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Case study: Seven Shocks and Finland (2014)

Abstract

This report presents the materials, analyses, and conclusions produced during the Seven Shocks and Finland project, an activity of IIASA Exploratory Projects in June -December 2011. The primary objective of the project was to investigate the nature of the uncertainties and the resilience requirements that emerge from the complexity of the global social, political, economic and social systems. The longer-term goal was to examine resilience requirements from a decision-makers perspective and to define concrete actions and examples to improve national resilience.

Research focus and methods

The literature contains (e.g., Boin et al. 2010) some very ambiguous definitions of resilience, most based either in ecology or psychology. The definition that we use as a starting point for is the one formulated by Boin et all (op. cit p. 9):

Resilience is the capacity of a social system (e.g. an organization, city, or society) to adapt proactively to and recover from disturbances that are perceived within the system to fall outside the range of normal and expected disturbances.

Even in this definition one of the main elements is missing; the opportunity the disruption generates by changing the operating conditions. In the Game Changers Project (please find more information on www.exevents.fi) we defined resilience as a concept consisting of two elements

- 1) *Adaptability* – the capability to absorb an extreme event or shock; and

2) *Agility* – the capacity to benefit from the new situation the shock generates

Analysis of the 7 Shocks has provided us with greater understanding; we must add something to the definition. When we perceive society (or an economy) as a social system, an external shock will usually destabilize the system; but even if the system absorbs the shock, it cannot reverse time and is thus unable to return to the same state as before (Folke 1999). In the best case scenario, the shock triggers a reorganization process that will not only improve the system's resistance or resilience to further shocks but lead to renewal and innovation. In short, the social system learns from the experience (if it does not destroy it!).

Thus we will add one more element to our resilience definition:

3) *Assimilation* – the capability for using a shock as a trigger for renewal/improvement

The objectives of the Seven Shocks and Finland initiative were described in May 2010 as:

The project will collect understanding of long-term national resilience requirements that have emerged from increasing uncertainties in the global physical and social environments. The project will investigate the implications of 7 different shocks impacting Finnish society, and create a portfolio of actions that may be undertaken to increase the resilience of the country to absorb and benefit from these shocks.

At that time, these goals were distilled into two research questions:

- *What kinds of generic resilience requirements do the growing uncertainties in the global environment generate for a small, open national economy and society?*
- *What kinds of concrete actions are needed to create resilient structures?*

Methodological challenges

These research questions are challenging because we have not been able to define a theoretical framework to provide the concepts or methodologies needed to answer them. Risk management or

disaster theories are mostly focused on corrective actions and mitigation of consequences. Even social systems approach dealing with resilience do not have much to offer (Boin et al. 2010).

Another feature of this research program is that to distinguish the generic features of the type of resilience required in the current uncertain environment, we chose to analyze seven very different types of shocks. None of which has anyone had direct experience with since they have never happened before (please find a description of the methodological background pp. xxx-xxx in this Journal).

In this case, the most helpful frameworks come from complex adaptive system theory (Anderson 1999). These frameworks provide an understanding of the interaction between global systems and national economic or societal systems. Complex adaptive system theory is also able to describe dynamics that take place when a system is disrupted by a shock and how the renewal process takes place.

The method we employ is a case study approach. Cases are analyzed using two different systems modeling techniques, first describing the system's description (Goodier et al. 2010), then the trajectory of consequences that potentially take place.

As we have no data about events that have never happened before, our approach was primarily qualitative, with the data we collected coming from public sources (the project chose to use only the published sources), interviews, and consistency checks with experts. The only exception was the use of the Global Trade Network simulator developed earlier in the Game Changers Project (Casti et al. 2010). This simulation was used for part of the analysis of the China scenario.

The aim of the research project was to produce conclusions that would trigger a wide discussion about resilience. This is why we adopted a participatory method (Saritas and Miles 2010) for the generation of the concrete resilience portfolio. Altogether 180 participants supplied us with 257 action ideas and $15 \times 25 \times 7 = 2,625$ assessments!

SHOCK SCENARIOS

We will describe here two of the seven shocks analyzed. These shocks are first that Nokia leaves the country and secondly, the collapse of China. The first of the shocks describes an event that has a huge internal impact on the Finnish economy, while the second produced quite surprising results. The choice of these two shocks as show cases is also justified from methodological perspectives the tools were different in each case. The rest of the shocks are summarized in a table so that elaboration of results makes sense also from a reader's perspective.

In the analysis of each of the shocks, we drafted several alternatives for the shock scenario. We then analyzed the drivers of the business as the usual situation and after that defined a set of potential enablers and triggers for the shock. The outcome of the process was described using a causal mapping method.

Shock I: Nokia is bought out and leaves Finland

Scope of alternatives, choices, and justification for choices: The scope of alternatives for a drastic change in the relationship between Finland and Nokia (this scenario focused only on Nokia, and it does not include the operations of Nokia-Siemens Networks) were: a) Nokia continues to develop as it is now doing and ends up transferring all of its production (Salo) and R&D out of Finland, b) Nokia is acquired, and both the R&D and headquarters are moved from Finland. The third option, which was also used as one of the scenarios in the actions generation phase, was "a major international ICT corporation merges with Nokia and the headquarters of the merged firm is in Finland".

For the analysis, we chose option b). Finland has some experience on the impact of diminished R&D activities in the country as the most recent impacts in this field are still being felt; corrective actions have been defined, and some have already been taken. The third option, a new, bigger headquarters in Finland, is an interesting shock that generates plenty of opportunities for Finland. The justification for the choice of the second option is threefold: if it happens, it will have a major impact on the communications technology ecosystem in Finland. It will also impact national R&D investments and potentially even affect Finnish national identity. For analysis purposes, the time

frame for this shock was relatively short: the process started in 2014, and the event unfolds over one year.

Drivers for the development of global communications technology market: The growth of the mobile phone device market is based on smart phones,¹ the low end products have volume growth, but prices have gone down drastically. The competition for dominance in the ITC market is leading to mergers across the sector (at the time of the analysis, the case of Google merging with Motorola was actual).² Chinese producers (ZTE, HTC) are also entering the smart phones market. Market development toward more diverse devices and value added is based on differentiating the brand (Pajarinen et al. 2011), and adding applications and services³ not yet on the device.

Enablers: Nokia's market cap continues its downward trend.^{4,5} The collaboration with Microsoft is promising, but the share of the MS Windows mobile operating system is still less than 10% of all smart phones sold.⁷ Nokia owners,⁸ especially institutional owners in the USA, are unhappy about the company's recent performance. Institutional value investors are increasingly giving way to activist vulture investors.

