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Leveraging Business Modeling Tools For Ecosystemic Business Model Design

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Abstract

Business modeling tools are crucial for designing and implementing successful business models. However, there exist instances—which we refer to as the design of ecosystemic business models—in which developing a business model requires simultaneous consideration of both one's own business model and that of ecosystem partners. In these instances, standard business modeling tools focusing on representing business models in isolation may be inadequate. Based on a real-world example of a business ecosystem from the maritime logistics industry, we highlight five significant design challenges for ecosystemic business models. We then reflect on and discuss the extended role of the business model as an instrument for inter-organizational alignment, and draw out three implications for business modeling tools. The objective of this paper is to deduce implications and functional design requirements for business modeling tools from a conceptual perspective.

Introduction

Researchers and practitioners have increasingly started to use the term business ecosystem (Kapoor, 2018), to reflect the idea that organizations and their underlying business models should not only be seen as independent actors in a single industry but as one part in a wider business ecosystem (Snihur and Bocken, 2022). Recent research on the concept of ecosystems goes beyond simply describing collaborative organizations, seeing it rather as representing a lens and a unit of analysis that highlights the creation of a joint value proposition for the customer that a single organization cannot achieve in isolation (Adner, 2017; Kapoor, 2018). A joint value proposition is based on multilateral and non-generic complementarities of various organizations (Jacobides

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et al., 2018). This, in turn, requires organizations participating in ecosystem plays to review and adopt existing business models (Holm and Kringelum, 2022).

Business modeling tools are a vital element in supporting business model design (Bouwman *et al.*, 2020; Schwarz and Legner, 2020). Both separately and in combination, these tools help with reducing cognitive load, enhancing the ideation process, increasing business model coherence, and influencing decision-making (Henike *et al.*, 2020; Shepherd *et al.*, 2023; Massa and Hacklin, 2020). However, the most widely used business modeling tools tend to focus on representing and innovating the business model from the perspective of one focal organization, rather than considering joint value propositions, complementarities, and dependencies as the focal point of analysis (Henike *et al.*, 2020; Demil *et al.*, 2018; Iivari *et al.*, 2016; Westerlund *et al.*, 2014). This is a limitation because such tools could induce cognitive biases and framing effects stemming from the lack of attention to aspects that are critical to the development of a successful joint value proposition in ecosystems (Henike *et al.*, 2020; Adner and Feiler, 2019). In extreme cases, this can even lead to a complete collaboration failure (Zuzul, 2019).

We define an ecosystemic business model as a business model that focuses on both the way an organization creates and captures value, and on how the ecosystem creates and captures value to deliver a joint value proposition to customers (Iivari *et al.*, 2016; Adner, 2017). Designing an ecosystemic business model involves contributing to the joint value proposition and aligning the value creation and value capture logic accordingly (Adner, 2017; Xu *et al.*, 2019). This, in turn, affects business modeling tools, as a "change in business models as schema and [a] change in business models as formal representations are likely to go hand in hand" (Shepherd *et al.*, 2023, p. 101). Considering current business ecosystem ambitions in various industries, such as health (Gomes *et al.*, 2019), solar photovoltaic systems (Winkler *et al.*, 2023), and energy (Xu *et al.*, 2019), it is essential to critically reflect on and potentially adapt existing business modeling tools to ensure that they can effectively support the design of ecosystemic business models.

In this paper, we make three distinct contributions. First, we describe business model design challenges using the example of a current business ecosystem of autonomous shipping. Second, we propose an additional role for the business model as an "alignment instrument" (Al-Debei and Avison, 2010, p. 366) for inter-organizational settings, specifically for business ecosystems. Third, we discuss the implications of ecosystemic business model design for business modeling tools. In so doing, we point out that inter-organizational business model alignment poses additional functional design requirements for business modeling tools, on the basis of which we outline further research opportunities.

Theoretical Background

Business Modeling Tools

To succeed in the digital age, organizations need innovative business models that help them create value, deliver value to customers, and make a profit (Osterwalder and Pigneur, 2010). This has led researchers to describe the business model as an alignment instrument for digital businesses to mediate the gap between strategy and processes, including their information systems (Al-Debei and Avison, 2010; Veit *et al.*, 2014). Business modeling tools (i.e., visual models, frameworks, modeling languages, or IT support) are instrumental in supporting communication and collaboration regarding business model decision making (Schwarz and Legner, 2020; Bouwman *et al.*, 2020; Veit *et al.*, 2014).

