Business Model Innovation in Incumbent Firms: Cognition and Visual Representation

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Abstract

Business model innovation (BMI) constitutes a priority for managers across industries, but it represents a notoriously difficult innovation, with several challenges, many of which are cognitive in nature. The received literature has variously suggested that one way to overcome challenges to BMI, including cognitive ones, and support the cognitive tasks is using visual representations. Against this background, we aim at offering a contribution to the emerging line of inquiry at the nexus between business models (BMs), cognition and visual representations. Specifically, we develop a new method for visual representation of the BM in support of simplification of the cognitive effort and neutralisation of cognitive barriers. The resulting representation – a *network-based representation, anchored on the activity-system perspective and offering complementarity and centrality/periphery measures* – allows to visually represent an existing BM as a network (nodes and linkages) of interdependent activities and to express information related to the degree of centrality/periphery of single activities (nodes) with respect to the rest of a BM configuration. This information, we argue, is potentially very valuable in supporting the cognitive tasks involved in business model reconfiguration (BMR). We guide the reader to progressively appreciate how the development of the proposed method for visual representation is anchored to two main characteristics of BMR, namely the discovery-driven nature of BMR and the path-dependent nature of BMR. We offer initial insights on the cognitive value of such a type of representation in relationship to the simplification of the cognitive effort and the neutralisation of cognitive barriers in BMR.

Keywords: Business model innovation; business model reconfiguration; cognitive view; visual representation; activity system; network-based representation

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Introduction

Business model innovation (BMI) constitutes a priority for managers across industries (Amit & Zott, 2012), but it is a notoriously difficult innovation activity (see, e.g., Johnson, Christensen, & Kagermann, 2008) that is affected by numerous challenges (see, e.g., Björkdahl & Holmén, 2013; Koen, Bertels, & Elsum, 2011; Sund, Bogers, Villarroel, & Foss, 2016), many of which are cognitive in nature.

At a general level, these challenges range from sensing opportunities (Teece, 2007) and generating visions for BMI (De Reuver, Bouwman, & Haaker, 2013; Martins, Rindova, & Greenbaum, 2015) to the need to overcome dominant logic traps (Chesbrough, 2010; Zott, Amit, & Massa, 2011) and reduce the cognitive load associated with BMI (Doz & Kosonen, 2010). This last task is accomplished by simplifying the complexity inherent in business models (BMs) (Massa, Viscusi, & Tucci, 2018), including dynamic complexity that results from interdependencies among BM components (Casadesus-Masanell & Ricart, 2010). In addition to these difficulties, BMI is generally characterised by considerable uncertainty (Thompson & MacMillan, 2010), whether perceived or inherent, which creates challenges from the point of view of scanning, interpreting and acting upon external environments (Sund, 2015). In a nutshell, BMI involves many distinct types of cognitive tasks and relative barriers, making the study of BMI and cognition extremely rich, interesting and, simultaneously, challenging.

The received BM literature has variously suggested (see, e.g., Chesbrough, 2010; Henike, Kamprath, & Hölzle, 2019; Täusher & Abdelkafi, 2017) that one way to overcome challenges to BMI – including cognitive ones – and support the cognitive tasks involved in BMI is to use visual representations of the BM. Visual representations have several general cognitive merits, as well as communicative and collaborative ones, that can, in many ways, support overcoming not only cognitive but also general barriers to BMI (Chesbrough, 2010; Eppler & Hoffmann, 2012; Eppler, Hoffmann, & Bresciani, 2011; Eppler & Platts, 2009; Gordijn & Akkermans, 2003; Osterwalder & Pigneur, 2010; Snihur, Lamine, & Wright, 2018; Täuscher & Abdelkafi, 2017). Visual representations can support creativity and idea generation (Eppler & Hoffmann, 2012); they can reduce cognitive load (Doz & Kosonen, 2010), promote knowledge sharing (Doganova & Eyquem-Renault, 2009), support collective understanding and stimulate collaborative innovation (Eppler & Hoffmann, 2012). Importantly, visual representations can also be used to articulate, challenge, transfer and reassemble the tacit knowledge at the background of implicitly understood mental schemata, heuristics, narratives and other organisationally embedded manifestations of BMs as cognitive and linguistic instruments (Massa, Tucci, & Afuah, 2017). Thus, research on visual representations represents a fruitful area of inquiry for BMs and cognition, and for BMI in general (Foss & Saebi, 2017), across a broad spectrum of possible cognitive tasks. These include ideation, collective sense-making and simply neutralising dominant logic traps. Arguably, these cognitive tasks are distinct or only partly overlap, but this heterogeneity is rarely discussed, and its implications for research at the nexus between BMI, cognition and visual representations may not be sufficiently recognised.

This is perplexing, given the quantity of research that has now accumulated. Since the beginning of research on BMs, much work has been published (albeit not always in top-ranked journals) on visual representations of BMs. This work has resulted in a plethora of tools, design artefacts and instruments that offer visual representations of BMs (see, e.g., Henike et al., 2019, for a recently published review). Yet there has been a potential disconnect between these visual-representation instruments and research on BMs and cognition, as recently noted by Täusher and Abdelkafi (2017). This disconnect, we suggest, manifests in two main ways: notably, in 1) the design of the instruments themselves, in relation to the specific tasks under investigation, and 2) the validation of their cognitive value.

The first manifestation refers to the fact that the design of the instrument – i.e., the process followed to generate the instrument itself – may have not been sufficiently accompanied by efforts to understand the specific sub-phenomena behind BMI. Within the domain of conceptual modelling, these efforts are referred to as requirements engineering. Many tools for visually representing BMs claim to be useful for BMI (or parts of BMI), but it is difficult to understand what specific features of the BMI process have informed the design of such tools. How to use them and under what conditions to do so are similarly unclear. As previously noted, BMI involves several different activities with different cognitive manifestations. This heterogeneity of activities and cognitive manifestations suggests that it is unlikely to find a universally valid instrument that would work effectively for all activities. However, the prevailing literature at the nexus between visual representations and cognition seems to be relatively silent on this matter. We are left without knowledge of how to ground a tool's design in the specific cognitive tasks involved in a given phenomenon – in our case, BMI in its different delineations (see later).

The second way in which the disconnect has manifested refers to the fact that the cognitive values of different instruments – their abilities to overcome cognitive barriers and biases resulting from taken-for-granted heuristics, or to support collective sense-making or ideation, for example – have not been subject to empirical validation and testing. It could be that a method to visually represent the BM has the potential to support certain activities or specific BMI tasks by intervening in the cognitive process underlying them, but this potential does not ensure that it actually does. Given also that organisation-level interpretation and cognition are affected by a number of boundary conditions (including modes of search) and various types of uncertainty (Sund, 2015), a fact that would further invite embracing a contingent approach, this lack of validation is a particularly strong qualifier of claims that a tool can effectively support certain tasks. Validation requires the testing of specific hypotheses in carefully designed experiments and other forms of empirical investigation. In turn, the ability to validate a tool requires that the specific phenomena and cognitive tasks for which the tool is employed are understood and delineated and that the design choices that led to the generation of a given visual representation are made explicit. This specificity is largely lacking.

Building on these premises, this paper aims to contribute to the emerging line of inquiry at the nexus between BMs, cognition and visual representations.

Specifically, we illustrate the process that we followed in developing a new method for visual representation of the BM in support of the simplification of the cognitive effort in, and the neutralisation of cognitive barriers to, the innovation of *existing* BMs.

We differentiate between BMI in existing organisations, or business model reconfiguration (BMR), and BMI for newly formed organisations, or business model design (BMD) – arguably related yet distinct phenomena (Massa & Tucci, 2014) – and focus on the former.

