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Transforming a Supply Chain towards a Digital Business Ecosystem

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Abstract. This study describes the intervention process of transforming a peat production supply chain towards a digital business ecosystem. We conducted a series of participative, co-creative workshops to facilitate and to research the transformation process. According to our findings, a wider ecosystem perspective to transformation helped to overcome the initial motivational challenges felt by the supply chain members. In the workshops, the participants were able to create joint meanings of social, financial, and use value of digital data, and to collaboratively make decisions about the transformation towards a digital business ecosystem. This was due to the participants' collaborative knowledge creation and negotiation processes, supported by the facilitators applying co-creative methods. Our results suggest that a developmental intervention provided a temporary governance structure for the participants to collaboratively create a shared logic for the digital business ecosystem creation.

Keywords. Digital transformation; Developmental intervention; Business ecosystem; Peat production; Supply Chain

1 Introduction

The digitalization of data and business processes opens up new avenues for improving existing business and for creating new business. Companies often approach digitalization as a technical exercise – the right technical tools are thought to digitalize the business. However, especially in a supply chain, the biggest challenges hindering digitalization usually relate to the differing interests, working cultures, and economic models of the members [1].

Digitalization changes the interdependencies between existing supply chain members, and can open it to new members, so that the supply chain can start transforming towards a business ecosystem. The transformation threatens the members' existing roles and “micro-specialized competences” in the existing value network [2]. On the other hand, digitalization of a supply chain

necessitates collaboration between the current and future potential members of the forming digital business ecosystem. Any single member alone cannot grasp the potential value of the forming business ecosystem as a whole [3], and thus the integration of the members' competences into collective value creation should be a shared responsibility. More research [3] is called for to understand the dynamics of ecosystem transformation. Our study addresses this need by analyzing the institutional characteristics of an ecosystem, and specifically, how these characteristics are co-created in an emerging ecosystem in a process of negotiation.

Our study focuses on the transformation of an established institutional value chain in the Finnish energy sector, namely the peat supply chain. We conducted a developmental intervention in this supply chain to facilitate its transformation towards a digital ecosystem and to study the transformation itself [4]. We aim at contributing to the emerging theory on creating digital business ecosystems that builds on organizational ecosystem and co-creation literatures.

2 Theoretical Background

2.1 Organizational Ecosystems and Negotiated Order

Thomas and Autio define an ecosystem as an organizational field that encompasses all participants that focus on collective value co-creation [5]. The interdependent participants of an ecosystem are bound together through three characteristics [5:12]

1. *A network of participants*, each of them providing a particular, complementary *input* to the system. Through their cumulative interaction, the participants add value. The inputs of the participants need to co-evolve.
2. *A governance structure* coordinates the participants' interaction for collective value creation. It consists of an authority structure for decision-making, conflict resolution, membership control for handling ecosystem openness, and coordination.
3. *A shared logic* glues the participants of the ecosystem cognitively and socially together in understanding their interdependency: a sense of legitimacy, trust, and mutual awareness about being involved in a shared enterprise of the ecosystem.

The institutional approach on organizational ecosystems offers also theoretical insight into supply chain transformation. Negotiated order theory holds that organizations can collaborate in constructing their organizational field by

agreeing on the rules for their interactions through negotiation [5:23]. In practice-based theoretical research, negotiation is considered an important relationship between knowledge producing communities [6]. Negotiation is profoundly different from conventional organizational coordination: it is capable of creating dynamism in the organizational structure, and highlights the significance of balancing individual interests in inter-organizational collaboration [7]. Negotiation is also needed to deal with conflict in organizational transformation. Power asymmetries can result in a reduced likelihood of co-evolutionary change in the ecosystem [5].

2.2 Co-creation of Knowledge for Business Ecosystem Creation

The creation of a business innovation ecosystem proceeds in principle in three main steps [3]: first, the collaborators need to connect and define their relationships. Second, they negotiate shared objectives and define a common identity. Third, they define the actions needed to achieve the objectives.

When an existing supply chain begins transforming towards a digital ecosystem, it starts with the current members and their interdependencies, motives, and value adding logic. Transformation is a challenge for the current and new members of the emerging ecosystem. They have to collaboratively redefine their value adding interdependencies [4]. This requires sharing and co-creating knowledge [1]. Modelling the knowledge into visual boundary-objects supports knowledge sharing, collaborative ideation, and co-creation [8]. External facilitators help ecosystem members make sense of the situation, share, negotiate, collaborate, and design their changing interdependencies [3].