We conceptualize business models as "formal conceptual representations of how a business functions" (Massa *et al.*, 2017, p. 73), and the tools as boundary objects that facilitate communication and collaboration across knowledge boundaries, and enable decision makers to align their ideas and expectations (Shepherd *et al.*, 2023; Schwarz and Legner, 2020). A number of different business modeling tools are currently available. Among them, two examples—the Business Model Canvas (Osterwalder and Pigneur, 2010) and Eriksson-Penker Business Extensions (Eriksson and Penker, 2000)—highlight the profound differences that tools can have in terms of syntax (e.g., map-based vs. network-based visual form) and semantics (e.g., number of unique semantic constructs offered)

(Szopinski *et al.*, 2022). Researchers who have analyzed business modeling tools have focused either on general representations (Henike *et al.*, 2020; Täuscher and Abdelkafi, 2017), on modeling languages (Szopinski *et al.*, 2022), or on IT support (Szopinski *et al.*, 2020), often in great detail. However, the merits and limitations of ecosystemic business model design have only been touched upon briefly (e.g., Ma, 2019; Szopinski *et al.*, 2022).

Business Ecosystems

The concept of a business ecosystem was introduced by Moore, who highlights the importance of an 'ecological' approach to describe the context in which companies compete and collaborate. According to Moore's theory, a business ecosystem consists of companies that coevolve their capabilities and roles to achieve a common goal (Moore, 1993).

Since then, a comprehensive body of scholarly works has been published on business ecosystems. Especially since the publication of two seminal conceptual papers (Adner, 2017; Jacobides *et al.*, 2018), knowledge on the ecosystem construct has become more comprehensive, centered around three specific attributes. First, the purpose of an ecosystem (-as-structure) is to realize a focal (joint) value proposition (Adner, 2017). Second, ecosystems are a group of organizations consisting of "varying degrees of multilateral, nongeneric complementarities" (Jacobides *et al.*, 2018, p. 2264). Third, ecosystems exist without full hierarchical governance (Jacobides *et al.*, 2018).

These attributes of ecosystems also distinguish the concept from related concepts such as supply chains (Adner, 2017), networks (Kapoor, 2018), and platforms[1] (Hakanen, 2021). Furthermore, while various definitions of different types of ecosystem (e.g., business, innovation, knowledge, and entrepreneurial) have been proposed, they are not always fully reconcilable with each other[2] (Thomas and Autio, 2020).

In this paper, we use 'business ecosystem' in generic terms and refer to the three attributes above.

Ecosystemic Business Models

The work of Massa *et al.* (2018) expands the business model concept towards a more complex and systemic view of interdependent components. In a business ecosystem, value creation, delivery and capture are embedded within a complex system, based on multiple business models and the (inter)dependencies between them (Hellström *et al.*, 2015; Snihur and Bocken, 2022). We follow other studies on ecosystemic business models (Iivari *et al.*, 2016; Xu *et al.*, 2019) by viewing the business model as a boundary-spanning unit of analysis for value co-creation and co-capture. Therefore, an ecosystemic business model is a system of interdependent components embedded in an ecosystem, which seeks to exploit business opportunities in concert with a network of partners with whom value is co-created and co-captured (Westerlund *et al.*, 2014; Holm and Kringelum, 2022; Gomes *et al.*, 2019).

Business Model Design Challenges

While ecosystems are increasingly recognized as a strategic imperative, managers struggle with business ecosystem design. For example, a recent study by Reeves et al. (2019) conducted on 57 ecosystems across eleven sectors and various geographic regions revealed that fewer than 15% of the business ecosystems were successful in the long term. Interestingly, the main reason for most business ecosystem failures (85%) is bad design, rather than bad execution (Pidun *et al.*, 2020).

As already mentioned, business ecosystems are characterized by some important attributes, namely, a joint value proposition, non-generic complementarities, and no hierarchical control. To demystify this theoretical concept and to illustrate its meaning and significance for the design of business models—and the design challenges it brings—we use an example

[1] Platforms can facilitate transactions of multiple actors in an ecosystem, but ecosystems can exist without platforms (Hakanen, 2021).

[2] There are many examples of conflation of different types of ecosystem in the literature. For example, Jacobides *et al.* (2018) differentiate between business, innovation and platform ecosystems in their theoretical background, but title their main contribution chapter "Towards a Theory of Different Ecosystems" (p. 2260).

from the context of autonomous shipping (Tsvetkova and Hellström, 2022; Tsvetkova *et al.*, 2021).

To understand autonomous shipping, a good starting point is to grasp how conventional maritime logistics works. Conventional maritime shipping is centered around the following main actors: (1) ship systems providers (technology providers), (2) shipbuilders (shipyards), (3) shipowners, (4) ship operators, (5) shipper (owners or suppliers of commodities that are shipped), and (6) port operators. The business models for building and operating conventional cargo ships have remained largely unchanged since the start of globalization, their primary aim being cost reduction through containerized standardization and cargo capacity.