Our proposed method culminates in a new tool for visual representation of BMs. The result, a *network-based representation, anchored on the activity-system perspective and offering complementarity and centrality/periphery measures*, allows the visual representation of an existing BM as a network (nodes and linkages) of interdependent activities and the numerical (but also visual) expression of information related to the degree of centrality/periphery of single activities (nodes) with respect to the rest of the BM configuration. This information, we argue, is potentially very valuable in supporting the cognitive tasks involved in BMR. We guide the reader to progressively understand how the development of the proposed method for visual representation is anchored to two primary characteristics of BMR, namely its discovery-driven nature and path-dependent nature. We offer initial insights on the cognitive value of such a representation as regards simplifying the cognitive effort involved in BMR and neutralising cognitive barriers to it.

Thus, our main contribution is to offer an illustrative example of the process involved in grounding the development of a visual tool for BMI in a specific instance of BMR (innovation of *existing* BMs) and in a relationship to specific cognitive tasks: simplifying cognitive effort and neutralising cognitive barriers. This is a small yet potentially important initial step towards a more consolidated scholarship of BM, cognition and visual representations.

We do not offer to test hypotheses related to the cognitive value of the proposed instrument but offer some insights and considerations which could be taken as a basis for future research.

This article proceeds as follows: We begin by offering a discussion on the BMR phenomenon, specifically emphasising its discovery-driven and path-dependent nature. Building on the main insights that emerge from this first step, we highlight four main design criteria motivating the proposed method, namely i) network-based representation, ii) activity-system perspective, iii) complementarities and fit and iv) centrality/periphery measures/visuals. Next, we illustrate how to embed each of these in a methodology for visual representation in BMR. Finally, we illustrate the application of this methodology to produce a representation of the BM. We exemplify the illustration using the iconic case of Ryanair, as its low-cost BM has been well documented in the accepted literature (e.g., Casadesus-Masanell & Ricart, 2010; Rivkin, 2000b), making analysis, comparison and understanding of this example easier and less ambiguous. We conclude by discussing our proposed approach's meaning and significance for research on BMs and cognition, and we detail ideas for future research.

BMI, BMR and BMD

We began by defining our goal, i.e., the purpose of modelling (see Burton-Jones et al., 2009), in broad terms: to offer a tool in support of the cognitive process involved in BMR. This general objective implies two sub-tasks that follow as corollaries: isolate BMR from other instances of BMI and unpack the cognitive process involved in it.

As noted earlier, BMI comprises two distinct phenomena with different implications for research at the nexus between BMs and cognition: BMR and BMD. In general terms, BMR has been defined as the process of innovating a BM when one is already in place. BMD, however, refers the process of designing an entirely new BM (Massa & Tucci, 2014). To slightly oversimplify, BMR is relevant to incumbent organisations, which, by definition, already have a BM. BMD is a challenge for start-ups, which are temporary organisations in search of a scalable BM (Blank & Dorf, 2010). Both are forms of BMI, but they entail important differences. In the words of Massa and Tucci (2014, p. 425),

> because reconfiguration assumes the existence of a BM, it involves facing challenges that are idiosyncratic to existing organizations, such as organizational inertia, management processes (that may inhibit or foster change), modes of organizational learning, modes of change, and path dependent constraints in general, which may not be an issue in newly formed organizations. On the other hand, newly formed organizations may face other issues such as considerable technological uncertainty, lack of legitimacy, lack of resources and, in general, liability of newness, which do influence the design and validation of new BMs (cf. Aldrich & Auster, 1986; Bruderl & Schussler, 1990).

To put it differently, BMR is about the tension between the old and the new, while BMD is about the tension between the new and nothing else – or between the new and everything.[1] BMD and BMR both involve cognitive challenges, but these challenges are arguably different.

Thus, an important qualifier is that this paper focuses on BMR and the nature of the phenomenon behind it in relation to cognition.

Following our reading of the BMI and BMR literature, we decided to focus on two main facets of the BMR phenomenon that are meaningful from a cognitive standpoint and have been explicitly or implicitly addressed in the prevailing literature. The first is the discovery-driven nature of BMR (McGrath, 2010; Teece, 2007, 2010), emphasising the appropriateness of experimentation for BMR. The second is BMR's path-dependent nature, i.e., the fact that an existing BM

[1]We thank an anonymous reviewer for this insight.

introduces structural and cognitive constraints that generate path dependence.[2] We treat them separately for analytical purposes, but the reader will realise that they are overlapping concepts.

Discovery-Driven Nature of BMR – Requirements

The literature has variously emphasised that BMR is the result of discovery-driven processes (see, e.g., McGrath, 2010). This stands in contrast with ideas of strategic planning, and even control, for BMR. BMR and, to a large extent, BMI, in general, cannot be planned in the strict sense.

These ideas have their theoretical roots in the notion of discovery-driven planning (DDP) (McGrath & MacMillan, 1995) and modern versions of it, including lean-start-up or agile management. The basic idea is that because of considerable uncertainty, it is impossible to ascertain what will work through formal analysis and planning (Thompson & MacMillan, 2010). Analysis and planning are more appropriate in more stable, more predictable, less cognitively complex and less uncertain environments and contexts, such as innovation manoeuvres within well-defined industry or BM boundaries or in highly integrated value chains (as opposed to fragmented ecosystems across industry and BM boundaries). On the contrary, identifying the 'BM of the future' for an existing company is an exercise characterised by a degree of uncertainty that cannot be resolved through standard analysis and planning. Many sources of uncertainty stem from events, such as the way technology evolves, regulation and market dynamics, which are related to the future and as such as not predictable. This fact even further emphasises the importance of proceeding via experimentation and exploration of different growth opportunities while working with an existing BM. In this way, new BMs are 'discovered' rather than planned: they progressively 'emerge' as firms engage in experiments, trial-and-error learning and continuous adjustment (see, e.g., Sosna, Trevigno-Rodriguez, & Velamuri, 2010).

A fundamental question then arises: 'what do firms experiment with?' Answering this question is beyond the scope of this paper's humble contribution. For the purposes of this paper, it suffices to say that the seizing of growth opportunities (while employing a contemporary BM) requires a firm to change specific activities

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[2]Here, it is important to underline that the phenomenon behind BMR, given that it involves dynamics within an organisation, is complex and multifaceted; it comprises aspects such as organisational inertia, collective sense-making, structural and cognitive barriers, managerial interpretation and interpretation systems, organisational learning and many other aspects – both scientific, as in 'theory-driven' or 'theory-oriented', and more practice-oriented – that have variously been described by the literature under the umbrella term of 'organisational change'. It would have been impossible to consider all of these aspects together. We purposefully decided to focus on BMR as configurations of interdependent activities and the discovery-driven nature of BMR since these two aspects, to the best of our knowledge, represent two of the most important qualities that set BMR apart from more 'typical' strategic and organisational-change thinking.

(or entire bundles of activities) within the existing BM. According to Amit and Zott (2012), there are three ways in which existing activities can be changed: i) by changing the 'content' of an activity (e.g., by adding novel activities, as through forwards or backwards integration); ii) by changing the 'structure' linking activities; and iii) by innovating the 'governance' of an activity (e.g., by changing one or more parties that perform any of the activities). In short, the discovery-driven nature of BMR implies that the locus of innovation, the fundamental unit of analysis in experimentation, is the single activity (or the bundle of activities).

However, as also indirectly highlighted by Amit and Zott (2012), a single activity cannot be changed without making changes to other activities. This is because activities in an existing BM are interdependent. We now turn to the second aspect of BMR, its path dependence.

