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SUSTAINABLE BUSINESS MODEL INNOVATION FOR DIGITAL REMOTE MONITORING: A FOLLOW UP STUDY ON A WATER IOT SERVICE

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Annotation. *This study is a follow-up on the implementation of a business model created in a co-creation process with two universities and an established SME Preventos Informatics Ltd. specialized in monitoring municipal and industrial water distribution systems. The shared collaboration sustainability innovation results between the collaborators on research, development and innovation context were analyzed. A product was innovated for water distribution monitoring service's needs and then generated based on shared RDI pilot, finally Preventos Informatics Ltd. was found on 2018 as result of the RDI project and business model creation process. Authors elaborate findings for commercialization possibilities success factors and challenges for the co-creation concept. Evaluation criteria used are the feasibility of implementation and the environmental and economic value. Literature review focuses on collaboration enhanced sustainability innovations, which is used as comparison frame. Authors suggest efficient actions for collaborative innovation in order to boost commercialization of environmental innovations.*

Keywords: *Collaboration, sustainability, innovation, industry university partnership, business model canvas, remote monitoring, water monitoring, water management*

1 Introduction: background for the collaboration and business model creation activities

Collaboration as a term is commonly referring multiple entities working together to produce a desired and shared outcome, which actors would not reach alone. For successful RDI collaboration, a lot of open and non-open data needs to be collected and skills, knowledge and resources to be shared. Specially, openly shared information and data can easily be one of the main boosting catalysts to promote new novel findings [1]. According to [2] open data as free resource holds a promise for private and in public sector innovations, resulting to additional open data offerings to stimulate citizen engagement. This helps governments and businesses in decision making leading to different interpretations and raising discussions towards wanted directions. Also, citizen engagement has been used another way around, harnessing the community wisdom, which has shown resource efficiency in municipality collaboration side, where citizens have been participating to municipality operations development enhancement work [3]. Since the open data can be easily replicable, the success lies in the business model formation, concept development and intangible resources. Specially, reliable real-time data can be a key aspect for strategic decision-making. In this article the combination of open

and non-open data offers opportunity for building a competitive advantage for the IoT company and its customers in the aspect of decision making.

Industry – university collaboration deals with specific projects but often lacks with follow up of achieved results [4], which may partly relate to operational differences between universities and businesses. It should be beneficial in matters of time saving and risk management for companies if universities would perform the basic research on their behalf, for different option value evaluation front [5]. In the specific focus area on sustainability aspects, universities have a major role in collaboration [6], especially because of their social capital, student engagement, technological facilities and if they have sustainable-orientated values [7].

In the context of the sustainability research, one of the key aspects for earth to be able to sustain life is water [10] and especially fresh clean water as lifeline for the planet and humankind [11], who has done a set of bad decisions in past leading into pollution of some fresh water reserves and river streams [12]. For reliable and efficient decision making in the future, the accurate data is needed [13] [14] to make existing problems and opportunities visible in correct scope and scale efficiently. For this particular data gathering need, the water monitoring services business model was created [15]. The idea was to start from the business idea, brainstorm items to a business model canvas, evaluate the items in a multicriteria evaluation against feasibility, and eventually, select and design the business model. This service design and co-creation process has been reported in a previous study [15], which was part of Akseli project to sought and test new tools and approaches to accelerate business development by applying smart specialisation and water safety projects. In this follow up publication, we seek answer for the research question: What were the essential additions to collaborated sustainability business model to achieve the real implementation, after university – industry collaboration?

2 Business potential and role of municipalities behind digital sustainable innovations

Digitalization has been reshaping the whole society with new technologies and business models, although SME sector still is under investigated topic for researchers [16]. In the industry side, many traditional businesses have transformed from tangible product developers to service businesses [17], because of their investments on digitalization. At the same time decision-making has moved from level of few assets all the way in the fleet level [18]. Development has been driven by the large-scale availability of a data, accessible nowadays for the decision-makers. On the other hand, digitalization has boosted the generation of open data, which in turn is a great source for new innovation development, specially e.g. for science [19], public sector [20] and the developing countries [21].

In societies, things do not usually evolve by accident. Motivation and inspiration sources change by sustainability innovations, political guidelines, decisions and restrictions, which are often behind the push towards new solutions. According to [23], municipal infrastructure decision making includes interpreting a large amount of fragmented data, which forces municipalities to utilize more efficient data analysis methods and simultaneously develop data collection and decision-making tools. The challenge is, the public funding alone will not be enough for e.g. Finnish nation to be able to reach the UN Sustainable Development Goals (SDGs) by 2030, government has published a roadmap for cooperation with public, private and third sector towards globally influencing sustainable financing ecosystem.