¹ IDC <http://www.idc.com/getdoc.jsp?containerId=prUS22974611>

² The Vancouver Sun
<http://www.vancouversun.com/business/BlackBerry+maker+left+Land+following+Google+Motorola+acquisition/5262001/story.html>

³ Gartner <http://www.gartner.com/it/page.jsp?id=1764714>

⁴ Bloomberg <http://www.bloomberg.com/news/2011-04-07/htc-surpasses-nokia-s-market-value-as-smartphones-drive-profit.html>

⁵ <http://www.itproportal.com/2011/06/02/nokia-market-value-equal-apple-quarterly-revenue/>

⁶ <http://www.ft.com/intl/cms/s/0/78586c86-6108-11e0-8899-00144feab49a.html#axzz1dfLMRCQ8>

⁷ Please note that according to Gartner predicts that by 2015 the largest operating system is Android and the second is Windows - <http://www.gartnerinsight.com/download/Predicts2011>

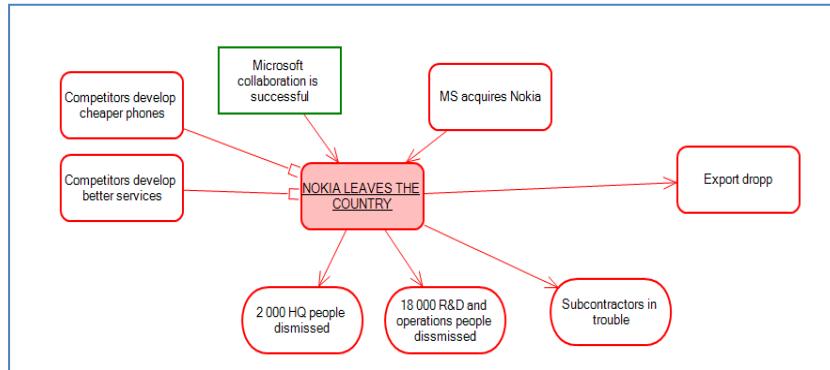
⁸ http://www.nokia.com/NOKIA_COM_1/About_Nokia/Financials/Financial_Statements/pdf_2009/Shares_09.pdf

Shock triggers: Nokia fails to reach its targets of its service development on the MS Windows operating system. Microsoft actively seeks ways to maintain its positioning in the ITC world. The relatively low value of Nokia shares makes it an attractive target for takeover.

Scenario: Nokia is leaving Finland. It is the year 2014. The trend of falling profits at Nokia that started in 2011 seemed to change its slope early in 2012. But then sales encountered serious challenges in 2013. Apple launches a new kind of intelligent mobile phone, and the Chinese ZTE has been able to create global distribution channels for its radically cheaper devices. The market value of Nokia is now below 14 billion USD. Nokia is a very good acquisition for Microsoft, which uses the higher category devices as the core of their new mobile phone business and sells the lower category products in Asia. Microsoft announces in the 13 May press conference that the headquarters of Microsoft Nokia will be relocated to Hong Kong and that R&D activities in Finland will be closed down.

Impact systems description

First order impacts mechanisms



Picture 1: First reactions on the shock.

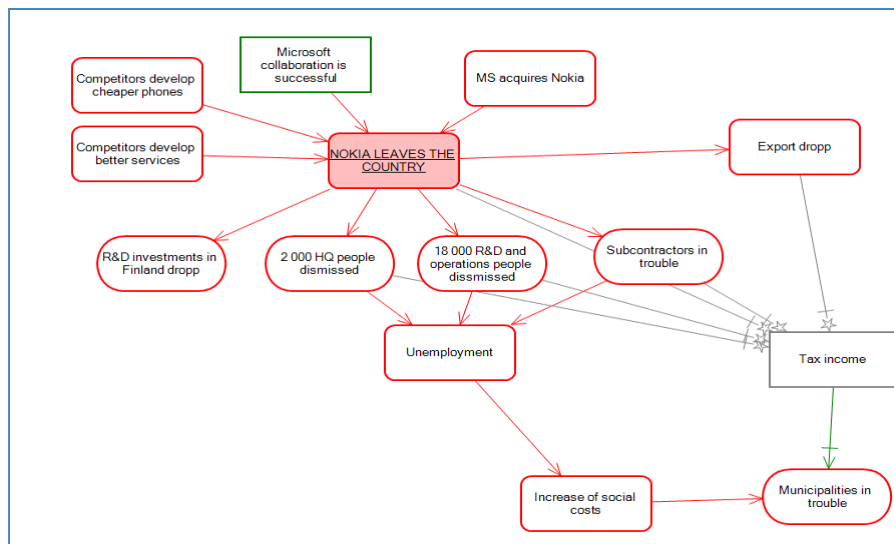
The number of unemployed in Finland increases, with 20,000⁹ Nokia administration, marketing, and R&D professionals being laid off. Even if some of the subcontractors continue serving the new company, Digia will dismiss most of its 1,500 employees, and the same applies to Ixonos, Sunmina,

⁹<http://www.nokia.fi/nokia/luvut/tunnuslukuja/henkilosto>

and Electrobit. The communications technology cluster has lost volume since 2004, but still the impact on total exports of Finland is around 5%.¹⁰

Second order impacts mechanism

The direct impact on unemployment of (academic, AMK)¹¹ professionals is dramatic, with the figures quadrupling. Around 7,000 former Nokia software developers and 2,000 software professionals formerly employed by the subcontractors are unemployed.¹² Most problematic is a group of middle-aged middle managers that do not have any competence in running small and medium-sized companies. One-third of the R&D investments disappear from Finnish statistics, and the position of Finland will drop from 7th to 15th in the global patent statistics.¹³



Picture 2: The shock spreads to the national economy.

Most of the newly unemployed are relatively young professionals with either technology or business background. Nokia does not pay any taxes in Finland,¹⁴ but employees do.¹⁵ The tax

¹⁰ Teknologiateollisuus: Vientiraportti (2010 total exports 37,9 bn eur, telecommunications equipment 1,280 bn eur)

¹¹ Akava http://www.akava.fi/files/3045/02_kuukausikuvat_tutkinnot_kuva3.pdf

¹² <http://www.digitoday.fi/bisnes/2011/03/02/nokia-pitaa-meeego-osaajista-kiinni-lisapalkkiolla/20112999/66>