Path-Dependent Nature of BMR – Requirements

BMR assumes the existence of a BM, which constrains experimentation and the changing of activities. Thus, and differing from BMD, BMR emphasises path dependence and inertia. The existence of a BM in BMR implies two types of barriers: cognitive and structural ones (Chesborugh, 2010).

Cognitive Barriers. The nature of cognitive barriers to BMR has been variously illustrated in BM literature (Chesbrough & Rosembloom, 2002; Massa et al., 2017; Zott et al., 2011). For the purposes of this manuscript, it suffices to remind the reader that managers in existing firms make sense of their BM by creating, over time, cognitive representations of it. Within a given firm, such a cognitive representation manifests as a general mental model, or 'a theory of the business' (Drucker, 1994), a prevailing 'wisdom'. This wisdom is the result of the largely unconscious process of selecting and retaining a collection of assumptions, 'theories' and rules of thumb concerning how business is done in a given industry and even how it *should* be done. These rules act as heuristics that speed decision-making (Kahneman, 2011). However, these heuristics risk becoming sources of inertia, opposing innovation and change. They represent a 'dominant logic' (Bettis & Prahald, 1995) that prevents the identification of opportunities falling outside what is believed to be important, a phenomenon defined as the dominant logic trap (Bettis & Prahald, 1995). Because dominant logic is largely unquestioned and taken for granted, it can easily engender myopic thinking (Levitt, 2004).

One way to avoid this risk and neutralise cognitive barriers to BMR is to develop a visual representation of the existing BM. This leads to the possibility of explicitly analysing otherwise taken-for-granted choices and activities. Alternatives (to past choices that led to the current BM's activities) become possible, and a formal representation offers the opportunity to deliberately challenge both taken-for-granted past choices and the activities of today. These challenges can take the form of posing 'what-ifs' or validity questions. In this way, a visual representation would contribute to avoiding dominant logic traps.

Structural Barriers. It has been suggested that structural barriers are manifested in terms of conflicts with the existing configuration of activities and assets (Chesbrough, 2010). A BM implies a structure in place: the assets and activities but also processes, flows of information, etc. which allow a firm to operate so as to create and capture value at a given point in time. Existing structures create path dependence insofar as initiatives that aim at innovating an existing BM are constrained by the existing BM itself by virtue of interdependencies among its parts. This idea finds its theoretical roots in strategy literature – specifically, in the notion of strategy evolution (how firms' realised strategies evolve over time), as reflected by, for example, the work of Siggelkow and colleagues (Rivkin, 2000a; Rivkin & Siggelkow, 2003; Siggelkow, 2001, 2002). Such a view emphasises a firm's realised strategy as a configuration of interdependent choices/activities which evolve over time by means of progressive adjustments and evolutions that would lead to internal fit, i.e., consistency between organisational elements (Siggelkow, 2002).[3]

Coupling between BM parts implies that fast, radical changes of whole BM structures, or configurations, are unlikely. An existing BM (or, to continue with the same terminology, an existing configuration of highly interdependent and consistent parts) is typically not changed overnight (Siggelkow, 2002).[4]

In one way or another, even in strategic moves that contemplate employing two BMs simultaneously (Markides & Charitou, 2004) or introducing experimentation with a new BM in an existing organisation (Sund et al., 2016), the loci of innovation within the existing BM are single activities (Casadesus-Masanell & Ricart, 2010), a point that we have already emphasised.

Because of interdependencies, however, these changes in single activities are followed by necessary adjustments to the rest of the structure until fit has been reached again and the new configuration is in place.

The whole BM, at different points in time, has changed (Siggelkow, 2002), but the whole is not itself the object of change. Rather, it is the result of changes to single (bundles of) activities and adjustments to the whole configuration. To paraphrase Amit and Zott (2012), managers must embrace systemic thinking to understand a whole BM and 'see the forest rather than the trees' (the whole configuration and not only its constituents). This consideration adds to our previous discussion on the importance of focusing on single activities. According to the proposed line of reasoning, focus on single activities is important but not, in itself, sufficient. That focus must be complemented by explicit attention to the entire configuration.

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[3]The reader will probably recognise the strong conceptual overlap between the notion of a firm's realised strategy as a system of activities (Porter, 1996; Porter & Siggelkow, 2008; Siggelkow, 2002) and both the activity-system perspective of BMs (Zott & Amit, 2010) and the (strategic) choices-and-consequences perspective offered by Casadesus-Masanell and Ricart (2010). Each points to a system of interdependent activities that firms implement as they go to market.

[4]Even when playing with dual BMs (Markides & Charitou, 2004), companies need to consider the potential conflict, but also the possible synergies, with the existing structure and either build the new BM within that existing structure, preparing for separation, or build it outside of the existing structure but prepare for future integration.

Model Specification

Our excursus into the nature of BMR led us to distil the following considerations (see Table 1).

First of all, BMR (but also BMD) is non-deterministic in the sense of implying decision-making in the presence of Knightian uncertainty (Thompson & MacMillan, 2010).

The scope and value of standard analysis (and planning) in the presence of such uncertainty is limited; the range of outcomes and possible future states

Table 1. The Discovery-Driven Nature of BMR.

Interpretation	**Uncertainty Non-determinism**	**Cognitive and Structural Barriers Path Dependence; Inertia**
Consequences for managerial decision-making	Limited scope for formal planning Importance of experimentation	The BM in place generates cognitive as well as structural barriers. Managers interpret the environment and filter opportunities through the existing dominant logic and mental frames (cognitive path dependence) Changing a part has implications for the whole configuration (evolution towards fit). The existing configuration constrains how parts can be changed (structural path dependence). The locus of innovation is both a single activity (bundle) AND the whole configuration.
Implications for business modelling	Network-based visual representation (parts and interdependencies): BM visualised as a configuration of interdependent parts (units of analysis are single parts AND the whole configuration). Activity-system perspective: nodes expressed as choices/bundles of activities and interdependencies as simple linkages (units of analysis are choices/bundles of activities AND the whole activity system). Include information useful to understanding how changing one part will alter fit of the existing configuration. Distinguish between central and peripheral parts within the configuration.	

is largely unknown (and unknowable), and probabilities cannot be assigned to them. As a consequence, managers are left with the possibility of progressively changing single activities (or bundles of activities).[5]

Second, BMR is path dependent. The existence of a BM introduces constraints that generate path dependence. Constrains are of two types: cognitive and structural.

From the cognitive angle, managers interpret the 'environment' by means of a mental model, a high-level heuristic (Chesbrough & Rosenbloom, 2002) reflecting shared wisdom on how to do business in a given context, which can be source of myopic thinking (Levitt, 2004). This wisdom implies that the validity of today's activities, as related to past strategic choices, is often unquestioned and taken for granted. Thus, one way to avoid dominant logic traps is to focus on single activities and challenge their taken-for-granted nature.

Structural constraints are related to the current configuration intended as the *architectural logic* under which a firm operates its BM. Changing parts alters the fit within the existing configuration, potentially creating a instability until fit is established again. Conversely, the existing configuration determines the degree and the scope to which the parts can be changed (structural path dependence).[6]

These initial considerations led us to identify the following design criteria to be considered in our proposed methodology (see Table 1).

- *Network-based representation: BM visualised as a configuration of interdependent parts.*
- *Activity-system perspective: nodes expressed as bundles of activities (and related past strategic choices) and interdependencies expressed as simple linkages between activities.*
- *Strategic fit: interdependencies understood as strategic complementarities among pairs of choices/bundles of activities.*
- *Visualisation with centrality/periphery information to support analysis of structural path dependence.*

We elaborate on each of these in the following sections.

