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ORIGINAL ARTICLE

Managing Multiple Business Models: The Role Of Interdependencies

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Abstract How can a firm manage multiple and interdependent business models in the same industry? The literature has identified several possible strategies to do this but we still do not know under what circumstances one strategy may be better than others. Our paper identifies (substitute and complementary) interdependencies among business models as a key contingency and demonstrates through simulation modelling that the number, type and magnitude of these interdependencies, as well as their visibility and the pre-specification of strategic choices, determine which organizational structure is optimal in managing multiple business models.

Keywords Activity Systems · Business Models · Interdependencies · Organizational Design · Simulation Methods

JEL Classification Codes M10 · C15

Availability of data and material Not applicable

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1 Introduction

In the last twenty years, the concepts of business model and business model innovation have gained a lot of attention in both the academic and the practitioner-oriented literature (Amit and Zott 2021; Gassmann et al. 2018, 2020; Massa et al. 2017; Wirtz 2020; Wirtz et al. 2016; Zott et al. 2011). A key issue in this literature is the management of multiple, interdependent business models in the same industry by the same firm (e.g. Aversa et al. 2015, 2017; Bosbach et al. 2020; Christensen and Raynor 2003; Markides and Oyon 2010; Snihur and Tarziján 2018; Sohl and Vroom 2014, 2017; Sohl et al. 2020; Velu and Stiles 2013). A business model that might perform well as a standalone could display a different performance outcome once placed next to another business model in the same organization (e.g. Casadesus-Masanell and Ricart 2011). A good example of this is the case of Continental Airlines in the early 1990s. In 1993, in an attempt to imitate the success of the Southwest business model, Continental Airlines adopted the business model "Continental Lite" as an addition to its existing full-service business model. On its own, the no-frills, low-cost airline business model had proven to be very successful but when operated in conjunction with the full-service business model of Continental, it proved to be a disaster. Continental abandoned Continental Lite after two years and $140 million accumulated losses (cf. Porter 1996). On the other hand, airlines such as LAN from Chile (recently re-branded as LATAM after its merger with Brazil's TAM airlines) as well as Lufthansa from Germany seem to operate multiple business models quite successfully, at least prior to the Corona crisis (Snihur and Tarziján 2018). What contingencies can explain such different performance outcomes?

One possible answer proposed in the literature is the nature of interdependencies between the business models—whether and to what degree they are substitute (conflicting) or complementary (synergistic). The nature of these interdependencies will, in turn, determine whether operating multiple business models under the same organizational roof can either give rise to trade-offs such as inconsistencies in the firm's image and reputation or create synergies that would allow the firm to create even more value (e.g. Christensen and Raynor 2003; Markides and Oyon 2010; Porter 1980, 1996). Once these interdependencies are identified, the challenge is to determine an organizational structure that deals with the complexity that arises from these interdependencies—that keeps conflicts at a minimum and helps to exploit the synergies.

According to the extant academic literature (e.g., Christensen and Raynor 2003; Gilbert 2003; Gulati and Garino 2000; Khanagha et al. 2013; Markides and Charitou 2004)—and going beyond the classic centralization/decentralization distinction used by Snihur and Tarziján (2018)—we could identify four main organizational approaches that firms can use to manage multiple interdependent business models. These are: organizational *integration* whereby the different business models are kept within the same organization; *organizational separation* whereby the different business models are kept in separate units; *phased integration* (separate first, re-integrate later); and *phased separation* (start them in the same organization and separate them later). The last two choices are particularly interesting because they introduce a time dimension, allowing for learning and later adjustments to the decision

taken (Puranam and Jacobides 2006). However, although there is ample evidence that firms have been using these concepts, we still don't know very much under what circumstances one may be more optimal than another. One exception is an influential paper by Siggelkow and Levinthal (2003) that showed that one important contingency is the number of interactions among a firm's activities. Specifically, when interactions among the firm's activities are pervasive, the phased integration approach yields the highest long term performance. However, we still don't know what other contingencies make this particular approach superior nor do we know under what circumstances the other three structural alternatives may be superior. Our paper aims to fill this gap.

The extant literature has recognized the important role that interdependencies play but has failed to take into consideration the simple fact that these interdependencies vary from one business model to another. It remains to be analyzed how the number, type and strength of these interdependencies as well as additional contingencies such as the visibility of interdependencies as well as the pre-specification of strategic choices affect what organizational structure is optimal. Our goal is to adopt an activity system perspective on business models (Zott and Amit 2010) and generate new insights on the dynamics of managing multiple business models simultaneously in the same organization. We do so by relying on simulation modeling, a methodology that has become increasingly popular in strategic management and organization theory (Levinthal and Marengo 2018) and in complexity-related contexts (Davis et al. 2007). Thus, while we share the claim made by Snihur and Tarziján (2018, p. 51) that "the challenges of managing multiple BMs have not been studied in the detail they deserve" and "that the complexity of the BM portfolio is an important factor to consider when managing multiple BMs", we contribute to the literature by introducing a sufficiently rigorous modeling approach to explore this complexity in more detail.[1]

2 Related Literature

The questions where the optimal boundaries of a multi-business firm are and how such a multi-business firm should be managed are at the heart of organization theory (e.g., Williamson 1975; Zenger et al. 2011). Within strategic management, diversification research also considers how businesses—or "business units"—can be identified and how their "relatedness" can be defined, often with very unsatisfactory results (Lüthge 2020). Alfred Chandler's classic work (1962) is at the intersection of these research fields. Chandler argued that "structure follows strategy" and that the strategy of diversification (undertaken at the end of the 19th and the beginning of

[1] Interestingly, Snihur and Tarziján (2018, p. 60) claimed that they "formalize [business model portfolio complexity] in a parsimonious manner based on Kauffman's (1993) NK notation"—but they do so in a non-formal way. We provide an alternative to their approach.

the 20th century) led to the divisionalization of many firms in North America.[2] Our research addresses similar research questions but takes the business model concept as a starting point. A business *model* is more than a *business* in that it outlines in a more precise way the essential elements of a business as well as their interdependencies (a prerequisite for formal modeling). Additionally, a business model is more strategy- and less organization-related than a *business unit*. This basic understanding allows us to build on literature that conceptualizes business models as activity systems, and then to analyze how these activity systems—and more specifically how multiple business models (as activity systems)—are related to the performance of different organizational design choices (cf., Lüthge et al. 2021; Snihur and Tarziján 2018), as outlined in the following.

2.1 Interdependencies Within and Across Business Models

A business model has been defined as the configuration of activities that a firm puts together to translate its strategy into action (e.g., Teece 2010, 2018). Specifically, the business model is seen as an activity system made up of a number of interdependent choices such as the firm's value-chain activities, its choice of customers and its choice of products and services (e.g. Amit and Zott 2015; Casadesus-Masanell and Ricart 2010; Casadesus-Masanell and Zhu 2013; Markides 2008; Massa et al. 2017; Zott and Amit 2010, 2013; Zott et al. 2011). The right choice of interdependent activities determines the performance of the system.

Interdependencies exist not only among activities *within* a business model but also among activities *across* business models (Snihur and Tarziján 2018). Two business models are said to be interdependent if variation in the activities of one influences the level of activities in the other. An important stream in the literature distinguishes between two types of interdependencies—complementary interdependencies (i.e. the marginal benefit of one decision increases with the level of the complementing decision) and substitute interdependencies (i.e. the marginal benefit of one decision decreases with the level of the substituting decision) (Milgrom and Roberts 1990; Porter and Siggelkow 2008).

From a management point of view, the presence of interdependencies among business models is not a problem as long as the business models are operated by different companies. It becomes a more complex issue when two or more interdependent business models are placed under the same organizational roof, as an increasing number of firms is doing (e.g. Christensen and Raynor 2003; Johnson et al. 2008; Markides and Oyon 2010). If the interdependencies are complementary and interorganizational strategic alliance agreements are not available, then the firm must find ways to exploit them itself. On the other hand, if the interdependencies are substitutes, frictions will be created between the managers of the various busi-

[2] We are of course aware that reality can be more complex—that strategy (or in our case: a business model) can also follow structure (e.g., Hall and Saias 1980), or that both can co-evolve over the course of time (e.g., Jarzabowski et al. 2019). We refrain from further treatment of such alternative development paths in the interest of handling our modelling approach. Note, however, that the *performance implications* are indeed determined by the mutual fit between strategy (business model) and organizational design.

ness models and disruptive behaviors may ensue (e.g. Christensen and Raynor 2003; Porter 1996). The literature has documented several cases where these frictions were so large that the firm had to divest or shut down the second business model (e.g. Khanagha et al. 2013; Markides 2008).