3 Research Approach and Methods

This study is based on an action research based intervention where the researchers have the role of network facilitators [7]. Action research allows both to increase scientific knowledge in the area and to initiate change in the studied organizations [8, 9]. Action research gave us the unique access into the case network for researching the transformation of the supply chain.

3.1 Developmental Intervention for Digitalizing Peat Production

We organized a developmental intervention to help in digitalizing a peat production supply chain for energy production. Fig. 1 depicts the members of the

peat production supply chain: sub-contractors, a hub company, and a power plant client. In addition to these members, we invited representatives from a peat harvesting machine producer and from software providers as co-creators of ideas for digitalization, and university professors, researchers, and students. Public environmental organizations and regulative bodies were not represented but are part of the forming business ecosystem.

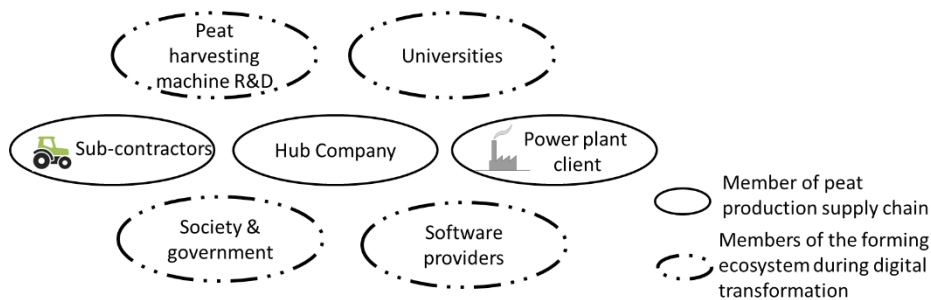


Fig. 1. The participants of the peat production ecosystem during digital transformation.

3.2 Data Collection and Analysis

The intervention was conducted during December 2016 - March 2017. Researchers and students from Aalto University designed and realized the intervention and collected the research data that included interview transcriptions, process and value network models, notes from four successive workshops, participant observation, and video recordings. Data triangulation increased the validity of research [9].

In the first workshop, a preliminary understanding of the process was co-created. Then, eighteen participants were thematically interviewed. They were members of peat production supply chains in two locations in Finland. The interviews dealt with information flows and work practices in peat production, but also with the basic assumptions and motivations of the different participants towards digital transformation. Three researchers designed and analyzed the next three workshop based on progressive problem identification and solution finding; the goal of each workshop was set based on the findings of the earlier workshops. (Table 1)

In the workshops, the participants were brought into facilitated dialogue about their forming digital business ecosystem, across their different views and goals. They discussed their networked operations and the possibilities of

producing and exploiting digital data throughout their peat production process. Based on the research data, the researchers designed peat production process models and value network models that were used in the workshops as visual boundary objects [8] to support knowledge co-creation.

Table 1. Goals and outputs of the developmental workshops.

	Workshop I <u>21.12.2016</u>	Workshop II <u>3.3.2017</u>	Workshop III <u>17.3.2017</u>	Workshop IV <u>31.3.2017</u>
Goal	Understand current data flows in the peat production process.	Understand the challenges in managing peat product quality data.	Develop solutions for tackling the challenges.	Develop a concept model for the digitalized peat production.
Output	An initial process model of peat production.	A value network model.	Detailed peat production process and value network models.	A concept model for digitalizing peat production.

In data analysis, we followed the logic of abductive scientific reasoning [10, 11]. Abductive reasoning is well suited for interpretive action research, where analysis progresses as a continuous dialogue between theoretical knowledge and the data that was collected at different points of time. [12]

4 Findings and Discussion

4.1 The Current Supply Chain and its Transforming Characteristics

The governance of the current peat production supply chain is decided by the hub company - subcontractor relationship based on competitive bidding. The hub sets the objectives for subcontractors and controls the supply chain. The production responsibility is largely transferred to the subcontractors, who work independently according to their contracts.

The peat production process is well established as an operational process, but the product data concerning the quality of the peat is estimated by the members of the supply chain through subjective and manual practices, and communicated through various means in the different phases of the production process. The members of the peat production would benefit from the digitalization of peat data and its communication because up-to-date product data is critical for the energy efficiency of the clients' power plants, and it determines the payments to the hub and the subcontractors.

