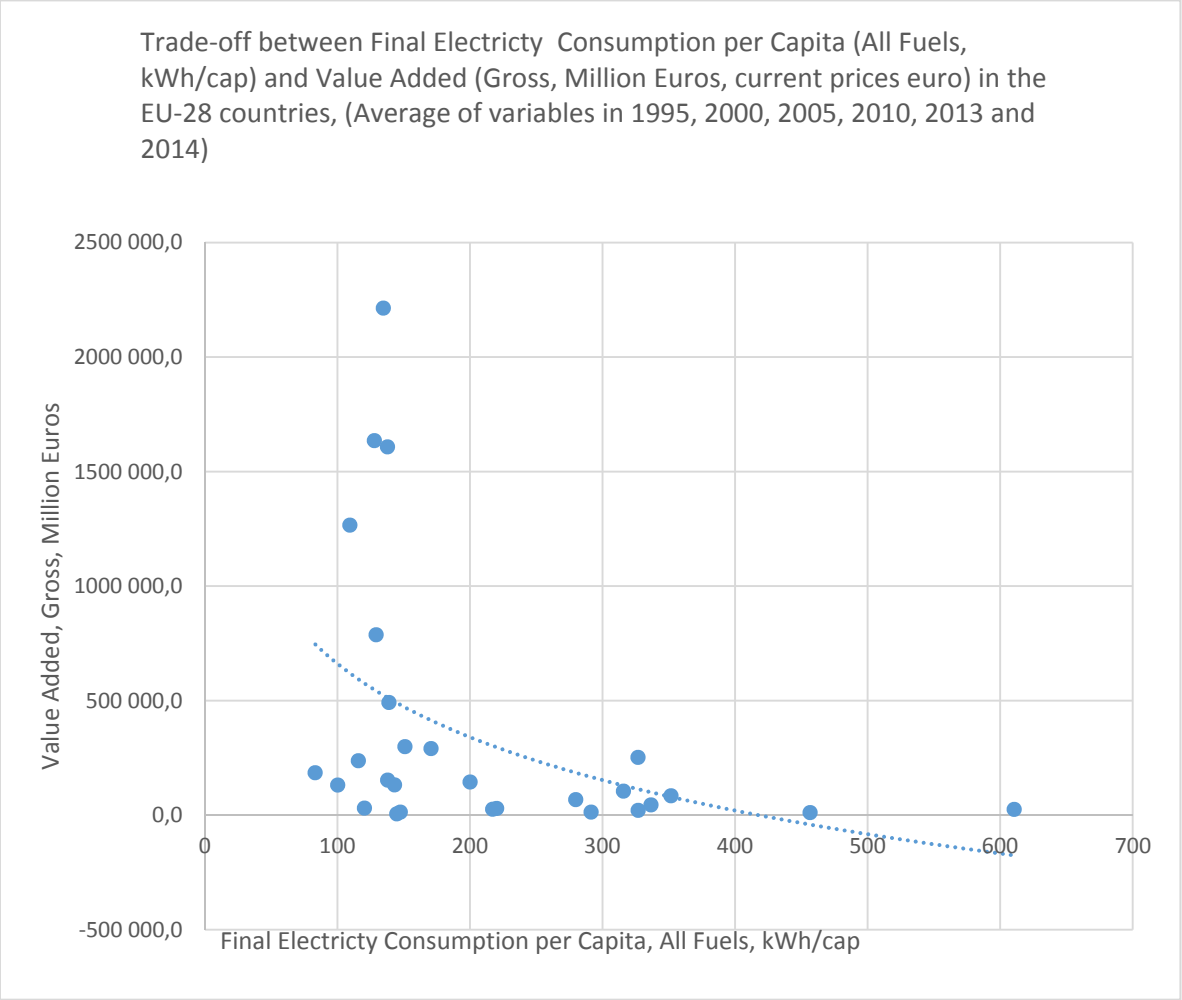

Figure 15. Trade-off analysis between final electricity consumption per capita and value added in the EU-28 countries. Average stabilised synergy level analysis in 1985-2014.

Eighth synergy analysis is presented in Fig. 16. The results are not quite clear, because there are both negative and positive synergies between final electricity consumption per capita and population in EU-28 countries. Positive synergies between final electricity consumption per capita and population were identified in Bulgaria, Germany, Estonia, Croatia, Latvia, Lithuania, Hungary, Poland and Romania. In Slovakia synergy level was on zero level. In other EU-28 countries synergy between final electricity consumption per capita and population was negative. If we think normatively, we would like to see negative synergy between final electricity consumption per capita and population. There are quite many EU-member countries, which have positive synergy between final electricity consumption per capita and population, but majority of EU-28 countries have negative synergy between final electricity consumption per capita and value added. Thus, in many Middle and Eastern European countries, there is positive synergy between these two variables.

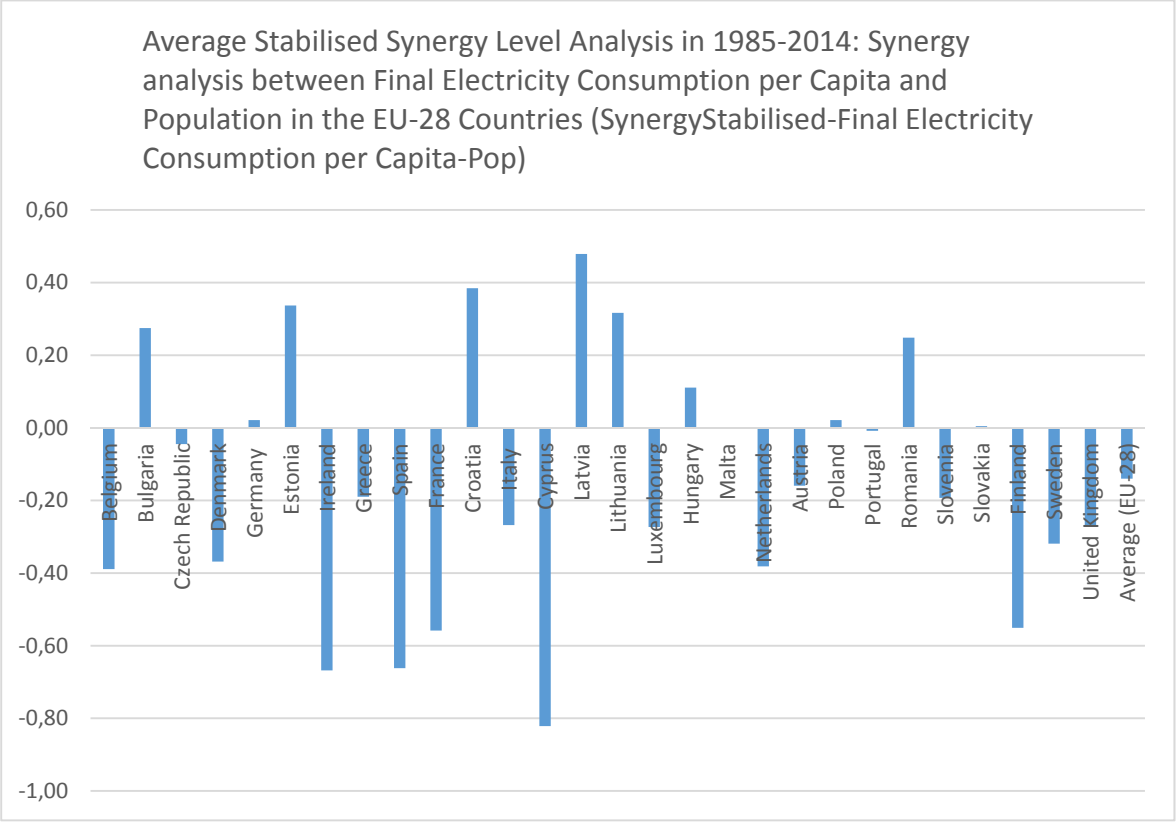

Figure 16. Average stabilised synergy level analysis in 1985-2014: Synergy analysis between final electricity consumption per capita and average population in the EU-28 countries.

In Fig. 17 trade-off curve between final electricity consumption per capita and average population in the EU-28 countries is outlined. We can observe negative trade-off curve. This result is consistent with the synergy analysis presented above. In general, the higher is population, the lower is final electricity consumption per capita.

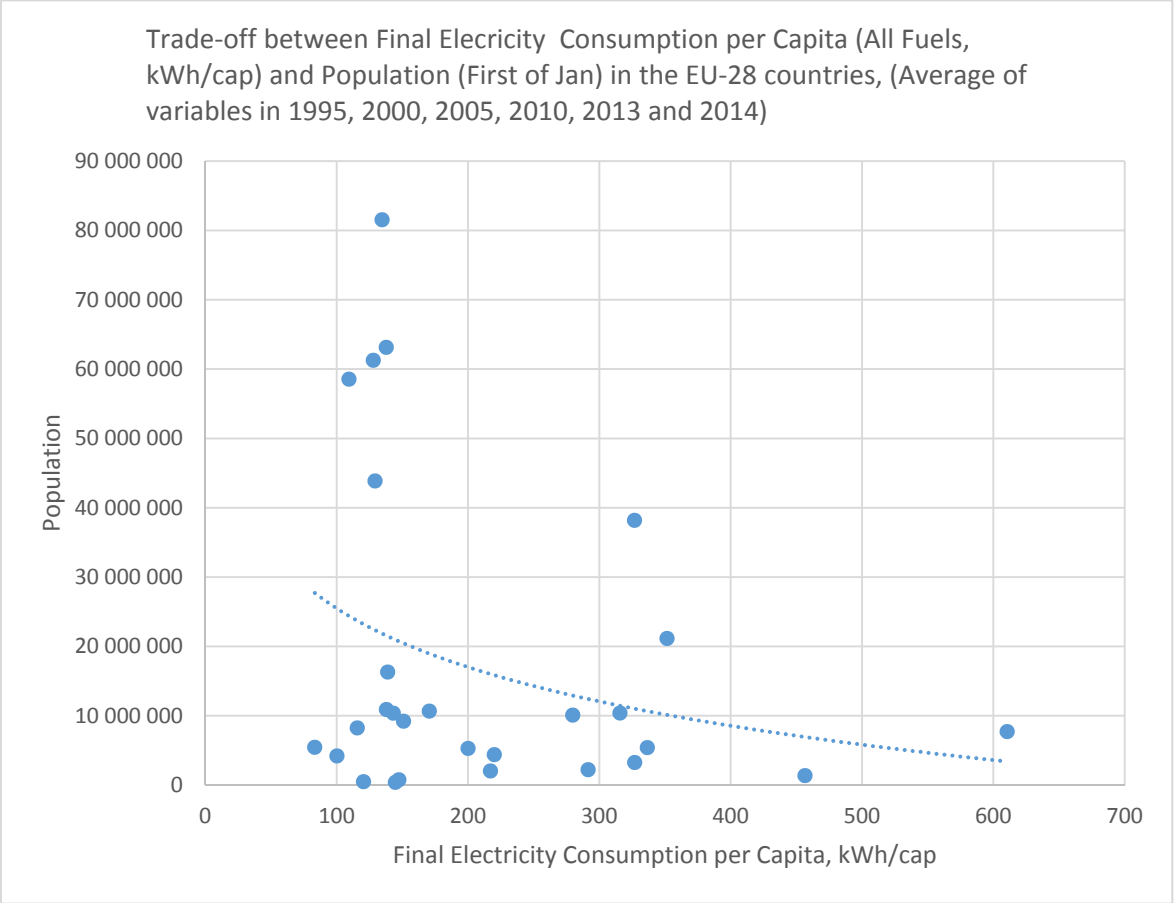

Figure 17. Trade-off analysis between final electricity consumption per capita and population in the EU-28 countries. Average stabilised synergy level analysis in 1985-2014.

Ninth synergy analysis is presented in Fig. 18. This figure shows us that in most EU-28 countries (21 EU-member countries) synergy between final electricity consumption per capita and urban population is negative. In some EU-member states synergy between final electricity consumption per capita and urban population is positive. Such countries are Bulgaria, Estonia, Latvia, Lithuania, Poland, Romania and Slovakia (7 EU-member countries).

If we think normatively, we would like to see negative synergy between final electricity consumption per capita and urban population. There are seven EU-member countries, which have positive synergy between final electricity consumption per capita and urban population, but majority of EU-28 countries have negative synergy between final electricity consumption per capita and value added. This observation is interesting and it should give reasons to think energy policy in these seven countries critically. Integration of urbanisation policy and energy policy needs special attention in these EU-member states.

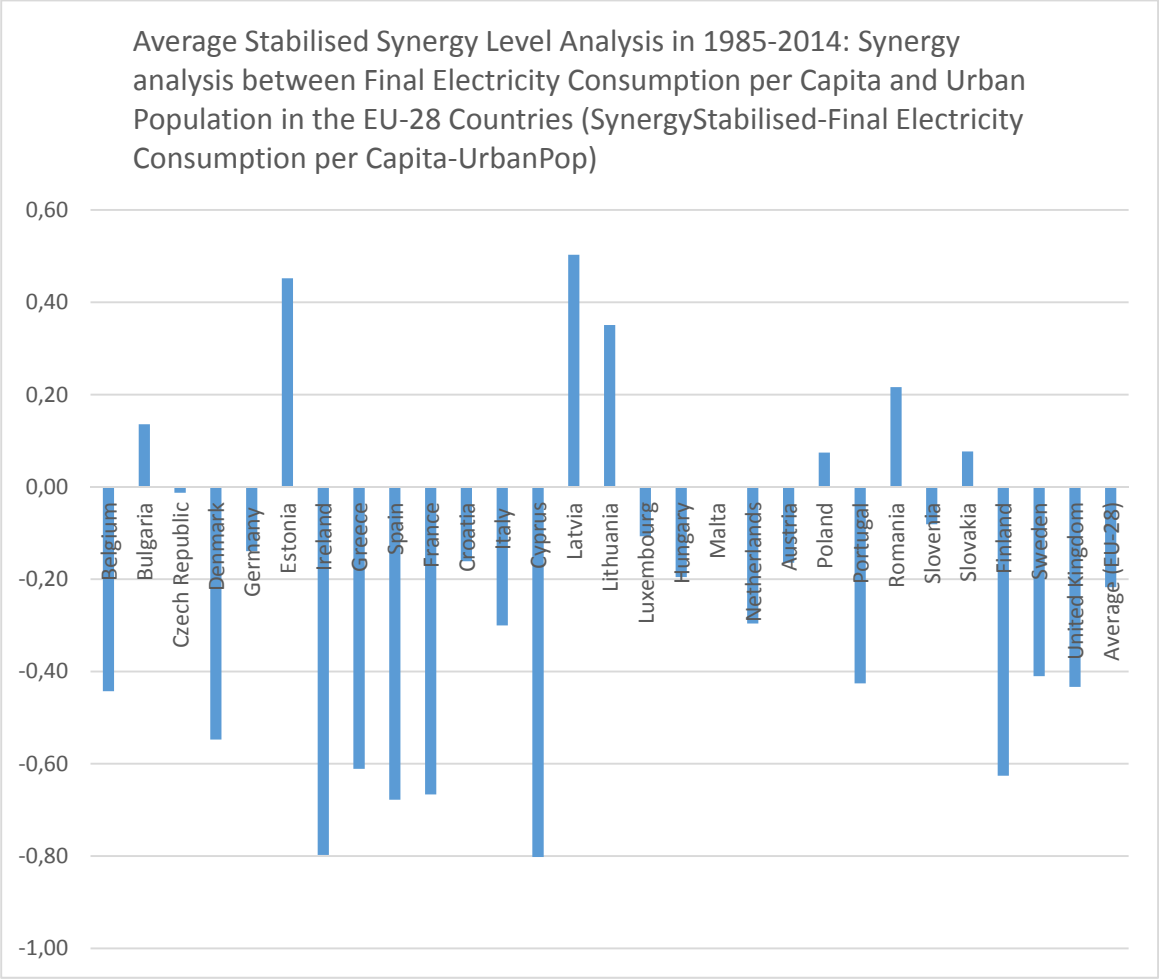

Figure 18. Average stabilised synergy level analysis in 1985-2014: Synergy analysis between final electricity consumption per capita and average urban population in the EU-28 countries.

In Fig. 19 trade-off curve between final electricity consumption per capita and average urban population in the EU-28 countries is figured out. We can observe negative trade-off curve. This result is consistent with the synergy analysis presented above. In general, the higher is urban population, the lower is final electricity consumption per capita.

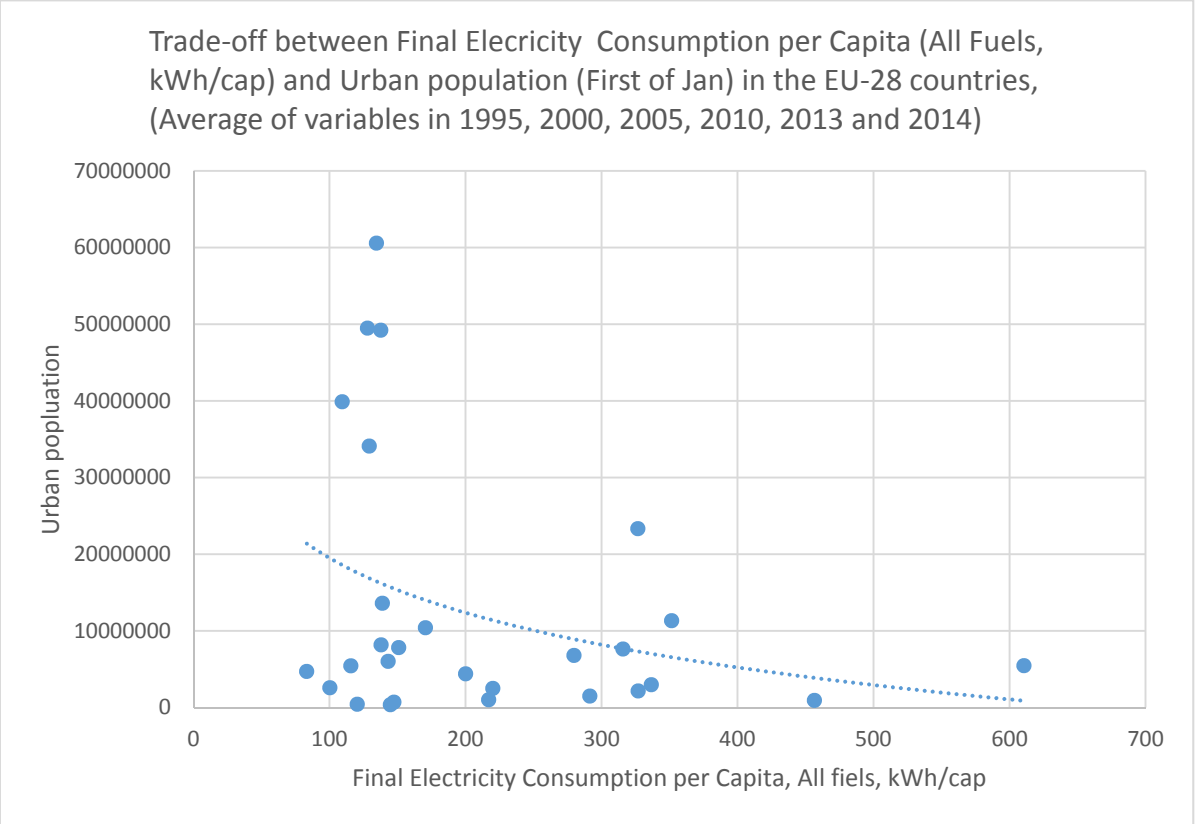

Figure 19. Trade-off analysis between final electricity consumption per capita and urban population in the EU-28 countries. Average stabilised synergy level analysis in 1985-2014.