2.2 Managing Interdependencies Through Organizational Design

Anecdotal evidence has emerged that shows that firms have developed a variety of structural alternatives to manage multiple interdependent business models. One such alternative is organizational separation, whereby the firm creates a separate unit to put the second business model in—a structural solution that Nestle, for example, adopted in developing its Nespresso business model and one that Medtronic adopted in developing its Nayamed business model. A second alternative is the "integrated" structure whereby the second business model is developed and allowed to grow within the existing organization. For example, Charitou and Markides (2003) reported the experiences of 68 companies that faced the challenge of competing with dual business models. Of these, forty-two created a separate unit for the new business model but twenty-six firms did not—they followed an integrated approach. A third structural alternative has been identified by Khanagha et al. (2013) who describes how a European telecom company followed the "phased integration" approach in developing their cloud business model. This involved starting the new business model in a separate unit but slowly re-integrating it into the existing organization—an approach also followed by numerous other companies such as BMW, British Airways, Barnes and Noble, Charles Schwab and the Danish bank Lan & Spar. Yet another possible structural alternative was identified by Markides and Charitou (2004) who report several cases of companies—such as the British supermarket chain Tesco—that followed the "phased separation" approach. This involved starting the new business model inside the existing organization and then spinning it off as a separate unit once it grew to a certain size.

Apart from identifying the various structural alternatives, the literature has not made any attempts to evaluate which alternative is optimal under what circumstances. The underlying assumption has been that because of the tensions and conflicts created by substitute interdependencies, the organizational separation alternative will be the optimal approach in most cases (see for example Bower and Christensen 1995; Christensen 1997; Gilbert and Bower 2002; O'Reilly and Tushman 2004; Raisch and Birkinshaw 2008). The rationale for organizational separation is that the presence of substitute interdependencies will lead to frictions among managers of the firm as well as behaviors that might be optimal for one part of the organization but sub-optimal for the whole. By keeping the two business models organizationally separate, potentially harmful interference in the affairs of the other business model is kept at a minimum and conflicts among managers are avoided.

Valid as this argument might be, it suffers from an implicit assumption—that the interdependencies between business models do not vary from one set of business models to another. We know that this assumption is often not justified. Not only do the number of interdependencies vary across business models but so does their strength or intensity (e.g. Markides 2008; Rivkin and Siggelkow 2003). For

example, Markides and Oyon (2010) argued that in the airline industry, the low cost, no frills, point-to-point business model presents numerous serious challenges to the traditional airline business model because the substitute interdependencies between the two business models are numerous and serious. By contrast, the online distribution business model in the banking industry is not particularly disruptive to the traditional banking business model because the interdependencies between the two business models are few and not particularly serious (at least until now; recent FinTech models developed by, e.g., N26 may be more challenging).

The arguments proposing organizational separation also suffer from an omission. The interdependencies between business models are not only substitute interdependencies—they could also be complementary interdependencies (see Baden-Fuller and Haefliger 2013; Visnjic et al. 2016). This implies that a firm that follows the organizational separation approach may succeed in reducing the problems created by substitute interdependencies but may also fail to exploit adequately the synergies that emerge from the presence of complementary interdependencies between two (or more) business models. As with substitute interdependencies, the number and strength of complementary interdependencies faced by one set of business models is likely to be different from the number and strength of those faced by another set of business models.

2.3 What Influences Which Organizational Structure is Optimal?

This discussion suggests that what organizational alternative will be the optimal one to manage interdependent business models should be a function of not only the mere presence of substitute interdependencies as the literature has long assumed. Which alternative will be optimal should also depend on two other factors: (i) the *number and strength* of these substitute interdependencies between two (or more) business models; and (ii) the presence of *complementary* interdependencies as well as their number and strength. An additional and most critical question then is what the *relative proportion* between these different types of interdependencies is.

Consider, for example, a scenario where two business models face many and serious substitute interdependencies while sharing few and minor complementary interdependencies. In such a scenario, organizational separation is more likely to be optimal—the second business model will need to be placed in a separate unit to "protect" it from the substitute interdependencies but this would not come at the expense of synergies (because the complementary interdependencies are few). For example, Markides and Charitou (2004) reported the cases of Nestle and Nespresso and HSBC and First Direct where separation was the chosen approach exactly because of the presence of serious substitute interdependencies between the business models.

Similarly, consider a second scenario where the business models face few or minor *substitute* interdependencies but share many and serious *complementary* interdependencies. In such a scenario, there is no need to separate the business models. Instead, the integrated structure (i.e. embracing the new business model through the firm's existing organizational infrastructure) may be the optimal solution. Good examples of this are the cases of the brokerage firms Edward Jones and Merrill Lynch

in the early 2000s. Both adopted the strategy of integration for online dealing of shares because they saw few conflicts but many synergies between the traditional way of doing business and the new way (Markides and Charitou 2004).

A third scenario arises when the business models share many complementary interdependencies but also many substitute interdependencies. In such a case, it might be better to start with the separation approach but then re-integrate the second business model into the organization once it has grown in size and stature to withstand internal antagonism (see also Puranam et al. 2006; and Siggelkow and Levinthal 2003; for an analogous argument). The literature has documented several company cases which adopted this "phased integration" solution (e.g. Khanagha et al. 2013; Markides and Charitou 2004). Finally, a fourth scenario arises when the two business models share few complementary or substitute interdependencies. In such a scenario, the optimal structure may be "phased separation" (Markides and Charitou 2004). This would involve starting the second business model inside the organization so as to leverage the firm's existing assets and experience but then spinning it off as a separate entity once it has grown to a certain size and stature.

This discussion suggests that contrary to the prevailing view in the literature, organizational separation will *not* be the optimal solution under all circumstances. It should be particularly effective in situations where the business models face many (and serious) substitute interdependencies but few complementary interdependencies. On the other hand, when substitute interdependencies are few or minor, the integration or phased-integration strategies ought to outperform the organizational separation one. Which of these two alternative strategies is preferable should be determined by the number of complementary interdependencies present.

2.4 The Role of Managers

Which organizational structure is optimal in managing interdependent business models should depend not only on the number and strength of interdependencies between the business models and their proportional weight against each other, but also on how well these interdependencies are managed. One implicit assumption found in the literature is that the interdependencies between business models are visible and known to the managers of the firm. It is therefore up to them to manage them effectively. However, the visibility of interdependencies cannot be taken for granted. Many times, managers discover the presence of interdependencies or appreciate their full extent only after they have been operating with multiple business models for some time (Baldwin and Clark 2000; Ethiraj and Levinthal 2004). The visibility of interdependencies will therefore determine whether a company can manage these interdependencies effectively. We'd expect the organizational separation approach to perform better than the other strategies only in situations where the visibility of interdependencies between business models is high.

Beyond this visibility contingency, the organizational design and modularity literature has proposed a number of integrating mechanisms that companies need to put in place to manage complementary interdependencies—such as a common general manager, an active integrator, common incentives, shared values and so on (e.g. Gilbert 2003; Gulati and Garino 2000; Langlois 2002; O'Reilly and Tushman 2004;

Thompson 1967). One of those integrating mechanisms is the pre-specification of key strategic decisions, a prerequisite to better alignment between the parent and the separate unit housing the second business model. Building on Simon (1962), the modularity literature discusses these pre-specifications under the title of "design rules" which reduce the overall complexity and allow bounded rational managers to focus on their modules (Baldwin and Clark 1997, 2000).

There are risks to setting design rules or pre-specifying strategic choices early. As Baldwin and Clark (2000) argued, designers are not aware ex ante of all interdependencies in a system and new "hidden interdependencies" become visible over time. Furthermore, as Ethiraj and Levinthal (2004) pointed out, good designs evolve over time through trial-and-error rather than emerge fully-fledged through a planning process. However, it is generally acknowledged that the benefits of pre-specifying strategic choices outweigh the potential costs. For example, in the case of non-modular interaction structures, Ghemawat and Levinthal (2008) showed that deciding strategic choices early can lead to increased performance. Pre-specifying strategic choices early is especially important in the management of multiple business models because it allows the managers to exploit complementary interdependencies between the business models. Therefore we will expect that the more strategic choices are pre-specified, the better the performance of the organizational separation approach compared to other strategies.