The application of advanced digital technologies can, however, increase ship intelligence towards fully autonomous shipping. This has the potential to rapidly change the maritime logistics industry and provide opportunities for a redesigned business ecosystem. Maritime autonomous surface ships (MASS) transport commodities without seafarers on board. The expected value proposition of MASS includes increased ship safety, reduced operating costs, and better supply chain transparency. To achieve that, however, the business models of many actors must change, and "it is not immediately apparent how value creation and capture will change in such a transformed ecosystem" (Tsvetkova and Hellström, 2022, p. 268). In the following, we highlight five major design challenges:

Challenge 1: Joint value proposition. Although each partner, with its own strategy, remains independent, it is essential to secure the engagement and trust of all the partners in the ecosystem. To do so requires all organizations to create a joint vision and value proposition to enable every participant to see the 'bigger picture' and their role in realizing it. For example, technology providers are the main drivers of a MASS business ecosystem. However, as they rarely have the required in-depth understanding of the maritime logistics industry, with all its actors, there is a high risk that the technology providers will build a solution that does not suit all the other actors (e.g., port operators do not benefit).

Challenge 2: Aligning complementarities. MASS need certain non-generic complementarities to be established or revised between the different logistics actors involved. For example, port operators need to adjust their activities and resources (e.g., integrating sensors) to complement MASS technology and allow for value creation through automated operations in ports. Lack of investment in non-generic complementarities from port operators that can accommodate MASS creates a barrier for the whole business ecosystem.

Challenge 3: Aligning business model dependencies. A successful business ecosystem is built on a system of dependent business models whose performance depends on the actions of the collaborators (Adner, 2017). For example, MASS spend more time in port to carry out operations such as maintenance that would otherwise have been performed by the crew during the voyage. This leads to a decrease in ship throughput, and influences the value creation for port operators.

Challenge 4: Value capture allocation. Challenges arise in motivating actors to engage or invest in MASS if it is unclear who will invest and who will capture the value. For example, "the shipowners who usually undertake the ship investment benefit only partly from the expensive technology installed on MASS, while the benefits from operating such ships [...] will be enjoyed by the ship operator" (Tsvetkova and Hellström, 2022, p. 256).

Challenge 5: Dynamic changes. As MASS will be increasingly introduced by ships with four different degrees of autonomy, the business ecosystem of fully autonomous ships without any human interaction is the fourth degree of autonomy (similar to driverless cars). This development over time means that during the transition to full autonomy, actor roles and their value creation and capture mechanisms are in constant state of flux, depending on the degree of autonomy achieved and aimed for. The dynamic advancement of digital technologies, along with changing (de)regulations by governments, are typical challenges of business ecosystems (Gomes *et al.*, 2019; Winkler *et al.*, 2023).

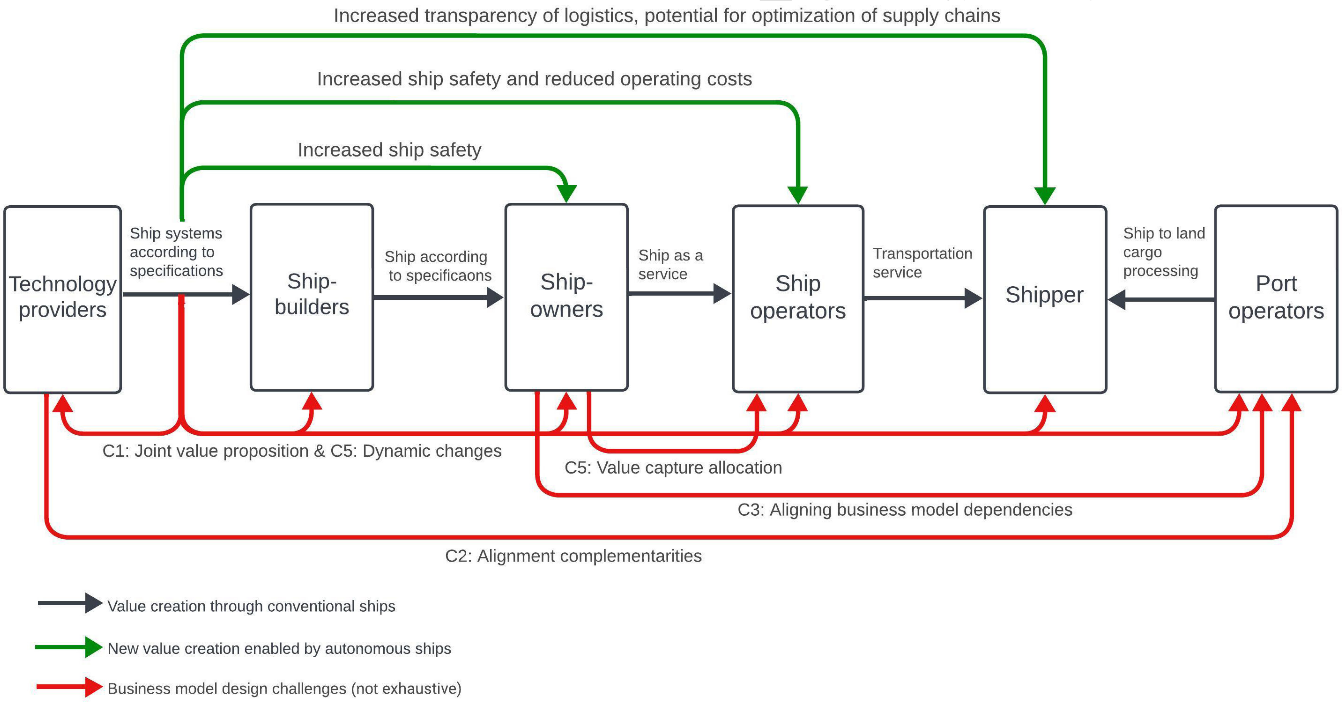

Figure 1: Value creation enabled by autonomous ships and typical business model design challenges (based on Tsvetkova *et al.*, 2021)