[5]We add that experimentation is an activity that involves risk in the sense that it is partly conducted with the goal of acquiring information that is not available before the experiments are conducted. To contain risk while maximising learning, companies should conduct small experiments that would allow learning while containing the costs of failing. Within the boundaries of BMR, conducting small experiments implies operating at the periphery of an existing BM and focusing on single activities.

[6]To paraphrase Amit and Zott (2012) once more, managers need not only to 'look at the forest rather than the trees' but also to 'act on the trees while considering the implications for the configuration of the forest'. If parts are interdependent, then changing one part has consequences on the overall configuration of the other parts. In addition, the existing configuration affects the ability to change specific BM parts. Linkages among parts constrain how parts can be changed (structural path-dependence).

Network-Based Representation: BM Visualised as a Configuration of Interdependent Parts.

A network-based representation is here defined as a representation of the BM that is obtained by formally representing the BM parts as well as the linkages between parts.

Within the mainstream BM literature, network-based representations have been relatively rare. Casadesus-Masanell and Ricart (2010) were among the first to formally develop an approach of this type. The pair based their visual model on choices and their consequences, and they included the notion of feedback loops. Similarly, Cosenz and Noto (2018) have offered a dynamic business-modelling approach that builds on system dynamics (see, e.g., Forrester, 1994) to express causal interdependencies. In the broader strategy literature, there is a tradition, albeit one outside of mainstream strategy work, of strategy visualisation with network-based models emphasising interdependencies. These include, for example, strategy maps with causal linkages (see, e.g., Cheng & Humpreys, 2012) and dynamic scorecards with causal loop diagrams (Barnabè; 2010).

Network-based representations are different from static representations, which are obtained by spatially placing the main components without explicit information on the interdependencies among them. The majority of visual tools for BMs that have been offered tend to fall into this latter category. Examples include the famous Business Model Canvas (Osterwalder & Pigneur, 2010, the Platform Business Model Canvas, or the four-component tool offered by Johnson et al. (2010), to mention a few.

A network-based representation is needed to represent how a BM functions as a configuration, but it is also necessary to understand how the existing configuration constrains trajectories for BMR experimentation by determining the conditions for successful modification of activities. Since geometric representations, by definition, don't show the interdependencies between elements, it would not be possible to use a static representation to accomplish our objectives.

Activity-System Perspective: Nodes Expressed as Bundles of Activities (and Related Past Strategic Choices) and Interdependencies Expressed as Simple Linkages Between Activities.

At a general level, an activity system is a representation that focuses on expressing an organisation by visualising its main activities and their linkages. Porter (1996) introduced the concept (to strategy theory) with the goal of elaborating on the notion of strategic fit (see Sheehan & Foss, 2009, for a discussion of the intellectual roots of the activity-based view). Competitive strategies (e.g., cost leadership or differentiation) are products of the selection and implementation of specific activities and of the linkages between the activities. Activities imply committed choices (Ghemawatt, 1991); thus, choices and activities can be viewed as two sides of the same coin (Zott & Amit, 2010).

The key to understanding the importance of the activity system for mainstream strategy is to appreciate that activities, in isolation, are not sources of competitive advantage in terms of either cost leadership or differentiation. To be sources of rents vis-à-vis competition, activities should be 'coherent' with one another. It is the entire system of activities and their fit that explains how companies achieve sources of competitive advantage, not the list of isolated activities.

Zott and Amit (2010) were among the first to embrace the activity-system perspective and adopt it to analyse BMs, even if only conceptually (as opposed to visually). In their words,

> an activity in a focal firm's BM can be viewed as the engagement of human, physical and/or capital resources of any party to the BM […] to serve a specific purpose toward the fulfillment of the overall objective. An activity system is thus a set of interdependent organizational activities centered on a focal firm. (2010, p. 217)

They noted that the whole of BM literature implicitly or explicitly supports the activity-system perspective (Zott & Amit, 2010; Zott et al., 2011).

Within an activity system, interdependencies among BM parts are expressed as simple linkages. There are two possibilities for representing linkages (interdependencies) between a BM's parts: either with causalities (causal linkages) or without (simple linkages). In the representation of Casadesus-Masanell and Ricart (2010) and that of Cosenz and Noto (2018), the visualised linkages are two-directional and/or causal. They display information in the form of 'A causes B' (and/or vice versa).

It was identified earlier that the purpose of the modelling defines what should be included in a representation/visual tool. Strategy maps (and BM tools that take a strategy-implementation angle to the BM, as in Casadesus-Masanell & Ricart, 2010, and Cosenz & Noto, 2018[7]) are used for translating a strategy to all levels of the organisation and help understand how strategic objectives are achieved (Kaplan & Norton, 2004a, 2004b). In cases such as these, causalities are important. In the context of BMR, and for reasons related to structural path dependence, as earlier illustrated, it is important to know how changing a single activity is likely to affect other activities – to use the words of Zott and Amit, to understand interdependencies so as to 'provide insights into the processes that enable the evolution of a focal firm's activity system over time' (2010, p. 2018). This formulation of interdependencies is coherent with the path-dependent nature of BMR.

Overall, the activity-system perspective offers a language and tool for BMR which emphasises system-level design over partial optimisation (and is thus

[7]Both take a strategy-implementation angle to business modelling. To explain this intuition, Casadesus-Masanell and Ricart (2010) explicitly state that in their view, a BM is a manifestation of the firm's realised strategy. Similarly, Cosenz and Noto (2018) suggest that their proposed modelling approach, which combines conventional business model schemata with system dynamics modelling, results in a 'strategy design tool' (p. 127).

coherent with the idea of BM as a system-level concept where the system is composed of components and interdependencies) (Zott et al., 2011). This creates the possibility of shedding light on the path-dependent nature of BMR and on evolution through experimentation in BMR (Zott & Amit, 2010). These attributes identify the activity system as a useful perspective for our goals.

Strategic Fit: Interdependencies Understood as Strategic Complementarities Among Pairs of Choices/Bundles of Activities.

We suggest that there are several possible ways in which one could express the content of interdependencies between two or more activities. This is related to the fact that organisations (and BMs) are very complex entities (see, e.g., Massa et al., 2018). Different images/metaphors for organisations are possible (Morgan, 1986; Senge, 1990), each producing a different conceptualisation of the content of interdependencies. For example, the image of an organisation (and its BM) as a *machine* implicitly produces an understanding of linkages in terms of operations or specific processes between parts (see, e.g., Morgan, 1986), pointing to the content of the linkage as flows of materials. The image of an organisation as a *brain*, which emphasises information processing and knowledge transfer within the organisation, produces an understanding of linkages as flows of information. The image of an organisation as a *coalition*, which emphasises human dynamics, informal organisation and power hierarchies, implicitly produces an understanding of linkages as related to the interests of different sections within the firm as well as the existing power structure. In this latter view, the content of linkages could be conceptualised as negotiation tactics and activities of institutional design. It is, once more, beyond the objectives of this contribution to offer an exhaustive analysis of this important aspect of visual representations of BMR. What is sufficient is to notice i) that there are several possible methods of expressing the content of linkages between components of a BM and ii) that the choice of which one is appropriate is a function, as before, of the goal of the representation.