Discussion and Conclusions

Synergy and trade-off analyses provide together a transparent methodological approach to sustainability evaluations. By synergy and trade-off analyses we can provide reflective analyses about sustainability processes and on-going energy efficiency trends in the European Union. Transition path(s) towards better sustainability can be analysed by synergy and trade-off analyses. We can compare synergy levels of the EU member countries by synergy and trade-off analyses.

It is possible to find out interesting country-level out-layer cases by this methodological approach. The reported synergy and trade-off analyses in this article reveal that in many EU member there are urgent needs to correct incentive schemes of energy efficiency policy. For European integration policy it is very interesting to observe, monitor and benchmark the observed synergy level between key variables.

On the basis of our analysis the European Union also has knowledge based reasons to pay more attention to the following energy policy issues:

(1) Improving energy efficiency especially in Central and Eastern European member states;

(2) Improving energy efficiency in the context of fast urbanization process in European cities and metropolitan regions, and finally;

(3) Paying a special attention to energy, growth and population and urbanisation policy harmonisation in the EU member states.

This empirical study is an empirical demonstration about the power of trade-off and synergy analyses in the sustainability science and especially in energy efficiency evaluation.

There are many other vital research fields where we can apply this methodological tool box. Validation of synergy is going to be big scientific challenge in the field of trend analyses and Big Data analysis. Synergy analysis can also be seen to be a key method, when we analyse complex relationships of large and smaller sub-systems.

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Energy Efficiency Trends in the European Union

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Abstract

This article analyses energy efficiency at the macro level in the EU-28 Member States during the period 1990-2013. Special reference is made to the impact of energy efficiency to total primary energy supply. The analysis is carried out by using incremental decomposition analysis, and the results are presented for four time periods: 1990-2000, 2000-2005, 2005-2010 And 2010-2013. Energy efficiency in terms of decreasing energy intensity has improved during the analysed period in the European Union. Since 2005, this impact can also be seen in decreasing total primary energy supply in many EU-28 Member States.

Acknowledgements

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Introduction and Background

Energy efficiency has been a very common and always actual policy objective of the EU and its Member States' energy policies since the 1970s. At a first glance, energy efficiency seems very handy to offer a win-win situation: improving energy efficiency decreases energy use and thus also energy costs, and at the same time, negative impacts related to energy use such as carbon dioxide (CO_2) and other emissions in the air decrease. Thus, improving energy efficiency is considered as an important means to reach climate and energy policy targets as well as other policy goals related to energy use, directly or indirectly.

Energy efficiency is one of the most studied phenomenon in the field of energy and energy policy studies. In the Elsevier ScienceDirect service keyword "energy efficiency" can be found in the title of more than 2000 peer-reviewed scientific journal articles.

Energy efficiency, however, is a relative concept, and as such far from being without problems. This is one of the reasons to its popularity both in scientific and political discussions. The win-win solution mentioned above assumes decreasing energy consumption, but actually per unit of production only. The Jevons paradox (see e.g. Polimeni et al 2009) implies that improvements gained by increasing energy efficiency per unit are wasted in additional energy consumption, either by increasing the amount of units, or elsewhere. This kind of argumentation is included also in the Advanced Sustainability (ASA) approach as a "gross rebound effect" (Kaivo-oja et al 2001a; 2001b). Gross rebound effect

and the Jevons paradox have quite little to do with energy economists' recent discussion on the rebound effect (cf. Herring 2006) at the micro level, which is, however, based on the same basic idea but focuses to more strict definition. This discussion is, however, beyond the scope of this article.

Energy consumption is a result of three basic drivers as identified widely in many decomposition studies (e.g. Kaivo-oja & Luukkanen 2004): activity effect, intensity effect and structural effect (cf. Kasanen 1990). What is usually meant with energy efficiency, deals directly with only one of these drivers, i.e. the intensity effect.

The objective of this article is to provide a comparative analysis on energy efficiency in the EU-28 Member States. The report includes a comparison of the EU Member States at national level, and also a comparison of EU-28 as a whole. The structure of this article is the following: In this introductory chapter, a general definition of energy efficiency will be provided, and the definition will be applied to the macro level analysis. In the next chapter, the empirical analysis framework based on the Advanced Sustainability (ASA) approach (see Kaivo-oja et al 2001a; 2001b; Vehmas et al 2003; Vehmas 2009) developed in Finland Futures Research Centre (FFRC) will be presented and described. The following chapters present the indicator-based trends of energy efficiency in the EU-28 Member States, results from a decomposition analysis of total primary energy supply (TPES), and conclusions and policy recommendations from the macro level analysis.

Methodology

Definition of energy efficiency

In general systems perspective, efficiency refers to a relationship between the input and output of a defined system. Change of efficiency over time brings out the common efficiency idea of getting more from less, which explains the fact that improving energy efficiency has been a common energy policy goal all over the World from the 1970's oil shocks. The idea is that using less energy for a certain task decreases energy consumption and gives better possibilities to use energy sources with a predictable price development, which in practice means domestic energy sources especially in those countries depending on imported crude oil and imported liquid fuels.

When energy use is chosen as an input of a system, energy efficiency refers to a relationship between energy use and the output (Equation 1):

$$Energy\ efficiency = \frac{Output}{Energy\ input} \quad (1)$$

An alternative interpretation to the relationship between energy input and the system output is *energy productivity*. These definitions are valid in all systems, and do not depend on any scale or type of system *per se*. However, the system boundary must be clearly defined. In large systems, the energy input usually consists of different energy sources such as electricity, heat, or different types of fuels. Energy efficiency of a system requires that the total energy input to the system is considered. So in

large systems, the use of aggregate energy units have to be used, although a lot of information is lost. On the other hand, also the output should be considered in total terms, which makes the use of monetary as an alternative to the physical units which usually cannot be easily aggregated in large systems. One can argue for focusing on systems with only one energy source and one output product only, but the question how to select the systems for analysis remains. Here the focus is on macro level systems at national level, and aggregated data will be used.

ASA Decomposition Analysis

The Advanced Sustainability Analysis (ASA) is an approach based on so-called IPAT identity. The IPAT identity emerged out of the Ehrlich & Holdren/Commoner debate in the early 1970s about the driving forces of global environmental impacts (York et al 2003). The IPAT identity identifies the major drivers of environmental impact (I) at the global level: the amount of population (P), the affluence of that population (A), and level of technology (T). Waggoner and Ausubel (1992) added a new term, consumption (C) in the identity and called the result as an ImPACT identity. Kaya (1990) applied the idea of IPAT identity to identify the drivers of climate change and carbon dioxide emissions. His application has been called as Kaya identity, which has had an influence also to the ASA approach.

Advanced Sustainability Analysis (ASA) is a mathematical information system developed by Finland Futures Research Centre (see e.g. Malaska et al 1999; Kaivo-oja et al 2001a; 2001b; Vehmas et al 2003; Luukkanen et al 2005). The ASA approach can be used to analyze sustainable development from different points of view. The focus is on changes over time between economic and environmental, economic and social, and social and environmental dimensions of sustainability which can be measured with any preferred indicator or index. The choice of indicators enables the use of ASA approach to specific topics such as energy efficiency. The ASA approach can be applied to all levels of economic activity, from company level to national even to global level.

The objectives of the ASA approach include the following:

(1) to identify factors contributing to a change in a studied (environmental, social or economic) sustainable development indicator
(2) to estimate the contribution of each factor to the studied change in quantitative terms
(3) define and operationalize new concepts related to sustainable development
(4) to answer policy-relevant what if –type questions related to sustainable development objectives.

The ASA approach is capable of providing tools to fulfil objectives (2), (3) and (4), but objective (1) requires something else such as theoretical or empirical evidence related to the studied phenomena. In this article objective (2) is in the focus, because the ASA approach can be used to analyse the effects of energy efficiency indicators on relevant energy policy goals, such as those related to energy consumption or CO_2 emissions from fuel combustion.

ASA applies decomposition analysis in order to divide the observed change in environmental, social or economic indicators into the effects of contributing factors. Identifying the contributing factors in the format required by the ASA approach may be challenging, because selection of potential factors must be supported by theoretical or empirical arguments not based on the ASA approach. The approach itself does not support or give tools for factor identification, so it is based on either theory-based or assumed causal relationship between the identified factors and the studied indicator.

The decomposition analysis calculates the effect/contribution of each explaining factor and their "joint effect" (residual term), which in a complete decomposition must be allocated to the explaining factors. Sun (1996; 1998) has preferred the choice of equal allocation to the explaining factors. This choice is in principle the same made in the so-called Sun/Shapley decomposition method, which is considered as one of the preferred methods suggested by Ang (2004).

Decomposition analysis of total primary energy supply (TPES) is based on the following master equation:

$$TPES = \frac{TPES}{FEC} \times \frac{FEC}{GDP} \times \frac{GDP}{POP} \times POP \quad (2)$$

Driver TPES/FEC (total primary energy supply divided by final energy consumption) represents the efficiency of the energy transformation system. This efficiency changes when changes in the transformation process take place, e.g. when fuel use is replaced with electricity. If electricity is produced in condensing power plants, the transformation process becomes more inefficient because in condensing power plants only 35-40 % of the fuel's energy content is transformed into electricity, the rest is waste heat. Thus, a drop in the efficiency of the energy transformation process increases the need of primary energy (TPES). If CHP is used, the overall efficiency change is smaller, because the heat is not wasted but used for heating purposes either in industrial processes or as district heat (which is common e.g. in Finland).

Driver FEC/GDP (final energy consumption divided by gross domestic product) describes energy intensity of the economy, which is an inverse of energy efficiency at national level, i.e. GDP productivity of energy use. Changes in this driver are due to changes in the structure of the economy, such as change from energy intensive to lighter industrial branches and services or vice versa.

Driver GDP/POP (gross domestic product divided by number of population), GDP per capita, describes affluence of the population referred to in the original IPAT identity.

Driver POP (number of population) was considered as the most important driver in the original IPAT identity which focused on global environmental issues. In energy analysis of industrial countries it is less significant, but defends its position in the driver identification.

The equations for calculating the decomposed effects of the factors identified in the master equation (3) of total primary energy supply are the following (equations 3-5)

$$TPES/FEC = (FEC_{t-1} + \lambda 1_{tt-1}\Delta FEC_{tt-1}) \times \Delta\left(\frac{TPES}{FEC}\right)_{tt-1} \quad (3a)$$

$$FEC = \left[\left(\frac{TPES}{FEC}\right)_{t-1} + (1-\lambda 1_{tt-1})\Delta\left(\frac{TPES}{FEC}\right)_{tt-1}\right] \times \Delta FEC_{tt-1} \quad (3b)$$

$$FEC/GDP = \left[\left(\frac{TPES}{FEC}\right)_{t-1} + (1-\lambda 1_{tt-1})\Delta\left(\frac{TPES}{FEC}\right)_{tt-1}\right] \times (GDP_{t-1} + \lambda 2_{tt-1}\Delta GDP_{tt-1}) \times \Delta\left(\frac{FEC}{GDP}\right)_{tt-1} \quad (4a)$$

$$GDP = \left[\left(\frac{TPES}{FEC}\right)_{t-1} + (1-\lambda 1_{tt-1})\Delta\left(\frac{TPES}{FEC}\right)_{tt-1}\right] \times \left[\left(\frac{FEC}{GDP}\right)_{t-1} + (1-\lambda 2_{tt-1})\Delta\left(\frac{FEC}{GDPC}\right)_{tt-1}\right] \times \Delta GDP_{tt-1} \quad (4b)$$

$$GDP/POP = \left[\left(\frac{TPES}{FEC}\right)_{t-1} + (1-\lambda 1_{tt-1})\Delta\left(\frac{TPES}{FEC}\right)_{tt-1}\right] \times \left[\left(\frac{FEC}{GDP}\right)_{t-1} + (1-\lambda 2_{tt-1})\Delta\left(\frac{FEC}{GDP}\right)_{tt-1}\right] \times \left(POP_{t-1} + \lambda 3_{tt-1}\Delta POP_{tt-1}\right) \times \Delta\left(\frac{GDP}{POP}\right)_{tt-1} \quad (5a)$$

$$POP = \left[\left(\frac{TPES}{FEC}\right)_{t-1} + (1-\lambda 1_{tt-1})\Delta\left(\frac{TPES}{FEC}\right)_{tt-1}\right] \times \left[\left(\frac{FEC}{GDP}\right)_{t-1} + (1-\lambda 2)_{tt-1}\Delta\left(\frac{FEC}{GDP}\right)_{tt-1}\right] \times \left[\left(\frac{GDP}{POP}\right)_{t-1} + (1-\lambda 3_{tt-1})\Delta\left(\frac{GDP}{POP}\right)_{tt-1}\right] \times \Delta POP_{tt-1} \quad (5b)$$

In all equations 8-10, subscript *tt-1* refers to a change between a calendar year and the next year. Subscript *t-1* refers to the absolute value of the previous year. Coefficients λ1...λ3 define how the joint effect of the two variables are divided into the corresponding factor in each two-factor decomposition. In all decomposition analyses carried out in this article, λ1=λ2=λ3=0.5.

Special reference is made to the key drivers TPES/FEC and FEC/GDP, because they are indicators directly describing energy efficiency at the national level.

Ideally, total primary energy supply (TPES) consists of (i) final energy consumption (FEC), (ii) all losses when primary energy is transformed into energy carriers, and (iii) losses in the transfer and distribution of energy carriers (such as electricity) into the sites of final consumption. However, in

some cases such as electricity generation from hydro, wind, solar, geothermal, and nuclear energy, measuring the amount of primary energy is difficult or impossible. In these cases different practices have been developed. In International Energy Agency statistics, which are used in the empirical analyses of this report, hydro, wind and solar power are included as electricity in the primary energy, so statistically their transformation is 100% efficient. In the case of nuclear, on the other hand, it has been assumed that electricity is generated with a 33% thermal efficiency. In other words, one unit of nuclear electricity requires three units of primary energy. In the case of geothermal electricity, a 10% thermal efficiency is assumed – one nit of geothermal electricity requires ten units of primary energy. Thus, a comparison between different countries is challenging – e.g. the difference between Norway (with lot of hydro) and France (lot of nuclear) may look too large in terms of primary energy.

Energy efficiency trends in the EU-28 Member States

In the following, the trends of the energy efficiency related indicators TPES/FEC (total primary energy supply divided by final energy consumption) and FEC/GDP (final energy consumption divided by gross domestic product) are described by using the time series data provided by International Energy Agency (IEA 2015). For most Member States, the data during the years 1971-2013 will be used. For Croatia, Estonia, Latvia, Lithuania, and Slovenia, data is available during the time period 1990-2013.

Trends of TPES/FEC ratio

Figure 1 shows the TPES/FEC trend during the years 1971-2013 for the Mediterranean EU Member States Cyprus, Greece, Italy, Malta, Portugal, and Spain. The trends are rather stabile in all Member States. Italy and Portugal show the most efficient energy transformation systems, where the rate between TPES and FEC is around 1.2-1.3 during the whole time period.

The trend of Malta is exceptional. The efficiency of the energy transformation system in Malta varies a lot but is much more inefficient than in the other Mediterranean Member States during the whole time period. While the TPES/FEC rate in other Mediterranean Member States varies between 1.2 and 1.6, in Malta the variation takes place between 1.6 and 2.8. The reason can be found in changes in the very few large units of either energy production or industrial consumption.

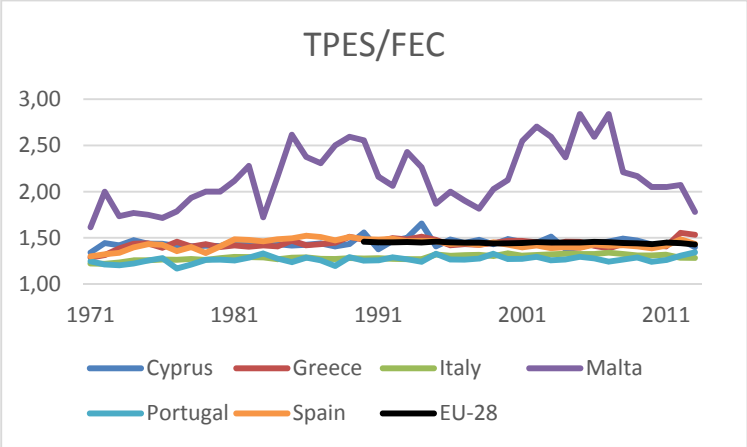

Figure 1. Trend of energy efficiency of the energy transformation system (TPES/FEC ratio) in Cyprus, Greece, Italy, Malta, Portugal and Spain, 1971-2013.

Figure 2 describes the same trend in the three largest EU Member States, i.e. France, Germany, and the United Kingdom. These Member States differ from each other. France, highly relying on nuclear power, shows an increasing trend of TPES/FEC (from 1.3 to 1.6), which means that the efficiency of the energy transformation system is decreasing. Nuclear electricity is calculated in the IEA statistics as primary energy by multiplying the amount of produced electricity by 3, and the increasing use of electricity is the major reason for the bad trend of energy transformation efficiency in France. The long period trend of Germany is quite stabile with some annual variation (1.4-1.5), and the trend of the UK is slightly decreasing. This reflects a slight improvement in the efficiency of the energy transformation system over time in the UK.

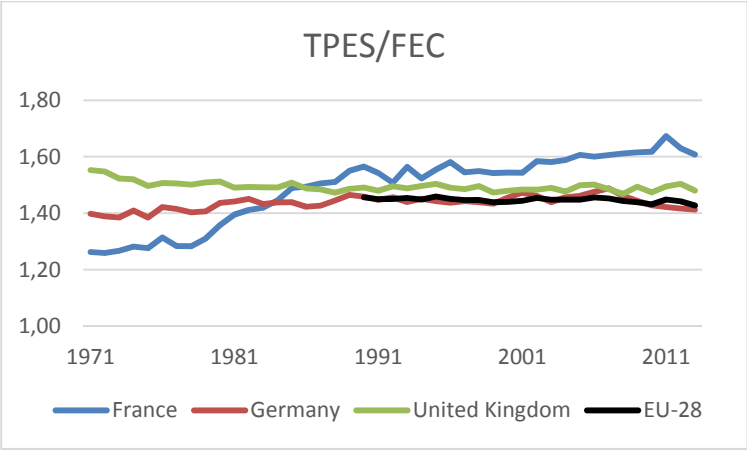

Figure 2. Trend of energy efficiency of the energy transformation system (TPES/FEC ratio) in France, Germany and the United Kingdom, 1971-2013.