Implications for Business Model Design

Conceptual Implications for the Business Model as an 'Inter-Organizational Alignment Instrument'

The business model as an *intra*-organizational alignment instrument between an organization's overall strategy and the more specific operational design of business processes is well-established in the literature (e.g., Al-Debei and Avison, 2010; Veit *et al.*, 2014; see Figure 2, red colored rectangle). In the process of designing an ecosystemic business model there are, however, more alignment necessities involved. As highlighted in the autonomous shipping example, the organizations have to engage in a business model alignment process that requires extensive discussions and knowledge sharing to understand the impact of individual business model changes on the business models of other participants in the ecosystem. Hence, we propose an additional role for the business model concept, namely as an instrument for *inter*-organizational alignment (see Figure 2, blue colored rectangle). Figure 2 illustrates an integrative framework where the business ecosystem consists of multiple organizations (here using two organizations, A and B). The boundary of a business ecosystem is defined by non-generic complementarities between the participating organizations and the joint value proposition for customers (Jacobides *et al.*, 2018; Adner, 2017). The individual business models constitute "the infrastructure of business ecosystems" (Snihur and Bocken, 2022, p. 8), together with business model dependencies, which in themselves form a distinct unit of analysis (Vorbohle *et al.*, 2021; Hellström *et al.*, 2015).

Implications for Business Modeling Tools

Research in the area of business modeling tools is considered helpful in supporting the intra-organizational alignment of digital businesses (Schwarz and Legner, 2020). Inter-organizational alignment requires the careful consideration of not only one's own business model but also that of partners, and the dependencies between them, which leads to additional requirements for business modeling tools (Bouwman *et al.*, 2020). We propose that decision makers in organizations can overcome the previously discussed challenges and be better supported to design successful ecosystemic business models if they use business modeling tools that focus not only

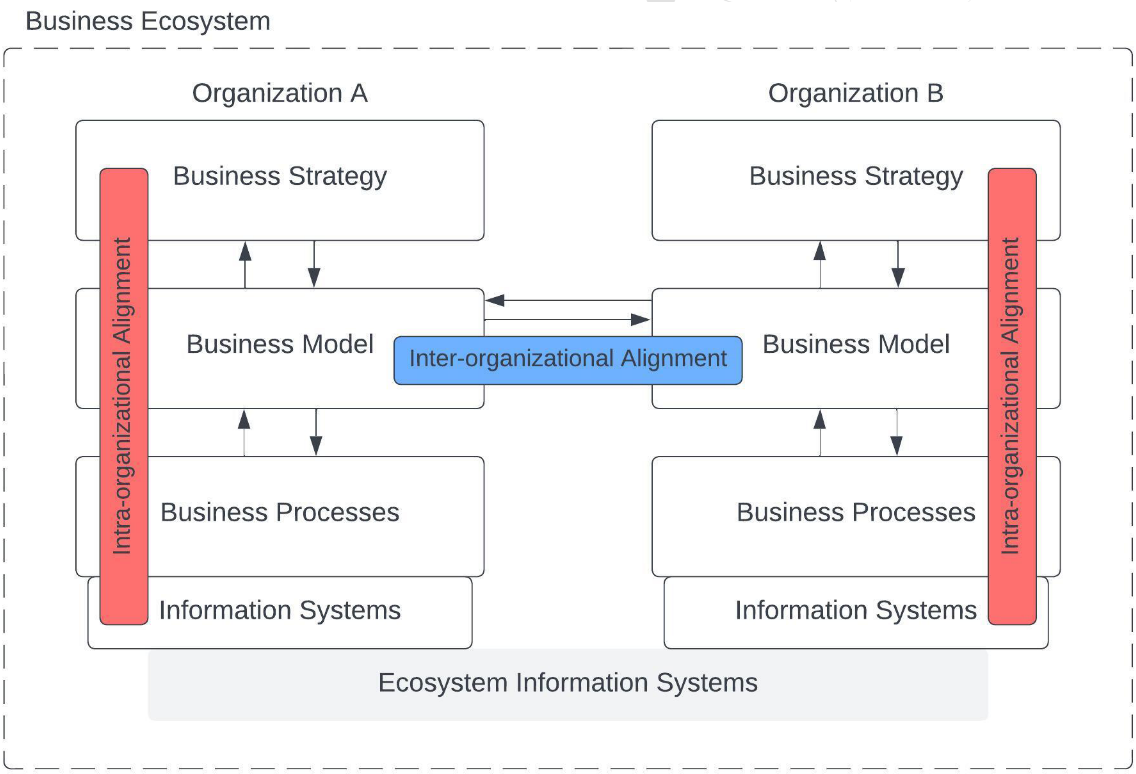

Figure 2: The business model as an alignment instrument (based on Al-Debei and Avison, 2010; Veit et al., 2014; Adner, 2017)

on the inside of an organization but also draw attention to the alignment between organizations. In the following, we discuss three particular implications for business modeling tools and areas for future inquiry. Each implication involves extending existing tools or developing new ones that consider specific functional design requirements (FDR).