Which structure is optimal in managing interdependent business models should depend not only on the number and strength of interdependencies between the business models but also on how well these interdependencies are managed. This, in turn, depends on whether these interdependencies are visible to managers. As argued by Baldwin and Clark (2000) as well as Ethiraj and Levinthal (2004), managers may discover the presence of interdependencies or appreciate their full extent only after they have been operating with multiple business models for some time. This suggests that the visibility of interdependencies should not be taken for granted and that whether they are visible or not should influence the optimal organizational setup of multiple business models. In addition, the proper management of these interdependencies should influence what organizational structure would be optimal. The literature has already proposed the pre-specification of key strategic decisions as one way to achieve better alignment between the parent and the separate unit housing the second business model (Baldwin and Clark 1997, 2000). We will therefore test to see whether also this variable is important in determining the optimal organizational solution.

3 Research Design: A Simulation Model

To test these expectations, we utilize a simulation model. We build an NK-model similar to the one used by Kauffman (1993)[3] but we extend it in one important

[3] For a review of management literature that is based on this modeling approach, see Baumann et al. (2019). This literature review also entails an outline of the behavioral assumptions on which the models are built (bounded rationality, complexity, and search as a sequential process).

respect. In the Kauffman model, interdependencies between activities were taken as one and the same. In our model, we need to distinguish between complementary interdependencies (i.e. synergies) and substitute interdependencies (i.e. conflicts). We also need to incorporate not only interdependencies among the activities of a business model (i.e. intra-business model independencies) but also independencies between the activities of business model A and business model B[4] (inter-business model interdependencies).

3.1 The Firm and its Business Models

The activities of a company f can be represented as a vector of N binary variables $f = \{d_1, ..., d_N\}$. Each activity can either be selected ($d_i = 1 \mid i \in \{1, ..., N\}$) or not selected ($d_i = 0$). For example, d_1 could stand for "direct distribution". A company with the activity system $f = \{100000\ 000000\}$ would choose a direct distribution sales activity.

While some activities influence the performance of the organization in isolation, the ones with interdependencies to other activities cannot be evaluated on their own. Let's assume d_2 to be the activity of indirect distribution through retailers. If a company relies on retailers ($d_2 = 1$), the introduction of a direct distribution channel ($d_1 = 1$) is likely to cause conflicts (the activities are substitutes to each other). The number of interdependent activities is k. If there are no interdependencies between the activities ($k = 0$), each activity contributes independently to the company's performance. In the case of interdependencies, the performance contribution depends on the selected activity and the activities it has interdependencies with. Selecting a particular activity might increase this activity's performance contribution but the overall company performance can decrease. Thus, whether or not an increase in one variable X leads to a performance increase depends upon the level of another variable Y—a setting that leads, metaphorically speaking, to a "rugged performance landscape" with local peaks and valleys, as described by Levinthal (1997) and Siggelkow (2002). In a simulation run, the firm is placed on such a performance landscape and then searches for the highest peak. The initial position is randomly chosen and the search strategy depends on the organizational design of the firm, as described below.

3.2 Modeling the Interdependencies Within Business Models

We use the NK-model to represent the interdependencies within a business model (intra-business model interdependencies). Ethiraj et al. (2008) used a similar notation. Under the NK-model the performance contribution of each activity (ω_i) depends upon the state of the *i*th activity and the state of j interdependent activities. Let:

$$D = \{d_j \mid j \in \{1, ..., N\}\}, \text{then } \omega_i = \omega_i(d_i; D_i), \text{where } D_i \subseteq D \ \forall i \in \{1, ..., N\} \quad (1)$$

[4] For simplicity, we will only consider two and not more business models in our modeling approach.

The value of ω_i is randomly drawn from the uniform distribution U[0,1] for each (d_i;D_i), which means that every possible combination of the state of the *i*th activity and its interdependent activities is assigned a random number between 0 and 1. Because of this randomness, the researcher has no control over the type of interdependency assigned by the NK-model.

The overall performance of the company—or in our case the business model—is determined by calculating the mean over the activity performance contributions:

$$\Omega = \frac{1}{N}\sum_{i=1}^{N}\omega_i(d_i; D_i) \tag{2}$$

Note that the value of Ω is in the interval of [0,1].

In our simulation, we use two modules, so that—for intra-business model interdependencies—the activities 1 to 6 are only dependent upon activities 1 to 6 (analogous for activities 7–12). Fig. 1 illustrates the setup with an interaction matrix. The interaction matrix (cf. Rivkin and Siggelkow 2007) shows an "x" if interactions (interdependencies) exist between two activities. For example, in the matrix shown, the performance contribution of activity 1 is dependent upon activities 3, 4, 5 and 6, so that k equals 4.

Because the performance value is randomly assigned, we use the approach described above to model the performance within the two business models but not the interdependencies between them. This results in a modular design setup which is created randomly in a controlled manner (Siggelkow and Levinthal 2003). The simulation sets up an interaction matrix with two modules and randomly assigns k interactions for each decision in the same module. This means, for activities d_1

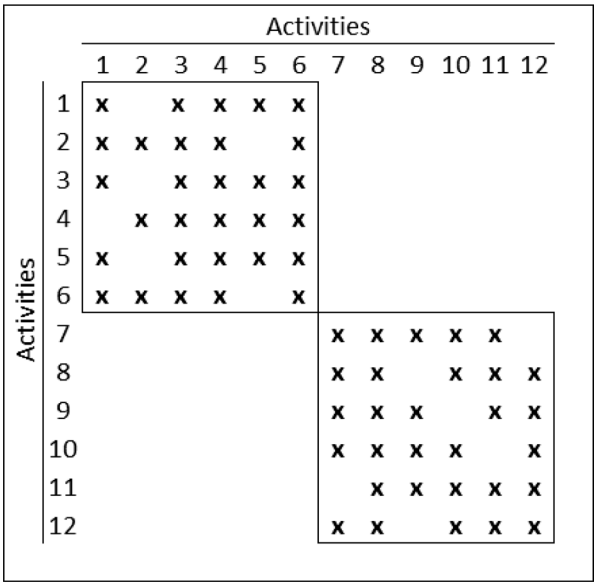

Fig. 1 Intra-business model interaction matrix ($N = 12$; $k = 4$)

through d_6 the interactions are with activities d_1 through d_6 (for d_7 through d_{12} analogous).

3.3 Modeling the Interdependencies Between Business Models

We could model the inter-business model interdependencies (e.g. the interdependency between activity 1 and 7) using the NK-model, but this would not allow us to control for the type of interdependence (i.e. whether the activities are substitutes or complements). Porter and Siggelkow (2008) defined a performance function V that allows control over this type of interdependence between activities. For $N=4$ the following function would capture all interdependencies between the activities:

$$\begin{aligned}&V(d_1,d_2,d_3,d_4)=\alpha_1d_1+\alpha_2d_2+\alpha_3d_3+\alpha_4d_4+\\&\beta_1d_1d_2+\beta_2d_1d_3+\beta_3d_1d_4+\beta_4d_2d_3+\beta_5d_2d_4+\beta_6d_3d_4+\\&\gamma_1d_1d_2d_3+\gamma_2d_1d_2d_4+\gamma_3d_1d_3d_4+\gamma_4d_2d_3d_4+\\&\theta d_1d_2d_3d_4\end{aligned}$$

Varying the values of α_i, β_i, γ_i and θ, the function allows us to generate different types of interdependencies. If $\beta_i=\gamma_i=\theta=0$, the activities are independent. If $\gamma_i=\theta=0$ and $\beta_i>0$, all activities are complements. Similarly, if $\gamma_i=\theta=0$ and $\beta_i<0$, all activities are substitutes to each other. γ_i and θ can be used to model contextual interaction, i.e. the type of interdependency between activities changes based on the state of other activities (Porter and Siggelkow 2008).