We suggest that the notion of fit, or overall coherence in an activity system, is central to the conceptualisation of interdependencies in relation to BMR. Strategic fit entails that activities reinforce one another (Casadesus-Masanell & Ricart, 2010; Porter, 1996). That is, activities that display reinforcing links 'fit' each other in the sense of creating more value together than individually. Other possible understandings of 'fit' within activities, originally proposed in Porter (1996), are the ideas of removing overlaps and creating synergies between the activities. Notwithstanding these nuances, the basic idea of strategic fit is one of system-level optimisation. Given the centrality of the notion of value creation to the BM discussion, it seems reasonable to build on a conceptualisation of system-level optimisation and coherence in value creation. The accepted literature, implicitly or explicitly, supports this perspective. For example, Baden-Fuller and Morgan (2010) state that a BM cannot be defined simply as a set of elements as this would ignore that the BM's elements are combined and arranged in unique ways that determine the value-creation potential of the particular BM. Similarly, Teece (2010) suggests that BM elements must be designed in reference to one another to support value creation and capture.

Building on these considerations, we suggest understanding linkages as strategic complements (see, e.g., Brandenburger & Nalebuff, 1996; Milgrom & Roberts, 1985). The notion of strategic complementarity herein offered is qualitatively coherent with the concept of complementarity originally proposed by Edgeworth in his seminal work *Mathematical Physics* (1881) and subsequently popularised, about a century later, in strategy and management economics by Milgrom and Roberts (1990, 1995) (see Furlan, Vinelli, & Dal Pont, 2011, for an historical excursus on the notion of complementarity and a recent empirical investigation).

According to this perspective, activities are defined as complements if *doing (more of) any one of them increases the returns of doing (more of) the others*. In mathematical language, this idea corresponds to having positive mixed-partial derivatives of a payoff function: the marginal returns to one variable are increasing in the levels of the other variables. In other words, the activities reinforce each other.

In the proposed model, and coherent with the notion of complementarity applied to BMs (see, e.g., Amit & Zott, 2001; Zott & Amit, 2007), we simplify the original formulation of complements to understand complementarity simply as the quality where having bundles of activities together provides more potential for value creation than the value obtainable by each activity in and of itself. Thus, our (non-mathematical) conceptualisation of complementarity is conceptually close to an idea of mutual reinforcement/exclusivity or coherence/trade-off.

An exemplary BM will help bring this abstract concept down to earth. Consider the case of IKEA, the Swedish multinational known for having introduced the ready-to-assemble BM that has revolutionised the furniture and home-accessory industry. A central element of IKEA's BM is represented by the choice to build its shops (comprising showrooms and pick-up-yourself areas) at cities' peripheries, with no presence in city centres. For simplicity and convenience, we refer to this choice (and the related bundle of activities that allows it to materialise) as 'periphery'. The bundle of activities labelled 'periphery' is consistent with another distinctive feature of the IKEA BM (and its value creation), which is 'no delivery': warehouses are placed next to the showrooms, and clients themselves pick up their goods immediately after having selected and paid for them. Thus, the two bundles of activities (i.e., 'periphery' and 'no delivery') are complements, according to the perspective proposed and discussed above. They are in a condition of mutual reinforcement with respect to the value-creation potential of IKEA's BM.

In turn, these two activities increase the payoff of offering non-assembled products ('ready to assemble'). The size of non-assembled products is contained, allowing clients to carry most of the purchased materials in their cars, which in turn supports (reinforces) a 'no delivery' model that is catalysed by the 'periphery' choice (which provides inexpensive land and large spaces for storage and pickup operations). In this example, these bundles of activities, 'periphery', 'no delivery' and 'ready to assemble', are complements; they reinforce one another in a coherent fashion. A corollary of this formulation of complementarity as reinforcement among distinct BM activities is that when two (or more) activities are complements, the negation of one activity introduces some form of trade-off from a value-creation (coherence) standpoint. It is not only true that doing A reinforces simultaneously doing B but also true that doing 'non-A' (the opposite of A) is in conflict with doing B. Going back to the IKEA example, the negation of 'periphery' – which would imply 'city centre' as the opposite alternative – introduces trade-offs with respect to the choices of 'no delivery' and 'ready to assemble'. Both 'no delivery' and 'ready to assemble' are inconsistent with the idea of having warehouses and showrooms in city centres. The first prospect is simply not practical in economic and even structural terms. The second, having showrooms in the city centre, is incoherent with the IKEA customer journey and customer experience. We return to this aspect of trade-offs (and complementarity) in the following section. For now, it is sufficient to highlight that i) the value-creation potential of a BM is increased when activities have the quality of mutual reinforcement and ii) that such reinforcement can be expressed by understanding the linkage between activities as complementarity.

Centrality and Periphery in Relation to the Entire Configuration

Since BMR involves experimenting with activities and activities are interdependent, it may be important to have information on the centrality or, conversely, the periphery of a focal part with respect to the rest of a configuration. Centrality/periphery is here understood as a measure of the degree of interdependence of a focal part with respect to the rest of the configuration (also referred as the 'structure'). Parts (or activities) that are peripheral have only few connections to the rest of the BM configuration. This means that changing or experimenting with them is, *ceteris paribus*, easier because it is not going to alter the fit with the existing configuration. In contrast, activities with high degrees of centrality – those that have several connections to the rest of the configuration – are more difficult to experiment with as their modification implies diffused modifications to the rest of a BM configuration. Altering them can profoundly alter the fit within the rest of a BM.

Having information about centrality/periphery of specific activities vis-à-vis the entire configuration is possible with our proposed approach. Centrality/periphery measures are common in network analysis. Our proposed methodology visualises a BM as a network in which nodes represent activities and linkages express the complementarity between them. In the simplest version, with binary linkages (either complementarity or no complementarity), the network will simply display a linkage between two activities whenever they display any degree of complementarity. Symmetrically, the absence of a linkage between two activities indicates that the two activities have no complementarity.

Overall, our proposed approach offers *a network-based representation anchored on the activity-system perspective with complementarity and centrality/periphery information*. It allows the representation of an existing BM as a network (of nodes and linkages) that includes information on the nature of the main activities and expresses numerically (but also visually) the degree of centrality/periphery of single activities (nodes) with respect to the configuration at large. In the following section, we illustrate how to produce a visual representation of a BM in support of BMR efforts according to our proposed methodology. We use the case of Ryanair, the airline which pioneered the low-cost BM in Europe. As will become clear below, the Ryanair case has certain advantages, most notably a popular and novel BM that is quite well documented in existing literature (see, e.g., Casadesus-Masanell & Ricart, 2010; Rivkin, 2000b), that characterise it as uniquely appropriate for the goals of this contribution. Applications of the methodology to cases not displaying the same characteristics (a known BM with easily identifiable activities) are possible and require some adaptation of the proposed methodology. Because of space constraints and for simplicity's sake, these adaptations are only marginally described in this contribution.

Generation of Visual Representation

The generation of a visual representation, *model generation*, with the proposed methodology is based on four main steps: i) identification of core activities, ii) assessment of complementarity, iii) centrality calculation and iv) visualisation.

Identification of Core Activities

Model generation starts by identifying the key activities (Zott & Amit, 2010) that underlie how a BM functions. As noted earlier, both key activities and strategic choices (Casadesus-Masanell & Ricart, 2010) work for this purpose because they represent two sides of the same coin (we also use the terms interchangeably from time to time). As the name suggests, the goal of this phase is to identify the main choices/activities characterising the BM in use.

We illustrate the generation of the model using the Ryanair case.

Ryanair is a low-cost airline that was founded in Ireland in 1985. It is known for being the first company to offer extremely cheap flights on continental routes in Europe. At the background of Ryanair's BM were, at that time, very unconventional strategic choices, setting the Ryanair BM apart from those of conventional airlines in Europe. For example, unlike conventional airlines that create value for customers by flying to airports conveniently located at main destinations (we call this choice/activity bundle 'primary airports'), Ryanair explicitly employed a model based on flying to secondary airports (for example, the Bergamo Airport for Milan or the Girona airport for Barcelona). In our language, 'secondary airports' is a strategic choice that involves a set of activities. Additionally, Ryanair has never offered, since its inception, meal service on flights. 'No meals' is another strategic choice that is entails a bundle of specific activities.