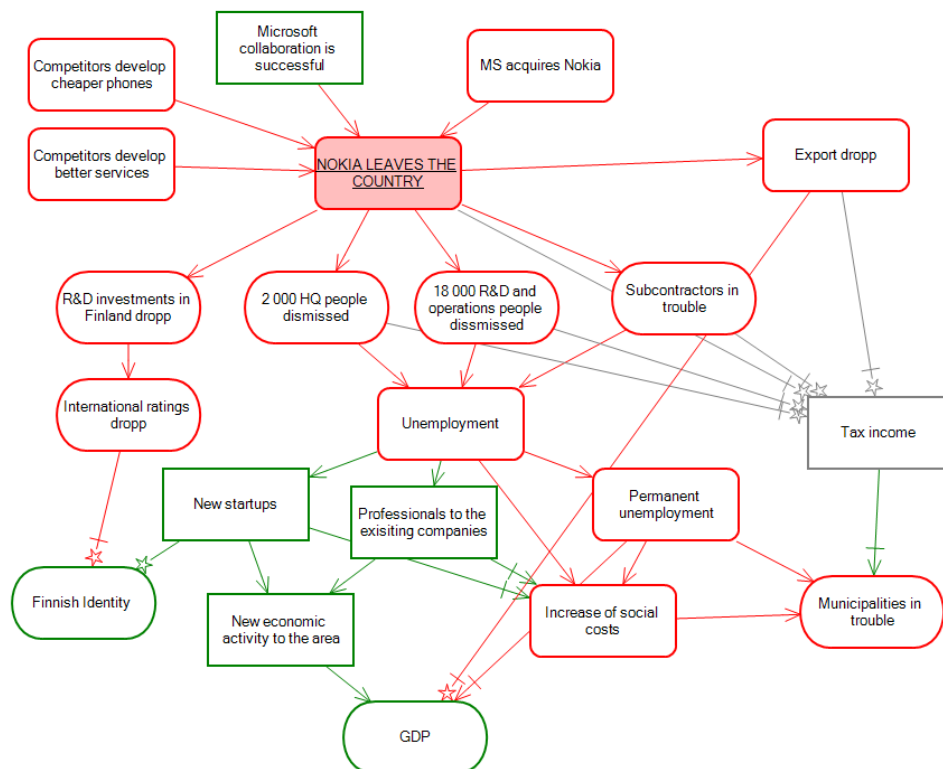
¹³ World Intellectual Property Organization (WIPO) <http://www.wipo.int/ipstats/en/statistics/patents/>

¹⁴ <http://www.uusisuomi.fi/raha/117434-nokian-verot-suomeen-025>

¹⁵ <http://www.digipaper.fi/akava/29884/> (the average monthly income is 2 700 eur, annual income 30 000, tax per employee is around 10 000 eur/year > 200 milj. eur per year)

revenues will drop with €200 million, and simultaneously social costs are increasing;¹⁶ the total cost (unemployment payments, tax loss) is €17,500 per unemployed person. The scenario would in the worst case indicate an annual cost of €350 million to the society.

Outcome options



Picture 3: The final impact of the shock has both positive and negative implications on the national GDP.

Young engineers and software developers are potentially active startup initiators and will generate new kinds of companies. Many unemployed people with a good international business background will probably be recruited by existing companies.¹⁷ All this will generate a positive impact on the Finnish economy. The key question is, how long will it take for these positive injections to generate the economic activity that would compensate for Nokia's loss? Nokia's share of GDP has dropped lately, but it was still over 1%, close to €700 million in 2010.

¹⁶ <http://www.sosiaalipoliittinenyhdistys.fi/Tiainen.pdf>

¹⁷ Please note that the recent experience of Nokia lay-offs show that r&d professionals have been recruited very efficiently.

Shock II: China suffers weaker growth and introspection in 2020

Scenario: The USA is still the world's sole super power, while China is rapidly emerging as a super power and is the only country that can realistically challenge the US for global dominance.

Meanwhile, the economic ties between China and the USA are now so important that since 2007 they have been described as 'Chimerical' - two sides of a single economy that comprise a third of the global GDP. Therefore, any deterioration in this relationship would be detrimental to global political, economic, and financial stability. There are several areas where the two countries are in conflict, or at least have sharply differing views that color the trade picture.

Global Economy

- trade and exchange rates
- China's holdings of US Treasuries
- demand for energy

Geopolitical Issues and Global Security

- narrowing competitive power gap
- Taiwan
- future of North Korea
- competition for key resource regions

Ideological and Philosophical Issues

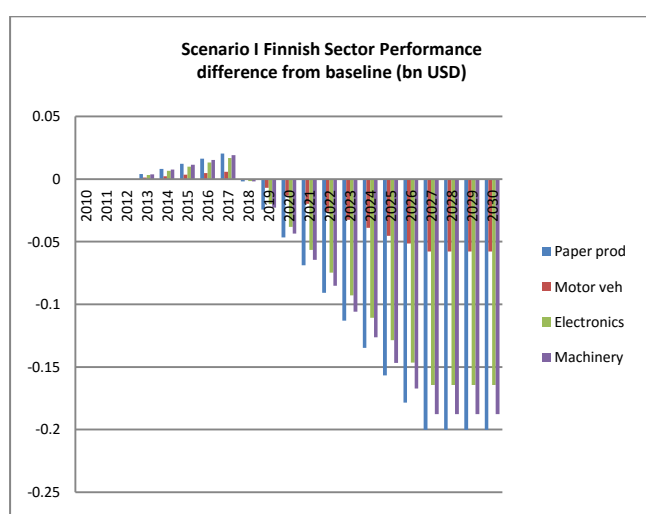
- democracy
- human rights
- religious freedom

The basic assumption governing all three scenarios we examined were: China challenges US dominance This challenge had three variations, each leading to a kind of “sub-scenario”:

- I. *China is increasingly assertive, belligerent even, in all areas of conflict and contention (the “hard” path).* In this scenario, the wildest card is an actual military confrontation between China and the USA.
- II. *China is still assertive but exercises its assertiveness in a more subtle way, often through diplomatic channels, denial of resource exports and the like (the “soft” path).*

Sub-Scenario I: Between 2010 and 2015, an aggressive China increases its trade in Asia. The Asian partners then turn their back on the Chinese in 2015, returning to the USA as their main trading partner until 2030. The result is that by 2030 China is by far worse off than any of the other countries – it achieves 40% less GDP than in the baseline scenario. Finland also suffers, being off the baseline by 4.7%.

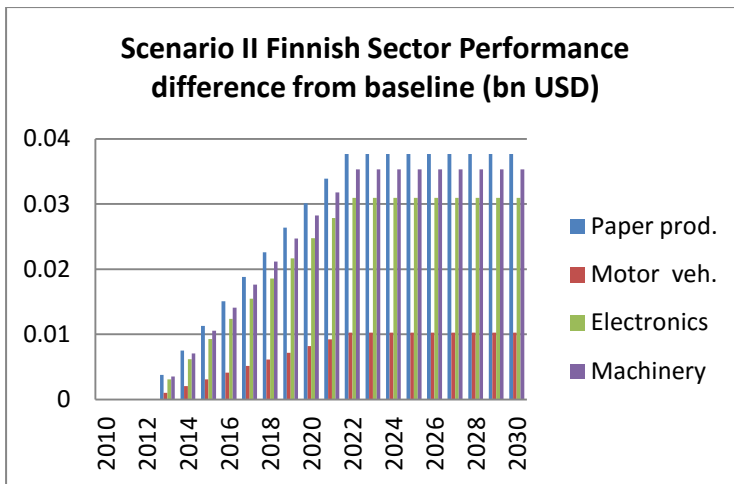
All Finland sectors do badly as well, with the worst-performing ones together generating billions of dollars less than in the baseline case. The outcome of the worst-performing sectors of the Finnish economy are described in the chart below.