1) Support the design of a joint vision and value proposition

The case of autonomous shipping posits that business ecosystems form around a joint value proposition, which only functions if all required partners are involved. For example, autonomous ships cannot unload cargo if port operators do not participate in the ecosystem. Across industries, one out of five ecosystems fail due to the absence of required partners (Pidun *et al.*, 2020). For instance, Michelin failed to see that car repair shops had no incentive to adopt their new tire innovation, which subsequently failed (Adner, 2017). Business modeling tools can help to avoid this failure if all required partners with different roles can contribute and discuss their interests and concerns, and ideate on a joint vision. Accordingly: *Provide functions for facilitating discussions and alignment among all required partners on the joint vision and value proposition for the customer* (***FDR1.1***).

However, the cognitive impact and usefulness of tools are often taken for granted. Among the business model frameworks that have been evaluated, most have been judged as ineffective or unhelpful by experts, notably due to creating cognitive overload (Henike *et al.*, 2020) . The business ecosystem of autonomous shipping consists of at least six different business models. Using a business modeling tool to align that many business models on a joint value proposition has the potential to cognitively overwhelm its users—who are often already overwhelmed from visualizing just one business model. If the added value of a partner is incomprehensible to other partners, they will not develop trust amongst each other, and alignment fails (Tsvetkova *et al.*, 2021; Zuzul, 2019). Therefore, to align multiple organizations on a joint value proposition, the shared visualizations should remain simple and comprehensible, and only display information strictly required and manageable for "the heterogeneous members of cross-boundary teams" (Avdiji *et al.*, 2020, p. 24). Hence, the number of syntactic and semantic constructs used in the business modeling tool should be parsimonious. Accordingly: *Provide functions for parsimonious information representation for each step of the development process of a joint value proposition (**FDR1.2**).*

An additional challenge arises from the very diverse industry backgrounds and experiences with autonomous technologies that the partners in a business ecosystem of autonomous shipping (e.g., technology providers and shipowners) bring to the table, and with it, their different conceptual understandings. For example, 'autonomy' can be understood in many different ways. Zuzul (2019) shows that especially highly novel projects give rise to conceptual ambiguities, leading to divergent mental models and ending in various conflicts and collaboration failure through the use of boundary objects. For this reason, and to provide a basis to jointly align or create knowledge on important concepts, it is important for business modeling tools to use syntactic and semantic constructs that are easy to understand (i.e., avoid jargon) for decision makers who are not modeling experts. Accordingly: *Provide functions for harmonizing the meaning of concepts and terms in use across organizations (**FDR1.3**).*

Moreover, as the case of autonomous shipping posits, the vision and value proposition are likely to change over time (e.g., due to technological improvements). As a result, ecosystemic business models operate in highly dynamic environments and managers must constantly reassess their decisions (Reeves *et al.*, 2019). This evolutionary nature implies the need for tools to be flexible and adaptable to internal and external changes and integrable in an iterative design process, such as design thinking. Following Schwarz and Legner (2020), this flexibility also implies the need for easy access to previous versions and sharing of these versions across organizations. Accordingly: *Provide functions for a flexible and iterative design approach over time, including functions for version control (**FDR1.4**).*

2) Support the design of complementarities and business model dependencies

The case of autonomous shipping describes the identification and alignment of complementarities and business model dependencies as major challenges. On the one hand, organizations involved in ecosystems should not only focus on how their business model can serve the customer but also be able to identify complementary assets from other organizations that complement their value. On the other hand, organizations ought to consider the business model dependencies within the business ecosystem. However, visualizing both aspects simultaneously may create cognitive overload. It is advisable that the coupling between the (1) need for complementary value creation (how value is created) and the (2) need for causal dependencies (who will create value for whom) is considered holistically and separately by the user. Accordingly: *Provide functions for visualizing and analyzing complementary value creation and business model dependencies jointly and separately (**FDR2.1**).*