In the Northern EU Member States, Denmark, Finland and Sweden (Figure 3), the TPES/FEC trend fluctuates quite a lot. One obvious reason for this is seasonal variation in imported electricity and hydropower availability (due to changes in precipitation). The long-term TPES/FEC trend of Denmark has turned into a decreasing one while the trends of Sweden and Finland are still increasing. Increase

is due to increased use of electricity produced by nuclear with a low statistical efficiency. Thus, the share of electricity in final energy consumption increases, and the value of TPES/FEC increases.

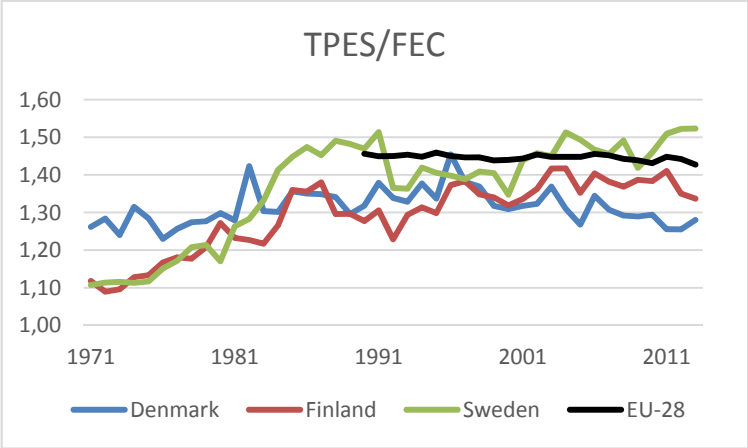

Figure 3. Trend of energy efficiency of the energy transformation system (TPES/FEC ratio) in Denmark, Finland and Sweden, 1971-2013.

In Figure 4, the trends of TPES/FEC for Belgium, Luxembourg, the Netherlands, Austria and Ireland are presented. In general, a slightly decreasing trend can be observed from the 1990s onwards, Luxembourg is an exception because changes in one factory may change the whole system because of the extremely small size of the economy. In the 2000s, the TPES/FEC value of Luxembourg is the lowest among all EU-28 Member States.

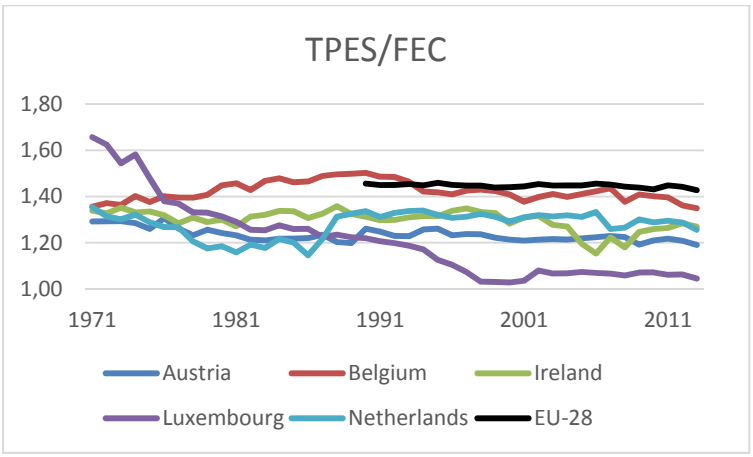

Figure 4. Trend of energy efficiency of the energy transformation system (TPES/FEC ratio) in Austria, Belgium, Ireland, Luxembourg and the Netherlands, 1971-2013.

The Baltic Member States Estonia, Latvia and Lithuania show very different trends of TPES/FEC (Figure 5). Based on the IEA (2015) data, Latvia has the most efficient energy transformation system of the Baltic countries. The TPES/FEC trend of Estonia and Lithuania varies quite a lot, which is a common case in small EU Member States. However, the energy transformation system of Estonia is among the most inefficient ones in the EU.

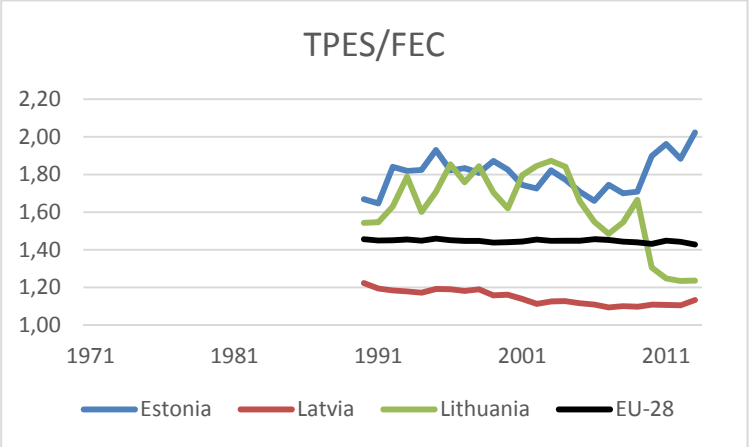

Figure 5. Trend of energy efficiency of the energy transformation system (TPES/FEC ratio) in Estonia, Latvia and Lithuania, 1990-2013.

The East European EU Member States Czech Republic, Hungary, Poland and Slovakia have performed in two different ways regarding their TPES/FEC ratio (Figure 6). When Czechoslovakia collapsed, the TPES/FEC trend of Czech Republic started to increase, and the trend of Slovakia decreased. Shortly after that the trend of Slovakia started to increase again. Hungary and Poland, on the other hand, have had decreasing TPES/FEC trends since the 1990s. As such, the energy transformation systems of all these EU Member States are not among the efficient ones. In the 2000s, only Hungary has been below the average EU-28 level.

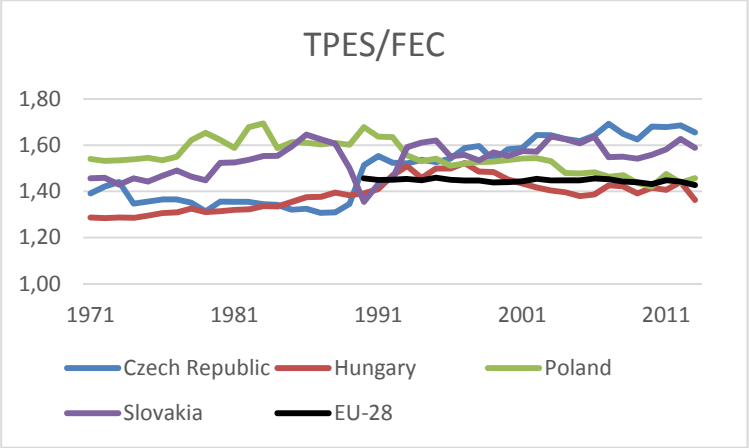

Figure 6. Trend of energy efficiency of the energy transformation system (TPES/FEC ratio) in Czech Republic, Hungary, Poland and Slovakia, 1971-2013.

Figure 7 shows the TPES/FEC trends of four Member States recently joining the European Union. The trends of Croatia and Slovenia are decreasing during the period of their data availability (1990-2013). During the same period, also the trend of Romania is a decreasing one while Bulgaria still tends to increase its trend. Bulgaria has quite an ineffective energy transformation system in the light of the IEA data.

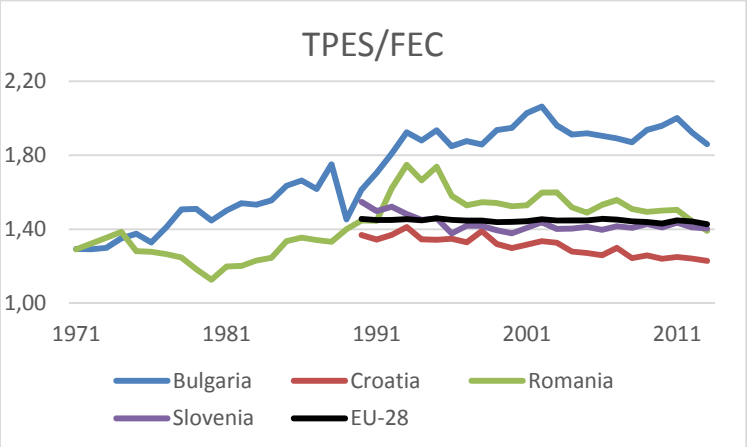

Figure 7. Trend of energy efficiency of the energy transformation system (TPES/FEC ratio) in Bulgaria, Croatia, Romania and Slovenia, 1971/1990-2013.

Trends of energy intensity (FEC/GDP)

When the trends of energy intensity, an inverse of energy efficiency, are looked at, there are not so many differences as in the case of the trend of TPES/FEC above. In practice all EU-28 Member States show a decreasing trend of energy intensity (FEC/GDP), the major difference is in the rate and starting time of the decrease. In the following, the energy intensity trends are presented by using the same groups of EU Member States as in presenting the TPES/FEC trends above. In general, energy intensity is a poor indicator of energy efficiency at the macro level because there are so many possible reasons for change, starting from structural change in the economy from energy intensive industrial branches to lighter branches and services and ending in technological improvements in a part of energy consuming activities of the society.

Figure 8 shows how energy intensity has changed in the Mediterranean Member States. The change in energy intensity is rather small, and in some Member States such as Greece, Portugal and Spain, the decrease has started quite recently. Italy has a nice slightly decreasing trend of energy intensity from the early 1970s, while in the small islands Malta and Cyprus there is quite a lot of variation. Malta is exceptional case of TPES/FEC with an increasing trend of energy intensity in the most recent years of the analysis.

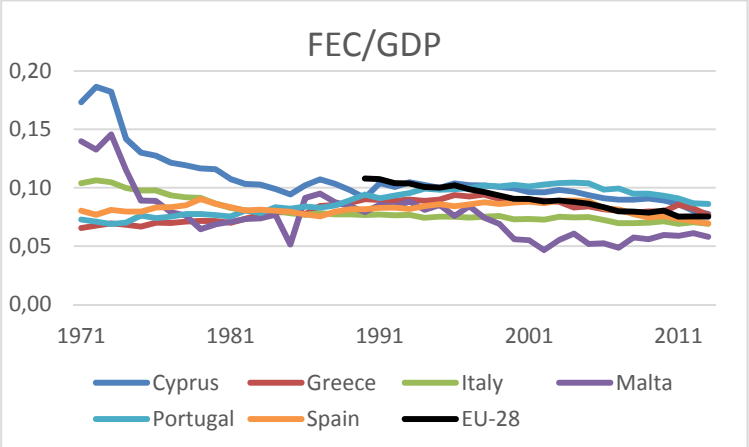

Figure 8. Trend of energy intensity (FEC/GDP) in Cyprus, Greece, Italy, Malta, Portugal and Spain, 1971-2013

Figure 9 shows the long-term decreasing trend of energy intensity in the large EU Member States France, Germany and the United Kingdom. The level of energy intensity recently reached by the UK, 0.05 Mtoe/1000 USD_{2005}, is one of the lowest in the whole European Union. Denmark (Figure 13 below) and Ireland (Figure 14 below) are the closest competitors. In these Member States, one Mtoe of consumed energy produces GDP worth 20 000 USD_{2005}.

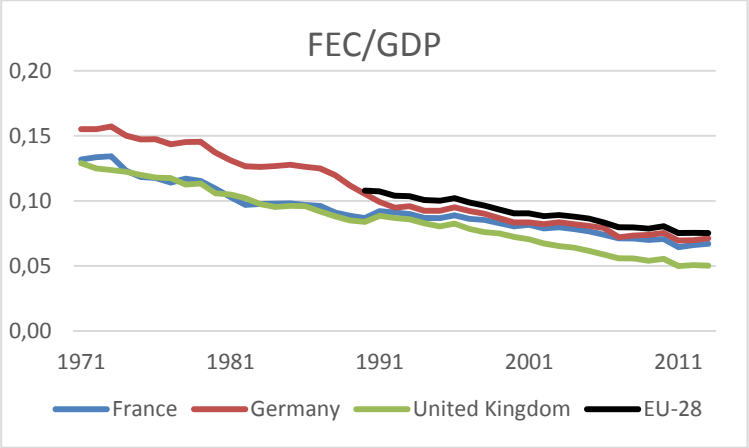

Figure 9. Trend of energy intensity (FEC/GDP) in France, Germany, and the United KIngdom, 1971-2013

In the Nordic Member States Denmark, Finland and Sweden (Figure 10), a clear decreasing trend of energy intensity can be observed. Only during the recession periods the decreasing trend has been shortly interrupted in Finland and Sweden. As noted above, Denmark has reached a level of energy intensity among the lowest in the whole EU.

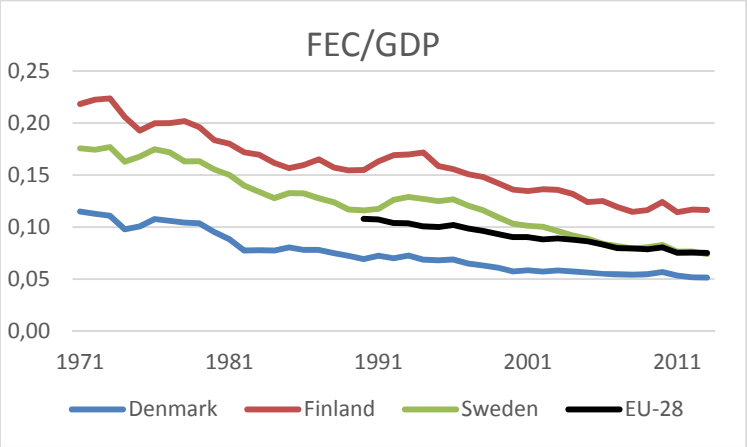

Figure 10. Trend of energy intensity (FEC/GDP) in Denmark, Finland and Sweden, 1971-2013.

Figure 11 describes the energy intensity trends in the Benelux countries Belgium, Luxembourg and the Netherlands, and also in Austria and Ireland. The trends are decreasing ones, and Ireland together with Denmark (Figure 13 above) and the UK (Figure 9 above) has had one of the lowest energy intensities in the European Union during the recent years. The 2013 values, for example, were 0.047, 0.050 and 0.051 Mtoe/USD_{2005} for Ireland, the UK and Denmark, respectively, while the value for EU-28 was 0.075 Mtoe/USD_{2005} in 2013.

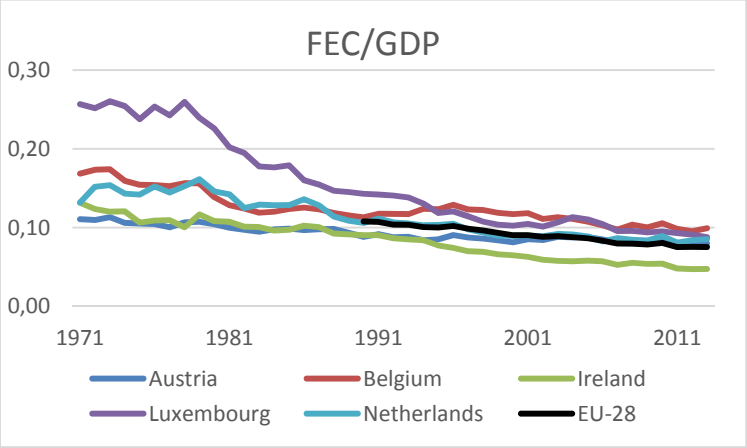

Figure 11. Trend of energy intensity (FEC/GDP) in Austria, Belgium, Ireland, Luxembourg and the Netherlands, 1971-2013.

The Baltic Member States have data in the IEA database from the year 1990 onwards. In these countries, however, the decrease of energy intensity has been quite a rapid one (Figure 12). However, these Member States still have quite a high energy intensity rate around 0.2 Mtoe/1000 USD_{2005}, which is clearly above the EU-28 average.

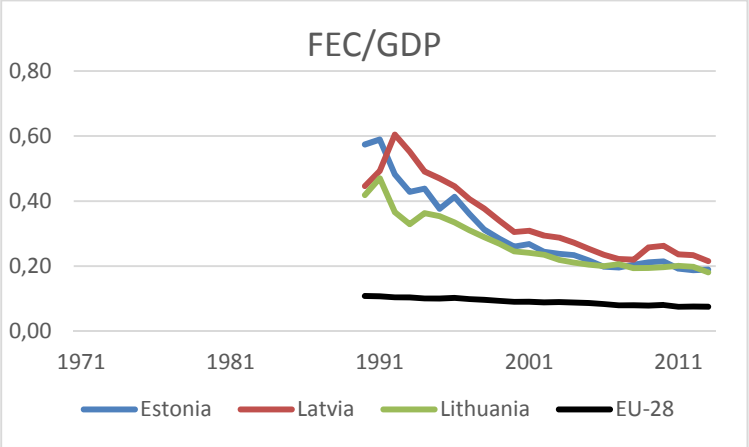

Figure 12. Trend of energy intensity (FEC/GDP) in Estonia, Latvia and Lithuania, 1990-2013.

The East European Member States Czech Republic, Hungary, Poland, and Slovakia also have a decreasing trend in energy intensity (Figure 13). The trends have turned into continuous decrease in the 1990s, before that there have been several increasing phases too. The most recent values are very close to each other, around 0.15 Mtoe/1000 USD_{2005}.

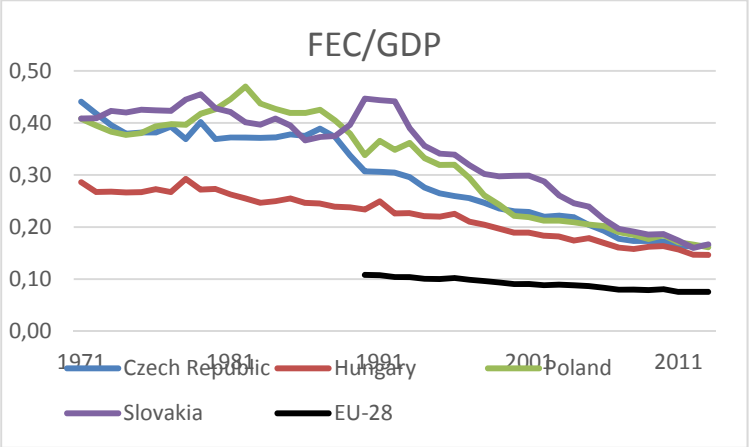

Figure 13. Trend of energy intensity (FEC/GDP) in Czech Republic, Hungary, Poland and Slovakia, 1971-2013.

Figure 14 shows how the energy intensity trends of Bulgaria and Romania have come down from the high values in early 1970s towards the level of 0.2 Mtoe/1000 USD_{2005}. In comparison, the trends of Croatia and Slovenia are quite flat, but their nicely decreasing trends during the 2000s are hidden by the scale of Figure 17 caused by the high 1970s values of Bulgaria and Romania.