Picture 5: Machine industry will have the strongest negative impact of the event.

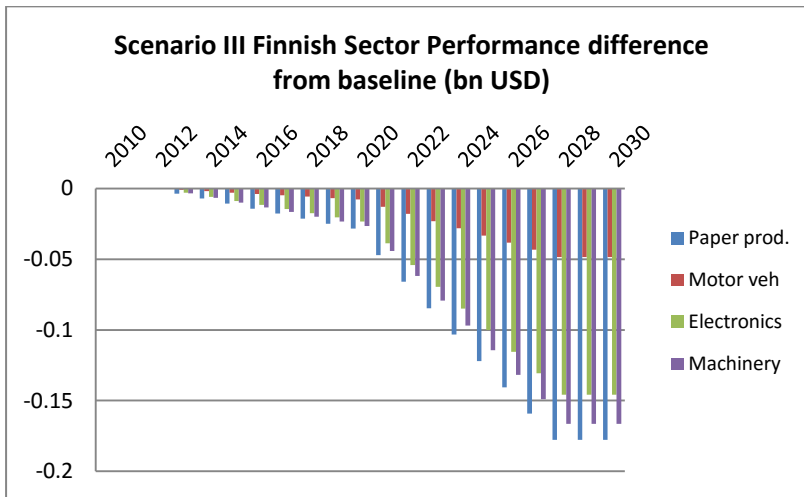
*Sub-Scenario II*¹⁸: Between 2010 and 2020, China slowly increases exports to Asia following a careful, yet determined, strategy to push the USA out of the Asian import market. By 2030 all economies do well, particularly China, which achieves 12% higher GDP than in the baseline scenario. Finland also does marginally better, showing an increase of 1.7%.

¹⁸ Please note that the outcomes of the GTN simulation for sub-scenarios II and III will be presented in the Analysis Seminar Nov 23.



Picture 6: This shock will have a very small positive impact on the Finnish sectors.

Sub-Scenario III: Between 2010 and 2020 China shrinks by 3% while the USA grows by 1%, then after 2020 China shrinks by 5% per year for the next 10 years. As a result, Mexico, Canada, and the USA all do well. Finland does 4% worse than in the baseline case. Perhaps surprisingly, this performance is worse than in a world with the more aggressive China of Sub-Scenario I.



Picture 7: Once again, Machinery, paper products, and electronics sectors will suffer, but please note that the difference to the base line scenario is very small.

Summary of the results of the other shock cases:

SHOCK	BAU Drivers	Enablers	Triggers	Scenario	Results
Pulp and paper industry leaves the country	Efficiency, product cost per unit	EU demand drop	Financial market collapse	Consolidation process is speeding up. Chinese Chenmrig Paper acquires one of the Finnish paper companies, one of the companies get into bankruptcy and the third of the companies is an object of a hostile takeover.	230 000 unemployed for 1-2 years. Massive loss of tax income.
	Digital communications	Ageing mills	Liquidity problems		Exports drop by 20%
	Overcapacity	Consolidation process	EU regulation of sea transport		50 M m3 of wood raw material without usage.
	Growth in Asia	China lookin for access to raw materials.	China's plantation project delayed.		Bioenergy production increases.
Internet crash	Efficiency built by increasing usage of internet.	Consolidation process of operators	Connected global network.	Internet collapses and the reason is not identified. Plenty of misleading ideas of the problem, after 10 days the root cause detected; the DNS system is hacked by a criminal organization that hat been able to take over most of the existing DNS servers.	Food (and fuel) shortage in stores in 2 days.
	Better services via internet.	Telecom profitability dropped.	Hacking is increasing.		Liquidity problems due total failure of payment system.
	Telecom industry promote heavily.	Global recession, no investments.	Malware incidents more severe.		Global value chains do not work, factories closed for 2 weeks
	Increased demand for capacity.	Domain name shortage.	Spying		No mobile communicatons, great uncertainty, potential for riots.
Extreme weathers in Central Europe	Climate change	Weak political decision making in EU and globally.	Flood control systems are underdeveloped.	Storms damage electricitiy supply system and some parts of the power grid are physically damaged. The flood covers all the Central-Europe. The Inter-European payment transfer system (SEPA) has serious problems sending money where it needs to go, as the combined impact of power failures and flood damage drastically reduces the flow of information between 31 SEPA countries and the processing centers. Backup systems are much slower than anticipated in coming online.	Liquidity problems for consumers and small businesses.
	Efficiency requirements increased in the financial market.	Cost saving in infrastructure in Europe.	New weathers more severe than ever.		Rush to banks' branch office, no capacity to serve. Production delays in companies with low liquidity.
	EU integration, EMU	Lack of Europe wide control.	Large share of the land is built.		Slow-down effect on European economies.
	Profitability of banking decreasing- Banks consolidate into Europe wide financial corporations.	Banks are lobbying heavily.	Back-up systems planned for "the most severe flooding in the history"		Major loss of confidence in SEPA and investments in the local systems.
		Very clear benefits to the businesses.	All the Central Europe is flooding.		
Price of energy drops by 90%	Concern on energy prices.	Political pressure on alternative energy.	Disruption in Middle-East	New energy technologies emerge very fast. Shared perception is that energy will solve both the resource scarcity, climate change and productivity problems globally. Global economy is finally growing. The fossile fuel exprot based economies are getting into trouble.	Growth of economy in Finland.
					State investments in R&D are producing results. New start-ups are getting investments from abroad.
	Situation of non-oil countries.	Number of technological breakthroughs	Politicians panic and invest heavily into new forms of energy		People change their planning criteria (location, holidays, houses etc.) much earlier than cheap energy is available.
	Sustainability requirements.	Plenty of development initiatives.	Private investors rush to energy technologies.		Close to civil war in Russia, 200 000 asylum seekers to Finland.
	Climate change	Alternatives compete with eachother.	Good results from early tests of technologies.		Burst on development in technology.
	Spell of new technology.	Geopolitical fragility.	Light taxes for alternative energies.		

The low probability high impact scenarios presented above served two purposes; they are directly our raw material when we analyze structures to define features of the resilient systems. They are used for another purpose, as well. The aim of this exercise to investigate the nature of actions that would improve resilience against space of uncertainty, defined by all of the shocks described. The aim of the next phase is to define a concrete portfolio of resilience improving actions.

Resilient Actions Portfolio

Each of the extreme events scenarios described above is revealing features of one of the potential extremes of the uncertainty. There is no way for us to predict what will be the outcome of the development, which is why we have to extend our analysis to the opposite extreme outcome as well. Please find below one example of the opposite scenarios, the forest case.

Flourishing modern bio-refineries (opposite to “Forest industry leaves Finland”)

It is the year 2020. Wood has taken on a whole new prominence as raw material!

The effects of global warming are obvious, and the use of fossil fuels is limited by regulations. Taxation increases rapidly the cost of using non-renewable energy sources. Everywhere in the northern hemisphere, there are new bio-refineries under construction. These refine coniferous cellulose into molecules used in the chemical, textile, construction and electronics industries.