The simplest way to identify the key activities/choices is to rely on prior representations of the BM or, if available (and reliable), on archival data. As noted earlier, Ryanair was purposefully selected to illustrate our proposed methodology partly because a rich description of key activities is available (Rivkin, 2000b). We report them in Table 2. Whenever such information is not available, researchers

Table 2. Ryanair BM: Core Strategic Choices and Activities.

Resources
• Standardised fleet
• Non-union workers
Management
• Strict management (extremely cost-conscious culture)
• High-powered incentives
Operations
• Secondary airports
• Short-haul flights (point-to-point routing)
Services
• No meals
• No business class
• Nothing extra is free (luggage, check-in, etc.)
Partners
• Low commissions to travel agencies

Source: Adapted from Rivkin (2000b).

can seek to gather it via interviews with managers or other company informants. Procedures similar to those used to guarantee inter-coder reliability in content analysis can be employed to guarantee the reliability of the data.[8] The output of this phase is a list of the key activities that underlie how the focal BM functions. With the goal of managing the tension between parsimony and comprehensiveness, we suggest limiting the number of activities to between 10 and 15 as a pragmatic heuristic.

Assessment of Complementarity

The next step involves assessing the complementarity between each pair of activities. We recall that complementarity is conceptualised as the degree to which two activities are mutually reinforcing in the sense of increasing the value-creation

[8]As noted, a discussion on how to apply our proposed procedures to cases in which information on high-level activities is not available falls outside the scope of this contribution. Yet one consideration is worth mentioning: the identification of core activities could be a daunting task. As noted by Porter, but also Zott and Amit, the number of potential activities is often quite large, and the breadth of these activities depends on the level of aggregation and decomposition that is chosen. One way to deal with this issue is to focus on choices, which, as noted, are simply another way to conceptualise activities. In our experience, while activities may lead to complications in terms of fixing the aggregation level, high-level strategic choices suffer from this problem less. Also, our previous exploratory applications of the proposed model have provided some initial evidence that focusing on choices also naturally leads to fixing the number of choices at a manageable quantity (as a heuristic, we suggest dealing with a number of choices–activities in the 10-to-20 range).

potential of the focal BM. One of the advantages of the proposed approach is that complementarity is assessed only for pairs of activities (first-order complementarity), which strongly reduces complexity even as the overall model is able to offer information on system-level interdependencies.

The first step for assessing complementarity involves building a matrix in which the key activities/choices previously identified are located on the rows and columns in the same order. This generates a squared, symmetric matrix. Let n and m identify the n-activity on the rows and the m-activity on the columns, respectively. With this nomenclature, the cell corresponding to $n = 3;m = 5$ identifies the linkage (vertex) between the third activity/choice (node) in the rows and the fifth activity/choice (node) on the columns. Similarly, each cell in the diagonal ($n;m$, with $n = m$) identifies the intersection of an activity/choice with itself. Referring back to the IKEA example previously discussed, assuming that n corresponds to the node 'no delivery' and m to the node 'periphery', the cell n,m identifies the linkage between 'no delivery' and 'periphery'. In this cell, therefore, the degree of complementarity between 'no delivery' and 'periphery' is to be expressed.

The degree of complementarity is estimated qualitatively, using an l-intervals Likert scale with values in the interval 0–1. Zero indicates no complementarity (no reinforcement), and 1 indicates the activities' full complementarity (activities fully reinforce each other). Values between 0 and 1, typically with $l = 5$ intervals, indicate different degrees of the magnitude of reinforcement. For simplification, we limit the analysis in this paper to the use of binary values ($l = 1$). Amit and Zott (2001) used a similar procedure to evaluate the extent to which BMs include elements of complementarity, lock-in, novelty or efficiency in their system of activities.

To assess complementarity, we adopted an iterative process and involved multiple researchers. First, we brought on a research assistant and explained our methodology. Second, we independently filled the matrix after having read the Harvard Business School Ryanair Case Study (Rivkin, 2000b). During this phase, each researcher also took extensive notes on the rationale for scoring the matrix. For example, with reference to the choice 'secondary airport', we discussed that secondary airports primarily appeal to leisure travellers or students but not to business travellers, which is coherent with the choice 'no business class'. On this coherence, we wrote 's*econdary airports*: *suitable for leisure travellers, not for business travellers → no business class*'. We produced similar notes for each pair of activities. These notes are available from the authors of this article upon request.

We held meetings to contrast and compare our individual assessments and notes and to discuss sources of possible disagreement. The process was iterated twice until consensus was reached; Table 4 presents the result of this process. It should be underlined, for clarity's sake, that even though we applied a scoring methodology based on qualitative assessment by multiple independent researchers (a way to ensure that subjectivity is limited), this methodology does not, by itself, ensure that the assessed values match the 'real' level of strategic complementarity among BM Ryanair key choices/activities. It should also be underlined that in this particular case, this approximation is not a concern; the goal is simply to walk progressively the reader through the steps to producing the visual representation. Nonetheless, our intuition is that the match between the assessed value and the 'real' value can be improved in several ways, including increasing the number of independent analysts, measuring inter-coder reliability, employing expert scoring (e.g., the Delphi method) and engaging in data triangulation (for example, including informants from the focal company if archival data of good quality are non-existent).

Calculation of Centrality/Periphery

The output of the previous step is a squared, symmetric matrix that includes information on the degree of complementarity for each pair of activities. We refer to this as the complementarity matrix (Table 3). This matrix is used as the basis for a calculation of the centrality/periphery of each node in the configuration. Centrality is a measure of the degree of connectedness of a node with respect to the whole configuration. One straightforward way to calculate centrality is simply to impute the number of directly affected elements weighted by the intensity of the linkage, if relevant (Freeman, 1979). However, in complex configurations, as is the case with interdependencies in a BM, nodes tend to have important complex ramifications (Siggelkow, 2002). Node A is not only connected to node B (a first-order connection) but is also, via B, connected to the rest of the configuration (second-order connections). Our choice of centrality is eigenvector centrality, which is suitable for these purposes and applicable to the case of a squared matrix. We compute this measure with the software NodeXL®; other possibilities exist.

Table 4 illustrates the calculated degree of centrality for each activity in our graph. Table 5 presents some general information about the network.

Visualisation

Fig. 1 illustrates the visual representation obtained by following the steps above. We produced the visualisation in this article using the built-in features of NodeXL. In this visualisation, the area of each node is representative of the measure of centrality, as expressed in Table 4. As the visualisation illustrates, the choice 'non-union workers' is highly central. Moving from 'non-union workers' to union workers is a difficult manoeuvre because changing this choice involves making many changes to other choices that are interlinked with it. To use the same terminology employed in our theory section, the change of this choice may strongly alter the fit within the entire configuration. Conversely, the choice 'low commissions to travel agencies' is relatively easy to change (experimentation is easy, at least from a configurational fit point of view, with this choice). The software offers several possibilities for customising the visualisation; other possibilities beyond NodeXL exist.

Table 3. The Complementarity Matrix.

