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Developing Visionary Concepts for the Water Sector

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Abstract

This paper is based on CIRCLE research project running from September 2016 to November 2018 financed by ERDF, with the focus on the energy and nutrient recycling in the context of the water supply services. Laurea's FuturesLab CoFi research team has built alternative scenarios for the water supply services in long run as well as visionary concepts for water supply service business in general. We have applied scenario working and visionary concept design to find out new solutions for the water supply/demand problems faced both at the global level in the world and at the regional level in Finland, too.

Introduction and Background

According to the international climate change panel, the consequences of the climate change are more concrete, rapid and visible in practice than ever expected (IPCC 2018). The global warming will have its expressions often in the form of the heavy storms causing floods and shortage of the clean water in the catastrophe areas. On the other hand, the draught is at the same time a big problem because of the climate change causing rapid fluctuations in the weather conditions. The lack of clean water has its explanation also from agricultural reasons, namely nutrients running from the fields to the seas, rivers and lakes.

This paper is based on CIRCLE research project (9/2016–11/2018), financed by ERDF 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.

CIRCLE project will focus on the energy and nutrient recycling in the context of the water supply services. Laurea's FuturesLab CoFi is responsible for the future-orientation in the CIRCLE project, building alternative scenarios for the water supply services in long run as well as building visionary concepts for water supply service business in general. The key questions in this context are as follows:

- What the world or the society needs? -to create future-oriented solutions to resource scarcity and polarization at world level
- What the water supply service branch needs? -to find knowhow-intensive education modules for export
- What the firm needs? -to exploit new opportunities and visionary concepts based on scenario alternatives
- What the individual or the consumer needs? to get easy solutions to everyday life concerning sustainable way of living

We have applied scenario working and visionary concept design to find out new solutions at the world level but also at the regional level.

The framework of our study consists of three elements, which are scenario planning, visionary concept design and hybrid product concept model (Figure 1).



Figure 1. The framework for the study in the context of water supply services.

Scenario planning includes the recognition of key drivers and key actors influencing on the future in long run and visionary concept design will use alternative scenarios as a basis for service and product concept design for different needs. Finally, hybrid product concept model will deepen these concepts more precise with the help of its elements consisting of physical, service and know-how core elements but also of financial services, customer relationships and open innovation ecosystem elements which should be taken into consideration to form comprehensive solutions (Figure 2).



(c) Tarja Meristö 2009 (adapted from Meristö 1991)

Figure 2. The framework of hybrid product concept model.

Preliminary visionary concepts were created first with the student group in spring 2017, results were presented in the futures research conference in Turku 2017 (Laitinen & Meristö 2018a). The completed results and visionary concepts were produced in the facilitated visionary concept design workshop in spring 2018, and this paper will focus on that process and those concepts developed there.

Material and Methods

Data collection for the study included 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 main data of this study comes from the visionary concept workshop held in March 2018 but several preparatory phases preceded it (Figure 3). The preliminary scenarios were created by the research group based on the data collection done in 2017 which included web survey, interviews and a future workshop (Meristö & Laitinen 2017, 2018b). The contents of the scenarios were supplemented by the futures table method in a workshop. The futures table results offered input to form scenario stories which were used as a basis for the visionary concept workshop.



Figure 3. The main phases of the research process.

The goal of the visionary concept workshop was to develop new solutions (product/service/operational model) based on the scenarios. The workshop was carried out in three different groups. Two of the groups had a case organisation perspective: training & education organisation had education as a theme and expert & guiding services organisation had water management in rural areas as a theme. Additionally, the third group focused on a consumer perspective at a general level.

The main method applied in the study is scenario planning integrated to the visionary concept design. Visionary concept design starts from the future and its alternative development paths and focuses on needs and opportunities identified from alternative scenarios. Scenarios will serve as an ideation source to design visionary concepts, but also as wind tunnels to test ideas and concepts (Kokkonen et al. 2005). The method for creating visionary future product concepts consists of five main steps. The first step is the identification of change factors, which forms a basis for the second step i.e. scenario building. The third step is the identification of product needs in each scenario. The fourth step is the actual generation of future concepts based on the market need identified in each scenario. The fifth and last step of the method is the timing of R&D activities and operations. This step also includes other considerations concerning the contribution the visionary concepts might have to the company's business planning or strategy (Kokkonen et al. 2005).