Complete descriptions of the 25 ideas selected for evaluation

Altogether, we collected over 700 action ideas that were clustered according to their key concepts and their nature (pre-shock prevention, aftershock corrective actions, etc.) Out of 9 clusters, the research team assessed 50 actions Ideas From these the most feasible set of 24 actions were sent for assessment to the expert group.

Three examples of the concrete actions (please find the list of assessed actions in the attachment 1):

Prepare to increase self-sufficiency in food production

As the crisis lengthens, local food production becomes increasingly vital. Seasonal radio shows that give tips for fishing and gathering berries and mushrooms would become popular. Small, currently worthless, fish should be caught and turned into fish-fingers.

Tax incentives for local urban food

Local food production should be encouraged through taxation breaks. For example, using your balcony as a greenhouse would become tax deductible according to its production.

Invest in new rapidly exploitable knowledge combinations

Combine old and new knowledge that already exists cutting back on longer-term development with higher expertise requirements.

Results of the assessment

The objective of the second Web survey was to evaluate the utility of the 25 actions in each of the seven environments. More specifically, the experts were asked which of the actions- if taken now or shortly – would most help Finland succeed in each environment. The assessments were given graphically by placing the most useful actions near the center of the evaluation panel and least useful actions on the periphery. The distances were mapped to a continuous utility scale ranging from 0 (not useful at all) to 100 (very useful). The survey resulted in 8 to 18 assessments for each action-environment pair. The resulting average utilities are presented in Table 1.

Table 1 Actions' utilities in each environment

	Internet crashes	Forest industry leaves Finland	Price of Energy drops 90%	EMU collapse	Nokia leaves Finland	China is in trouble	Storms of the century
1. Invest in maintaining trust in the society	87	63	63	80	71	67	68
2. Security and resilience requirements for information networks	86	48	48	48	46	56	76
3. Take care of small networked production	71	72	49	70	71	63	80
4. Prepare to increase self-sufficiency in food production	65	46	37	57	32	56	74
5. Increase respect for every type of work	59	62	58	53	70	74	62
6. Promote innovation for a rainy-day	64	81	77	67	84	81	69
7. Tax incentives for energy self-sufficient housing	55	43	35	50	30	37	48
8. Tax incentives for urban local food	67	38	29	47	21	46	60
9. Create an ICT-ecosystem	60	58	52	55	79	62	45
10. Develop services that require little energy	59	61	41	53	57	58	57
11. Invest in sustainable well-being know-how	59	73	75	72	83	78	68
12. Finland a global IT-service center for public authorities	50	60	51	53	68	42	42
13. Invest in new rapidly exploitable knowledge combinations	54	81	83	71	85	73	62
14. Let the forest industry disappear	29	64	38	31	30	31	25
15. Build more nuclear power to hedge against price shocks	28	41	34	48	48	44	39
16. Commercialize forest into an investment product	33	66	37	41	29	28	39
17. Manage a single global service	30	54	51	53	60	50	37
18. Train workforce as the reserve for global companies	35	48	56	51	65	42	35
19. Switch to exchange economy with no currency	35	30	20	36	16	22	28
20. Establish a Nordic monetary union	31	48	33	70	23	35	26
21. Make Finland the center for Asian and Russian connections	39	68	69	80	78	53	54
22. Specialize in fast piloting	41	74	75	60	85	82	59
23. Exploit Finland's neutral and apolitical reputation	48	61	61	68	62	65	44
24. Create Finnish Mittelstand to replace Nokia	37	80	65	60	76	71	48
25. Invest in trade outside the EU	38	65	61	74	67	58	52

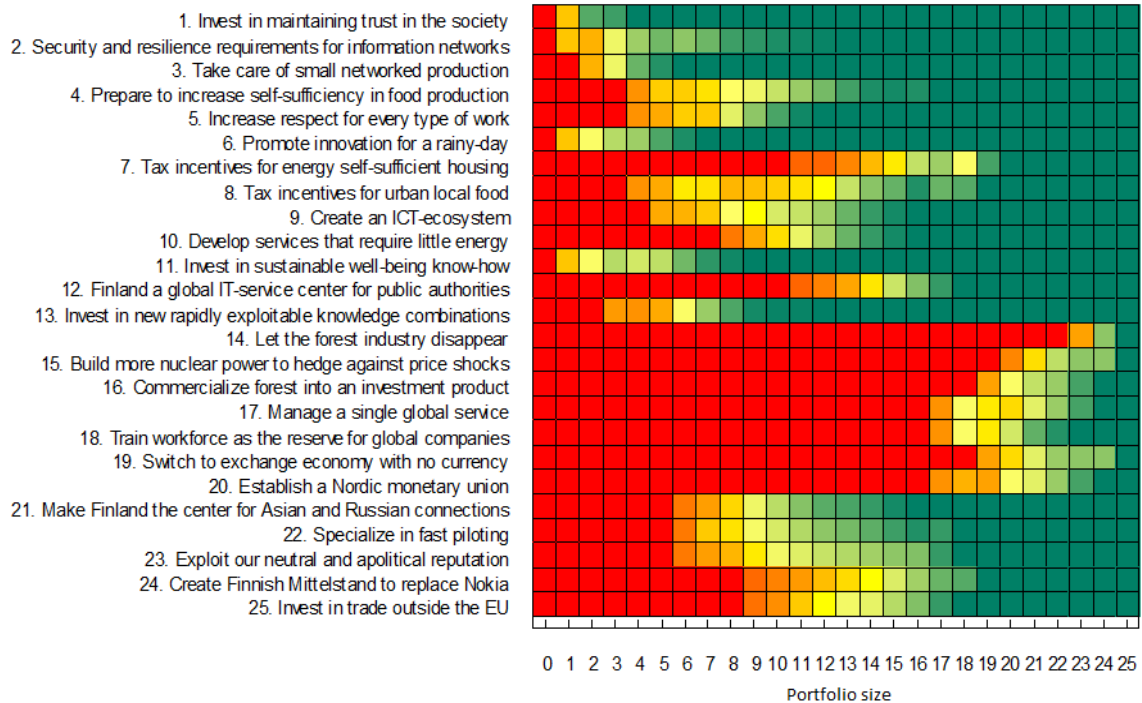
Picture 8: Experts defined a utility value for each of the actions assessed.

Robust Portfolio Modelling (please look for the detailed description pp. x-x in this Journal) was used to compute all efficient portfolios using the utilities in picture 8. Experts' views on the environment's relevance/importance were used to restrict the environment's weights in the RPM model. Picture 9 shows the composition of efficient portfolios containing 8 actions (i.e., about one-third of 25 actions). All of these portfolios contain actions 1, 3, and 6, which call for promoting trust in society, small networked production, and innovation. Most of the efficient portfolios also include actions 2 and 11, which relate to security of information networks and Finland's know-how on well-being.