Since we are only interested in substitutes or complements, we need a performance function which has cross-partial derivatives that are definitely positive (complements) or negative (substitutes). The summands containing α do not play a role, since the cross-partial derivative is always 0. The cross-partial derivative of the summands containing a γ or θ can either be positive or negative, depending on the remaining variables activities. The latter case is an example of contextual interaction, which is not relevant for our research question. We therefore simplify Porter and Siggelkow's (2008) performance function to:

$$V(d_1,d_2,d_3,d_4)=\beta_1d_1d_2+\beta_2d_1d_3+\beta_3d_1d_4+\beta_4d_2d_3+\beta_5d_2d_4+\beta_6d_3d_4 \quad (3)$$

Analogous to the NK-model above, the simulation randomly draws values for β_i from the uniform distribution U[–1,0] when the two activities in the summand are substitutes and from the uniform distribution U[0,1] when the two activities are complements. Most studies use a uniform distribution (compare e.g. Siggelkow and Levinthal 2003), which is one parametrization of the beta function (with the parameters $a=1$ and $b=1$). In experiments in which we control the strength of substitutes and/or complements, we use the beta distribution with an adapted parametrization.[5]

Since the performance of the NK-model is between 0 and 1, we normalize the performance function, so that the performance is within the interval of [0,1]. Anal-

[5] In the probability density function of the beta distribution, we use the shape parameters $a=4$ and $b=4$ for medium strength as well as $a=4$ and $b=1$ for strong and $a=1$ and $b=4$ for weak interdependencies.

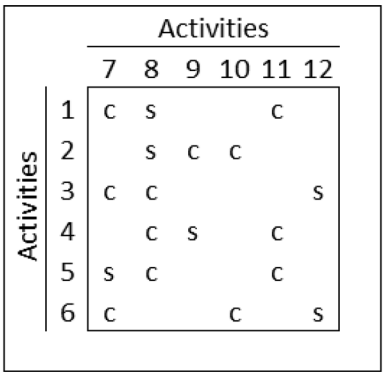

Fig. 2 Inter-Business-Model Interaction Matrix ($N = 12$; $k_s = 1$; $k_c = 2$)

ogous to k in the NK-model, we define k_s as the number of substitute inter-business model interdependencies of each activity (i.e. conflicts) and k_c as the number of complementary inter-business model interdependencies (i.e. synergies). The maximum spread between the minimum and maximum of the performance function is $\frac{N}{2}(k_s + k_c)$. This is because the term $\frac{N}{2}(k_s + k_c)$ is the number or interactions between the two business models. To understand that this is also the maximum spread, imagine the extreme case that all interactions receive a β_i value of 1 and all activities would be selected by the company. The resulting performance would be $\frac{N}{2}(k_s + k_c)$ and 0 if no activity is chosen. No other value configuration for the β_i would lead to a higher spread. Therefore, the maximum spread is $\frac{N}{2}(k_s + k_c)$. Dividing the performance function by $\frac{N}{2}(k_s + k_c)$ limits it to an interval of [–0.5; 0.5] and by adding +0.5 the function is normalized and has a value in the interval of [0,1], which is the same as the performance interval of the NK-model. The final performance function[6] for $N = 4$ is:

$$V(d_1, d_2, d_3, d_4) = \frac{2}{N(k_s + k_c)}(\beta_1 d_1 d_2 + \beta_2 d_1 d_3 + \beta_3 d_1 d_4 + \beta_4 d_2 d_3 + \beta_5 d_2 d_4 + \beta_6 d_3 d_4) + 0.5 \quad (4)$$

The described function can be expanded from $N = 4$ to $N = 12$. We use it to model the interdependencies between the business models, which are the interdependencies between activity 1 to 6 and 7 to 12. The interdependences between the business models can also be displayed in an interaction matrix ("c" stands for complement and "s" stands for substitute), as shown in Fig. 2.

[6] Note that the interaction between activities is symmetrical (i.e. if activity 1 is a substitute to activity 7, then activity 7 is also a substitute to activity 1). This is true because the cross partial derivative $\frac{\partial^2 V}{\partial a1 \partial a7}$ is identical to $\frac{\partial^2 V}{\partial a7 \partial a1}$.

To integrate inter-business model interdependencies and the intra-business model interdependencies, we weight the resulting performance functions according to their number of interdependencies:

$$\mathrm{P} = \frac{\mathrm{k}}{\mathrm{k} + \mathrm{k}_s + \mathrm{k}_c}\Omega + \frac{\mathrm{k}_s + \mathrm{k}_c}{\mathrm{k} + \mathrm{k}_s + \mathrm{k}_c}\mathrm{V} \tag{5}$$

3.4 Modeling the Organizational Alternatives

We modeled four types of firms with different organizational structures. An *integrated firm* manages all business models in the same organizational structure; a *separated firm* manages the second business model in a separate unit; and two firms (*phased integrated* and *phased separated*) change their organizational structure during the simulation (i.e. start with a separate unit and then reintegrate it (*phased integrated*); or place the second business model in the same organizational structure and then move it in a separate unit (*phased separated*)).

To model the search process that these four types of firms use to find an optimum on a performance landscape, we applied the same algorithms as Siggelkow and Levinthal (2003), Ethiraj et al. (2008) and Rivkin and Siggelkow (2007). We generate a performance landscape according to the model described above (performance function P) and place a firm randomly on it. The firms differ in how they search for an optimal position.

For illustrative purposes, let's assume the initial position is 000000 000000 ($N = 12$). The *integrated firm* randomly chooses an activity and reverses its value. If the third activity was chosen, the new vector would be 001000 000000. The firm now evaluates the performance of the new position P(001000 000000) and compares it to the performance of the old position P(000000 000000). It keeps the position that has the higher performance value and continues its search in the next generation from there. This process is repeated in every generation.

The *separated firm* looks at the two business models separately. Imagine two business units each responsible for one half of the activities. The first business unit optimizes the first six activities and the second business unit optimizes the last six activities. In doing so, each business unit only considers its own performance to make its activity choices. The first business unit computes:

$\Omega_1 = \frac{1}{6}\sum_{i=1}^{6}\omega_i(d_i; D_i)$ and then $\mathrm{P}_1 = \frac{\mathrm{k}}{\mathrm{k}+\mathrm{k}_s+\mathrm{k}_c}\Omega_1 + \frac{\mathrm{k}_s+\mathrm{k}_c}{\mathrm{k}+\mathrm{k}_s+\mathrm{k}_c}\mathrm{V}$.

while the second business unit computes:

$\Omega_2 = \frac{1}{6}\sum_{i=7}^{12}\omega_i(d_i; D_i)$ and then $\mathrm{P}_2 = \frac{\mathrm{k}}{\mathrm{k}+\mathrm{k}_s+\mathrm{k}_c}\Omega_2 + \frac{\mathrm{k}_s+\mathrm{k}_c}{\mathrm{k}+\mathrm{k}_s+\mathrm{k}_c}\mathrm{V}$.

In line with Siggelkow and Levinthal (2003), we assume that business unit managers have visibility over their interdependencies with the second business model (the inter-business-model performance function V). To determine their own payoff, each business unit incorporates the other business unit's choices from the previous round. Let's assume that the current position is 000000 000000 and the business units consider whether to change the first and last activity. The first business unit computes P_1(100000 000000) and compares it to P_1(000000 000000). It applies the change to the activity system if the former shows a higher performance value. At the same time, the second business unit evaluates P_2(000000 000001). Note that the

changes made can lead to a lower firm performance even though they made sense to one or both business units. A discussion of the underlying assumptions can be found in Siggelkow and Levinthal (2003).

The *phased integrated* and *phased separated* firms change their organizational structure between the two structures described above in round 25 after the introduction of the second business model. The *phased integrated* firm first manages its two business models in two business units and integrates them after 25 rounds. The *phased separated* firm manages them integrated and then separates them after 25 rounds. The choice of 25 rounds was made to ensure comparability with Siggelkow and Levinthal (2003) who found in their experiments that "By period 25, all firms that are decentralized [separated] are stuck on local peaks; i.e., neither division can find a local change that is performance enhancing." (p. 656) Shifting the switching point had no effect on the results in our experiments either.

4 Simulation Results

We now explore how the number and seriousness of both complementary and substitute interdependencies between business models (section 4.1), as well as our selected contingency factors (section 4.2), influence the optimal organizational solution in competing with multiple business models. Of all conducted experiments, we report here only the most significant and stable results. For all experiments, we place one firm on a newly generated landscape and follow its development over 150 periods.[7] The initial position and the interdependencies are randomly generated. Since we are interested in the cases in which a company adds a new business model to an existing one, the firm optimizes only one business model for the first 50 periods in an integrated fashion. We then add the second business model and start the optimization process according to the organizational setup of the firm (integrated, separated or phased-integrated/separated). Period 1 in our diagrams is the first period with two business models. The firms that use the phased integration or phased separation strategies implement the change in period 25 (Siggelkow and Levinthal 2003). We repeated the experiment 2000 times for each firm,[8] with different seeds for initial position and interdependencies. The first experiment, therefore, had 8000 runs.