The time perspective of the visionary concepts is long which has several benefits. Visionary concepts enable systematic examination of alternative future developments because future scenarios are illustrations of the operational environment in the future. It also takes into account the driving forces as well as market potential, uncertainty and challenges related to future in alternative scenarios. Moreover, visionary

concepts enable product concept design and R&D for the future, over the next product generation visualizes the future as products which are corresponding to the future needs (Leppimäki et. al. 2008).

Based on the collected data we ended up to two main drivers for the Finnish water services sector: 1) Focus of innovations (infrastructure maintenance vs. opening new opportunities) and 2) Focus of technology (technologies based on digitality vs. traditional technologies).

Examining the chosen drivers against each other, we built a fourfold table which formed starting points for the scenarios (Figure 4). Solutions based on digital technology are opening new market opportunities enabling profitable business and saving the world at the same time (Scenario 1) whereas expertise based on traditional technology can focus on exporting the current know-how to all around the globe to the new markets (Scenario 2.). On the other hand, focusing on traditional technology combined and maintaining the current infrastructure leads to the business as usual development (Scenario 3). Maintaining the infrastructure by totally new solution based on digital technology is also a possible alternative (Scenario 4).



Figure 4. Water supply service scenarios according to the key drivers in the field.

These four scenario alternatives were deepened by using futures tables describing all the factors and actors influencing on the future in long run. Three different scenario levels were used: the World level, the level of Europe/Finland and the level of Water Branch with its Actors. Altogether 30 variables were used: eight (8) from the world level, 13 from the Europe/Finland level and nine (9) from the branch level. All these variables carry alternative values varying from three to five alternatives each. E.g. at World level *Leading countries in water management business: /Finland/USA/China/Europe/No leading countries/* or at Europe/Finland level *Integrated energy production to water purification:/New normal/Not common/Locally somewhere/Only pilots/Not at all/* and at the Water branch with its actors *Key actors: /Water treat-ment actors/R&D&I actors/User sector organisations /Consumers/Legislators and International agree-ments/*.

The driving forces for each scenario were recognized and marked to the futures tables first, the consequences according to these driving forces were estimated and finally the scenario storylines based on these marks in the futures tables were written as follows.

Scenario 1. Saving the world

In this scenario all interest groups including companies, public sector and consumers are committed to save the world and the environment. The opinions of NGOs are also taken into consideration in public discussion and decision making. The focus of the water sector solutions is on business and social innovations. The goal is to open new opportunities for the water service business sector especially by applying solutions based on the digital technology. The business is focused not only on B-to-B and B-to-P solutions but also B-to-C solutions are looked for.

The basic assumption behind the scenario is the legislation, which enables developing new business activities so that the supply of water is ensured also in the free market economy. The water services sector is investing in new technologies, abandoning conservativeness and looking for new opportunities. Water service providers form an international network of small companies which takes into consideration local circumstances but also global standards in its operational development work.

The sufficiency of water resources is ensured by new technology but also the administration and payment collecting system of the water sector is working well. The migration of people due to water resources is working as driver, which also awakens Finnish people who do not have much experience of the lack of water. Water crises are a recognized risk which is taken into account in the water sector's development work. China is the leading country developing business in the water sector where as Europe is the leader in the social innovations regarding the water sector.

Scenario 2. Exporting current expertise to the world

The starting point for the scenario is the export of education and project management know-how based on traditional technologies to the new market. The demand for the water supply services and other water related business increases everywhere in the world. The biggest need is focusing on Africa but also in the Asian big metropolitan cities there is a demand for the top of world expertise which can be found from the Finnish and Scandinavian actors. Especially the Finnish expertise in water treatment and water supply is appreciated around the world.