Picture 9 shows the compositions of all efficient portfolios. The size of the portfolio is displayed on the horizontal axis, and the colours correspond to the share of efficient portfolios of a specific size that include each action: red (green) indicates that the action is included in none (all) of the efficient portfolios of fixed size. For instance action 1, "Invest in maintaining trust in the society" is

included in all efficient portfolios composed of four or more actions. In turn action 22, “Specialize in fast piloting” is not included in any efficient portfolio that contains less than five actions.

Figure 1 Composition of efficient portfolios of containing 8 actions.



Picture 9: Composition of all efficient portfolios of different sizes.

5. CONCLUSIONS

The principal idea of the 7 Shocks project was to use seven different shocks as instruments for collecting insights about resilience. The cases presented in this report are based on open source information and interviews. They are internally coherent and fact-based but have not been investigated in depth. Some of the cases, such as the impact of Internet on the Finnish energy system and the complex, indirect impact mechanisms of the potential loss of the pulp and paper industry, should be studied in a stand-alone research project. One of the alternative futures, life without the European Economic and Monetary Union, needs to be analyzed using proper econometric modeling.

The results presented below are based on the detailed analysis of the shock environment before the shock has occurred. In this way, we have been able to reveal some of the generic features that seem to be independent of the nature of the specific shock.

What causes lack of resilience?

The seven shocks under investigation call for an environment that makes the shocks possible. The basic assumption that has guided both the economic and political decision-making has been the requirement for constant growth. The principal driver of this development is globalization, which has led to increasing systemic dependencies and vulnerabilities in our economy and society. Globalization has facilitated continuous growth. But it has also generated structures that are fragile and too rigid for a fast changing environment.

Increased productivity has been an outcome of the advanced division of global roles. By specializing, we have been able to optimize efficiency. This development requires large production units able to minimize the price per unit production cost. Productivity development has had another facilitator: newly- emerging economies have been able to provide the global system with cheap labor, as well as consumers who seek cheap products.

The same efficiency requirement has also been one of the drivers of the integration of European national economies (free flow of resources) or the inter-European payment system SEPA (optimization of speed and transaction cost). The global systems have been successful; the principle of markets as an efficient allocator of resources and the self-sustaining Internet have done their job well enough. It seems that both of these global systems can optimize themselves without any visible intervention on the part of the public sector.

The very same idea of specialization and power of large units has also led to the situation where decision-making power has been channeled to experts (“technocrats”). In the case of SEPA, decisions are made by technical experts and in the EMU design process by economists and by a political elite. Our power grid is naturally designed by energy experts from large power companies.

The design choices presented above are good ones and are justified in an economy of constant growth and a relatively stable environment.

Results of the shock analysis

The aim of the shock analysis was to gather insight into resilience requirements. As defined at the beginning of the report, resilience is an outcome of three elements: adaptation, agility, and systems capability to learn and reconfigure itself; active renewal. Each of these resilience components can be divided into three systemic features: the purpose, structure, and function of a system.

The purpose is essential for a social system. The social system differs from an ecological system because it has a self-defined or given purpose and can change its structure and function if its purpose changes. By structure, we mean the power structure, production structure, and consumption structure. The third feature refers both to the flows of information and matter within the system and to the ways that flow takes place, along with the dynamics of the system.

Shock impact analysis framework

(Please add a section on assimilation here, as this is the first logical condition for resilience)

Adaptation

The main goal of economic planning is growth. The new criteria we introduce to decision-making is resilience. When uncertainties are increasing, and the cost of surprise is accumulating, it seems wise to invest in resilience. In the planning procedures, this implies that traditional risk management and risk minimization are not adequate for dealing with uncertainty. Uncertainty has to be considered as one of the basic assumptions of strategic and even tactical planning. Two examples:

- ✓ Social resilience requires a strong sense of fairness of the society. Increasing segregation of our society should be resisted.(Group work)
- ✓ Primary needs will have a higher priority in a world of surprises. Citizens should be prepared for the world in which everything may not operate as we expect a group to work)

Structure: Current systems – financial, value networks, the Internet – are worldwide. In an environment in which resilience becomes more important, large global networks will have to be

split into smaller overlapping networks. We are speaking about *globalized* networks operating locally, but which are also interacting with other local networks as well as with global networks.

Our study showed that sectors relying on a few large companies/production units (ref to Game Changers) are vulnerable because they are too rigid to change when the structure of global consumption/regulatory environment is changing. A more resilient structure is an ecosystem of small and medium-sized companies that are agile and quick to change their offerings according to the needs of the consumers. Even if some of these companies fail, the ecosystem as a whole is sustainable.

The resilient structure is based on a portfolio of diverse units/subsectors that react to shocks in different ways. When one of the subsectors/companies/businesses/technologies loses its foothold due to the shock, another subsectors/companies/businesses/technologies benefit from the situation. Examples:

- ✓ *Security and resilience requirements for information networks.* Let's build systems that consist of several smaller systems - local networks and separated cloud services which are connected by an integrating layer so that the whole system can be kept from crashing if one part of it goes down.
- ✓ *Develop services that require little energy.* Investment in companies offering expert services. These are not as dependent on energy prices and can continue their business activities more or less as usual, even when faced with higher energy prices. (Actions Portfolio)

Function: Networks are adaptive structures if the members of the network are ready to change their role and function when required. This idea comes from traditional Keynesian policymaking. But instead of changing the nature of production during the recessionary periods in the economy Finland has allowed its workforce to go fishing and to fund their livelihoods through unemployment benefits. The nature of the global system is increasingly volatile which means that all members of the network – both public and private sector – should be able to change their roles according to the requirements of the global environment. The adaptation should be immediate, either in the way

that the production is arranged so that it is based on self-service (users are creating the product by themselves) or the role shift is built in to the controlling system (regulation).

Two examples:

- ✓ We have to communicate uncertainties so that citizens have strong self-motivation for the preparedness and produce “a surprise kit” that is for sale in the leading supermarket) chains. (Group C3, B1)
- ✓ Production of public services. The importance of supporting new kinds of co-production models in producing services on a local level. In the production of public services, we could apply new kinds of co-production models on a local level.

Agility

Adaptation keeps us alive, but it does not automatically imply growth. The life cycles of products, services and ideas are getting shorter, and the pressure of increasing uncertainty strengthens this phenomenon. Social systems seek stability and high predictability, both features that are not favorable for growth in volatile environments. To grow, we have to use actively the opportunities that a fast changing environment provides. We call this element of resilience agility. Agile nations/sectors/organizations can release some of their resources (people and money) and use the temporary opportunity the environment provides. Growth as a purpose of the system is valid, but stability is not. Instead of predictability, controllability and manageability we must seek surprising opportunities and be quick to utilize them. Maximizing speed is one of the purposes of a resilient system.