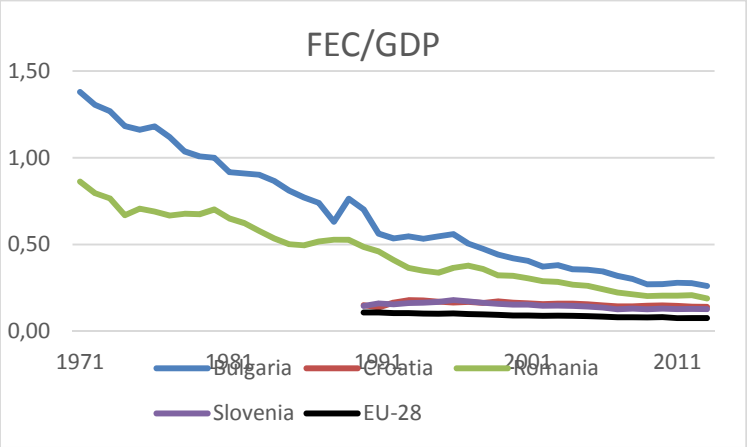

Figure 14. Trend of energy intensity (FEC/GDP) in Bulgaria, Croatia, Romania and Slovenia, 1971/1990-2013.

Energy efficiency as a driver of total primary energy supply (TPES)

In the following, change total primary energy supply (ΔTPES) will be decomposed into the relative contributions of the drivers described above in Equation (2). Data used in this decomposition activity is taken from the International Energy Agency online database (IEA 2015). This data includes total primary energy supply (TPES), final energy consumption (FEC), gross domestic product (GDP) in real prices (in 2005 USD, adjusted by exchange rates), and number of population. The data used in the analyses covers the years 1990-2013 and it is taken from International Energy Agency (IEA 2015).

The results are based on an analysis of incremental (annual) changes, and they are always presented as percentage of a selected base year value of the decomposed indicator, i.e. total primary energy supply (TPES). Tables 1-4 show results from analyses carried out for the years 1990-2013, divided into four time periods: 1990-2000 (Table 1), 2000-2005 (Table 2), 2005-2010 (Table 3) and 2010-2013 (Table 4). The main results are the relative contributions of the energy efficiency related drivers TPES/FEC and FEC/GDP as well as other drivers, i.e. GDP/POP and POP, to the change of total primary energy supply (ΔTPES). The incremental effects are summed up for each time period and presented as percentage from the absolute TPES value of the first year of each time period. Basic statistical info (median, average, standard deviation and minimum and maximum values) on the annual effects during each of the selected time periods (as percentage of the previous year's TPES value) are presented as well.

T

Table 1. Results of total primary energy supply (ΔTPES) decomposition analysis for EU Member States and EU15 and EU-28 aggregates, 1990-2000. Cumulative effects are sums of incremental (annual) effects.

EU-28 Member State	ΔTPES 1990-2000, % of 1990 TPES	Cumulative TPES/FEC effect, % of 1990 TPES	Statistical info on incremental TPES/FEC effects, % of previous year's TPES					Cumulative FEC/GDP effect, % of 1990 TPES	Statistical info on incremental FEC/GDP effects, % of previous year's TPES					Cumulative GDP/POP effect, % of 1990 TPES	Cumulative POP effect, % of 1990 TPES
			Md	Av.	Stdev	Min	Max		Md	Av.	Stdev	Min	Max		
Austria	6.6	-1.9	-0.4	-0.4	1.3	-2.3	2.3	-4.1	-2.1	-0.8	3.7	-5.0	6.1	10.6	2.0
Belgium	9.7	-3.1	-0.5	-0.7	1.1	-3.1	1.1	1.2	-0.4	0.4	3.3	-4.7	5.6	10.2	1.4
Bulgaria	-12.9	5.4	2.2	1.8	3.6	-4.6	6.4	-15.2	-5.0	-4.7	6.7	-19.5	2.6	-1.2	-1.9
Croatia	-6.0	-2.0	-0.8	-0.5	3.1	-5.2	4.6	2.6	-2.2	1.0	7.8	-8.3	18.3	-3.5	-3.0
Cyprus	19.8	-1.4	2.3	-0.2	8.2	-15.2	10.5	2.4	-1.3	0.9	5.0	-3.5	13.2	10.4	8.4
Czech	-5.8	1.3	0.8	0.5	2.2	-3.7	3.1	-7.9	-2.6	-2.8	2.0	-6.9	-0.3	1.1	-0.3
Denmark	2.5	-0.3	-0.8	0.1	4.4	-5.0	9.0	-7.4	-3.1	-1.8	3.8	-5.8	4.8	8.7	1.5
Estonia	-14.1	1.9	-0.4	0.7	4.4	-6.1	9.7	-12.9	-9.9	-7.3	9.1	-17.3	9.9	-0.7	-2.4
Finland	7.3	1.6	0.1	0.4	3.6	-5.9	5.8	-8.0	-1.8	-1.3	3.9	-7.7	5.4	11.7	2.1
France	8.1	-1.0	-0.2	-0.1	2.1	-2.6	3.7	-5.6	-1.2	-0.7	3.0	-3.4	6.1	11.5	3.1
Germany	-1.6	-0.1	-0.3	0.0	0.8	-1.2	1.5	-8.5	-3.4	-2.3	2.8	-6.1	3.0	5.8	1.3
Greece	8.1	-0.2	0.2	-0.1	2.2	-4.2	2.5	-0.2	-0.5	0.0	2.3	-4.1	4.4	6.6	1.8
Hungary	-5.8	1.8	0.7	0.4	2.5	-3.4	4.0	-8.1	-2.7	-2.1	4.5	-9.4	6.3	1.2	-0.6
Ireland	12.9	-1.2	0.0	-0.2	1.5	-3.6	1.8	-12.4	-3.1	-3.4	2.6	-8.4	0.1	23.5	3.1
Italy	6.4	1.8	0.1	0.5	1.6	-1.1	4.2	-2.0	0.2	-0.5	1.8	-4.0	1.4	6.5	0.2
Latvia	-21.4	-1.7	-0.5	-0.5	1.3	-2.7	1.6	-5.2	-8.0	-3.8	10.0	-11.1	18.9	-11.3	-3.2
Lithuania	-27.7	2.9	2.3	0.6	7.0	-10.4	8.5	-16.0	-6.9	-4.7	9.3	-20.3	12.0	-13.2	-1.5
Luxembourg	-0.4	-5.2	-1.2	-1.7	1.4	-3.9	-0.1	-10.2	-2.8	-3.3	3.2	-9.1	1.7	10.5	4.6
Malta	-0.4	-5.7	-4.5	-1.5	11.8	-18.5	18.6	-11.0	-4.5	-3.2	10.2	-20.1	11.2	13.7	2.6
Netherlands	5.2	-1.7	-0.4	-0.4	1.2	-2.0	1.3	-8.5	-1.7	-1.7	3.6	-6.9	5.1	12.3	3.1
Poland	-4.2	-2.6	0.0	-0.9	1.9	-5.0	0.7	-11.9	-6.0	-4.2	6.2	-11.6	7.7	10.1	0.2
Portugal	20.6	0.5	0.0	0.2	3.7	-4.8	7.2	4.5	1.1	0.9	2.1	-3.4	4.0	14.0	1.7
Romania	-15.5	1.7	-0.2	0.5	6.0	-9.6	11.0	-11.3	-4.8	-4.0	6.3	-11.5	8.1	-4.8	-1.0
Slovakia	-6.5	4.7	0.9	1.3	3.6	-4.4	8.7	-13.2	-2.9	-4.0	4.3	-12.4	0.3	1.3	0.6
Slovenia	5.2	-5.0	-1.4	-1.2	2.6	-5.9	3.1	1.4	-1.1	0.6	5.2	-4.9	9.7	8.9	-0.2
Spain	15.7	-2.1	-0.3	-0.4	1.3	-2.1	2.0	3.4	1.5	0.7	1.8	-2.0	3.0	12.7	1.7
Sweden	0.7	-8.0	-0.4	-0.8	4.0	-10.1	4.2	-11.7	-1.6	-1.2	4.1	-5.9	6.8	17.1	3.3
UK	3.1	-0.3	0.0	-0.1	0.8	-1.5	1.1	-6.1	-2.3	-1.5	3.2	-5.0	5.4	8.4	1.1
EU-15	*4.3*	*-0.5*	*-0.1*	*-0.1*	*0.4*	*-0.5*	*0.6*	*-5.3*	*-1.6*	*-1.2*	*1.7*	*-3.0*	*1.8*	*8.7*	*1.5*
EU-28	*1.2*	*-0.5*	*-0.1*	*-0.1*	*0.4*	*-0.6*	*0.8*	*-7.3*	*-2.6*	*-1.8*	*1.8*	*-3.3*	*2.0*	*8.1*	*0.8*

Table 2. Results of total primary energy supply (ΔTPES) decomposition analysis for EU-28 Member States, 2000-2005. Cumulative effects are sums of incremental (annual) effects.

EU-28 Member State	ΔTPES 2000-2005, % of 2000 TPES	Cumulative TPES/FEC effect, % of 2000 TPES	Statistical info on incremental TPES/FEC effects, % of previous year's TPES					Cumulative FEC/GDP effect, % of 2000 TPES	Statistical info on incremental FEC/GDP effects, % of previous year's TPES					Cumulative GDP/POP effect, % of 2000 TPES	Cumulative POP effect, % of 2000 TPES
			Md	Av.	Stdev	Min	Max		Md	Av.	Stdev	Min	Max		
Austria	8.5	0.3	0.2	0.1	0.4	-0.4	0.5	3.8	0.7	1.6	2.9	-1.0	4.8	3.0	1.4
Belgium	0.2	0.0	0.9	0.0	1.6	-2.3	1.4	-4.3	-2.1	-1.7	3.4	-6.4	2.2	3.3	1.1
Bulgaria	3.1	-0.7	0.4	-0.3	3.6	-5.1	4.1	-7.8	-3.7	-3.4	4.3	-8.5	2.3	14.0	-2.5
Croatia	6.6	-1.2	-0.7	-0.4	2.1	-3.6	1.5	-3.2	-2.7	-1.3	2.2	-3.0	2.0	10.9	0.1
Cyprus	1.3	-2.2	-0.6	-1.1	5.0	-8.9	4.7	-2.1	-1.5	-1.2	2.3	-3.2	2.1	3.6	1.9
Czech	3.3	0.7	0.0	0.4	1.8	-1.0	3.5	-4.4	-1.5	-2.4	3.1	-6.9	1.1	7.1	-0.1
Denmark	0.5	-1.3	0.4	-0.6	3.2	-4.3	3.5	-0.8	-1.5	-0.4	2.0	-2.0	1.9	2.0	0.6
Estonia	3.4	-2.3	-2.8	-1.3	4.1	-4.6	5.7	-6.2	-2.6	-3.5	4.7	-9.0	3.0	13.0	-1.0
Finland	3.7	1.5	1.3	0.6	3.2	-4.5	4.0	-6.1	-1.1	-1.8	2.7	-5.8	1.3	7.4	0.9
France	5.3	2.9	0.5	0.8	1.1	-0.2	2.6	-3.6	-1.8	-1.0	2.2	-3.5	1.5	3.3	2.6
Germany	0.1	0.2	0.3	0.1	1.2	-1.5	1.2	-1.3	-1.5	-0.6	1.5	-1.8	1.7	1.1	0.1
Greece	3.6	-0.3	-0.1	-0.2	1.9	-2.5	2.8	-2.3	-1.0	-1.4	2.6	-5.8	1.1	5.7	0.5
Hungary	4.8	-2.5	-1.2	-1.0	0.3	-1.2	-0.5	-2.8	-0.7	-1.1	2.8	-4.4	2.6	10.6	-0.6
Ireland	1.9	-2.5	-0.6	-1.4	3.2	-6.0	2.1	-4.0	-2.3	-2.3	2.6	-6.0	1.1	5.1	3.2
Italy	2.9	-0.2	0.4	-0.1	1.1	-2.0	0.6	1.1	0.3	0.5	1.7	-0.7	3.4	1.0	0.9
Latvia	10.2	-2.4	-1.0	-0.8	1.5	-2.3	1.2	-11.9	-4.9	-3.8	3.3	-7.2	1.3	27.9	-3.5
Lithuania	16.8	0.4	1.5	0.7	7.7	-10.2	11.1	-15.8	-2.8	-3.7	2.0	-7.0	-2.0	36.9	-4.6
Luxembourg	12.9	2.0	0.6	0.9	2.1	-1.3	4.3	3.5	2.3	1.6	4.5	-3.6	6.3	4.2	3.3
Malta	9.4	10.6	5.7	6.1	13.0	-9.0	19.6	-3.0	-1.7	-1.3	15.2	-16.3	18.0	0.0	1.8
Netherlands	3.3	0.7	0.4	0.3	0.8	-0.5	1.4	-0.4	-0.5	-0.1	2.1	-2.6	3.2	1.7	1.2
Poland	1.2	-1.2	-0.1	-0.8	1.5	-3.4	0.5	-2.4	-1.4	-1.5	1.1	-3.1	-0.1	4.8	-0.1
Portugal	3.2	0.8	0.7	0.4	2.0	-2.9	2.2	0.5	0.3	0.2	1.2	-1.3	1.6	1.0	0.9
Romania	2.7	-1.1	0.0	-0.4	3.5	-5.1	4.4	-8.7	-4.3	-4.0	1.9	-5.8	-1.5	14.8	-2.2
Slovakia	3.0	1.7	-0.2	0.7	2.1	-1.1	4.1	-11.2	-3.7	-4.4	3.7	-9.9	0.1	12.5	-0.1
Slovenia	6.3	1.2	0.7	0.5	1.9	-2.6	2.2	-3.6	-1.3	-1.5	2.2	-4.6	0.9	8.5	0.2
Spain	7.2	-1.1	-0.6	-0.5	1.7	-2.1	1.5	0.5	0.3	0.2	1.5	-1.4	2.4	4.0	3.8
Sweden	7.7	9.9	1.3	2.1	3.4	-1.3	6.8	-14.9	-3.4	-3.0	1.5	-4.8	-0.9	11.0	1.8
UK	-0.1	0.6	0.3	0.3	0.9	-0.9	1.5	-6.8	-3.0	-3.2	1.0	-4.6	-2.0	5.1	1.1
EU-15	*2.4*	*0.5*	*0.2*	*0.2*	*0.4*	*-0.5*	*0.6*	*-2.2*	*-1.5*	*-0.9*	*1.4*	*-2.2*	*1.0*	*2.9*	*1.3*
EU-28	*2.5*	*0.2*	*0.0*	*0.1*	*0.4*	*-0.4*	*0.7*	*-2.1*	*-1.4*	*-0.9*	*1.3*	*-2.3*	*1.0*	*3.6*	*0.8*

Table 3. Results of total primary energy supply (ΔTPES) decomposition analysis for EU-28 Member States, 2005-2010. Cumulative effects are sums of incremental (annual) effects.

EU-28 Member State	ΔTPES 2005-2010, % of 2005 TPES	Cumulative TPES/FEC effect, % of 2005 TPES	Statistical info on incremental TPES/FEC effects, % of previous year's TPES					Cumulative FEC/GDP effect, % of 2005 TPES	Statistical info on incremental FEC/GDP effects, % of previous year's TPES					Cumulative GDP/POP effect, % of 2005 TPES	Cumulative POP effect, % of 2005 TPES
			Md	Av.	Stdev	Min	Max		Md	Av.	Stdev	Min	Max		
Austria	0.5	-0.3	0.4	-0.1	1.6	-2.7	1.6	-2.1	-0.6	-0.9	3.5	-5.2	3.3	2.2	0.7
Belgium	2.1	-0.4	0.8	-0.2	2.5	-4.3	2.3	-1.0	-3.3	-0.3	5.7	-5.5	6.3	1.4	2.1
Bulgaria	-4.4	0.7	-0.7	0.4	1.8	-1.1	3.3	-11.3	-5.8	-5.2	4.1	-10.2	0.2	8.1	-1.9
Croatia	-1.7	-1.1	-1.0	-0.5	2.8	-4.3	3.2	-1.7	-0.4	-0.8	2.8	-4.0	2.4	1.3	-0.2
Cyprus	3.1	0.6	1.9	0.5	2.5	-3.0	2.8	-1.6	-1.4	-1.0	1.6	-2.8	1.1	0.1	4.0
Czech	-0.5	1.4	1.5	0.8	2.7	-2.6	3.5	-6.6	-2.3	-3.4	3.6	-8.4	-0.1	3.6	1.1
Denmark	1.2	0.8	-0.2	0.5	3.3	-2.7	6.1	0.2	-0.5	0.1	2.4	-2.7	3.9	-0.8	0.9
Estonia	2.4	3.3	0.5	2.3	6.0	-2.8	11.3	-0.4	1.4	-0.3	5.6	-9.5	4.5	0.2	-0.7
Finland	4.2	1.4	-0.3	0.5	2.2	-1.6	3.9	-0.2	0.9	0.1	4.6	-4.8	6.8	1.6	1.4
France	-2.5	0.5	0.2	0.1	0.3	-0.4	0.4	-5.8	-1.6	-1.6	2.1	-3.9	1.1	0.7	2.0
Germany	-1.3	-0.9	-1.1	-0.5	1.3	-1.8	1.0	-3.0	0.5	-1.3	4.7	-9.3	2.3	3.0	-0.4
Greece	-2.8	-0.7	-0.6	-0.5	2.4	-2.9	3.5	-1.7	-1.5	-1.1	1.8	-2.9	1.6	-0.5	0.2
Hungary	-3.4	1.3	0.5	0.5	1.9	-2.1	2.7	-4.5	-1.6	-1.8	3.5	-5.4	2.6	0.2	-0.4
Ireland	-0.3	1.7	1.0	1.0	4.7	-3.7	6.0	-2.3	-1.2	-1.4	4.6	-8.1	4.6	-2.8	3.1
Italy	-3.0	-0.5	-0.1	-0.2	1.0	-1.3	1.2	-2.0	0.0	-1.0	2.5	-3.9	1.8	-1.6	1.1
Latvia	-0.3	-0.5	-0.3	-0.1	1.0	-1.4	1.0	1.9	-0.8	0.7	9.2	-7.6	15.6	2.2	-3.9
Lithuania	-14.7	-14.9	-4.4	-4.4	11.4	-21.9	7.2	-3.3	0.1	-0.8	3.6	-6.2	3.1	8.5	-4.9
Luxembourg	-1.5	-0.1	-0.3	0.0	0.7	-0.8	1.1	-5.5	-1.8	-2.9	4.2	-8.6	1.3	1.2	3.0
Malta	-2.2	-10.2	-5.7	-6.3	12.3	-24.6	9.3	4.3	1.0	2.7	9.2	-7.7	16.4	2.2	1.5
Netherlands	3.1	-0.9	0.5	-0.4	3.3	-5.8	2.7	0.3	-1.1	0.2	5.6	-7.2	6.6	2.8	0.9
Poland	2.8	-1.3	-1.1	-0.8	1.2	-2.3	0.5	-3.4	-2.9	-2.1	3.8	-6.0	4.1	7.2	0.3
Portugal	-4.8	-1.7	-1.3	-0.8	2.5	-3.6	1.8	-4.4	-1.7	-2.1	2.7	-5.2	1.0	1.0	0.3
Romania	-3.9	0.3	0.4	0.2	2.3	-3.2	2.8	-10.4	-4.7	-4.9	3.7	-8.2	0.9	8.4	-2.2
Slovakia	-2.7	-1.5	0.1	-0.6	2.8	-5.4	1.7	-12.3	-3.0	-4.9	4.6	-10.7	0.6	10.8	0.4
Slovenia	-0.3	-0.1	-0.6	-0.1	1.3	-1.3	1.4	-4.2	-2.7	-1.7	4.8	-8.1	3.0	2.9	1.2
Spain	-4.3	-0.1	-0.9	-0.1	1.7	-1.5	2.6	-6.5	-3.7	-3.0	3.2	-6.8	1.4	-0.4	2.7
Sweden	-1.4	-2.2	-0.8	-0.4	3.2	-4.8	3.1	-7.4	-2.8	-1.4	3.4	-5.4	2.9	4.3	3.8
UK	-3.8	-0.7	-1.0	-0.3	1.3	-1.4	1.7	-4.3	-3.1	-2.1	3.4	-5.1	2.8	-0.3	1.5
EU-15	*-2.0*	*-0.5*	*-0.3*	*-0.2*	*0.5*	*-0.6*	*0.5*	*-3.3*	*-0.9*	*-1.4*	*2.8*	*-4.4*	*2.5*	*0.6*	*1.2*
EU-28	*-1.7*	*-0.5*	*-0.3*	*-0.2*	*0.5*	*-0.6*	*0.6*	*-3.3*	*-1.1*	*-1.4*	*2.7*	*-4.4*	*2.4*	*1.3*	*0.8*

Table 4. Results of total primary energy supply (ΔTPES) decomposition analysis for EU-28 Member States, 2010-2013. Cumulative effects are sums of incremental (annual) effects.