At the start of the intervention, the members of the supply chain had some ideas about digital sensors and data management systems for peat quality data. However, digitalization motivated mainly the hub company that would potentially gain the most business benefit from it. While the subcontractors in general welcomed new quality measurement technologies, they did not see how they could get any added value. With digitalization of the members' data input, their interdependencies in collective value creation could change, and the benefit that each member would gain from it was uncertain. There was no shared logic of being "in the same business ecosystem of digitalized peat production".

According to the interviews, the members had their own development agendas for digital solutions, and sub-optimization was felt a challenge. The companies did not yet perceive digitalization as a supply-chain wide effort. The powerful hub company was carrying out internal technology projects, and the sub-contractors were not part of the development work. The harvesting equipment manufacturers were only seen as providers of production machines for the current production process, not as partners in the forming ecosystem. The hub company's greater power in the present supply chain seemed to dampen the other members' motivation for transformation.

In the facilitated workshops, the supply chain members felt inspired by the idea of a wider peat production ecosystem that they could jointly start creating, supported by visual boundary objects. The competitors, technology providers, government bodies, and national policies (peat is classified as a fossil fuel in Finland and its use is considered as non-sustainable in the long run) create threats but on the other hand also offer resources and novel possibilities for digitalization. Digital transformation clearly expands the existing boundaries towards a wider ecosystem. Our results suggest that the digital transformation of the existing supply chain should be understood and facilitated from a wider ecosystem perspective. (Fig. 1)

4.2 Knowledge Co-creation and Negotiation for Transformation

During the intervention, for the first time a substantial amount of knowledge concerning the data management of the current peat production supply chain was collected and shared among the participants. In the workshops, the participants clarified their tasks in peat production. They shared knowledge, views and, motives while discussing the challenges in data management, and

jointly created digital solutions for tackling them. Further, they could now grasp the importance of digital peat quality data: the whole ecosystem is partly financially compensated based on the quality of peat. A shared logic of the forming ecosystem started to germinate among the participants as they jointly created meanings of social, financial, and use value of digital data.

At this point, we have not yet collected follow-up data on the effects of the intervention on ecosystem creation. However, we can already observe some early evidence. In the facilitated workshops, the participants could collaboratively negotiate and select issues that they considered most significant for the digital transformation of the peat production supply chain. The representatives of the hub company, the sub-contractors, and the wider ecosystem members all participated actively in the negotiations that resulted in focused project proposals for furthering the digital transformation, and in ideas for the implementation of those projects. The intervention thus contributed importantly to the governance of supply chain transformation. Summarizing these effects, the intervention provided a temporary governance structure and a shared logic for ecosystem creation (Fig. 2).

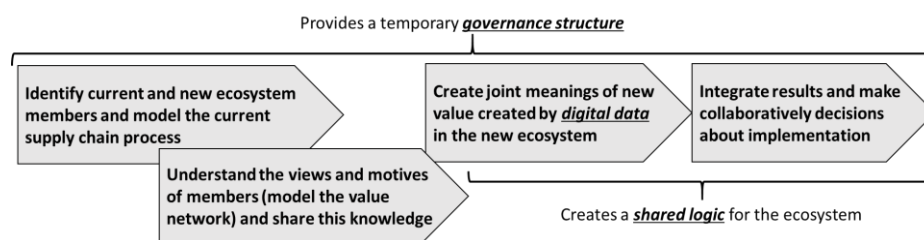


Fig. 2. The intervention created a “temporary governance structure” for digital transformation

5 Conclusions

We facilitated the transformation of a supply chain towards a digital business ecosystem systematically through a developmental intervention that included four participative workshops. In these workshops, the participants discussed, developed, negotiated, and agreed upon collaborative actions to digitalize their operations and to transform towards a digitalized business ecosystem. We contribute to the emerging literature on creating digital business ecosystems by showing how the members of the forming ecosystem can find com-

mon goals, discuss the value of digitalization, and make collaboratively decisions about implementation of digital solutions through facilitated knowledge co-creation and collaborative negotiation. Our results suggest that digital transformation of an existing supply chain should be facilitated from a wider ecosystem perspective which helps the supply chain members to overcome the initial motivational challenges and create a shared logic.

Based on our results, we create a hypothesis that a developmental intervention provides a temporary governance structure for the participants to collaboratively make decisions about the transformation of a supply chain towards a digital business ecosystem. The hypothesis should be tested in other supply chain contexts. Also, to what extent the temporary governance structure carries over to the real life ecosystem creation should be studied.

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