	Standardised Fleet	**Non-union Workers**	**Strict Management (Extremely Cost-Conscious Culture)**	**High-Powered Incentives**	**Secondary Airports**	**Short-Haul Flights**	**No Meals**	**All Passengers Treated Equally (No Business Class)**	**Nothing Extra Is Free (Luggage, Check-in, Etc.)**	**Low Commissions to Travel Agencies**
Standardised fleet	1	1	1	0	0	1	0	0	0	0
Non-union workers		1	1	1	0	1	1	1	1	0
Strict management (extremely cost-conscious culture)			1	1	1	0	1	1	1	1
High-powered incentives				1	0	0	0	0	0	0
Secondary airports					1	0	0	1	0	0
Short-haul flights						1	1	0	1	0
No meals							1	1	1	0
All passengers treated equally (no business class)								1	1	0
Nothing extra is free (luggage, check-in, etc.)									1	0
Low commissions to travel agencies										1

Source: Own assessment.

Table 4. Graph Metrics: Centrality Measures.

Choices/Activities	**Centrality**
Low commissions to travel agencies	3
Strict management	10
Secondary airports	4
No business class	7
Nothing extra is free	7
No meals	7
Short-haul flights	6
Non-union workers	9
High-powered incentives	4
Standardised fleet	5

Table 5. Network Information.

Graph Type	**Undirected**
Vertices	10
Unique edges	31
Edges with duplicates	0
Total edges	31
Self-loops	10
Reciprocated vertex pair ratio	Not applicable
Reciprocated edge ratio	Not applicable
Connected components	1
Single-vertex connected components	0
Maximum vertices in a connected component	10
Maximum edges in a connected component	31
Maximum geodesic distance (diameter)	3
Average geodesic distance	1,42
Graph density	0.466666667
Modularity	Not applicable
NodeXL version	1.0.1.418

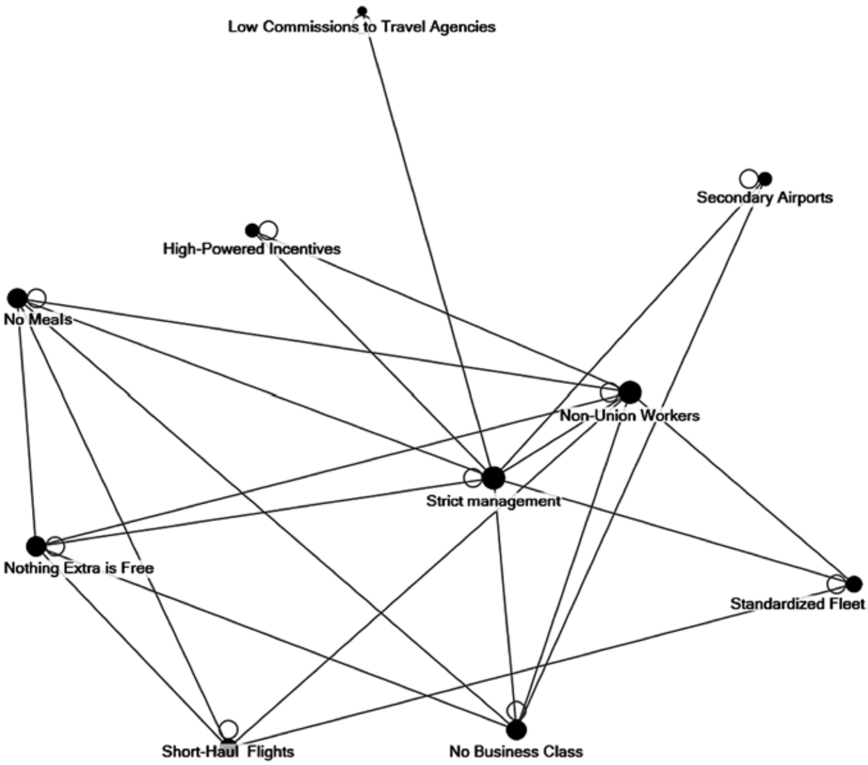

Fig. 1. Representation of the BM as an Activity System With Complementarity Information. *Source*: Own elaboration.

Discussion

We started this contribution by observing that BMI involves several tasks and barriers, many of which are cognitive in nature. The accepted literature has repeatedly highlighted that visual representations of the BM can help managers overcome barriers to BMI, including those involving cognitive tasks, and can support BMI in general. Scholars have produced numerous different tools and instruments to represent BMs, many of which have been accompanied by claims of their value in supporting BMI. Unfortunately, there has been a disconnect between these instruments for visual representation and research on BMs and cognition. This disconnect, we argue, is manifested in at least two ways: one a failure in anchoring the design of the instrument in the phenomenology of BMI and the other a lack of validation of the cognitive value of the instrument itself for specific cognitive tasks.

Concerning the first manifestation of the disconnect, we have highlighted the following limitations. First, BMI is an umbrella term potentially covering very different instances, which only partly overlap, of innovation of a BM. As a consequence, the chances of finding a one-size-fits-all method that works equally well across different manifestations of BMI are miniscule. Second, even within different manifestations of BMI, cognitive tasks are likely to be different, inviting once more the reflection that decision-makers may benefit from the use of dedicated tools that have been designed to support specific activities in BMI. Both considerations highlight the importance of anchoring the design of instruments for visually representing BMs in specific instances of BMI and doing so with reference to the specific cognitive tasks involved in BMI. This can also increase transparency in the main design choices made in producing a tool and, as a consequence, in the design of empirical tests and other forms of validation to assess the cognitive value of the instrument.

Against this backdrop, we have proposed to distinguish between BMR and BMD. We have focused on the former and discussed two facets of the phenomenon behind BMR that, in our view, have cognitive implications. These are the discovery-driven nature of BMR and its path dependence, both cognitive and structural. In our theory section, we offered an analysis of the meaning and significance of these aspects of BMR for the design of an instrument in support of the innovation of existing BMs.

Building on this analysis and against a set of criteria representing multiple perspectives, we have proposed a conceptual design for a visual model in support of BMR. The proposed visual representation specifically serves to reduce complexity in representing the inherent relationships within a BM by drawing on some basic elements of graph theory.

And now, the time has come to offer some more reflections on the possible value of the proposed approach as an instrument related to BMs and cognition. The widely emerging cognitive view on strategy has begun to make increasing headway into BM-related research. The relevance of this entrance has previously been argued as self-evident as the notion of cognition cannot find strong antecedents only throughout the history of science, but moreover, it demonstrates conceptual and logical links to managerial problems such as decision-making in relation to value creation and capture (Baden-Fuller & Haefliger, 2013; Baden-Fuller & Mangematin, 2013; Baden-Fuller & Morgan, 2010; Morgan, 2012; Nersessian, 2008). Such decision-making oftentimes takes place in the form of models. In this vein, the cognitive view on modelling provides important perspectives on modelling's inherent basis – in particular, the cognitive basis of model-based reasoning practices (Nersessian, 2008). Against this backdrop, we argue, our work contributes to further establishing a cognitive basis of model-based reasoning in the practice of business.

As mentioned transparently, this paper does not offer to test hypotheses related to the cognitive value of the proposed method for BMR in relation to specific aspects of BMR. Here, we limit our discussion to highlighting certain aspects of this nexus that could offer guidance for future research.