EU-28 Member State	ΔTPES 2010-2013, % of 2010 TPES	Cumulative TPES/FEC effect, % of 2010 TPES	Statistical info on incremental TPES/FEC effects, % of previous year's TPES					Cumulative FEC/GDP effect, % of 2010 TPES	Statistical info on incremental FEC/GDP effects, % of previous year's TPES					Cumulative GDP/POP effect, % of 2010 TPES	Cumulative POP effect, % of 2010 TPES
			Md	Av.	Stdev	Min	Max		Md	Av.	Stdev	Min	Max		
Austria	-1.3	-0.8	-0.8	-0.6	1.1	-1.5	0.6	-2.5	0.0	-1.7	4.3	-6.6	1.5	1.3	0.7
Belgium	-4.6	-2.1	-0.9	-1.2	1.1	-2.5	-0.3	-3.6	-3.2	-1.9	5.6	-6.8	4.2	0.0	1.2
Bulgaria	-2.2	-2.1	-3.2	-1.6	3.3	-3.9	2.2	-1.5	-1.1	-1.2	4.6	-5.8	3.4	2.2	-0.7
Croatia	-4.6	-0.4	-0.7	-0.3	0.9	-1.0	0.8	-2.7	-1.9	-2.0	1.4	-3.3	-0.6	0.2	-1.7
Cyprus	-7.0	-0.5	0.1	-0.6	4.2	-5.1	3.3	-4.3	-3.3	-4.5	2.1	-6.8	-3.2	-4.1	1.9
Czech	-2.2	-0.6	-0.1	-0.5	1.2	-1.8	0.4	-1.8	-0.1	-1.5	3.4	-5.4	0.9	0.2	0.0
Denmark	-4.3	-0.5	0.0	-0.3	2.5	-2.9	2.0	-3.8	-3.1	-3.2	2.5	-5.8	-0.8	-0.4	0.4
Estonia	2.5	2.0	3.3	2.3	5.8	-4.0	7.5	-3.7	-2.4	-4.1	6.3	-11.1	1.1	4.5	-0.2
Finland	-5.7	-1.9	-1.0	-1.1	3.1	-4.3	1.9	-3.8	-0.4	-2.1	5.4	-8.2	2.2	-0.9	0.8
France	-2.5	-0.4	-1.4	-0.2	3.1	-2.6	3.3	-4.1	1.5	-1.7	6.4	-9.1	2.5	1.0	1.1
Germany	-1.2	-0.4	-0.3	-0.4	0.1	-0.4	-0.3	-2.4	0.3	-1.9	5.4	-8.0	2.1	1.5	0.2
Greece	-5.0	2.4	-1.0	2.5	6.4	-1.3	10.0	-1.1	-3.9	-1.2	7.3	-6.8	7.0	-6.1	-0.3
Hungary	-6.6	-1.8	-0.6	-1.2	3.9	-5.4	2.3	-5.7	-3.9	-3.6	3.2	-6.6	-0.2	1.5	-0.6
Ireland	-3.5	0.3	0.3	0.3	1.4	-1.2	1.7	-4.6	-1.4	-4.3	6.4	-11.5	0.2	0.6	0.3
Italy	-3.7	-0.8	-0.1	-0.6	1.7	-2.5	0.7	-1.3	-1.9	-1.0	2.6	-3.1	1.9	-2.2	0.6
Latvia	-2.0	1.2	-0.1	0.7	1.5	-0.1	2.5	-10.8	-8.1	-6.5	4.8	-10.4	-1.1	10.0	-2.4
Lithuania	-0.7	-3.3	-1.1	-1.9	2.5	-4.6	0.1	-4.9	-1.6	-2.7	5.7	-8.8	2.4	10.3	-2.7
Luxembourg	-2.3	-1.0	-0.9	-0.8	0.9	-1.6	0.1	-3.1	-2.6	-2.6	0.8	-3.5	-1.9	-1.2	2.9
Malta	-3.5	-4.4	0.0	-4.3	8.3	-13.9	1.1	-0.8	-1.3	-0.7	4.4	-4.8	4.0	1.7	0.0
Netherlands	-3.6	-1.2	-0.6	-0.9	1.5	-2.5	0.5	-2.1	1.7	-1.3	7.0	-9.3	3.7	-0.8	0.5
Poland	-0.9	0.8	1.4	0.9	3.2	-2.5	3.8	-4.3	-3.1	-4.5	2.9	-7.8	-2.5	2.6	0.0
Portugal	-3.6	3.7	2.8	2.6	1.0	1.5	3.5	-3.8	-2.4	-2.6	2.1	-4.8	-0.6	-3.1	-0.5
Romania	-4.3	-3.5	-3.5	-2.4	2.3	-4.1	0.2	-3.6	-0.3	-2.6	5.4	-8.8	1.3	3.4	-0.6
Slovakia	-1.8	1.0	1.4	0.6	2.7	-2.4	2.8	-5.6	-6.8	-3.6	6.8	-8.3	4.2	3.0	-0.2
Slovenia	-2.6	-0.2	-0.5	-0.1	1.8	-1.8	1.8	-1.0	-0.8	-0.7	1.3	-2.0	0.7	-1.6	0.2
Spain	-4.2	1.7	2.1	1.2	4.1	-3.3	4.7	-4.0	-2.7	-2.8	0.3	-3.1	-2.5	-1.9	0.0
Sweden	-3.6	4.6	0.9	1.4	1.7	0.1	3.3	-12.1	-3.1	-3.7	4.1	-8.0	0.1	1.4	2.5
UK	-2.4	0.2	0.6	0.1	1.5	-1.6	1.4	-4.2	-1.1	-3.3	6.2	-10.2	1.5	0.7	0.9
EU-15	*-2.8*	*-0.1*	*-0.2*	*-0.1*	*1.0*	*-1.0*	*1.0*	*-3.2*	*0.0*	*-2.2*	*4.2*	*-7.0*	*0.5*	*0.0*	*0.5*
EU-28	*-2.7*	*-0.1*	*-0.4*	*-0.1*	*1.1*	*-1.0*	*1.2*	*-3.2*	*-0.3*	*-2.2*	*3.8*	*-6.6*	*0.2*	*0.3*	*0.3*

In Tables 1-4, the most decreasing and the most increasing values for the effects of TPES/FEC and FEC/GDP have been marked with different shades of green (decreasing effect) and red (increasing effect). The scales of the shades are based on the following decrease/increase categories:

-20.00% or more	bright green
-19.99%...-10.00%	green
-9.99%...-2.50%	light green
-2.49% – 2.49%	white
2.50%...9.99%	light red
10.00%...19.99%	red
20.00% or more	bright red

In the sense how changes in energy efficiency related indicators TPES/FEC and FEC/GDP have contributed to change in total primary energy supply (ΔTPES), the performance of EU Member States as well as the performance of the EU as a whole has been very different during the four different time periods, 1990-2000, 2000-2005, 2005-2010 and 2010.2013.

Results, EU-28 Member States 1990-2000

In the first time period 1990-2000 (Table 1), total primary energy supply increased in 17 Member States and also at the aggregate levels of EU-15 (4.3%) and EU-28 (1.2%). Large increase took place in Portugal (20.6%), Cyprus (19.8%), Spain (15.7%) and Ireland (12.9%). Total primary energy supply decreased in 11 Member States, larges decreases took place in Lithuania (-27.7%), Latvia (-21.4%), Romania (-15.5%), Estonia (14.1%) and Bulgaria (-12.9%). Generally speaking, TPES increased especially in the Mediterranean Member States and decreased in the Baltic and East European Member States. Among the large EU Member States, changes were quite modest, TPES increased in France (8.1%), the UK (3.1%) and Italy (1.8%), and decreased in Germany (-1.6%).

The change in energy intensity (FEC/GDP) had a decreasing effect in 22 Member States and increasing effect in six Member States, i.e. in Portugal, Spain Bulgaria, Cyprus, Slovenia and Belgium (Table 1). Decreasing effect was relatively large (compared to the 1990 absolute TPES value) in Lithuania (-16.0%), Bulgaria (-15.2%), Slovakia (-13.2%), Estonia (-12.9%), Ireland (-12.4%), Poland (-11.9%), Sweden (-11.7%), Romania (-11.3%), Malta (-11.0%), and Luxembourg (-10.2%). From these Member States, in Bulgaria, Estonia and Romania the change in TPES was also large. At the EU aggregate level, change in energy intensity had a modest decreasing effect, -5.3% in EU-15 and -7.3% in EU-28. An interesting observation is that the incremental (annual) change in energy intensity had a large variation in values (large difference in minimum and maximum values and large standard deviation) in those Member States with large decrease in total primary energy supply. The Member States with large increase in TPES had much smaller difference in minimum and maximum values as well as smaller standard deviation of FEC/GDP.

The change in efficiency of the energy transformation process (TPES/FEC) had a decreasing effect in 18 Member States (Table 1). The larges decreasing effects were in Sweden (-8.0%), Malta (-5.7%), Luxembourg (-5.2%), and Slovenia (-5.0%). In most of the Member States with decreasing TPES/FEC effect, however, total primary energy supply increased during the years 1990-2000. Change in TPES/FEC decreased total primary energy supply also in the EU aggregates, -0.5% in EU-15 and the same in EU-28. When looking at the annual changes, Member States such as Malta, Cyprus, Romania and Sweden had large difference in minimum and maximum values and large standard deviation of TPES/FEC with very different change of TPES in percentage (-0.4%, 19.8%, -15.5% and 0.7%, respectively.

EU Member States with a decrease in total primary energy supply (TPES) and decreasing effect in both energy efficiency related drivers in the time period 1990-2000, included Latvia, Poland, Germany, Malta, and Luxembourg. Unlike the others, during this 10-year period Latvia suffered from a decreasing effect of economic growth (GDP/POP).

TPES decomposition results, EU-28 Member States 2000-2005

In the second time period 2000-2005 (Table 2), total primary energy supply (TPES) increased even more, in 27 Member States and in the EU aggregates (2.4% in EU-15 and 2.5% in EU-28, from the absolute TPES value in the year 2000). TPES increase was large in Lithuania (16.8%), Luxembourg (12.9%) and Latvia (10.2%), totally different Member States than in the previous time period. Total primary energy supply decreased only in the UK, and even there very marginally (-0.1%). In France, Germany, and Italy TPES increased 5.3%, 0.1%, and 2.9%, respectively.

Change in energy intensity (FEC/GDP) had in the period 2000-2005 a decreasing effect on TPES in 23 EU Member States (Table 2). A small increasing effect took place in four Member States, i.e. in Austria, Italy, Portugal and Spain, and there was no effect in Belgium. Decreasing effect was large in Lithuania (-15.9%), Sweden (-14.9%), Latvia (-11.9%) and Slovakia (-11.2%). Large Member States France, Germany, and the UK had decreasing effects -3.6%, -1.3%, and -6.8%, respectively. At the aggregate level, change in energy intensity had a decreasing effect, -2.2% in EU-15 and -2.1% in EU-28. Regarding the incremental (annual) values of FEC/GDP change, variation in terms of standard deviation and difference between minimum and maximum values was the largest in Malta.

Change in the efficiency of the energy transformation system (TPES/FEC) decreased total primary energy supply in 13 EU Member States in the period 2000-2005 (Table 2), but the decreasing effects were in all cases only modest, Hungary and Ireland had the largest effects, both -2.5%. The UK was the only one of the large Member States with a decreasing effect (-0.2%). Increasing effects were the largest in Malta (10.6% and Sweden (9.9%). Large Member States France, Germany, and the UK had increasing effects 2.9%, 0.2%, and 0.6%, respectively. EU aggregates had small increasing effects, 0.5% in EU-15 and 0.2% in EU-28. Large variation in annual (incremental) effects took place in Malta and Lithuania.

In general, 2000-2005 was a poor period in terms of impacts of energy efficiency on total primary energy supply, although there were decreasing effects in both of the energy efficiency related drivers in many EU Member States. However, none of the Member States reached a situation where decreasing effects in both energy efficiency related drivers were combined to a decrease in total primary energy supply (TPES) during the period 2000-2005.

TPES decomposition results, EU-28 Member States 2005-2010

In the third time period 2005-2010 (Table 3), total primary energy supply (TPES) decreased in 20 EU Member States and increased in 8 Member States. Largest decreases took place in Lithuania (-14.7%), while in all the others decrease was only modest varying between -4.8% and -0.3%. TPES increases were also modest ones varying between 0.5% and 4.2%. The large EU Member States France, Germany, Italy, and the UK all had a decrease of TPES in 2005-2010; -2.5%, -1.3%, -3.0%, and -3.8%, respectively. At the EU aggregate level, TPES change was -2.0% in EU-15 and -1.7% in EU-28.

Change in energy intensity (FEC/GDP) had a decreasing effect on TPES in 23 Member States in 2005-2010 (Table 3). Large effects were in Slovakia (-12.3%), Bulgaria (-11.3%), and Romania (-10.4%). In other Member States, the decreasing TPES change varied between -7.4% and -0.2%. All the large Member States (France, Germany, Italy, and the UK) had a modest decreasing FEC/GDP effect. The increasing effect in five Member States varied modestly between 0.2% and 4.3%. In both EU aggregates, energy intensity had a -3.3% decreasing effect on TPES. Malta, Latvia, Slovakia and Bulgaria had the largest variation in incremental (annual) FEC/GDP effects.

Change in efficiency of the energy transformation system (TPES/FEC) had a decreasing effect on TPES in 18 Member States but a significant one in Lithuania (-14.9%) and Malta (-10.2%) only (Table 3). These Member States had also a large variation in incremental (annual) effects (large standard deviation and large difference in minimum and maximum values). In other Member States, the decreasing FEC/GDP effect varied between -2.2% and -0.1%. The increasing effect of TPES/FEC in 10 Member States varied between 0.3% and 1.7%. At the EU aggregate level, the effect of TPES/FEC was a decreasing one, -0.5% both in EU-15 and EU-28. The large Member States were close to these figures, even France with an increasing effect of 0.5%. Large variation in incremental (annual) TPES/FEC effects (large standard deviation and large difference between minimum and maximum values) can be identified in Malta, Lithuania and Estonia.

In general, 2005-2010 was quite a good time period in terms of energy efficiency impact on total primary energy supply. 10 Member States, i.e. Croatia, Greece, Italy, Lithuania, Luxembourg, Portugal, Slovakia, Spain, Sweden, and the UK, as well as both EU aggregates EU-15 and EU-28, had a decrease in TPES and decreasing effect in both energy efficiency related drivers, FEC/GDP and TPES/FEC.

TPES decomposition results, EU-28 Member States 2010–2013

In the most recent time period 2010-2013 (Table 4), total primary energy supply (TPES) decreased in all EU Member States except Estonia, where TPES increased 2.5%. Decrease in this short 3-year time period varied between -7.0% and -0.7%. In the whole EU, decrease was -2.8% in EU-15 and -2.7% in EU-28. All large EU member States France, Germany, Italy, and the UK were close to these EU-level decreasing effects.

Change in the energy intensity (FEC/GDP) decreased total primary energy supply (TPES) in all 28 EU Member States during 2010-2013 (Table 4). Sweden (-12.1%) and Latvia (-10.8%) had the largest decreasing effects, while in other Member States, including the large ones, the value varied between -5.7% and -0.8%. The EU aggregate value was -3.2% for both EU-15 and EU-28. Regarding the annual (incremental) effects, quite a large variation took place during this time period in Estonia, Ireland, Latvia, and the UK.

Change in efficiency of the energy transformation system (TPES/FEC) had a decreasing effect in 18 EU Member States, the values varying between -6.6% and -0.2% from the absolute TPES value in 2010 (Table 4). Increasing effect in 10 Member States varied between 0.2% and 4.6%. EU-15 and EU-28 had both a TPES/FEC effect value -0.1%. Malta and Greece had a large variation in the incremental (annual) values of the TPES/FEC effect in terms of standard deviation and difference between the minimum and maximum values.

The most recent time period 2010-2013 was the shortest but also best in terms of the effects of energy intensity related drivers on total primary energy supply (TPES). 18 out of 28 EU Member States had a decrease in TPES and also a decreasing effect of both energy intensity related drivers, FEC/GDP and TPES/FEC.

Conclusions

In this article, energy efficiency of EU-28 Member States has been studied. Focus has been on macro level indicators of energy efficiency, their long-term historical trends and their decomposed effects on energy consumption (total primary energy supply TPES). In the empirical analyses, the most recent data from the International Energy Agency (IEA 2015) has been used.

The indicators of energy efficiency used in this study are energy intensity of the economy (final energy consumption FEC divided by gross domestic product GDP in fixed USD 2005 prices) and efficiency of the energy transformation system, ratio of total primary energy supply TPES and final energy consumption FEC). The long-term trends of these indicators can be heavily generalized by saying that energy intensity has decreased significantly in most of the EU-28 Member States, but the trend of TPES/FEC ratio is not so clear and varies a lot between different Member States. Increasing use of electricity affects the TPES/FEC ratio very differently, depending on the used primary energy sources (fossil, nuclear, renewables) and modes of electricity production (CHP, condensing power). Essential here is how primary energy is calculated in energy statistics. In some cases such as hydro, wind, and

solar, produced electricity is calculated as such also in primary energy, in some other cases such as nuclear or geothermal, a thermal efficiency is assumed. This may make the use of aggregated energy indicators and their international comparison problematic. Thus, the EU Member States relying on nuclear power and fossil fuels may have a stronger increasing trend in the TPES/FEC ratio than Member States relying on energy sources where the statistical ratio equals to 1. On the other hand, calculation principles are similar for all EU Member States, so it is possible to make comparisons being aware of the statistical calculation procedures.