4.1 The Presence and Relative Number and Strength of Inter-business Model Interdependencies

Our first set of experiments (not reported here) confirmed our expectation that the presence of interdependencies influences which organizational solution is optimal. We found that in the presence of few substitute interdependencies and no complementary interdependencies, the *separation* approach was the optimal one to follow, whereas in the presence of many complementary interdependencies and no substi-

[7] In our diagrams, we zoom only into the first 100 periods as no major changes happen thereafter.

[8] Averaging several hundred firms already gave us the same results that we received with 2000 repetitions [firms]. Adding more repetitions did not change the results in any way.

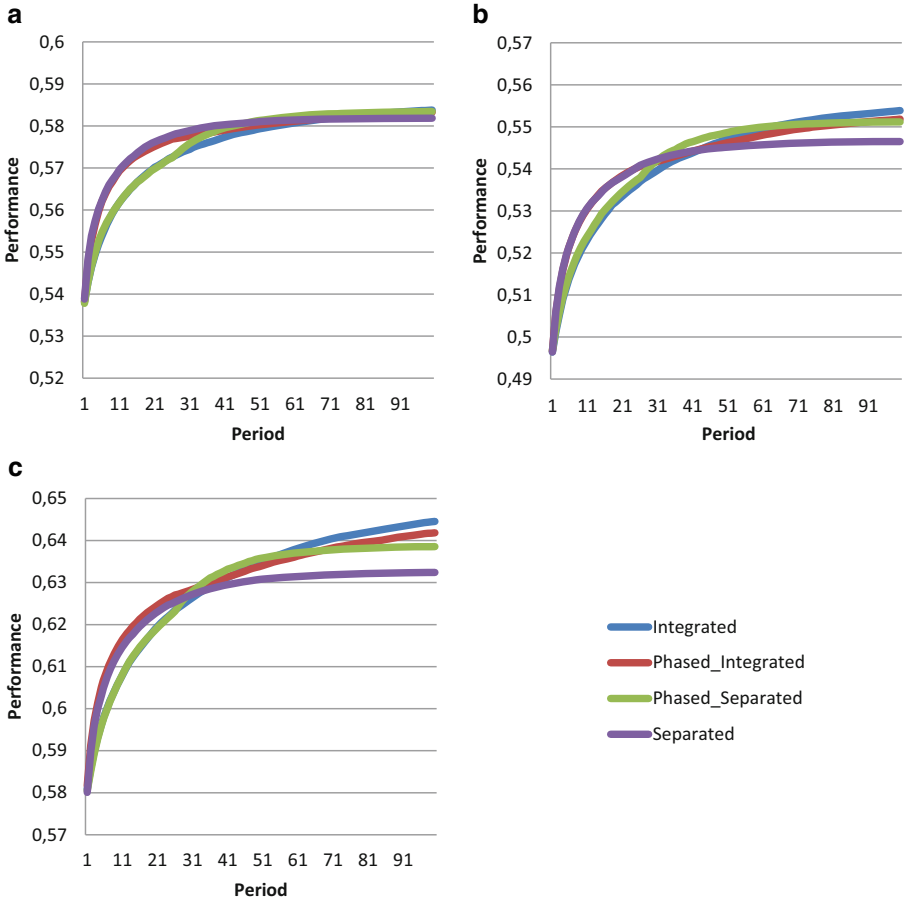

Fig. 3 Performance development with examples of strong and weak interdependencies. **a** Medium substitute and complementary interdependencies ($k = 8$, $k_s = 5$, $k_c = 5$). **b** Strong substitute and weak complementary interdependencies ($k = 8$, $k_s = 5$, $k_c = 5$). **c** Weak substitute and strong complementary interdependencies ($k = 8$, $k_s = 5$, $k_c = 5$)

tute interdependencies, the *integration* approach was the optimal way to adopt (and the separation strategy was significantly inferior to all others).

We then examined whether the actual *strength* (rather than the mere presence) of interdependencies influenced what organizational structure would be optimal. Representative examples of our results can be seen in Fig. 3.[9] The first figure (Fig. 3a) shows that when both complementary and substitute interdependencies are of medium strength, the separation approach is clearly superior[10] to the phased integration one in the short term and is then on par with it in the long run. However,

[9] To understand how we modeled the strength of interdependencies, please refer to footnote 5 above.

[10] An approach is superior, if it has higher performance than an inferior one. An approach can be superior during certain periods and inferior during other periods.

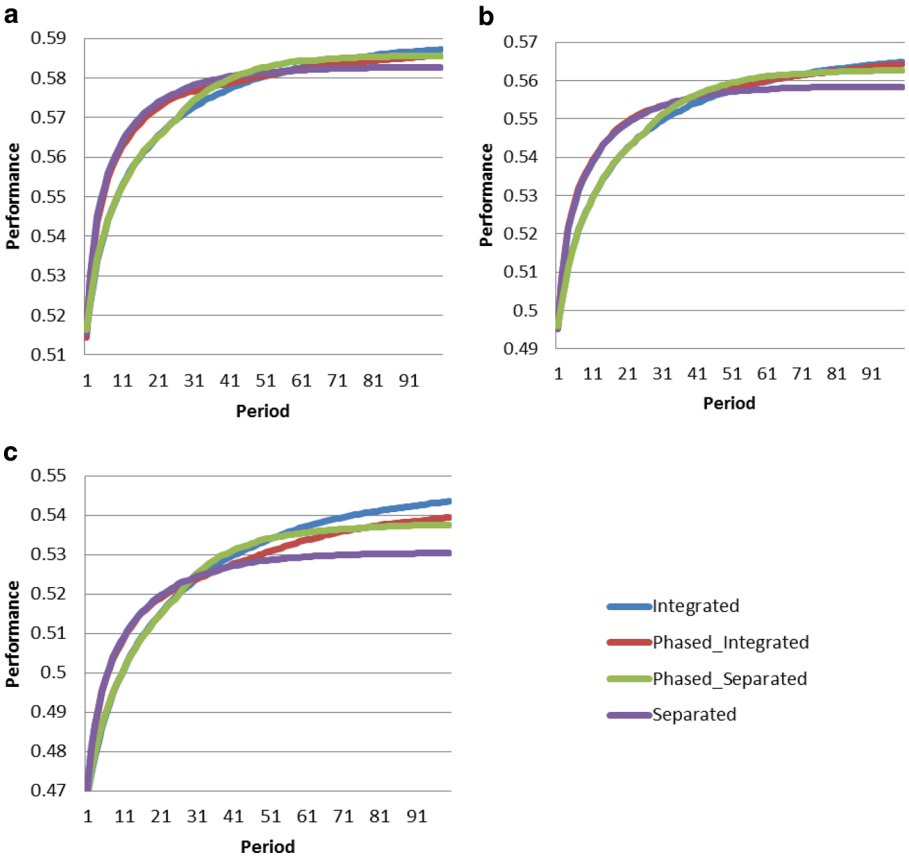

Fig. 4 Performance development with no complementary interdependencies and varying substituting interdependencies. a Performance development with low number of substituting interdependencies ($k = 8$, $k_s = 4$, $k_c = 0$). b Performance development with medium number of substituting interdependencies ($k = 8$, $k_s = 6$, $k_c = 0$). c Performance development with many substituting interdependencies ($k = 8$, $k_s = 10$, $k_c = 0$)

in the presence of strong substitute interdependencies (Fig. 3b) or strong complementary interdependencies (Fig. 3c), organizational separation becomes inferior to the other structural alternatives. Again, this supports our argument that whether the organizational separation approach will be the optimal one to follow will depend not only on the number but also the strength of the interdependencies present between two business models.