(1) Complementary Value Creation. The biggest challenge for business ecosystems is to determine the right degree of non-generic complementarity, considering their influence on joint investment costs (Pidun *et al.*, 2020). Massa and Hackling (2020) propose an approach to analyze and visualize strategic complementarities within an organization. This approach could also be adapted for business ecosystems, for example by including different types of complementarities (e.g., unique vs. supermodular; see Jacobides *et al.*, 2018). However, the degree of non-generic complementarity between ecosystem partners also influences the value proposition for the customer (Lingens *et al.*, 2023). Value propositions with a high degree of complementary investment tend to focus more on the requirements of the ecosystem partners but less on the needs of customers. Hence, on the one hand, the customer may suffer from a high degree of non-generic complementarity, but on the other hand, partners may be less likely to drop out (Lingens *et al.*, 2023). This important trade-off should be considered when designing a business ecosystem. Accordingly: *Provide functions for considering and aligning on the required level of complementarity (co-specialization) to*

*achieve the necessary commitment of partners, and simultaneously attract customers (**FDR2.2**).*

(2) Business Model Dependencies. Despite dozens of business model visualizations having been proposed, only a few allow for the visualization of causal interactions, and these few are also assessed as cognitively ineffective. Hence, decision makers lack "causal visual instruments that are helpful and can be easily applied" (Henike *et al.*, 2020, p. 25). Understanding dependencies is important for analyzing how a change in a business model affects the business models of ecosystem partners. For that, an advanced understanding of the characteristics of business model dependencies is required to formalize parsimonious and helpful semantic and syntactic constructs, for example indicating whether a dependency is one-sided, reciprocal, or even multi-sided (Vorbohle *et al.*, 2021). Accordingly: *Provide functions for identifying business model dependencies and specifying dependency types that are consequential in a specific context (**FDR2.3**).*

Another important consideration is the distinction between the awareness and the perception of dependencies (Adner and Feiler, 2019). While awareness is about identifying critical dependencies, perception is about the assessment of risks and opportunities. By examining different presentations of dependencies, research on the perception of dependencies in an ecosystem setting has found a systematic cognitive bias toward overoptimistic evaluation resulting in overinvestments (Adner and Feiler, 2019). Hence, modeling tools focusing on business model dependencies should not only be able to visualize causal dependencies but also consider the psychological biases affecting the risk assessment of decision makers. Accordingly: *Provide functions for avoiding psychological biases when assessing risks of business model dependencies (**FDR2.4**).*

3) Support dynamic business modeling and quantitative simulations

Various business modeling tools with IT support and different levels of detail in their usage have been proposed in research and practice. Examples include idea management software or dynamic simulations (Szopinski *et al.*, 2020). However, most existing software tools are based on the Business Model Canvas (Szopinski *et al.*, 2020), and focusing on a single business model. The case of autonomous shipping shows that value creation in a business ecosystem is interdependent and dynamic. This means that it is necessary to analyze changes of business models from a complex system perspective (Massa *et al.*, 2018). Accordingly: *Provide functions for enabling a dynamic system-level perspective of value creation (**FDR3.1**).*

Moreover, business model literature suggests that decision makers can adjust or pivot their business model through experimentation with customers over time (Bland and Osterwalder, 2019). However, as our case of autonomous shipping illustrates, quantitative financial evaluations are already highly relevant in the design phase of an ecosystemic business model. Actors want to know whether investing in a business ecosystem is worth financially by assessing whether their own business model can capture a sufficient amount of value. Accordingly: *Provide functions for dynamic quantitative (financial) simulations and early assessment of investments, revenues and costs (**FDR3.2**).*

5. Concluding Remarks

Business ecosystems have conspicuously attracted the interest of researchers and practitioners of late, and the literature has already discussed the business model as a valuable concept for business ecosystem design (Iivari *et al.*, 2016; Xu *et al.*, 2019; Gomes *et al.*, 2019). With this conceptual study, we offer further coherence and direction by bridging and synthesizing three streams of literature: business modeling tools, business ecosystems, and ecosystemic business models.

Despite some interesting tools for creating an ecosystem value proposition (e.g., Talmar *et al.*, 2020) or value modeling (Westerlund *et al.*, 2014) having already been proposed, we call for more research on business modeling tools to be undertaken to: (1) *Discover and analyze business modeling tools* relevant to the design of ecosystemic business models. Existing approaches may come from different research fields, such as strategy, computer science and circular economy. (2) *Extend or revise these tools* with explicit focus on specific design challenges, and taking into account existing theoretical knowledge, e.g. cognitive fit theory (Veit *et al.*, 2014; Täuscher and Abdelkafi, 2017) to implement the FDR1.2 effectively. Another line of line of inquiry could be the use of system dynamics to support FDR3.1 and FDR3.2. By modeling the dynamics as feedback loops, decision makers can analyze the impact of specific parameters on a business model to test whether ecosystem-specific investments lead to plausible financial outcomes (Ksouri-Gerwien and Vorbohle, 2023). (3) *Evaluate the tools* regarding their usefulness. Evaluation, however, requires that the design choices leading to the given artifact are made explicit and that the tools are tested in rigorously designed experiments to examine their cognitive value (Massa and Hacklin, 2020). To date, such research on the evaluation of business modeling tools remains scarce (Shepherd *et al.*, 2023).