The effect of energy intensity on total primary energy supply (TPES) was studied by chained two-factor decomposition analysis based on the Advanced Sustainability Approach (ASA) developed by the Finland Futures Research Centre at Turku School of Economics, University of Turku. The analysis was made for the period 1990-2013 using incremental (annual) changes for the first time, and the results were presented as incremental sums for four time periods, the first one was ten years (1990-2000), then two five-year periods (2000-2005, 2005-2010) and the most recent three-year period (2010-2013).

There are quite significant differences between EU Member States' performance in energy efficiency, and this study brings something out of them. There is significant variation between the annual changes among the EU Member States, both in the absolute trends of energy efficiency drivers FEC/GDP and TPES/FEC, as well as in the decomposed effects of these drivers on total primary energy supply. The variation is large especially in small EU Member States and the new EU Member States.

The energy efficiency performance of the EU Member States seems to improve over time. Time period 2000-2005 was the worst period in practically all Member States, but since then total primary energy supply has decreased in many Member States, but not in all of them.

The trend of energy intensity is good in general terms, but in practice it depends not only on good performance in energy efficiency, but also on poor economic performance which is directly reflected into the indicator FEC/GDP. This is important to keep in when looking at the period 2005-2010, which includes the period of the financial crisis. During that time, however, the decreasing effect of driver GPD/POP has a decreasing effect in a few Member States only. However, increasing effect to total primary energy supply is quite small in many Member States during that period.

The trend of TPES/FEC ratio reflects the efficiency of the energy transformation system from primary energy to final energy consumption. In some countries there is a decreasing trend, but also increasing trends have been identified. This may partly be due to changes in real efficiency, but is also influenced by the fact that energy statistics do not treat different energy sources used in electricity production in a similar way. Some energy sources such as hydro, wind and solar have a TPES/FEC ratio of 1, but nuclear has a ratio 3. Fuel-based electricity generation is more coherent in this sense, when primary energy is calculated from the fuel's energy content, and electricity and heat are treated as such in final energy consumption. However, the TPES/FEC ratio does not take into account the efficiency of the appliances consuming the final energy and providing the actual energy service.

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7. FUTURES THINKING FOR EU AND ASIA

China 2030 – The way towards a viable cooperation with China

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Abstract

The paper presents the outcome of a cooperative foresight work that took place simultaneously in EU and China, aiming to produce scenarios for the global innovation environment in 2030, drawing special focus in the cooperation potential between EU and China. The research team has utilised a combination of foresight methodologies such us desk-study analysis, Delphi, media scanning, interviews, exploratory workshops, and patent/paper analysis, in order to identify critical drivers and trends, and draw plausible scenarios for China in 2030.

During the first phase of the study, the team focused on China's current innovation capabilities, and challenges that may drive innovation toward 2030, as well as on specific trends in business model innovation resulting in scenarios for Chinese innovation in 2030. In parallel, in Europe the team focused on the western views towards China (current status and future cooperation potential). In addition, specific technological areas presenting opportunities for research and technological cooperation, and emerging business models and markets are presented and discussed.

Finally, the paper pinpoints specific technological sectors that gather the greatest cooperation potential between EU and China, aiming to support the "future-proof" decisions of policy makers, RTOs, and corporations.

Key words: China, innovation, business model, 2030, scenarios, EU

Introduction and Background

The aim of this research is to investigate the future of the Innovation landscape in China by 2030, and it is performed in the context of the DRAGON-STAR Plus project (funded by the European Commission under Horizon 2020).

The research work has focused on identifying trends, driving forces, and novel business models and markets that will shape Europe, China and the rest of World over the next 20 years, while special focus was drawn upon the interaction between EU and China in the area of Research and Innovation. The overall objective is to identify specific areas with potential for cooperation, and suggest policies for successful bilateral cooperation.

Material and Methods

The research team has followed a multidimensional methodology, in order to validate findings and assess trends and drivers leading to the formulation of future scenarios (*Figure 1*). Furthermore, the research team proceeded with the capitalization of outcomes and results through the interaction with policy making stakeholders. Due to the specific requirements and resources available, the work was performed in parallel by two teams, in Europe and China, and different tools were utilized to match specific needs. The outcomes of the two teams were synthesized periodically, allowing the validation and cross-check of components of the research.

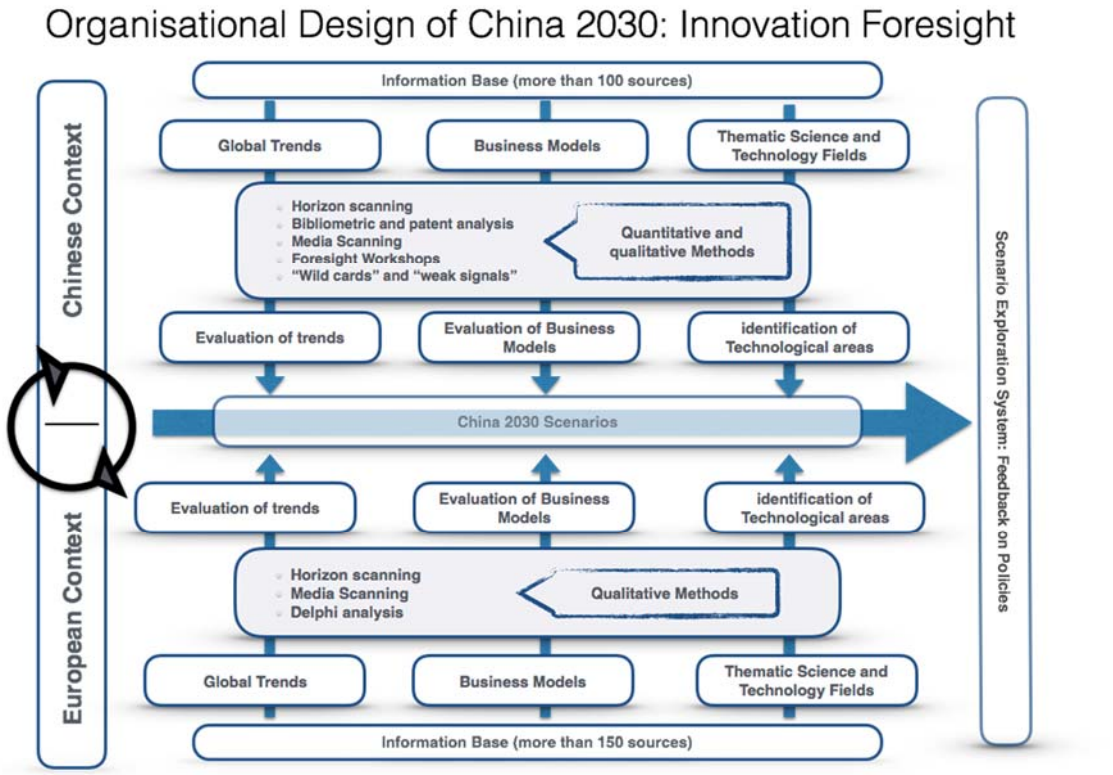


Figure 1: Organisational Design

The basis of the research was the composition of findings of existing body of literature; academic papers, foresight books and studies, executive reports, and the media. Foci were trends, drivers, and novel business models transforming the innovation environment in Europe and China, documented and complemented by a data mining study of Chinese patents and scientific publications to identify key growth areas and knowledge ecosystems. The patent analysis (see Abbas, A, Zhang, L and Khan S.K., 2014), has revealed trends in patent fillings in China and was used to compare them with respective patent fillings in Europe. The desk study provided the necessary knowledge basis to formulate the research, to identify and select relevant trends and drivers, and design the next research steps. Interviews with Chinese innovators were used during the scoping phase to identify and validate emerging business models, and trends in China.

The desk research was further validated through a consultation process that was held in China in the form of a workshop. The interactive workshop in Shanghai aimed in exploring different possible futures for innovation in China toward 2030 using the scenario approach. The full-day workshop was held on May 22nd 2015, with 21 participants representing European multinationals, start-ups, academia, and European national science and innovation agencies.

In order to consolidate the body of research and opinions gained at this point, the research team used the Delphi method, to collect views from various experts on specific trends and technological areas especially as regards the future of EU-China collaboration on research and innovation. 71 experts in total, from 29 countries, coming from various business, research and innovation backgrounds (44% with foresight experience), replied to 55 questions on Trends, Emerging Business Models, and for the perspectives of specific Technology Sectors as regards the future of EU-China Cooperation. The selection of the thematic areas was based on a previous foresight exercise (Gokhberg, 2016) for Russia (Russia 2030: Science and Technology Foresight, but was slightly adapted to better fit our research.

Results

The preliminary findings of the research provide insights for the future innovation environment in China and the perspectives for collaboration with the EU. The extensive patent analysis (*Figures 2 and 3*), focused on growth rates of patents in China and Europe per thematic area, allowing to identify specific areas that present high development, as well as specific topics where China is championing in comparison with Europe, such as Nantennas and Drones. Two sources were used for this analysis. The first source was the complete database of Chinese invention patents from 2012 to 2015, where patents filed from an address in Mainland China were used for the analysis. The second was the database of patents filed with the European Patent Office.

In order to validate the above results and the insights gained through the desk research, the research group proceeded with a consultation process in the form of Workshop. The workshop was divided into two parts; in the first part the participants discussed China's current innovation capabilities, challenges that may drive innovation toward 2030 and trends in business model innovation. In the second part, drivers, options, and scenarios were discussed and analyzed. While a drivers and options had been researched before the workshop and used as input, additional drivers and options were added by the participants. This consultation process resulted in a scenario map for Chinese innovation in 2030. A brief description of the main outputs follows.

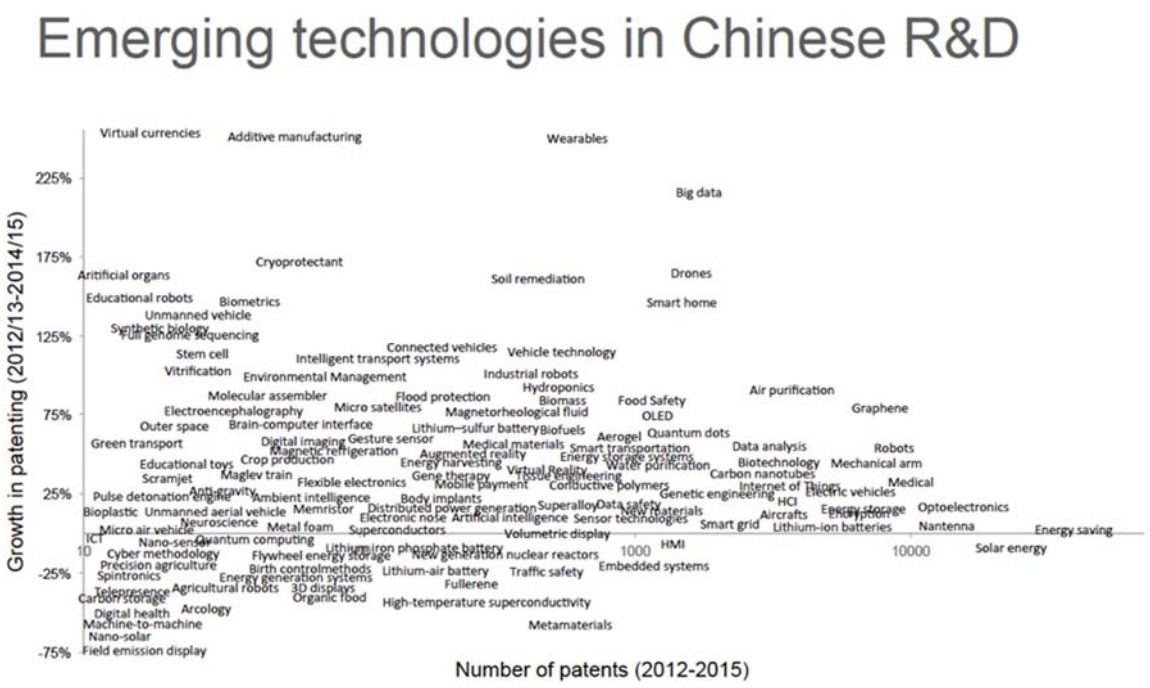


Figure 2: Emerging technologies in Chinese R&D

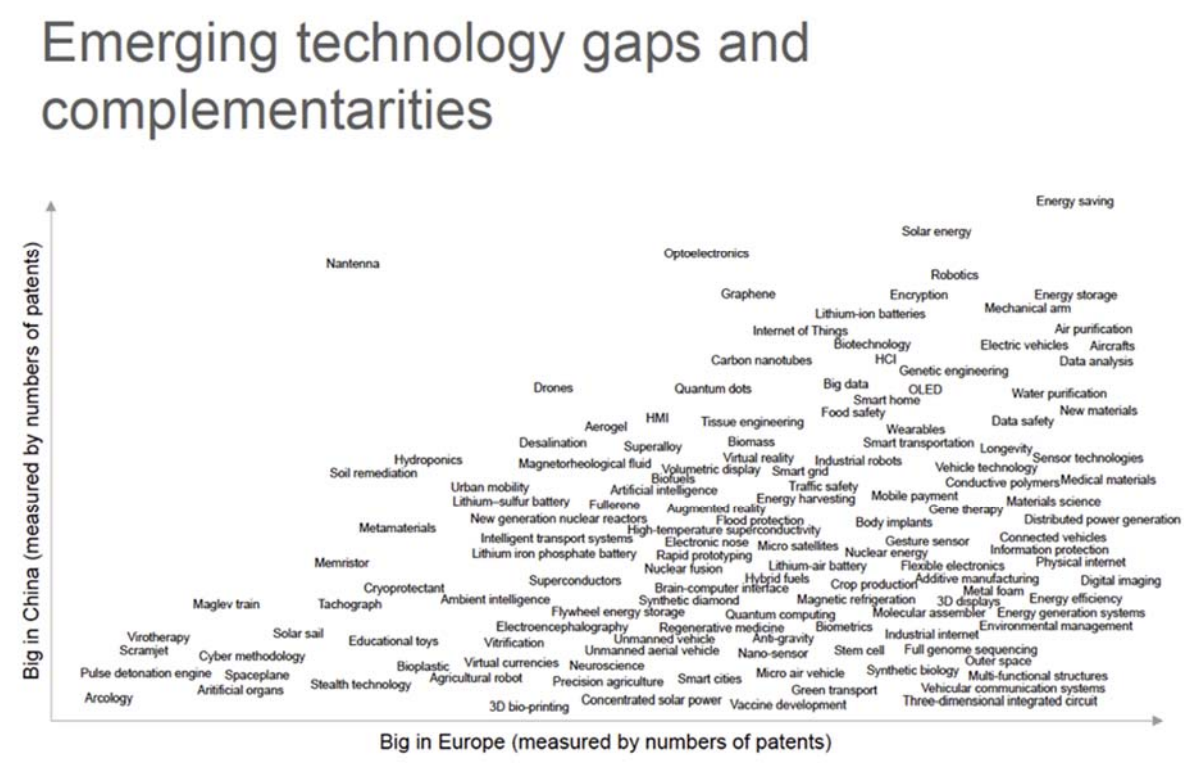


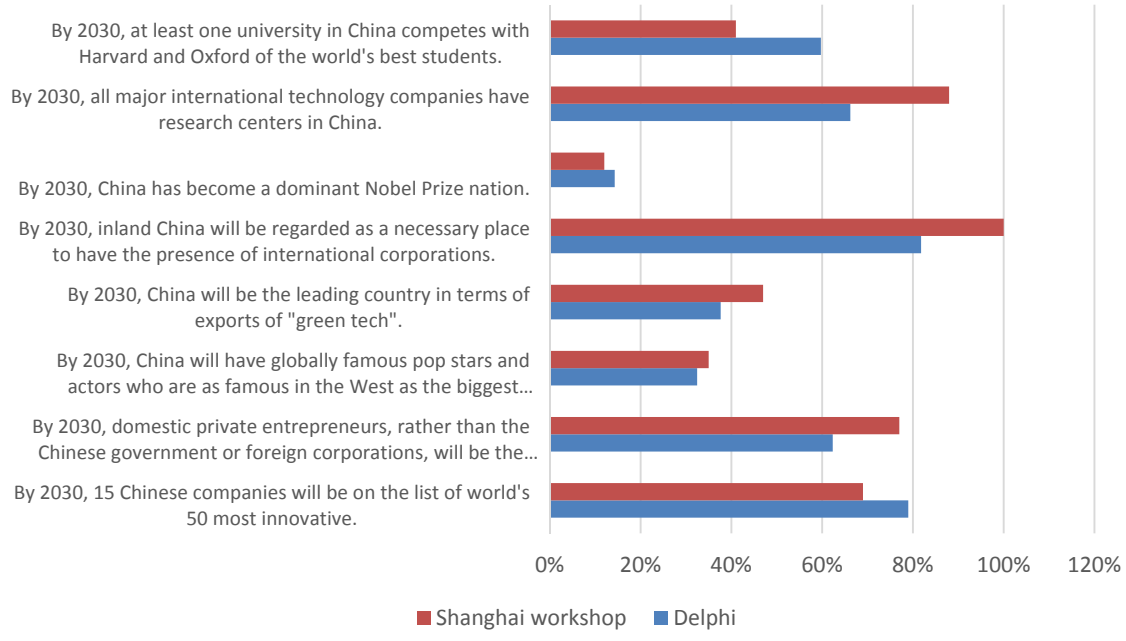
Figure 3: Emerging technology gaps and complementarities

At the start of the workshop, participants were asked to answer a set of introductory questions about innovation in China 2030. The questions were designed to cover different areas related to the focal topic and there were used as a warm up, and as a tool to scan the overall perception of the participants towards China. The same set of questions was also put to the experts participated in the Delphi study, allowing the comparison of the opinions and attitudes of experts settled in China and Europe. Figure 4 summarizes the results.

The results show that, in most of the cases, experts agree on the high performance of China in regard to science and innovation. They are, however, less optimistic when it comes to green technology and the appeal of Chinese culture.

Following the overall framework of the China innovation landscape, the participants were presented with 43 business model cases from China. The business model cases were generated through a review of Chinese news media prior to the workshop, where illustrative cases of different business models were selected. These cases were divided into three categories by the participants: specialized, generic, and traditionalist. *Specialized business models* translated into finding a new way to break into an area and carving out a niche in that area. *Generic business models* typically involve building a platform or creating a space for an ecosystem. Traditionalist models often entail cost-focused innovation, modularization, and process-based innovation in manufacturing.

Figure 4: Expert views about China 2030



As characterized by the participants, specialist business models are seeking specific value, while generalist business models create the conditions for such value to exist, and traditionalist business models focus on what is good enough. Innovation can be found in China in all three categories, but traditionalist models were believed by the participants to be an increasingly 'exhausted mine' with less

importance in the future. In relation to business model innovation, the major trends in China identified by the participants were; (a) the increasingly common practice of cutting out intermediaries and creating market places, (b) the merging of producers and consumers ("prosumers"), and (c) market data increasingly being collected in non-traditional ways.