Next, consider how the *relative* number of substitute and complementary interdependencies affects the optimality of the organizational separation approach. We expect that organizational separation will be particularly suitable in situations where substitute interdependencies outnumber complementary interdependencies. The results in Fig. 4 do not seem to support this argument. In this experiment, we hold complementary interdependencies constant but progressively increase substitute interdependencies from four (Fig. 4a) to six (Fig. 4b) to ten (Fig. 4c). We would expect the separation approach to become increasingly better relative to all others. In fact,

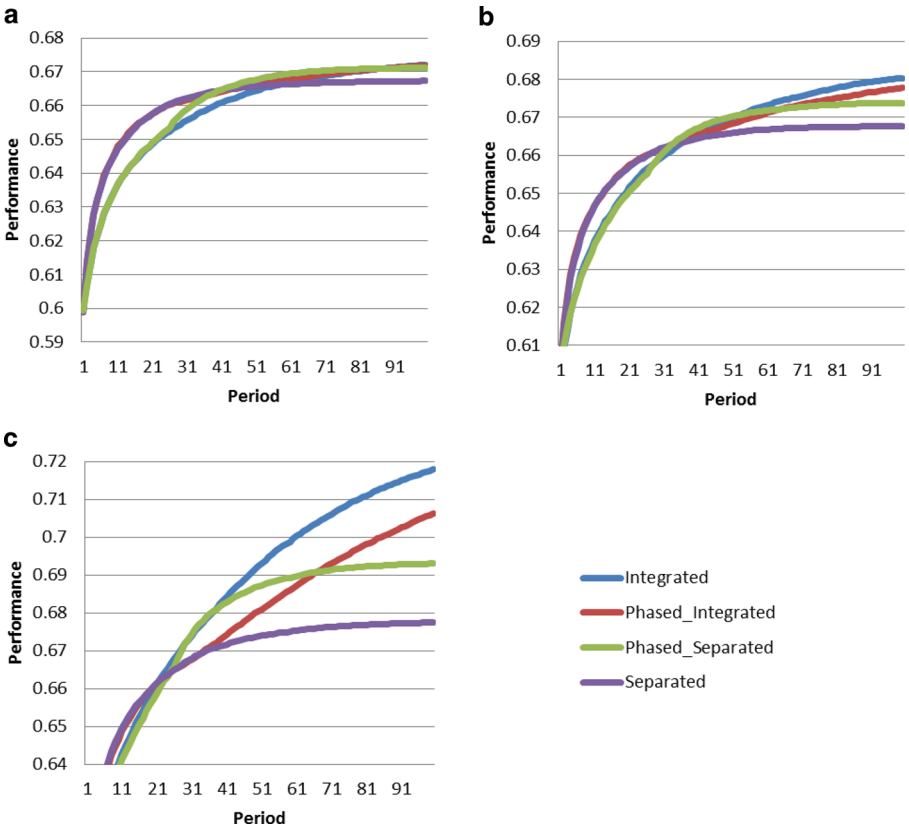

Fig. 5 Performance development with no substituting interdependencies and varying complementing interdependencies. a Performance development with low number of complementing interdependencies ($k = 8$, $k_s = 0$, $k_c = 4$). b Performance development with medium number of complementing interdependencies ($k = 8$, $k_s = 0$, $k_c = 6$). c Performance development with many complementing interdependencies ($k = 8$, $k_s = 0$, $k_c = 10$)

the opposite result emerges. We can see the performance gap between the separation and the integration alternative becoming bigger as we increase the number of substitute interdependencies relative to complementary interdependencies.

On the other hand, as shown in Fig. 5, the prediction that the more complementary interdependencies present (relative to substitute interdependencies) the more attractive an organizational integration will be (relative to organizational separation) is supported by the results. In this experiment, we hold substitute interdependencies constant and progressively increase the number of complementary interdependencies from four (Fig. 5a) to six (Fig. 5b) to ten (Fig. 5c). As the number of complementary interdependencies increases, we would expect the integration alternative to become increasingly better relative to all others. This is indeed the case and can be seen more vividly in Fig. 5c where the gap in the performance of the integration approach relative to organizational separation becomes particularly pronounced.

It is interesting to note that in almost all of the simulation results presented so far, the *phased integration approach* seems to always outperform the organizational separation approach (both in the short term and in the long term) (see for example Fig. 2b and 4b,c and 5a,b). This can also be seen in the results presented in Fig. 3 where the phased integration solution outperforms organizational separation not only in the expected case where we have strong complementary interdependencies (Fig. 3c) but even in situations where we have strong substitute interdependencies (Fig. 3b).

An important insight that stands out in these results is that exploiting complementary interdependencies is much more important than avoiding substitute interdependencies between the two business models. This can be seen by comparing Fig. 4c to Fig. 5c. In Fig. 5c, we have a situation of complementary interdependencies between the two business models ($k_c = 10$). As can be seen, the performance gap between the separation approach—that represents failure to exploit these complementary interdependencies—and the integrated or phased integrated alternatives is big. By contrast, in Fig. 4c we have a situation of substitute interdependencies between the business models ($k_s = 10$). Here, the performance gap between organizational separation—that aims to avoid such interdependencies —and the other organizational alternatives is not so big.

These results are consistent with the findings of Siggelkow (2002). He showed formally that "misperceptions with respect to complements are more costly than misperceptions with respect to substitutes" (p. 911). The study predicted that it would be more costly to divide complementary activities between two business units than to separate substitute activities, a prediction supported by our simulation results.

To illustrate why misperceived complements are more costly than substitutes, imagine a firm that overestimates the complementing effects between an activity set. The firm will choose many activities of the set because it expects the marginal performance contribution of each activity to increase the more interrelated activities are chosen. As this is not the case, the error multiplies. Now imagine a firm that overestimates substituting effects between its activities. The firm will be cautious with its activity choice, will select some activities but then choose less related activities than would have been optimal (as this would lower the performance contribution of the former). Here the error does not multiply.

This implies that if complementary activities exist, it is important to pay close attention to processes and mechanisms to exploit synergies (Markides and Charitou 2004), share resources (especially knowledge) between business units (Iansiti et al. 2003), align the incentive systems between the two units and properly allocate interdependent activities (Siggelkow 2002).

4.2 Coordination Across Business Models

So far we have assumed that the managers of the two business models are aware of interdependencies between business models and consider their impact on their own business model but do not actively manage them. What happens if we relax this assumption? After all, the literature suggests that even if a firm chooses the

separation approach, it must still put integrating mechanisms in place to manage any synergies between the two business models. As mentioned above, the literature suggests several integrating mechanisms that can be used. In our experiments, we focus on two of them: (a) visibility of interdependencies; and (b) alignment of key strategic decisions.

4.2.1 Visibility of Interdependencies

In the modularity literature "visible information" or "visible design rules" describe "what modules will be part of the system" as well as "how the modules will interact" and set "standards for testing" (Baldwin and Clark 1997). Interdependencies (interfaces) between modules are defined by an overseeing system architect rather than taken as a given. By contrast, when a new business models is introduced, it is fair to assume that many interdependencies are not known and need to be discovered. While bounded rationality implies that information on interdependencies within modules needs to be hidden from managers of other modules, it is crucially important that information on the interdependencies between modules be widely communicated (Baldwin and Clark 1997).

Representative results from our experiments are shown in Fig. 6. Fig. 6a shows the case where there is no visibility of inter-business model interdependencies. As shown by the big gap in performance, organizational separation is clearly inferior to all other structural alternatives. However, as visibility is increased to 75% (Fig. 6b) and then 100% (Fig. 6c), the performance gap between the separation alternative and the others shrinks considerably. These results are consistent with our expectations. In scenarios where the performance gap is small (i.e. in scenarios where visibility is high), it is likely that the separation approach is actually superior to all the others. This is because our model does not take into consideration the costs of keeping the two business models integrated. If we take these into consideration, organizational separation may be superior in cases where the performance gap is not that big.

The importance of visibility is seen clearly when we compare the performance of firms that follow the same approach—specifically the phased integration approach—with and without visibility (relative to firms following the integrative solution) (Fig. 7).