The EU legislation supports the developing of the water service business and export possibilities. In Finland, private companies will also become the owners of the water utilities in addition to the municipalities. In the operational environment of the free market economy, the water supply security has been ensured with the legislation. In a competitive environment, the Finnish water expertise develops into agile and top-quality. The appreciation towards clean high-quality water has risen and even in Finland the pure water is not taken for granted anymore. Consumers are willing to pay extra for the clean water. There will not be specific fees to the water use in Finland but the financing of the infrastructure of the water supply and sewerage is taken care of through the taxation. The solutions of water supply services in Finnish sparsely populated areas are high level and standardized. There is also global demand for the Finnish water expertise regarding sparsely populated areas. The export of the water expertise is supported by the advanced sales expertise. The expertise of immigrants who have moved to Finland are utilized opening new export opportunities.

The Finnish water expertise is based on the high-quality know-how of traditional technologies but the solutions based on digitalisation and artificial intelligence support the traditional technologies. In Finland, the energy production integrated into the water treatment plants becomes more common which increases new export possibilities for its part. The expertise related to the recycling of nutrients also develops and

creates new possibilities to the export. The Finnish water expertise is supported by the high-quality education which is carried out with the help of coordinated multiactor forum. The close cooperation of the water field with the bio and circulation economy also supports the development of the expertise.

Scenario 3. Business as usual / Conservative water sector

The use of traditional technologies in the water sector and the management of the repair debt of the infrastructure are the drivers for the scenario. Inadequacy of water resources cause conflicts. The specific problem in the global scale is a non-existent excrement management, likewise the non-existent handling level of waste waters. The leading countries in water supply services come from Europe, especially Netherlands. The main market is in the big towns of the world, in especially their slum areas.

In Europe, the legislation opens new opportunities but in Finland the legislation is more like restricting by nature. The awareness of the importance of clean water increases and the people are ready to pay a little extra fee for clean water also in the form of the sewage fees. The smart technology is widely applied in the field of anticipatory supervision solutions and controlling activities. The energy solutions integrated into the water purifying activities are the "new normal". The immigration does not have big effects on the water supply and sewerage; the effects are mainly for example local arrangements related to the water supply and sewerage of refugee centres.

The Finnish water services sector is investing in a digital technology and the market is around the globe. However, the operation philosophy of companies is conservative. Local water service providers are still the key actors of the field. The education and expertise in the water field are in the recession and its supply decreases. Public-private cooperation becomes more common in the field, in other words the municipalities have the possession of water treatments plants but the services will come from the companies. The water supply services are seen to an increasing extent as a part of bio economy and circulation economy, utilizing synergic advantages. To this kind of a combination there is a global demand but it requires investments in the infrastructure even in the present market areas.

Scenario 4. Smart pipe world

The drivers for the scenario are the investments into the digital technologies and into management of the repair debts of the infrastructure. Good even global economic growth is needed so that it is possible to invest in both. A mutual understanding of the climate change agreement will be reached and at least the current level of commitment and solution-centric attitude will be continued. No country in the world is a specific leader in the development of the water supply services but all are seen as equal actors in the water supply management.

The operational activities require regional cooperation and the wide applying of public private partnership models. The EU legislation enables circulation economy solutions and the rich big towns are willing to pay for the clean water or solutions related to it. The extra finance needs are solved in the form of the new payments, e.g. drainage water payment. The demand for water service solutions in the sparsely populated areas are not seen as an interesting market potential but the urbanisation enables new business opportunities due to the changing consumer habits.

The aware actors use smart technology and the digitalisation becomes common in all the functions of the water sector. New breakthrough technologies will come to the recycling of nutrients and the whole innovation system is renewed so the water sector gets along to the new phase of development. The market is over regional limits, however, paying attention to local special characteristics and to condition differences. The whole field must attempt to radical reforms so that the advantages of the scenario can be realized. The actors of the field are big, national companies which perhaps search for synergies from bio economy and circulation economy through the mergers.

Results

The idea of the visionary concept design is illustrated below (Figure 5), where the alternative scenarios and the innovation areas for the water supply services needed in the long run are described.



Figure 5. Water service scenarios in long run and visionary concept innovations needed in each case.

In the visionary concept design workshop every group firstly developed preliminary concept ideas for each scenario which are shown in Table 1. In the next phase groups chose one concept and to describe it more deeply.