The Proposed Model as an Instrument

The point of departure is the consideration that firms employ specific architectures for value creation and capture that manifest in the systems of activities they employ (see, e.g., Zott & Amit, 2010). These systems of activities are often quite complex in both computational (due to the large number of activities and parts of the system) and dynamic terms (due to the complexity inherent in a web of interdependencies between activities that give rise to a complex behaviour). Managers simplify this complexity and make sense of their (and others') BMs by creating mental representations. In its declination, the BM is prevailingly viewed as offering an implicit (that is, taken-for-granted) mental schema – a cognitive structure that operates as a 'focusing device' (Doganova & Eyquem-Renault, 2009). From a theoretical standpoint, this idea finds its roots into the notion of firms as 'interpretation systems' (Daft & Weick, 1984) as well as in theories concerning cognition and industry belief systems (see, e.g., Porac, Ventresca, & Mishina, 2002; Spender, 1989; see Massa et al., 2017, for a comparison with other interpretation of the BM construct), As noted, this prevailing mental model can constitute a barrier against BMI, but the proposed instrument can support overcoming this barrier. It invites managers to explicitly reflect on past choices that led to today's taken-for-granted activities, requiring those choices to be made explicit (by being listed, for example). This exercise provides the opportunity to more deliberately question past choices' present values vis-à-vis changes that may have occurred since the strategic choices were initially made, thereby shifting the perception of the value of activities from a condition of taking-for-granted to one of explicit awareness.

The proposed model also encourages embracing system-level design as opposed to partial optimisation, thus improving the ability to design coherent BMs, as advocated by Zott and Amit (2010). This is achieved by the complementarity assessment, which constitutes a quick and transparent way to illustrate available synergies as well as potential disconnects between components of the BM.

Uncovering Inefficiencies and Structural Path Dependence

The centrality/periphery analysis allows the BM to uncover implicit – marginal and not necessarily visible – inefficiencies, which may in turn prove particularly relevant to studying a BM in terms of strategic fit (assessing the extent to which the BM truly realises what the company's strategy predicts). In addition, the centrality/periphery analysis offers information that could improve decision-making in relation to the challenges stemming from structural path dependence. Structural path dependence is manifested by coupled structures, configurations of activities which are interdependent, constraining the ability to change single activities because such changes imply altering the existing fit. Within such a configuration, our proposed methodology offers information on the degree of centrality and periphery of each activity. Peripheral activities in a BM have less interdependencies with the rest of the configuration, and as such, they are easier to experiment with during a discovery-driven processes. Changing them will not alter the fit within the existing BM configuration. Central activities, in contrast, have many connections to other activities. As such, changing them is more challenging because it risks compromising the fit. By offering centrality/periphery information, our proposed methodology can empower managers to better anticipate the difficulties involved in experimenting with single activities, thus supporting planning as well as prioritisation.

From Visual to Cognitive

Strictly speaking, the visualisation approach put forward in this paper represents a mental model. It thereby embodies the capacity to mentally depict a bundle of both real-world and theoretical situations, but it also allows one to make inferences about future states. More specifically,

> a mental model is a structural analogy in that it embodies a representation of the salient spatial and temporal relations among, and the causal structures connecting, the events and entities depicted. (Johnson-Laird, 1983; as cited in Nersessian, 2008, p. 103)

Extant work on the BM as a construct still falls short of some of the conditions of providing a fully fledged mental model. For example, neither spatial and temporal relations nor causal structures are necessarily being considered a central part of mainstream BM construct definitions (for an exception, see Furnari's (2015) work on cognitive maps for BMs). In this context, we hope to offer an avenue to open up the BM to greater richness as its underlying mental model allows for a more granular and exhaustive representation of the real world.

At the end of the day, cognition remains contingent on underlying antecedents such as environmental, organisational or individual factors (Bandura et al., 1989). Hence, the efficacy of applying cognitive devices in practice – such as mental or cognitive maps for BMs – rests on a broad variety of contextual factors and biases that are supremely difficult to be entirely accounted for by any device, even the most comprehensively designed. Yet instead of running after the ultimate 'super tool', when it comes to making cognitive devices real and functional, simplicity can be more productive than comprehensiveness. In this vein, more recent developments of cognition literature have increasingly pointed to the notion of heuristics, or 'simple rules' (see, e.g., Vuori & Vuori, 2014), as a particular perspective of the cognitive view within strategy research at large. Similarly, both BMD and BMR can take place though a pragmatic modelling approach such as finding similarities to other 'simple rules' of previously seen BMs and multiplying these with others (e.g., based on Gestalt theory; see Loock & Hacklin, 2015). This not only makes business modelling a practice prone to cognitive limitations such as recognition bias (dominant logic), but moreover, it opens up avenues for more formal tool creation that are based on shaping and further articulating such simple rules. In this context, a formal representation that both visualises and embodies implicit simple rules (such as graph theory-based properties) can help us to avoid cognitive bias by more explicitly addressing it. For example, heuristics can become articulated through formal representations within the tool, as through frequently observed dominant patterns across various graphs of BMs.

Implications for Managerial Practice

The conceptualisation of a tool representing a BM has, in general, the potential to further contribute to the 'boundary object' property of the BM (Doganova & Eyquem-Renault, 2009). Specifically, this tool offers managers with increased richness and depth in driving informed discussions around the BM, such as 'how can synergies within different elements of our BM be enhanced?' or 'where can we find inefficiencies or bottlenecks in how our BM is operating?' In so doing, the tool has the potential to assist decision-makers in avoiding potential biases through the uncovering of complementarities, points of dominance and unequal balances in the BM. Further, being an analytic tool that is formalised at a higher level and that does not solely rely on individual qualitative judgment, this tool is particularly suitable for comparative analyses, such as analysing the difference between two focal BMs or tracking the development of BM change initiatives over time. Hence, the tool can serve in support of the essential steps of strategy formulation: scanning, sense-making and decision-making (Narayanan, Zane, & Kemmerer, 2011).

Limitations and Further Research

While the conceptual approach put forward in this study offers potential answers to some questions posed by the research on BMs and cognition, it simultaneously raises a few of its own. Most notably, while we consistently argue for the importance of this type of analysis for offering a neutral, easily reproducible perspective in order to overcome dominant logics, we are aware that we, at the same time, may be introducing one. Specifically, linking back to the pragmatic view on BMs, working with graphical illustrations like these may, in the cognitive reasoning of individuals involved, give rise to more easily recognisable frequent patterns ('this looks like …'). Repeatedly working with a tool like this may, in principle, make us more susceptible towards categorising BMs in light of what we have seen thus far, which would constitute a novel type of recognition bias. In other words, attempting to avoid biases by introducing 'simple rules' may potentially introduce new biases in turn. Therefore, we suggest that further research is needed to explore the interrelatedness of BMs as heuristics and dominant logics. As a starting point for such work, one may ask to what extent recognition bias may give rise to structural isomorphism. One potential avenue to resolving this could also lie in finding ways to link this graphical tool with more qualitative perspectives to provide richness on the content of its causal structures as well as mechanisms (Furnari, 2015).

Needless to say, a conceptual tool like this one can only benefit from being tested on a broader basis – tested both for codifying a larger sample of BMs for running more large-scale quantitative research and also in managerial settings, to drive internal discussions. In the latter case, we are aware of the challenge of identifying and selecting the right categories for preparing the adjacency analysis (i.e., the column/row titles in the matrix), which may not always be as evident as in the well-documented case of Ryanair. In this context, documentation and guidelines, as well as the development of a more intuitive software tool, will be needed not only to ensure this visual representation tool's ease of use but also, thereby, to gain more consistent adoption in managerial practice.

Conclusion

The existence of a BM creates barriers to BMI efforts aimed at innovating the existing BM. These barriers are manifested not only in general cognitive terms (dominant logic traps) but also in terms of structural impediments (structural-path dependence and evolution towards fit), which may have a cognitive manifestation and which require specific ways of visualising an existing BM.

Against this backdrop, we have introduced and discussed an attempt to build a visual representation that meets some of these requirements, showcasing a specific avenue for developing more work at the nexus between visual representations and cognition in BM research.

* * *

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