The next topic of the consultation were China's innovation capabilities based on the country's performance along a number of dimensions in the 2014 study Global Innovation Index (Cornell University, INSEAD, and WIPO, 2014), as well as the size and growth rate of more than 600 major patent categories based on the standard international patent classifications of the World Intellectual Property Organization. The results from the experts input indicate that key strengths to build on include: (a) strong manufacturing capabilities with fast execution, large scale, and a large domestic market; (b) Strong industrial learning and knowledge absorption capabilities; and (c) an entrepreneurial mindset among the Chinese people. On the contrary, capabilities that need improvement include: (a) Academic learning, where basic research, teaching, and language capabilities lag behind; (b) Institutions, which need to become more supportive of innovations; and (c) access to resources, where shortages of food, water, and natural resources are expected to be an important driver of innovation.

At the final stage of the consultation process, future challenges (i.e. trends and drivers) were discussed. *Figure 5* shows the outcome of the discussion on trends that will push innovation in China toward 2030. Areas of important were believed to include the development of smart cities, health care and e-health, ageing infrastructure, values and lifestyles of new generations, and the quest fofr credibility among Chinese brands.

In addition, a set of 9 uncertainty dimensions were identified through research and expert interviews in relation to the focal question: how will innovation in China develop toward 2030? These, nine key uncertainties were provided as input for the discussion, each with three possible options. The groups placed each option on a low impact-high impact as well as a low probability-high probability scale and the values were used as input for the scenario analysis (*figure 6*).

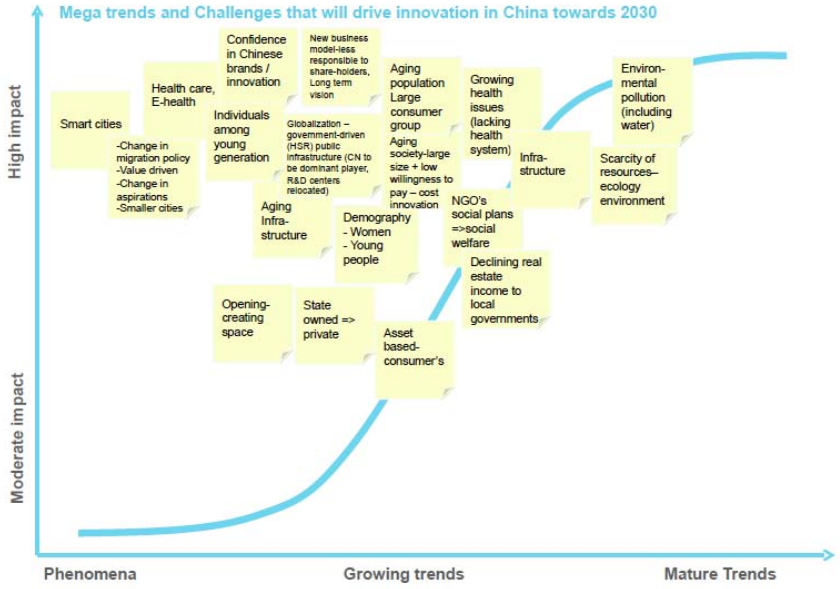


Figure 5. Trends that will drive innovation in China towards 2030

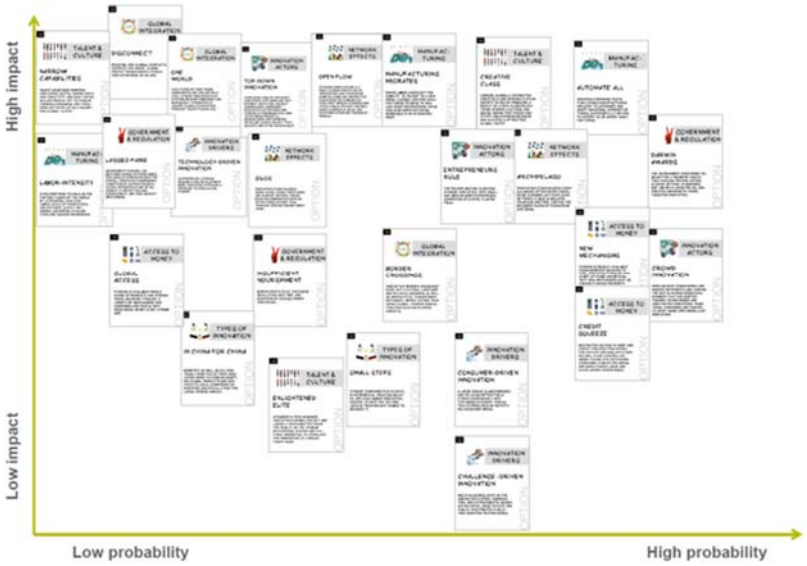


Figure 6. Drivers of innovation in China towards 2030

In order to converge the opinions and the knowledge derived from the literature review and the consultation process, a Delphi questionnaire was developed and used, in order to assess the views of experts from the "West" on the innovation landscape of China. The first step was the identification of relevant trends and future studies worldwide, followed by verification and analysis, in order to identify major megatrends (as defined by Naisbitt, 1982) and emerging business models. In the context, experts provided feedback on 55 questions on global megatrends, emerging business models, specific technological areas.

The global megatrends were evaluated by the experts towards their ability to transform the global innovation landscape by 2030. As it was expected, the Delphi analysis validated the importance and high probability of the five pre-selected megatrends (MGs), in shaping the innovation environment by 2030: Scarcity of Resources, Climate Change, New Technologies, Globalization 2.0, and Changing Demographics.

A second objective of the Delphi, was to identify specific technology areas that are going to be strong in Europe 2030. The experts evaluated 34 broad technological areas in various fields. The pre-selection of the technological areas was based on a smiliar study for Russia (Gokjberg, 2016) and adaptaded taking input from on-going horizon scanning of The Millennium Project (Glenn, 2015).

The overall results are summarized in the following *Figure 7*, while the strongest and the weakest technological areas in Europe by 2030 are summarized here:

Europe 2030	
Strongest Technological Areas	Weakest Technological Areas
Energy storage	Nuclear energy
IoT	Saltwater agriculture
Nano-sensor	Nuclear fusion
Brain science	Cultivated meat
Medical materials	Fish farming
Cancer diagnosis and treatment	Space exploration
Solar energy	Carbon capture and storage
3D/4D printing	Crop production
High-energy density materials	Unmanned aerial vehicle
Wearable health devices	Virtual Reality & Augmented reality
Artificial Intelligence	Customized food
Artificial organs	Aircrafts
Information protection	High density data storage

Figure 7: Strong and Weak technological areas in Europe 2030

In addition, experts were requested to evaluate (from 1 to 10) the importance of 12 business models and markets towards 2030 (*Figure 8*). The "rise of services" and the "silver economy" are rated as the most important towards 2030, followed by the business models of "circular economy model", "sharing economy", and "glocalizing", underlying specific opportunities and challenges for traditional European and Chinese industries.

The last set of the Delphi questions was focusing on the collaboration areas between Europe and China with highest pay-off potential (*Figure 9*). The areas with the highest cooperation potential between EU and China are: Environmental Management, Robotics, Telecommunications, Renewable energy, Smart energy systems of the Future, and Agricultural biotechnologies. The areas deemed with

the lowest cooperation potential between Europe and China are: Nuclear fusion, Safe nuclear engineering, Space exploration, Drugs, Hydrogen power.

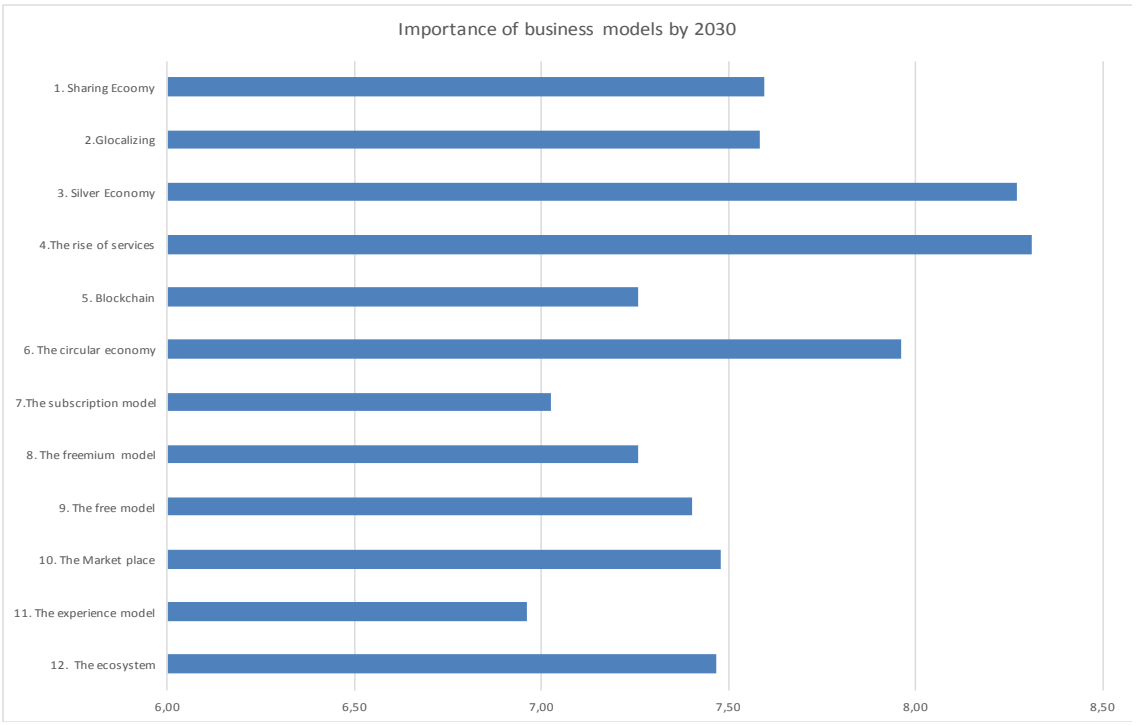


Figure 8: Importance of business models by 2030

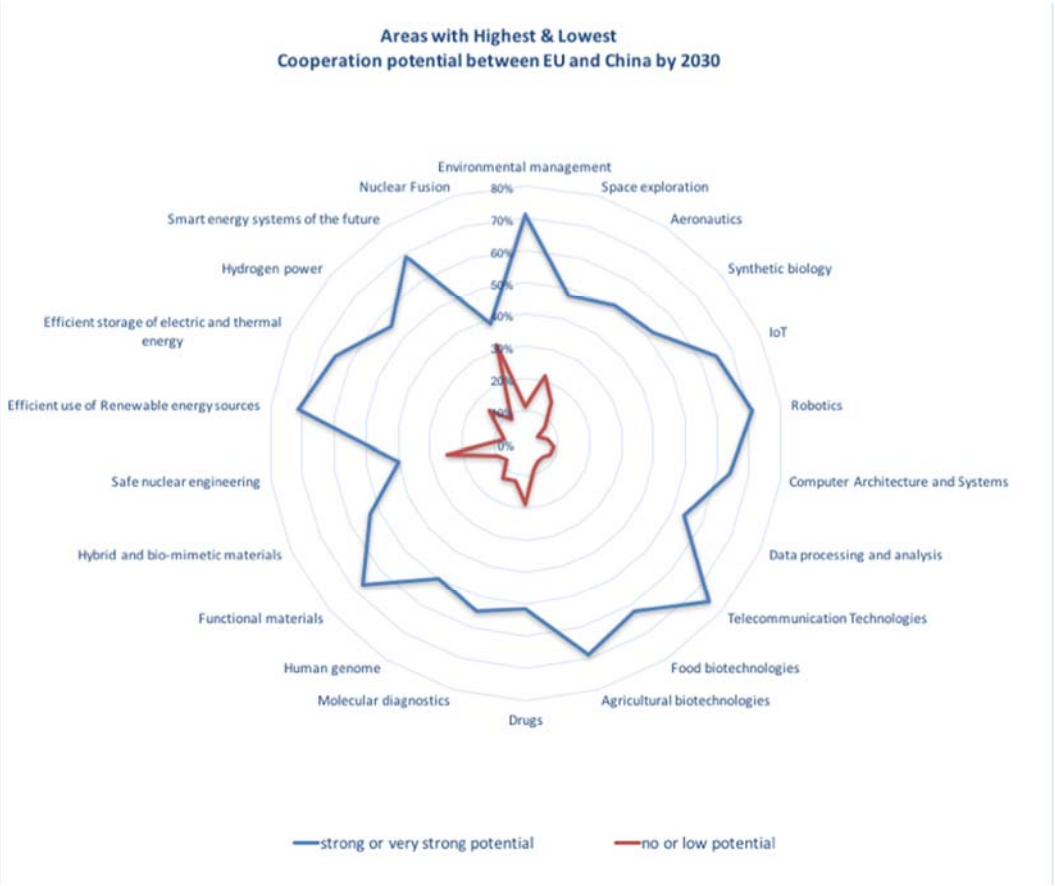


Figure 9: Areas with the highest and lowest cooperation potential between Europe and China

Scenarios & Conclusion

As it was briefly presented, having confirmed the megatrends, and emerging business models that are changing the global future, the team with the support of the experts identified a set of nine key dimensions (uncertainties), each with three options that generated 20,000 possible scenarios. The uncertainty dimensions were ranked in the following way:

1. Global integration, 2. Talent & culture, 3. Government & regulation, 4. Network effects, 5. Manufacturing, 6. Innovation drivers, 7. Access to money, 8. Innovation actors & 9. Types of innovation.

However, as not all uncertainties are independent, as smaller number of overall dimensions has been identified. The number of plausible scenarios was further reduced after ranking the uncertainties by importance, that revealed two overaching uncertainty dimensions. The first is related to the Chinese government's approach toward innovation, and the second dimension is relative to China's creative capabilities. These two overaching dimensions were used as the axes of the key four produced scenarios:

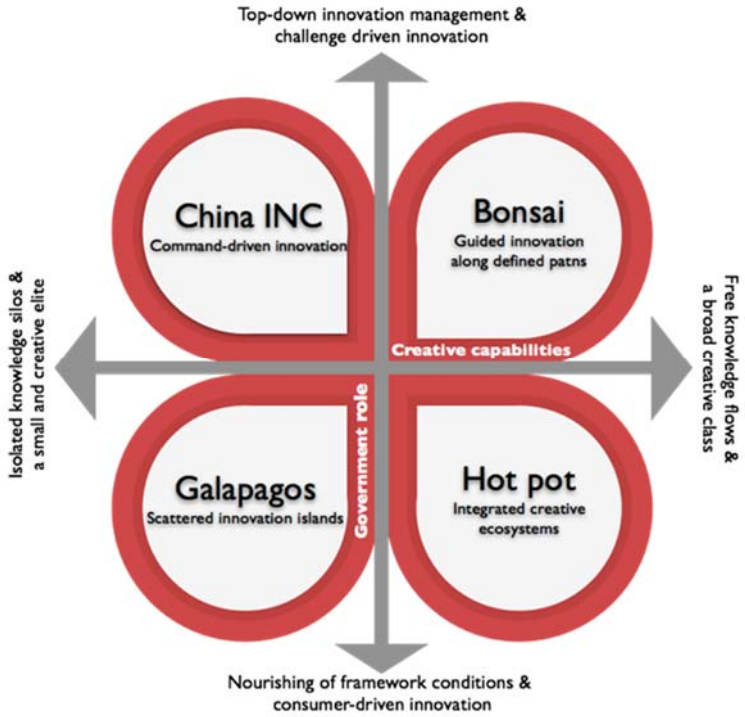


Figure 10: China 2030 innovation scenarios

China INC: Command-driven innovation

The Chinese government is the entrepreneur. It actively allocates resources to different innovation mega projects and is less interested in developing broad creative capabilities. A small creative elite takes charge in driving innovation, while foreign companies complain that the playing field is uneven.

Bonsai: Guided innovation along defined paths

The government takes an active role, while at the same time a large creative class and a free flows of knowledge and ideas emerge. Rather than allocating resources to specific projects, the state directs the industry and academia in certain directions by using incentives

Galapagos: Scattered innovation islands

The Chinese government focuses on framework conditions rather than taking an active role in driving innovation, but fails to creative a broad creative class. Rather than strong ecosystems with crowd-driven innovation, small cliques of innovation stakeholders form in different areas.

Hot pot: Integrated creative ecosystems

China has an open knowledge flow environment, and a strong creative class, while the government works on creating a favourable framework for innovation. This results in a vibrant startup ecosystem,

a stronger appeal of Chinese brands on the international stage, and new types of thinking that lead to disruptive innovation.

Foreseeing the future is practically impossible, investigating the innovation future of China and the collaborations prospects with Europe is an equally impossible task. Nevertheless the research findings of the research team in Europe and China has revealed, as briefly described above, some potential trajectories of the innovation future of China.

The main conclusion coming from the innovation scenarios is that everything will be about redifing the rules of the game. This is related with (a) the government policy and how it attempts to guide China's innovation trajectory, (b) the current industrial capabilities and the evolution over time of knowledge ecosystems, and the (c) the impact on innovation of cultural, creative, and consumer trends.

As regards the European actors, they need to learn from China how to be: (a) better and quicker adaptive to new business models, (b) able to tap into and benefit from Chinese ecosystems, (c) organized in a way that enables them to innovate fast. On the other hand,

Chinese actors can also learn from Europe, how to be more people-centered and environmental aware, how to nourish and use open models of innovation.

In the next steps, the team is going to involve relevant stakeholders in China & Europe, policy makers from the private and public sector, aiming to initiate a long-term discussion on potential cooperation routes.

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Creating a Participatory Public Space for Developing Futures for Hong Kong

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Abstract

This paper discusses the development of futures and foresight thinking in Hong Kong, analyses past and current public and private sector organisations that engage in foresight for the territory's socio-economic long-term development.

Introduction and Background

Structure of the paper:

Our research is: What is the current state of futures thinking and what is it potential? To answer this question, we analyse public and private organisations engaging in futures thinking related to grand societal challenges of Hong Kong. In the last part of the paper we draw on interviews and comments by advocates supporting ideas of the creation of a participatory public space where futures can be anticipated and co-created.

Material and Methods

Our approach is based on descriptive research and includes elements of action research, such as interviews and observation. We analyse and review activities of organisations relating to the practice of futures and foresight thinking in the public policy discourse. Our focus is on reflecting the perceptions and activities of different actors in the discourse on the future of Hong Kong.

Descriptive research provides answers to the questions of who, what, when, where, and how associated with a particular research problem; a descriptive study cannot conclusively ascertain answers to why. Descriptive research is used to obtain information concerning the current status of a phenomenon and to describe "what exists" with respect to variables or conditions in a situation. Our phenomenon is the state of foresight and futures thinking in Hong Kong from 2010 until today.

The materials are mostly public documents from organisations in Hong Kong, accessible through the internet or public repositories at universities. The documents of the HK Foresight Centre have been accessed through historical, non-published records.