First, Fig. 7a shows the results of our experiments under the scenario of the business models being interdependent with two substitute activities and no complementary activities ($k_s = 2$, $K_c = 0$). Consider first the case of a firm following the *phased integration* approach without visibility ($P_1 = \Omega_1, P_2 = \Omega_2$). It outperforms firms that follow the integrative solution but only for about 10 periods. After period 10, it clearly underperforms the integrated firms and the gap widens until period 25. At that point, the firm re-integrates the separate unit, an action that allows it to leave its suboptimal local equilibrium and start improving its performance. It doesn't catch up to the performance of the integrated firms until period 70. Its performance advantage in the first 10 periods is completely offset by its performance inferiority from period 10 to period 70 (area marked as I in Fig. 7a). By contrast, the companies following the phased integration approach *with visibility* outperform the integrated firms from the very beginning. Their performance advantage over the integrated

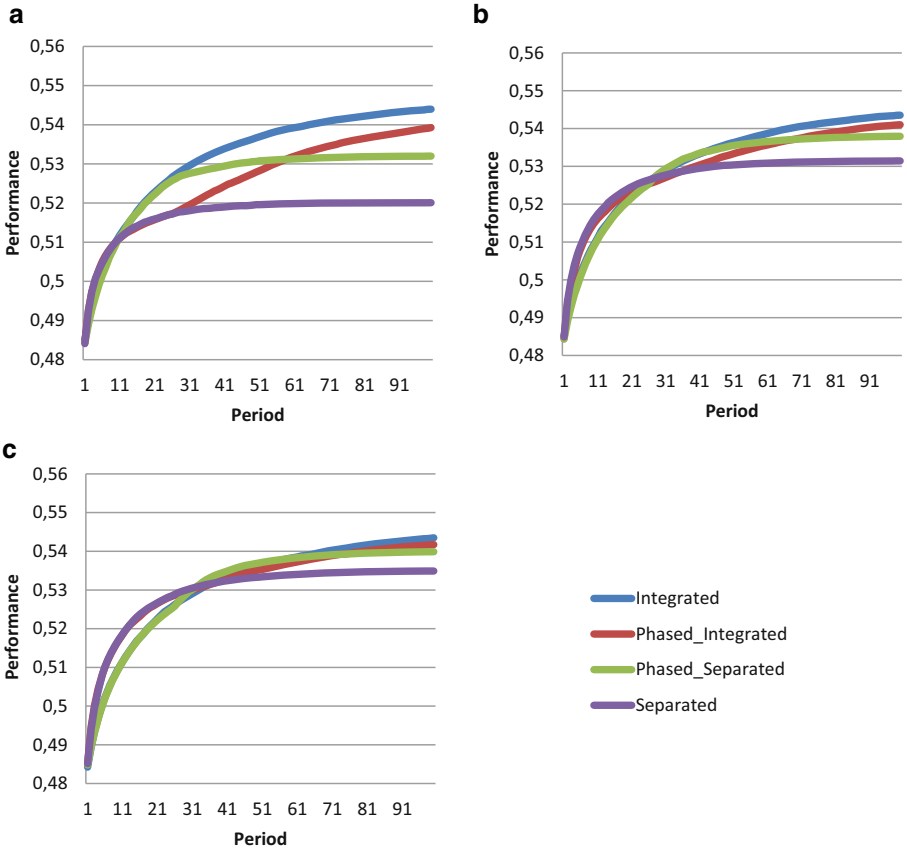

Fig. 6 Performance development with varying degrees of inter-business model visibility. **a** Performance development with no (0%) inter-business visibility ($k = 8$, $k_s = 10$, $k_c = 2$). **b** Performance development with medium-to-high (75%) inter-business visibility ($k = 8$, $k_s = 10$, $k_c = 2$). **c** Performance development with high (100%) inter-business visibility ($k = 8$, $k_s = 10$, $k_c = 2$)

firms (area between the performance lines in Fig. 7a marked as "II") is maintained till period 70.

These results imply that even in the absence of visibility, it may be better to place the second business model in a separate unit at least initially. However, the firm must then establish visibility quickly. If visibility cannot be established, then earlier re-integration is the only option. Fig. 7a shows that the optimal reintegration point needs to be moved to earlier periods if visibility on interdependencies is missing. It is also interesting to note that missing the optimal reintegration point is much more costly for firms without visibility than those with visibility.

The same pattern of results emerges when we change the scenario from substitute interdependencies to complementary ones (Fig. 7b). However, there is a crucial difference: the optimal re-integration point for the firms following the phased integration approach without visibility occurs much earlier in the case of complementary interdependencies. If they fail to re-integrate by period 8 (and wait till period 25

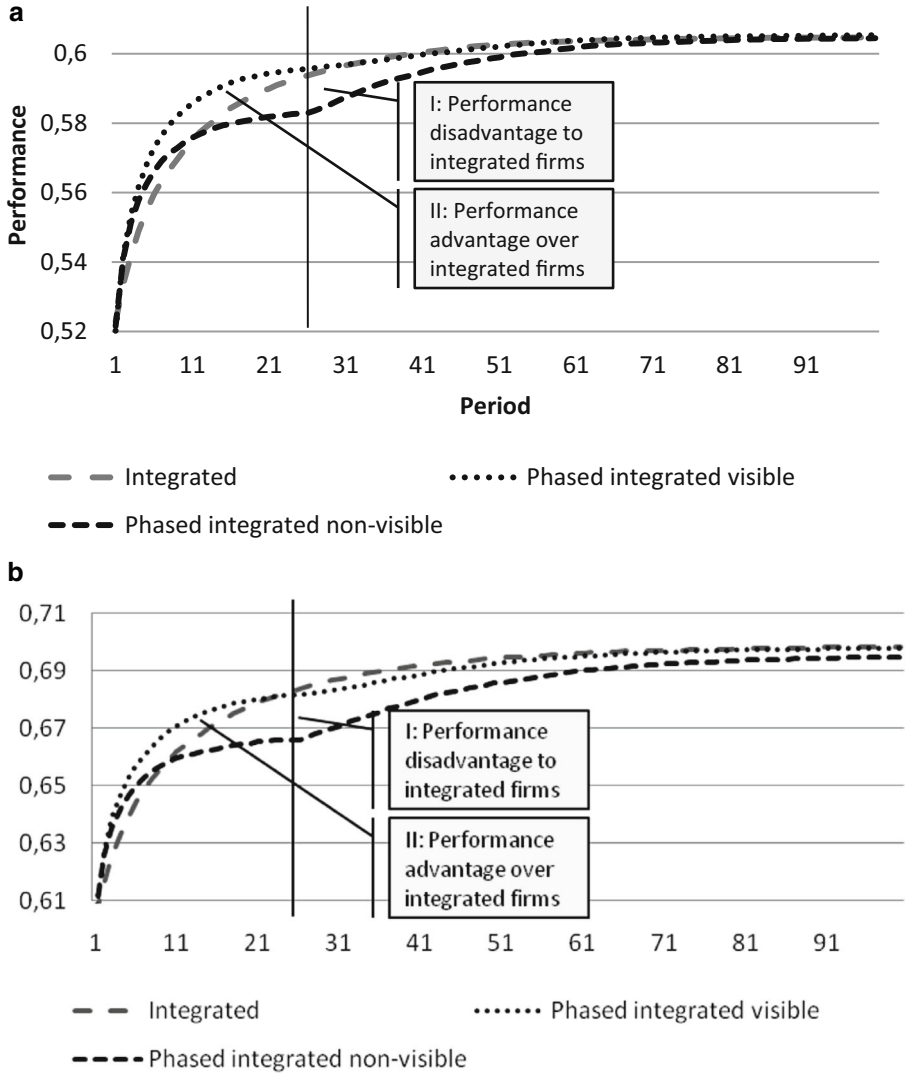

Fig. 7 Performance development of different types of interdependencies, visible vs. non visible. a Firm performance—Substitute interdependencies visible vs. non-visible ($k=4$, $k_s=2$, $k_c=0$). b Firm performance—Complementary interdependencies visible vs. non-visible ($k=4$, $k_s=0$, $k_c=2$)

to do so), their under-performance relative to the integrated firms gets worse until period 25. Even after period 25, their performance never catches up with the performance of the integrated firms. Thus, the risk of missing the right time for integration is higher compared to a scenario with substitute interdependencies. Interestingly, the optimal re-integration point occurs earlier even for firms with visibility. Thus, it appears that whether a firm faces complementary rather than substitute interdependencies is a key factor that influences the optimal time to re-integrate for both those firms that have visibility and those that do not.

In summary, visibility has a significant impact on the achievement of performance advantages and the optimal timing for reintegration. Depending on the type of interdependency, the optimal choice would be different. While complementary activities increase the risk of missing the right integration point and lower the chance to generate a sustainable competitive advantage, a phased integration approach shows upside opportunity especially in the case of complementary interdependencies.

4.2.2 Alignment of Key Strategic Decisions

Another integrating mechanism at the firm's disposal is to align key strategic choices between the parent firm and the separate unit. In our final set of experiments we investigate whether this variable affects the performance of separated firms. Fig. 8 shows our results. When the firm does not align any strategic choices, an organizational separation clearly underperforms the integrative alternative throughout. However, when 3 choices are aligned, the firms following the separative solution do as well as the firms following the integration approach. When 6 or 9 choices are aligned, the separation approach outperforms the integration one. These results suggest that separation can be a successful solution as long as the proper integrating mechanisms are put in place.