Examples:

- ✓ *Take care of small networked production.* The bigger the systems, the more far-reaching the consequences of failures. Cell-like production of goods and services is also dependent on global networks, but its resilience is better. The first player to restore services gets an advantage over slower competitors. (Actions Portfolio)

Structure: Agile structures are based either on their resource management model; there is enough slack in the organization so that it can react immediately to an opportunity, or its structure is based on distributed networks. An agile network can activate those parts that are useful in the new

situation (and those resources that are not needed will participate in production in another network). The agilest structures are based on co-creation. Users are simply innovating/producing the new service when it is needed. The new trend of self-creation is a good example of this.

Examples:

- ✓ Support entrepreneurship by applying sweat equity principle (experts or founding partners work is compensated by shares of a company) and a “failure insurance” that covers some of the losses of an entrepreneur.(Group B4)
- ✓ Invest in strong basic education that will operate as a strong platform for fast applications. (Group A3)

Function: Surprising and fast emerging opportunities require new kinds of innovation. Instead of years- long innovation investments, the agile organization is investing in capabilities that enhance combinations. Fast innovations are combinations of old and new technologies, existing products with innovative service layers and unique offerings that use both public and private resources. Low predictability favors diverse, relatively low investment experiments. If the portfolio of experiments is diverse enough, some of them will be useful in whatever happens in the environment. The same applies to the portfolio of country alliances, if the portfolio consists of a broad enough set of alternatives, the agile country can shift emphasis from one partnership to another according to the situation.

Examples:

- ✓ *Specialize in fast piloting.* We'll specialize in piloting. When market conditions change, new pilot projects take off. They are started with those companies and countries that are most advanced in their development work at that point. (Actions Portfolio)
- ✓ Experimenting with public policies in different pilots, early failures should be recognized if possible (Group A2)

Active renewal

In the most of the context, resilience refers only to absorption of the shock. In this study, we go further. After the shock, the system is not able to return to the same state, but will be qualitatively different after the shock has happened. The system may either collapse or continue as a “retarded” system. In the best case, a system uses the shock as a trigger for renewal, and it tries to learn and improve its performance. This element requires a shift in the purpose of the system. In the long run, it may be wise to give up growth for a while and focus on fast learning and improvement of resilience for the next shocks.

Structure and function: Resilient systems can self-organize. When the shock has disrupted the system (imported energy into the system), the system will in the best case reconfigure itself without or with minimal centralized control. To benefit from this phenomenon, the system has to accept creative destruction and immediately legitimize developed procedures for future use. This requires fast reactions from the policymaking and regulations system.

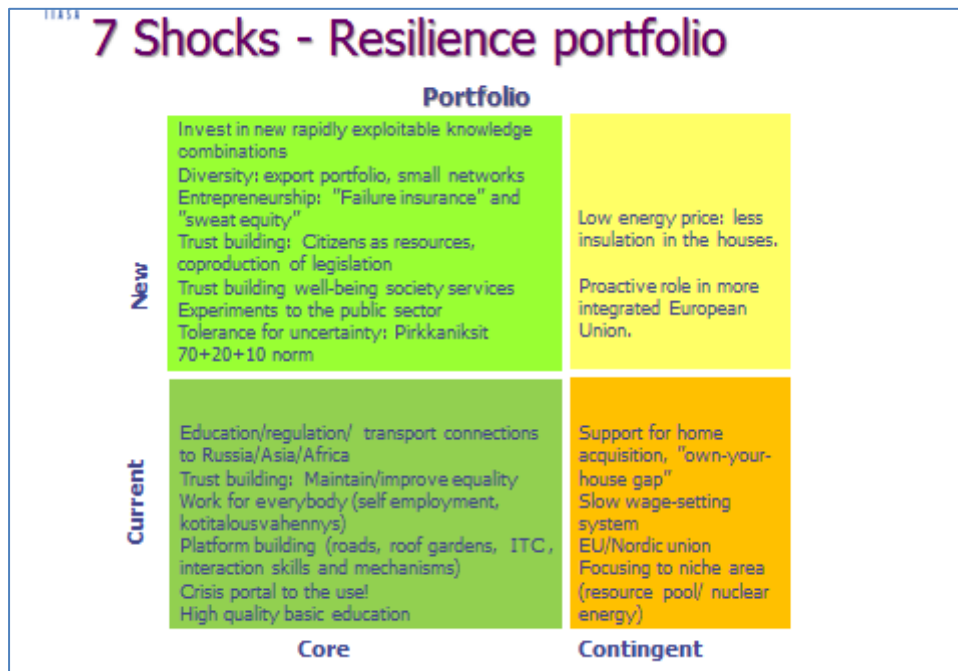
Renewal is based on learning. Learning systems have a high number of feedback loops. At the country level, this means that vertical dialogue between authorities and citizen, decision makers and subordinates should be enhanced. New opportunities for vertical interaction in government operations, modern social networks, and smaller local communities should be supported. Early detection of change provides time to learn, so constant information exchange with external connections is also a typical feature of renewing organizations. The interaction provides us with an opportunity for early failures so that resources can be reallocated early to the next experiments.

Example:

- ✓ *Invest in maintaining trust in the society.* Even Internet failure does not cause many problems in Finland as it does elsewhere. We can mutually agree that suppliers dispatch goods to stores, trusting that they will eventually be paid. Likewise, stores will advance store credit to consumers.
- ✓ Enable existing spontaneous activities of small communities such as food circles, urban culture events and restaurant days. (Group work)
 - ✓ Bottom-up crisis planning, where citizens are one of the planning resources. (Group work)

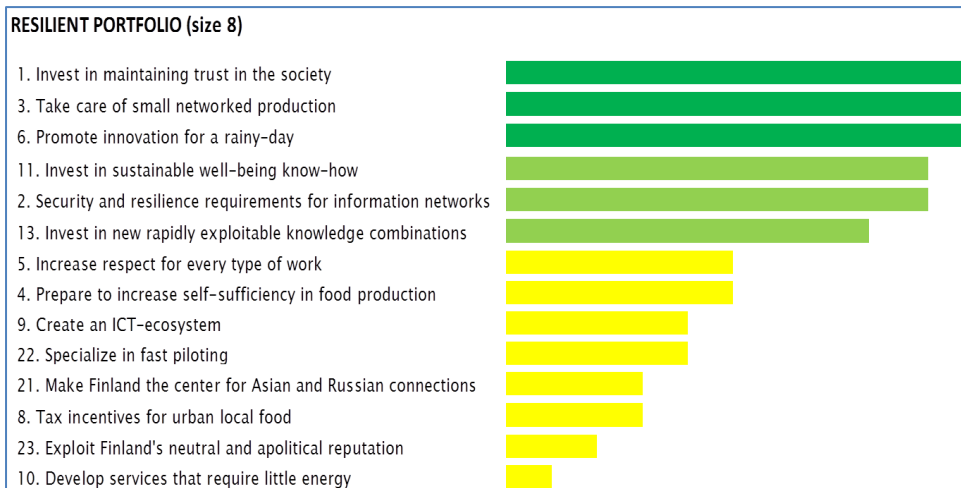
Resilience Portfolio

Decisions have to be made daily. In the best case, decisions serve both current goals and enhance shock resilience. The basic resilience portfolio was defined in the actions assessment process and processed further at the Analysis Seminar, which took place at IIASA, Laxenburg, Austria, on November 24-25, 2011.