3 Consumers role in sustainability development and business view to data generation services

Although consumers are knowledgeable and concerned about global warming and environment [26], there are multiple aspects supporting sustainable purchasing, there are also barriers e.g. in environmental-friendly food shopping: knowledge and marketing does not leads only to good intentions but not into actual purchasing actions, consumers make wrong conclusions, prefer other qualities as more important or they have a lack of awareness, credibility and/or motivation for

sustainable purchases [27]. Consumers opinions are somewhat polarized towards environmental-friendliness and sustainability, competing with cheap price, so consumers might need encouragement towards sustainable behaviour, e.g. by digitalization and gamification [29].

The world's water resources are stressed by the population and the socio-economic development [30]. 2020 corona pandemic led into decreasing in global markets, although major markets improve somewhat quickly towards normal [30], the unfortunate influences are that companies are postponing their sustainable development activities. Business model development plays a crucial role in survival in changing market conditions [31]. From the real problem setting, the idea for the new business model was in securing the clean water for future generations, based on real-time data about clean water leakages. Currently, leaks in distribution network lead to wasting clean water e.g. by the pressure bursts in aging infrastructure (pipes, pumps, valves). Because of this, there is a growing need for a smart water management to improve control of water flows and to optimize the use of clean water in general. According to [32] water distribution losses are circa: 48 % in Ireland, 23 % in Finland and 41 % in Romania. But in the end, the crucial question from business side is, what are the needed benefits, for the customer to be ready to pay for this sort of sustainability boosting solution?

4 Co-creation innovation process resulting sustainable business model design

Major positive influence between organizational culture, sustainable growth and innovation based competitive advantage will need favourable circumstances to create novel innovations. As part of these circumstances organizational culture can act as a social glue to fire up innovativeness turning to intangible asset and competitive advantage for a SME [35]. Co-creation method applied in this study increases frontline employee's effective involvement towards organization and development process while speeding up new service development and the quality of new services [36], especially in front end innovation phase [37].

The studied business model was developed in a four-stage innovation process: 1) context definition, 2) idea generation, 3) determining the business model items through core indexing and 4) defining the business model and re-designing due analysis of the evaluation information from multi-criteria decision support (MCDS) [15] [38]. The current study compares the 2017 collaboratively designed business model to 2020 implemented version. In context of university – industry collaboration, the business model research is not too often studied in practice, specially not with companies. Usual challenge is the business model creation process varies a lot among the constructed plan to trials and into the actual implementation. Success reasons evaluation of different business models is difficult, because of many variables caused by competition, development of world e.g. fast changes coming from digitalization [40] and constant changes in the market [41]. Many researches consider business models as slowly constructing iterative processes [42]. Also, researchers agree on a research gap in business model creation and practice-based understanding business model processes [45] [42] [46] [8].

5 Data collection and methodology

Data of the study is based on case company's CEO and scientists interviews who participated in the original RDI collaboration work covering the business model, circumstances for innovation, and sustainability aspects. The results are summarized to a business model canvas. Main author did the data analysis and comparison to the previous business model from the study (Table 1) [15] and the modelling of current business activities collected and obtained for this study. Interview answers were organized to a business model canvas (Table 2) [9] [15], which is currently in use, compared to previous 2017 version (Table 1) and compared similarities and differences (Table 3).

Based on 2017 business model, Preventos Ltd. was founded on 2018 with part-time employees (Table 1). The first accounting period revenue was circa 33 000 € and fulltime operations begun on 1st of March 2019.

Table 1: 2017 Designed extended Business Model Canvas. Clarified and based on [15] 2017 Preventos Ltd. Business Model Canvas

Customer Need Ready and easy to use, customized product. Automization of data analysis, predictive information				
Company Solutions Full-service package for company needs Reporting Services			Competing Solutions Commercial information systems	
Key Partners Meter and sensor manufacturers, authorities, ICT automation systems	Value Proposition Easy to use, saving time, useful information available	Key Tasks Ensure monitoring the supply chain and operational stability, guaranteeing continuity	Customer Relationships Refined measuring data, long-term customer relationships	Customer Segments Companies and industrial sector
Key Resources Service providers (software, knowledge transfer & accounting, field experts, environmental measurements & data production)			Channels Internet, direct contacts, sensor supplier	
Cost Structure System development and maintenance		Cash Flow Improved risk management, preventing and minimizing (environmental) damages		

Services were iteratively developed forward in co-creation with current customer basis and new co-operational partners are under negotiations in mining and water utilities sectors. The updated 2020 business model is seen in in Table 2.