Our research is not free of certain limitations. We identified our ecosystemic business model design challenges by using an example from autonomous shipping. Other business ecosystem examples may encounter different challenges. Moreover, our implications and functional design requirements for business modeling tools may not cover all functions that are important to incorporate. However, this conceptual study is intended to present a topical research direction for business modeling tools, and to help researchers to reflect on the opportunities presented.

References

Adner, R. (2017) Ecosystem as Structure. *Journal of Management*, 43(1), 39–58. https://doi.org/10.1177/0149206316678451.

Adner, R. & Feiler, D. (2019) Interdependence, Perception, and Investment Choices: An Experimental Approach to Decision Making in Innovation Ecosystems. *Organization Science*, 30(1), 109–125. https://doi.org/10.1287/orsc.2018.1242.

Al-Debei, M.M. & Avison, D. (2010) Developing a unified framework of the business model concept. *European Journal of Information Systems*, 19(3), 359–376. https://doi.org/10.1057/ejis.2010.21.

Avdiji, H., Elikan, D., Missonier, S. & Pigneur, Y. (2020) A Design Theory for Visual Inquiry Tools. *Journal of the Association for Information Systems*, 21(3), 695–734. https://doi.org/10.17705/1jais.00617.

Bland, D. & Osterwalder, A. (2019) *Testing Business Ideas*. John Wiley & Sons Incorporated: Newark.

Bouwman, H., Reuver, M. de, Heikkilä, M. & Fielt, E. (2020) Business model tooling: where research and practice meet. *Electronic Markets*, 30(3), 413–419. https://doi.org/10.1007/s12525-020-00424-5.

Demil, B., Lecocq, X. & Warnier, V. (2018) Business model thinking, business ecosystems and platforms: The new perspective on the environment of the organization. *M@n@gement*, 21(4), 1213. https://doi.org/10.3917/mana.214.1213.

Eriksson, H.-E. & Penker, M. (2000) *Business modeling with UML: Business patterns at work*. Wiley: New York.

Gomes, F.J., Kemppainen, L., Pikkarainen, M., Koivumäki, T. & Ahokangas, P. (2019) Ecosystemic business model scenarios for Connected Health. *Journal of Business Models*, 7(4), 27–33. https://doi.org/10.5278/ojs.jbm.v7i4.2932.

Hellström, M., Tsvetkova, A., Gustafsson, M. & Wikström, K. (2015) Collaboration mechanisms for business models in distributed energy ecosystems. *Journal of Cleaner Production*, 102, 226–236. https://doi.org/10.1016/j.jclepro.2015.04.128.

Henike, T., Kamprath, M. & Hölzle, K. (2020) Effecting, but effective? How business model visualisations unfold cognitive impacts. *Long Range Planning*, 53(4), 101925. https://doi.org/10.1016/j.lrp.2019.101925.

Holm, C.G. & Kringelum, L.B. (2022) Intra-organizational business model implications of inter-organizational collaboration. *Journal of Business Models*, 10(1), 1–10. https://doi.org/10.54337/jbm.v10i1.6827.

Iivari, M.M., Ahokangas, P., Komi, M., Tihinen, M. & Valtanen, K. (2016) Toward Ecosystemic Business Models in the Context of Industrial Internet. *Journal of Business Models*, 4(2), 42–59. https://doi.org/10.5278/ojs.jbm.v4i2.1624.

Jacobides, M.G., Cennamo, C. & Gawer, A. (2018) Towards a theory of ecosystems. *Strategic Management Journal*, 39(8), 2255–2276. https://doi.org/10.1002/smj.2904.

Kapoor, R. (2018) Ecosystems: broadening the locus of value creation. *Journal of Organization Design*, 7(1), 39. https://doi.org/10.1186/s41469-018-0035-4.

Ksouri-Gerwien, C. & Vorbohle, C. (2023) Supporting Business Model Decision-making in B2B Ecosystems: A Framework for Using System Dynamics. *Proceedings of the 55th Hawaii International Conference on System Sciences (HICSS)*. Available from: https://hdl.handle.net/10125/103363.

Lingens, B., Seeholzer, V. & Gassmann, O. (2023) Journey to the Big Bang: How firms define new value propositions in emerging ecosystems. *Journal of Engineering and Technology Management*, 69, 101762. https://doi.org/10.1016/j.jengtecman.2023.101762.

Ma, Z. (2019) Business ecosystem modeling- the hybrid of system modeling and ecological modeling: an application of the smart grid. *Energy Informatics*, 2(1). https://doi.org/10.1186/s42162-019-0100-4.

Massa, L. & Hacklin, F. (2020) Business Model Innovation in Incumbent Firms: Cognition and Visual Representation. In: Sund, K.J. (Ed.) *Business Models and Cognition*. Emerald Publishing Limited, pp. 203–232.

Massa, L., Tucci, C.L. & Afuah, A. (2017) A Critical Assessment of Business Model Research. *Academy of Management Annals*, 11(1), 73–104. https://doi.org/10.5465/annals.2014.0072.