1. The role of future thinking in shaping a city's/nation's long term development

At the 2016 Pujang Innovation Forum on Technology Foresight in Shanghai, jointly hosted by the Chinese Academy of Science and Technology for Development, the Shanghai Institute for Science of Science and UNESCO Shanghai in 2016, scholars discussed how futures thinking developed in Japan, Korea and China and how foresight practices support socio-economic long-term planning in a fast changing environment. Developing foresight is based on qualitative and quantitative, as well as exploratory methods, and aims to explore possibilities, discuss policy choices and assess alternatives.

Foresight is also about futures thinking, which includes the assessment of existing medium-to-long-term visions, the assessment of desired, possible and alternative scenarios; the identification of future applications and/or implications of new technologies; the identification of opportunities, threats and challenges for the future, the assessment of possible impacts of policy recommendations and decisions derived from foresight; as well as the creation of a foresight culture through methodology and capacity building. An important contribution of futures thinking in foresight exercises is the timely identification of issues that should alert and support decision-making, especially when it comes to priority-setting. (European Commission 2009, p. 27)

While all three countries have established public research institutions that aim to explore possible futures, it was noted that there is no dedicated public or private institution in Hong Kong that provides futures thinking for policy making in the Special Administrative Region of China, neither on technological or societal futures.

An important objective of foresight is to orient policy development. This often includes the provision of methodological support and advice on policy directions. Such orientation often requires the development of new perspectives into existing agenda-setting, consensus-based frameworks to explore policy options; and guidelines to assist government and other actors in policy design and decision-making processes. (European Commission, 2009)

Although technology foresight was the main topic at the forum, foresight today includes whole society perspectives, and is defined as a "process involved in systematically attempting to look into the longer-term future of science, technology, the economy, the environment and society with the aim of identifying the emerging generic technologies and the underpinning areas of strategic research likely to yield the greatest economic and social benefits" (Martin in Ruff 2002). Today, future and foresight research implies "society and technology foresight", as well as participatory spaces where actors can jointly use methods and tools to experiment with possible futures. Such social testbeds are called living labs, citizen laboratory or govlab, future centre or mindlabs.

One of the most common general objectives of foresight is to foster cooperation and networking, which implies "the creation of a common space for open thinking" (European Commission, p. 28). Despite different names, the operating principles of these spaces is similar.

2. Futures thinking in Hong Kong

Although Hong Kong does not have a single organisation dedicated to foresight, an analysis of past and current stakeholders in Hong Kong in government, universities, think tanks and non-government organisations shows that there are some futures and foresight related activities.

2.1 Government agencies:

Futures Thinking is a method for informed reflection on the major changes that will occur in the next decades in all areas of social life, including education. Futures Thinking uses a multidisciplinary approach to pierce the veil of received opinion and identify the dynamics that are creating the future.

The Planning Department, a government agency under the Development Bureau, has since the 1970s reviewed the territorial development strategy "to guide planning, land and infrastructure development and the shaping of the built environment". The last review, "Hong Kong 2030: Planning Vision and Strategy" ("Hong Kong 2030"), was published in 2007, with a continuation called Hong Kong 2030+ focusing on wider public engagement and including more stakeholders. Increasing public engagement and participatory methods has become a common practice in the futures research community.

"Hong Kong 2030+: Towards a Planning Vision and Strategy Transcending 2030" ("Hong Kong 2030+"), a comprehensive strategic study to update the territorial development strategy, is built on the foundations of Hong Kong 2030 and has revisited the planning strategy and spatial development directions beyond 2030 in the light of the dynamics and challenges ahead. It represents the Government's vision, policy and strategy for the territorial development of Hong Kong beyond 2030. A visionary, proactive, pragmatic and action-oriented approach is adopted to ensure a focused public dialogue on the key planning issues critical to future development and a timely response to the changing circumstances in and outside of Hong Kong. (quoted from http://www.hk2030plus.hk/about_a.htm)

The Efficiency Unit (EU) of the Chief Secretary's Office of HKSAR Government has been exploring the feasibility of a government-sponsored Future Centre since 2010, and refers to co-creation solutions with communities through innovation labs in a report on Public Sector Reform in Hong Kong. The EU sees futures thinking spaces as stimulus to cross-departmental government innovation with a future orientation. A Future Centre would integrate creative problem solving, organizational learning, knowledge creation, and organizational change and renewal by using the wisdom of crowds. The EU organized a "Innovation in Public Service" workshop in April 2011, and has also sent staff to attend Aalto Camp for Societal Innovation held at the Aalto University in Finland in August 2011, where societal issues were discussed and prototyped by participants from government, business, NGOs and academia.

The Central Policy Unit (CPU) had a Commission on Strategic Development between 1998 and mid-2017, which had the following task: "The Commission on Strategic Development ("Commission") is an important advisory body established in 1998 to explore the way forward for Hong Kong's long-term development strategies. The Chief Executive has invited talents from different fields to join the Commission. The Commission provides a platform for various sectors of the community to explore with the Government major issues pertaining to Hong Kong's long-term and overall development. The objective is to gauge a wide range of community views at the early stage of policy formulation to be considered by the relevant policy bureaux, thereby laying the foundation for formulating specific policies. The Commission's work can help make policy formulation more scientific and transparent, backed up by enhanced public participation and acceptance. (...)"

A analysis of research output of the past three years shows that the organisation primarily looked at current policy issues.

The Innovation and Technology Bureau

The HK government's Innovation and Technology Bureau, states that its role is to create a "vibrant ecosystem for the government, industry, academia and the research sector" and aims to "develop Hong Kong into a knowledge-based economy and an innovation hub for technology and its application in the region".

The bureau's main goal is to "strengthen cooperation among stakeholders and create greater synergy", however it does not engage in foresight or long-term perspectives on how R&D and technology might help to achieve that goal, nor does it explain what steps might be conducive for Hong Kong to develop into a knowledge-based economy.

Out of the eight measures, the ITB considers relevant for Hong Kong's future development, seven contain the word "technology", indicating a lack of whole society, inclusive innovation and futures thinking.

- strengthen support for the innovation and technology sector
- facilitate the development of the information and communications technology industry
- strengthen cooperation among stakeholders and create greater synergy
- encourage private sector participation in R&D and commercialisation of R&D results
- coordinate inter-bureau policy efforts in R&D and technology matters;
- strengthen collaboration with other economies to promote scientific and technology exchanges;
- enhance support for nurturing of innovation and technology talents;
- foster development of innovation and technology to promote development of high-end manufacturing industry

The OECD (1996) defines knowledge-based economies as economies which are directly based on the production, distribution and use of knowledge and information, which includes learning, education

and social aspects of knowledge networks. The societal and systemic perspectives of innovation are not addressed in Hong Kong's strategy about the role of R&D and its future.

Council for Sustainable Development

According to their website, the Study on Sustainable Development for the 21st Century in Hong Kong (SUSDEV 21) was commissioned by the Government in 1997. The study was conceived in response to the need to take account of environmental and social concerns as well as economic aspects when making decisions about the future of Hong Kong. The council is an example of a public sector unit tasked with futures thinking.

The SUSDEV 21 study has been primarily concerned with developing a systematic process to enable Hong Kong's decision makers to take into consideration the long term implications of strategic development decisions, using a set of forward-looking sustainability indicators.

Major outputs of the study include: Developed a definition of sustainable development which encapsulates the key themes and broad scope of sustainable development applicable to Hong Kong – "Sustainable development in Hong Kong balances social, economic, environmental and resource needs, both for present and future generations, simultaneously achieving a vibrant economy, social progress and a high quality environment, locally, nationally and internationally, through the efforts of the community and the Government".

The Council also developed foresight tools, such as the Computer-aided Sustainability Evaluation Tool (CASET) for conducting sustainability assessment of strategic policy and project proposals; and recommended institutional changes to help Government take better account of sustainable development issues in its decision making, including establishing the Council for Sustainable Development as well as the Sustainable Development Division (formerly known as the Sustainable Development Unit)

2.2 Universities

Futures Studies is a scientific research field involving scholars and researchers across many disciplines. There are undergraduate and postgraduate programs available in universities around the world, however, the eight research universities in Hong Kong currently do not provide Futures Research related programmes, apart from a few single topical courses, such as:

- Education University of Hong Kong has a "Futures Thinking and Creativity for Sustainability", a general education course
- The University of Hong Kong conducts a common course on "Global Issues Energy Futures, Globalization and Sustainability
- The Hong Kong Polytechnic University Design School includes futures thinking in the design thinking curriculum

Courses on future and foresight methods and tools, such as technology monitoring/scanning, environmental monitoring/scanning, Delphi studies, participatory methods, prototyping futures, trend research and impact analysis, systemic modelling, scenario construction, design thinking and co-creation may be included in some science courses, however, they are not offered for developing whole society futures.

According to Our Hong Kong Foundation the Research Assessment Exercise (RAE) among Hong Kong universities adopts an inclusive definition for research output covering publications, patents, artefacts, that are publicly accessible, contains an element of innovation and contributes to scholarship. Publication remains the dominant output in the RAE, thus implying that the KPIs for universities' research efforts are skewed towards publication rather than societal impact and contribution to foresight for Hong Kong's development. Members in the humanities discipline have raised concerns that the RAE fails to appreciate locally-oriented academic work that make an impact to the local community but may find it hard to get into international journals.

Another structural barrier to futures thinking in scholarly research lies in the lack of collaboration between institutions. The study by Our Hong Kong Foundation states that "in Hong Kong, around 30% of RGC funding goes to midsize and large projects that require some form of collaboration between institutions. Approximately 70% is allocated to small projects. The General Research Fund, the largest of the Research Grant Council's funding schemes, accounting for half of the 2015/16 funding, has a funding rate of over 30%, with an average funding size of less than US$100,000 per project for 2 years. The fragmentation in Hong Kong, on top of the already small size of the funding pool, makes it difficult to develop globally competitive niches." (p. 31)

2.3 Thinks Tanks and Non-governmental Organisations

Vision 2047 Foundation

Established in 1989, "committed to the future of Hong Kong" Vision 2047 Foundation "does not take an institutional position on issues that affect Hong Kong. Diversity of views amongst our members and frank and open exchange is encouraged. The common link between members is our commitment to the long-term well being of Hong Kong and the belief that thoughtful and respectful exchange generates greater understanding of different views" (quoted from website)

The foundation provides a space for discussion about the future of Hong Kong, however, it does not use futures or foresight methods, nor does it publish report and studies.

Hong Kong Democratic Foundation

Hong Kong Democratic Foundation (HKDF) was established in 1989 by Jimmy McGregor and C.H. Leung as a not-for-profit think tank on public policy issues, including the democratic development of Hong Kong under the One Country, Two Systems framework and The Basic Law. HKDF promotes dialogue among stakeholders, experts, and those keenly interested in the development of Hong Kong and China. HKDF seeks to influence Hong Kong's economic, political and social development through position papers, speaker luncheons and briefings, and meetings with Government, legislators, experts, and the corps consular. The foundation discusses aspects of the future of Hong Kong; it does not produce research.

Hong Kong Foresight Centre

A non-profit organisation founded in 2008 to create a space for future and foresight thinking in Hong Kong modelled after existing centres in Europe. The statement of intent describes the scope of activities:

Statement of Intent of the Hong Kong Foresight Project:

The project is an engagement and consensus building process to help identify issues of concern to Hong Kong and help formulate workable public policies to address them. There is a need for such a project because it was felt that in terms of policy development, Hong Kong seems to have lost the ability to engage stakeholders at an early stage, and that policy makers seem to lack both the conviction of the importance to gather and build consensus and the requisite political skills to do so.

The Hong Kong Foresight Project is not a think tank but provides a space to bring together various think tanks and relevant parties and to engage them in helping to provide idea generation and research support in the early stages of policy formulation. The genesis of the project is rooted in our shared love for Hong Kong, the desire to create a more well-functioning society and the motivation to make policies more effective. The following statement of intent might be a good way to describe the project at a more practical level: "The Hong Kong Foresight Project aims to provide a neutral space in which stakeholders may seek solutions to emerging issues of significant importance. The task is to find common ground through open discussions in a facilitated and supportive surrounding."

Project focus and output:

The Project will focus primarily on policy formulation (i.e. Issues > Vision > Policy > Policy Elements), and much less on specific implementation elements, (i.e. Programs > Program Elements > Implementation Process) unless they impinge on policy soundness.

Outputs of a specific Project should include a statement of vision, a set of recommended policies and succinct actionable plans. Furthermore such actionable plans should incorporate in their elements, Aims/Goals, Analysis, Action List, and Next Steps.

The outcomes of a project should take into account and incorporate to the extent possible divergent but relevant viewpoints. (end of citation)

The Hong Kong Foresight Project (the name was changed to Centre later on) had a council of voluntary founding members taking an active role in guiding the development of future issues; "*Connectors*", which were representatives from think tanks and NGOs interested in engaging the process, as well as "*Supporters",* individuals who would like to participate.

Between 2008 and 2012, the Hong Kong Foresight Centre organised a number of public events with futurists from the James Martin 21st Century School at Oxford University, representatives from similar organisations in the Netherlands, Sweden and Israel. Some of the events were hosted by government agencies, such at the Efficiency Unit and the Intellectual Property Department. The Hong Kong Foresight Centre also organised public seminars on Public Sector Information, on "Innovating with Information" through workshops for senior government officials, and facilitated discussion and collaboration among other local think tanks on poverty alleviation in Hong Kong.

The Hong Kong Foresight Centre ceased operations in 2012, both as result of lack of government support as well as internal organisational issues. Although the organisation could not be sustained, it brought the idea of future and foresight centres as participatory policy instrument and neutral space for multi-stakeholder engagement into the public discourse.

3. Renewed interest for a Participatory Future Space after 2017

After the Innovation and Technology Bureau (ITB) was set up in Nov 2015, the head of the agency had arranged a meeting with the head of Efficiency Unit to discuss establishing the first Future Centre in Hong Kong in Apr 2016. However, there was not enough support within the government at that time, and the talks were only taken up again after the new Chief Executive, Carrie Lam, came on board on 1 July 2017.

An experienced government administrator and ex-Convener of the Non-official Members of the Executive Council of the HKSAR Government, Mr Lam Woon-kwong, shared his views at an event hosted by Hong Kong Democratic Foundation on 7 January 2011. He acknowledged that better policy making is important, and that one problem with the civil service in Hong Kong is that talents are almost entirely inbred. With a fast-changing world, the Hong Kong civil service lacks specialist expertise, and even if some officers may be trained to handle specialist policy areas, they lack the political capacity to handle complex policy-making processes. He considered it being one the reasons why Hong Kong is lagging quite significantly behind in areas such as information, innovation, technology and creative industries. Five years after 1997, the permanent civil servants were topped with a layer of political appointees who were supposed to bring with them more specialist expertise and political capacity to tackle the complex political situation. However, circumstances turned for the worse: with deep economic recession and major political upheaval brought about by increasingly adversarial divide in the Legislative Council, the HKSAR Government had to fire-fight most of the time, leaving "no time for research and analysis" (Lung 2016)

According to Lam, the government should institutionalize a system to lead the community to agree on a common set of objectives. He pointed out that the best way forward would be to leave the engagement process open and empower stakeholders to make their own rules to resolve differences through organized interaction, guided and arbitrated by trusted third party leaders. "But if the lesson has already been learned and the precedent for success is recorded, how did we end up in our present impasse? The problem is again complex but it boils down to the common syndrome: lack of genuine desire to be open, lack of will to engage the opposition and be seriously inclusive, lack of honesty to admit failures, and in the end lack of sincere commitment from the top." (Lung 2016)

He further commented that the concept of an open forum where all stakeholders shared their views existed during the 2005-2012 government period. In his view, there are two pre-conditions for a Future Centre to work: it should be open and democratic. Being democratic is normally a prerequisite for openness. At least, people should broadly share some common values to be able to come to terms, like in the Scandinavian countries. Hong Kong might have been quite close to sharing these prerequisites before 1997, however, "over the past 20 years, Hong Kong has really been going down the drain in terms of openness".

Mr. Lam elaborated further on how he had steered a research project, commissioned by the Bauhinia Foundation and headed by Professor Joseph Chan Cho-wai of the University of Hong Kong, on prototyping a new model of civic engagement using the Kai Tak (old airport) Planning Study as an example. The planning project began before 1997 but failed repeatedly to get through the system because of strong objection from many stakeholders, including a substantial proportion of the general public. In the end, a truly open and inclusive system of civic engagement was adopted and a consensus was reached after two and a half years. All the requirements of the stakeholders were met in the final "2006 Outline Zoning Plan for Kai Tak". However, the lesson had not been promulgated within the government, thus the success of this case could not be replicated.

Under the new government, there is renewed discussion of a consensual approach on policy making. A Future Centre, as a civic engagement model in use in some European countries, might be a way forward. But it should preferably be initiated from within the government or at least it should show its commitment by providing the idea with administrative and funding support. One of the initial policy areas it could focus on is youth development where stakeholders are diverse and they hold a wide range of views, suggested Lam (discussion transcript 18 August 2017)

Results

By describing the organisations and the public discussion about the potential of a participatory public space to discuss the future of Hong Kong, the reasons for lack of futures thinking in Hong Kong, the reasons behind it, as well as exploring the opportunities for developing capacities for foresight in Hong Kong.

Organisations engaging in futures and foresight thinking are typically public research organisations, e.g. specialised government agencies, research institutes at universities or think tanks. Our analysis shows that while there is no dedicated organisation in Hong Kong, there are a few that include futures research in their agenda and programmes.

While Hong Kong is strong on strategic planning of the future of tangible infrastructure, intangible aspects of future, such as societal future issues, are less of a concern.

It is also evident that engaging citizen and stakeholders in issues relating to public policy formulation and building capacities for knowledge and action for complex issues is not very developed.

Constructive experiences with using neutral spaces where citizens and stakeholders seek solutions to emerging issues and finding common grounds through open discussion in a facilitated and neutral surrounding are largely not practised.

The notion that futures studies are the scientific study of "possible, desirable, and probable" future developments and scope for design, as well as the conditions for these in the past and in the present. Modern futures studies assume that the future is not entirely determinable and that different future developments ('futures') are possible and there is scope for design. (Kreibich et.al. 2012)

Discussion and Conclusions

Developing Future and Foresight is important for a city/region to understand the driving forces of change in society, economy and politics and shape desirable futures.

Hong Kong has a broad range of public and private research organisations that could collaborate on all aspects of future development in economy, politics, society, ecology on a global or regional scale. Currently, there are hardly any incentives for collaborations between Hong Kong's R&D organisations could strengthen the link between universities and industry. Through changing the mechanisms in funding schemes, the government could set priorities for research focusing on collaborative efforts.

Long-term foresight (10-50 years), not only focused on infrastructure, should also include anticipation of future developments in science, technology, economy, politics and and society. Foresight is not only about anticipation of futures, but also supporting identifying and prioritizing related policy measures.

A recent anthology with the title Hong Kong "Borrowed place, borrowed time" reflects about a phrase coined to describe colonial Hong Kong in the years before its return to China in 1997. The handover period under the one country, two systems arrangement will last until 2047. For those interested in the future of this special place, foresight and futures thinking might be a meaningful way to explore potential futures.

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