As an example, we will illustrate the concept of 'Standardized water footprint' in more details, including steps towards the desired vision. The concept was developed in the group focusing on the consumer theme and it was based on the idea of the taking water footprint widely to general use in the 'Scenario 1. Saving the world'. The concept on standardized water footprint suits well for this certain scenario because it raises awareness of scarce water resources and thus saves water resources.

The concept concerns a wide group of stakeholders including consumers, companies and government. Furthermore, the concept could be copied to other countries easily. The novel features of the standardized water footprint concept include all the core elements of the hybrid product framework: consumers can make better decisions and observe his own consumer behavior (know-how element); companies can monitor their activities and thus market their products and services based on the water footprint (service element); government can allocate taxation and tariffs on consumers and companies (service/know-how element); mobile devices can bring digital, real time information to consumers e.g. via different mobile applications (physical/service/know how element). The concept fits well into to the open innovation framework because companies and research institutions are developing the system together under the guidance of authorities including EU and the national level.

Theme Scenario	1. Education	2. Water management in rural areas	3. Consumer
1. Saving the world	 Exporting the management and development of water supply services to developing and less developed countries Educating water management in Central European way 	 Branding of voluntary work Committing companies to voluntary work Pointing out unsatisfactory state of affairs 	 'No waste at all'- mindset to the common use Denying the disposable bottles (and other disposable things), safe nondisposable bottles Digital meters Stopping the use of useless chemicals (e.g. when washing clothes) Consumer driven information channel: reliable information in understandable way (ensuring reliability e.g. with block chain technology) Water footprint widely to the general use
2. Exporting current expertise to the world	 Training of immigrants for water management expertise export 	 Productization of water expertise to e.g. supplementary education Productization of collecting water management data in rural areas 	 'Quality water' (standards and cerfication). Using of social media to raise awareness of water issues
3. Business as usual	 Organizing internal education of water treatments plants in order to utilise tacit knowledge BWSP (Building Water Safety Plan) 	Comprehensive, holistic solutions Co-operation of wide partner network	 Own activity of consumers in sustainability issues Preferring local products Recycling
4. Smart pipe world	Flow efficient graduation, i.e. removing barriers between different levels of education	 Continuous measurements Solutions utilising big data and artificial intellingence Automatic linking of different data 	 Digital solutions related to use of water Considering water footprint in all activities (e.g. measuring own daily water footprint by mobile app) Measuring the quality of water by cell phone scanning

Table 1. Summary of preliminary concept ideas for different themes

Finally, the necessary steps towards to the standardized water footprint were considered (Figure 6). Implementing the concept into the real life requires a wide co-operation of different interest groups, decisions and from authorities, commitment from companies, investments in research & development and coordinating partner network. The implementation could be done in 10 years.



Figure 6. Steps towards to the Standardized water footprint concept.

Discussion and Conclusions

The climate change with its wide consequences to many areas of the everyday life is one of the key factors related to the future in all industry branches. The future challenges related to energy, nutrients and water are fundamental and relevant to many different levels including society, industry, business and consumers as well. Scarcity of clean and pure water is one of the barriers towards the sustainable well-being in the world.

In the context of water service supply and energy recycling the elements of the hybrid solutions can come from various actors: service element from the water treatment plant, know-how from the university and education and the product element from industry companies in different branches. As a hybrid solution, these aspects can be combined in a new way towards a visionary solution for the future, as we have described above an example called standardized water footprint for the scenario number 1: Saving the world.

It is important to have global perspective even if looking for and considering local or national solutions. In the global context companies will reach the full potential in the market, also in the other scenarios e.g. in the scenario 2 Exporting current expertise to the world or in the scenario 4 Smart-pipe world, where technological innovations will bring new insights to the infrastructure investments worldwide. Also, the multinational pilots and even pop-up solutions can bring new perspectives to the domestic problems even in the scenario 3 Business as usual.

Finally, in order to get out the full potential of the facilitated workshops and to create holistic futureoriented solutions, it is recommendable that the workshop participants consist of different groups presenting business, society, NGOs and individual citizens, if possible, from other cultures, too.

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