Massa, L., Viscusi, G. & Tucci, C.L. (2018) Business Models and Complexity. *Journal of Business Models*, 6(1), 59–71. https://doi.org/10.5278/ojs.jbm.v6i1.2579.

Moore, J.F. (1993) Predators and prey: a new ecology of competition. *Harvard Business Review*, 71(3), 75–86.

Osterwalder, A. & Pigneur, Y. (2010) *Business model generation: a handbook for visionaries, game changers, and challengers*. Wiley: Hoboken, New Jersey.

Pidun, U., Reeves, M. & Schüssler, M. (2020) *Why do most business ecosystem fail?* Available from: https://www.bcg.com/publications/2020/why-do-most-business-ecosystems-fail [Accessed 7 October 2023].

Reeves, M., Lotan, H., Legrand, J. & Michael G., J. (2019) How Business Ecosystems Rise (and Often Fall) Ecosystems. *MIT Sloan Management Review*.

Schwarz, J.S. & Legner, C. (2020) Business model tools at the boundary: exploring communities of practice and knowledge boundaries in business model innovation. *Electronic Markets*, 30(3), 421–445. https://doi.org/10.1007/s12525-019-00379-2.

Shepherd, D.A., Seyb, S.K. & George, G. (2023) Grounding Business Models: Cognition, Boundary Objects, and Business Model Change. *Academy of Management Review*, 48(1), 100–122. https://doi.org/10.5465/amr.2020.0173.

Snihur, Y. & Bocken, N. (2022) A call for action: The impact of business model innovation on business ecosystems, society and planet. *Long Range Planning*, 55(6), 102182. https://doi.org/10.1016/j.lrp.2022.102182.

Szopinski, D., Massa, L., John, T., Kundisch, D. & Tucci, C. (2022) Modeling Business Models: A cross-disciplinary Analysis of Business Model Modeling Languages and Directions for Future Research. *Communications of the Association for Information Systems*, 51, 774–841. https://doi.org/10.17705/1CAIS.05133.

Szopinski, D., Schoormann, T., John, T., Knackstedt, R. & Kundisch, D. (2020) Software tools for business model innovation: current state and future challenges. *Electronic Markets*, 30(3), 469–494. https://doi.org/10.1007/s12525-018-0326-1.

Talmar, M., Walrave, B., Podoynitsyna, K.S., Holmström, J. & Romme, A.G.L. (2020) Mapping, analyzing and designing innovation ecosystems: The Ecosystem Pie Model. *Long Range Planning*, 53(4), 101850. https://doi.org/10.1016/j.lrp.2018.09.002.

Täuscher, K. & Abdelkafi, N. (2017) Visual tools for business model innovation: Recommendations from a cognitive perspective. *Creativity and Innovation Management*, 26(2), 160–174. https://doi.org/10.1111/caim.12208.

Thomas, L.D.W. & Autio, E. (Eds.) (2020) *Oxford Research Encyclopedia of Business and Management*. Oxford University Press.

Tsvetkova, A. & Hellström, M. (2022) Creating value through autonomous shipping: an ecosystem perspective. *Maritime Economics & Logistics*, 24(2), 255–277. https://doi.org/10.1057/s41278-022-00216-y.

Tsvetkova, A., Hellström, M. & Ringbom, H. (2021) Creating value through product-service-software systems in institutionalized ecosystems – The case of autonomous ships. *Industrial Marketing Management*, 99(08), 16–27. https://doi.org/10.1016/j.indmarman.2021.09.007.

Veit, D., Clemons, E., Benlian, A., Buxmann, P., Hess, T. & Kundisch, D. et al. (2014) Business Models. *Business & Information Systems Engineering*, 6(1), 45–53. https://doi.org/10.1007/s12599-013-0308-y.

Vorbohle, C., Szopinski, D. & Kundisch, D. (2021) Toward Understanding the Complexity of Business Models – A Taxonomy of Business Model Dependencies. *Proceedings of the 29th European Conference on Information Systems (ECIS)*. Available from: https://aisel.aisnet.org/ecis2021_rp/128/.

Westerlund, M., Leminen, S. & Rajahonka, M. (2014) Designing Business Models for the Internet of Things. *Technology Innovation Management Review*, 4(7), 5–14. https://doi.org/10.22215/timreview/807.

Winkler, C., Perez Vico, E. & Widén, K. (2023) Challenges to business ecosystem alignment when implementing solar photovoltaic systems in the Swedish built environment. *Building Research & Information*, 1–18. https://doi.org/10.1080/09613218.2023.2256435.

Xu, Y., Ahokangas, P. & Reuter, E. (2019) EaaS: Electricity as a Service? *Journal of Business Models*, 6(3), 1–23. https://doi.org/10.5278/ojs.jbm.v6i3.1954.

Zuzul, T.W. (2019) "Matter Battles": Cognitive Representations, Boundary Objects, and the Failure of Collaboration in Two Smart Cities. *Academy of Management Journal*, 62(3), 739–764. https://doi.org/10.5465/amj.2016.0625.

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