Picture 10: Resilience portfolio as articulated in the Analysis Seminar.

Core actions are those that are useful across all of the 7 shocks that were analyzed. Contingent actions are seen to be useful in only one to three of the shock situations. Current actions are those that are included in current action plans. In the top left hand corner, we see a list of new actions that should be initiated. In principle, the rule is that if resource constraints are severe, and resilience requirements are increasing, we should shift resources from contingent actions to core actions



Picture 11: The actions assessed are now arranged according to their usefulness.

The outcome of this process shows that the core actions seem to be twofold by their nature. As one of the groups in the Analysis Seminar noted, the majority of the actions in this list, such as an increase in equality, strong basic education, infrastructure enforcement and trust building are generic in that they develop the basic resilience capabilities of the society. The other core actions group of this study consists of fast and concrete actions such as activating the crisis portfolio, using household services taxation treatment or retargeting trade activities.

New actions initiated in this study require structural changes in society and the economy. During the discussions in the Analysis seminar, all the groups articulated one theme over all the others: social resilience. Trust is essential to social resilience and one of the central means presented was a new kind of collaboration; citizens as partners in resilience building.

The portfolio generated in the 7 Shocks, and Finland project presents a list of actions that are useful in an uncertain environment, with some of the actions even being rather controversial. The resilience portfolio is only input to the strategic planning, and the final choice of resilience strategies are made in the course of that process.

Discussion

The study was a first of its kind, and it was scanning for resilience requirements at the national level. The choice was taken because on account of the increasing systems dependencies; it is

essential to look first at both the economic and social systems level in the global context. The obvious next step is to dig deeper and run the same process at a sector/organization level.

The project was completed in February 2012. The project seems to have had some impact on the political decision making. The Finnish Government chose resilience as the cross cutting theme for the Government's Futures Review. The process ended up to propose that resilience should be one of the competitive advantages needed in the global market place. Finnish National Emergence Supply Agency (NESA) has defined that the third of their focus areas will be building the resilience into the Finnish society. The most interesting experiment that has its roots in the seven shocks and Finland project is the pilot of the new education model that is conducted this year. In this pilot, the student will collect a portfolio of different modules of education that consist both of traditional courses and working as a trainee in different jobs. The ultimate goal is to prepare individuals to be resilient in the world of surprises where companies, industries, and sectors have shorter life cycles.

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ATTACHMENT 1

Assessed action ideas

Promote innovation for rainy days	National "Google time, "in which every (employed) citizen can use maybe a fifth of their time to work on resilience-improving ideas for extreme environments.
Prepare to increase self-sufficiency in food production	As the crisis lengthens, local food production would become increasingly vital. Seasonal radio shows that give tips for fishing and gathering berries and mushrooms. Small. Currently, worthless fish should be caught and turned into fish-fingers.
Security and resilience requirements for information networks	Let's build systems that consist of several smaller systems - local networks and separated cloud services which are connected by an integrating layer to keep the whole system from crashing in case one part of it goes down. All routing is implemented in such a way that these networks can be connected to alternate cloud services if one part collapses,
Tax incentives for local urban food	Local food production should be encouraged through taxation breaks. For example, using your balcony as a greenhouse should be tax deductible according to its production.
Tax incentives for energy self-sufficient housing	Direct support or tax deductions for micro production equipment. For example, miniature wind generators on all yards and balconies.
Switch to exchange economy with no currency	The Golden era for small producers. Back to the barter economy.
Develop services that require little energy	Investment in companies offering expert services. These are not as dependent on energy prices and can continue their business more or less as usual, even when faced with higher energy prices.
Build more nuclear power to hedge against price shocks	Building additional nuclear capacity offers protection from price shocks. The price of uranium fuel is a small fraction of the cost of electricity generation.
Let the forest industry disappear	We should allow forest industry to wither away in Finland, and develop service-based and other timber-sector jobs. These are less cyclical.
Invest in new rapidly exploitable knowledge combinations	Let's combine old and new knowledge that already exists, and cut back on developing longer-term development with higher expertise requirements.
Invest in trade outside the EU	The government strongly encourages companies to diversify their exports to countries and regions outside the EU, such as Russia, Asia, and Africa.
Establish a Nordic monetary union	Nordic countries start collaborating on the same export markets, to compete with other countries more effectively. The possibilities for a Nordic free trade area and currency union are investigated.
Train workforce as the reserve for global companies	We should make sure that our global companies have the necessary employee resources when market growth picks up. If they are the only operating companies, demand for them goes up and they, need more people. Let's train reserves in advance.

Manage a single global service	Finland could control any market or a globally used service that is not currency-dependent, but in which other countries would be connected to our systems. For example, tax collection.
Create Finnish Mittelst and to replace Nokia	Building a sufficient network of globally operating slightly smaller companies that get a boost to their activities if Nokia leaves Finland.
Increase respect for every type of work	Start a major PR campaign to promote the idea that any form of self-employment is beneficial, and unemployment is damaging.
Create an ICT-ecosystem	In an ecosystem, individual knowledge workers can network globally and sell their expertise to anywhere in the world.
Exploit Finland's neutral and apolitical reputation	Finland's image as an apolitical and neutral country needs to be utilized. For Chinese (as well as others) it is safe to trade with Finns, to work for a Finnish company, or to buy Finnish products.
Invest in sustainable well-being know-how	The whole world badly needs a new vision and societal model based on sustainable wellbeing. Finland could be the forerunner of this trend, based on our strong social model.
Invest in maintaining trust in the society	Even Internet failure does not cause many problems in Finland as it does elsewhere. We can mutually agree that suppliers dispatch goods to stores, trusting that they will eventually be paid. Likewise, stores will advance store credit to consumers.
Specialize in fast piloting	We'll specialize in piloting. When market conditions change, new pilot projects take off. These start in those companies and countries that are most advanced in their development work at that point.
Commercialize forest into an investment product	Land area does not grow; forest area is declining, and the forest is good carbon sinks. Based on this, Finnish forests are productized as an investment opportunity and sold by the hectare to international investors.
Finland a global IT-service center for public authorities	Finland has the world's most efficient tax-collection system, medical administrative systems, and other public sector IT systems. These could be sold as cloud services to the whole world, producing cash flow without having to shift large amounts of physical matter.
Make Finland the center for Asian and Russian connections	Creating a new kind of hotspot for growing start-ups together with Russian entrepreneurs could turn Finland into a European innovation hub.
Take care of small networked production	The bigger the systems, the more far-reaching the consequences of failures. Cell-like production of goods and services are also dependent on global networks, but their resilience is better. The first player to restore services gains an advantage over slower competitors.