Table 2: Current (2020) extended Business Model Canvas based on interview data 2020 Preventos Ltd. Business Model Canvas

Customer Need Smart water management to improve control, water use efficiency and water safety. Small water utilities have lack of resources, ICT skills and technical support. Ready and easy to use information services. Customized product for water management. Automization of data analysis, information for predictive maintenance.				
Company Solutions ICT service: monitoring water distribution, wireless data transfer and data analysis.			Competing Solutions Commercial information systems. Not many dedicated for water management.	
Key Partners Wireless IoT data logger, sensor and meter manufacturers	Value Proposition Accurate long lasting wireless measurements, easy to use, saving time, situational awareness	Key Tasks Ensure monitoring the supply chain and operational stability, guaranteeing continuity	Customer Relationships Refined measuring data, long-term customer relationships	Customer Segments Water utilities (small to large), food industry (dairies), municipalities and cities (storm water)
Key Resources Service providers (software, knowledge transfer & accounting, field experts, environmental measurements & data production)			Channels Direct contacts, social media, internet	
Cost Structure Sensors, wireless data loggers, cloud-based ICT system development, system maintenance, marketing and sales		Cash Flow Improved risk management and water safety, planning of water network rehabilitation planning, preventing damages		

Finnish domestic markets have yearly estimated water infrastructure rehabilitation needs 320 M€ for 20 years as growth potential for the company. From 1500 water utilities, 400 are municipally owned and 1100 are private small water utilities. Also, global smart water market size is growing as other IoT industry and 2019 industry size was 7,14 billion USD and estimated market size on 2025 is 13,81 billion USD [22].

Table 3: Comparison of 2017 designed and 2020 implemented business models

BMC Building Block	Analysis of Differences Between 2017 and 2020
<i>Customer Need</i>	2020 more details: improved water management control, resources, ICT skills, automatization, predictive analysis
<i>Company Solution</i>	same principles, 2020 more details. Added: data analysis.
<i>Competing Solution</i>	same than 2017
<i>Key Partners</i>	same than 2017
<i>Value Proposition</i>	same principles, 2020 more details. Added: accurate, long lasting wireless measurements and situational awareness
<i>Key Tasks</i>	same than 2017
<i>Customer Relationships</i>	same than 2017
<i>Customer Segments</i>	a lot more detailed information 2020: water utilities & food industry. Added: municipalities and cities management.
<i>Key Resources</i>	same than 2017
<i>Channels</i>	Same: internet and direct contacts. Did not happen: sensor suppliers. More specified: social media
<i>Cost Structure</i>	same principles, 2020 more details. Added: marketing and sales costs.
<i>Cash Flow</i>	Same: improved risk management & damage prevention. Not: environmental. Added: planning of water network rehabilitation, improved water safety

According to CEO of Preventos Informatics Ltd, all the differences between 2017 and 2020 business models are caused by customer needs, buying behaviour and other habits in customers organizations, which influence in purchasing. Also, the customer segments (private company,

municipal institution or cooperative) need specific and differentiated marketing strategies, because each of them has their own purchasing behavioural habits.

6 Conclusions

Digitalization, IoT and platform solutions are currently biggest business generators crosscutting all business sectors. In Preventos Informatics Ltd. ICT related business model implementation case, essential elements were the proper customer needs discovery and business model development iteratively, based on customers inputs in business model formulation and technical functionalities they were ready to pay for. Target customer segment selection with formulation of marketing message was needed to reach the right audience. For future studies, additional sustainability cases related to customer analysis with criteria-based marketing messages should be revealed. In this case, university-SME collaboration offered expert knowledge, modern methods and networks to enhance companies' business models. Furthermore, the collaboration provides new possibilities to participate development projects, develop proper tools, methods and frameworks [47] and networking forums.

Then, in more general view of university-industry collaboration, the future work and research should take on all possibilities digitalization offers for resource efficiency and find new ways to share knowledge for 3rd parties, offering opportunities to contribute to new innovation generation. For example, universities could practically offer new knowhow for digital design process tools and support mass customisation considerations; companies might have with the newest business models [24] [25]. Additionally, to the idea, innovation seeds and business model collaboration, active university - industry collaboration has also shown lot of promise from idea to minimum viable product / practical implementation prototyping. For example, hackathons and code camp events [28] [33] [34] and capstone courses [39] with design thinking aspects have been successfully used for multitude of years to promote collaborative solution creation, thus these methods have proven been effective [43] also in sustainability innovation and solution development collaboration. Even for more successful and constant collaboration, both the companies and the universities should focus on developing additional lean and resource efficient means to co-operate with each other in the front-end phases [37] (fuzzy front) of the innovation collaboration and they need to work out gain sharing models and trust related matters properly too [44].

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