Two additional results stand out when we look only at the firms following the separation approach. First, the fewer the pre-specified choices the longer it takes for a firm to reach their best performance. For example, the companies that pre-specify 0 choices take 60 periods to reach peak performance. By contrast, companies that pre-specify 9 choices take less than 10 periods to reach their best performance. This is because with more pre-specified choices the remaining optimization gets less complex and the best solution is found quickly. The pre-specification of a large number of choices places the companies on the right hill in the performance land-

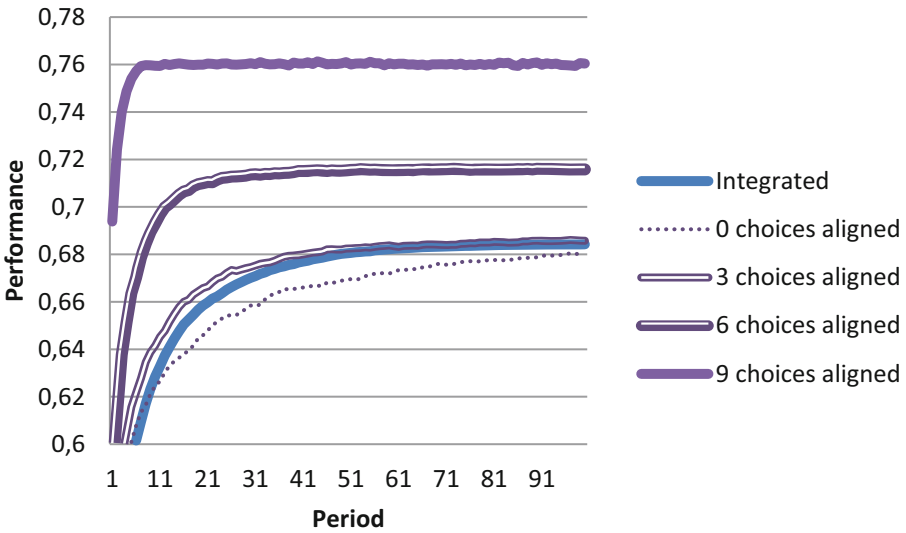

Fig. 8 Performance development—Separated firms with aligned choices ($N = 12$, $k = 4$, $k_{inter} = 3$)

scape so that the hill-climbing exercise allows the companies to reach respective peaks fast (Siggelkow and Levinthal 2003). While firms benefit from speed of decentralized decision-making, the pre-specification of strategic choices reduces the risk of misalignment between the organizational units.

Second, the more the number of pre-specified choices the higher the performance level attained by companies. Going from 0 pre-specified choices to 3 improves the level of performance significantly while going to 6 or 9 choices does so even more. The pre-specification of choices broadly places a company in the right area of the performance landscape and allows more companies to avoid local peaks. The more choices the company pre-specifies, the closer it gets to the global peak and the lower the probability to get stuck at a sub-optimal performance level. This is in line with the findings of Ghemawat and Levinthal (2008) who found that pre-specifying strategic choices increases long-term performance.

5 Discussion and Conclusions

We have started with the premise that interdependencies between business models should influence what organizational structure a firm ought to adopt to manage multiple interdependent business models under the same organizational roof. However, contrary to the existing literature, we have argued that the presence of interdependencies by itself is not enough to explain the choice of organizational structure adopted. Other factors should influence this choice such as: (i) the *number and strength* of substitute and complementary interdependencies between two (or more) business models, as well as their relative weight; and (ii) additional contingencies, in particular the visibility of interdependencies and the integrating mechanisms put in place to manage these interdependencies. Our objective in this paper was to document the impact of these contingencies.

Following the suggestion of Zott and Amit (2010), our study is one of the first to adopt an activity system perspective. We do this by using simulation methodology. By doing so, we address the methodological concerns raised in a recent article by Snihur and Tarziján (2018) by utilizing a more rigorous methodological approach and a more fine-grained conceptual framework. Our enhanced NK-model accounts for the type of interdependency between two business models (Kauffman 1993) and integrates it with the performance function of Porter and Siggelkow (2008). Our study is the first attempt to work with this performance function. Our model is verified as it is able to reproduce phenomena which were proposed by case study analysis or formal modeling. Enhancing the explorative power of previous studies, the simulation methodology allows us to deepen our understanding through experimentation by changing the applied assumptions as well as by investigating their elasticity (e.g. importance of visibility, different organizational structures, integration points, etc.).

Several of our results stand out. First, we found that there is no single best answer to the question: "How can the same firm manage two (or more) interdependent business models in the same industry?" Several strategies are viable and which one is the optimal one depends on the existence, number and strength of both substitute and complementary interdependencies between the two business models as well as

additional contingencies. This is an important result because it sheds light on an apparent discrepancy between mainstream theory and empirical evidence—namely the fact that empirically we can observe firms following a variety of strategies in managing interdependent business models whereas mainstream theory often argues in favor of only one, that isorganizational separation. The apparent discrepancy can be explained by the fact that mainstream theory looks only at the existence of interdependencies between business models but does not take into account how many or how serious these interdependencies are.

We have demonstrated that *organizational separation*—the approach that the literature on business models proposes as the optimal way to manage multiple business models—is *not* the optimal approach under all circumstances. We found organizational separation to be optimal only under the following conditions:

- when the two business models are weakly linked;
- when many decisions between the two units are aligned;
- when visibility of interdependencies between the two business models is high.

In most of the experiments we ran, we found the *phased integration* approach to outperform all others. However, our experiments also indicate that deciding exactly when to reintegrate the separate unit into the main organization is a key choice for those firms following this approach. We specifically identified two circumstances when reintegration must take place much earlier than normal:

- in the absence of visibility of interdependencies between the two business models;
- when the interdependencies are complementary rather than substitutes.

A second insight to emerge from our experiments is that exploiting synergies is much more important than avoiding conflicts between the two business models. This implies that if complementary activities exist, it is important to pay close attention to processes and mechanisms to exploit synergies. We were also able to show that, as predicted by previous studies (e.g. Markides and Charitou 2004; Siggelkow 2002), the risk of mismanagement is significantly higher if complementary interdependencies exist. Our results give us some hints as to why this might be the case: In the presence of complementary interdependencies, the performance difference between firms following an integrative approach and firms following the organizational separation alternative increases, the optimal reintegration point for a separated firm shifts to a much earlier period and missing the reintegration point results in higher performance discrepancies.

Finally, our results suggest that the continued separation of two units is not recommended if the interdependencies between them are visible but not managed. The literature has already identified several "integrating mechanisms" that the firm might use to manage these interdependencies. We investigated two of them—making interdependencies visible and aligning the strategic choices of the two units. Both were important in making the separative solution more attractive relative to the phased integration alternative. If the visibility of interdependencies could not be established in a timely manner, the separation approach will underperform in the long run.

Our study has implications for managers. When they introduce an additional business model, managers need to judge the type of interdependencies that exist with the parent firm. Most new business models will have interdependencies with existing ones and it's important to identify what these are because they will determine what organizational structure the firm must adopt. Even if the separation approach is chosen as a short-term solution, management should put emphasis on identifying the interdependencies present and make them visible to the senior managers of the two business models. Active management of these interdependencies must be established with particular attention being placed on managing complementary activities since the penalty for mismanaging this type of interdependency is high. They should also prepare the firm for reintegration. The identification of the right reintegration point is a key decision for the firm.

Our study is not without limitations. The simulation methodology has been criticized for just modeling actual phenomena and replicating the obvious (Davis et al. 2007). That this is not necessarily true follows directly from our results, some of which are surprising and new to the literature. Additionally, the question has to be asked whether our model actually behaves as real-world companies with a multitude of competitors would. We are convinced that we are making a valuable contribution to theory building since we verified the constructed models by reproducing phenomena described in related studies (Markides and Charitou 2004; Siggelkow 2002), which provides us with confidence that our other results are also built on solid grounds. And by conducting a multitude of experiments, we minimized the risk of missing important phenomena. But we have to concede that the dynamics of competition need more consideration than we were able to offer, and that the modeling approach we adopted from the literature cited in section 3 may need extensions along this line. Finally, the theoretical contribution of simulations needs to be tested with empirical methods but is suited to initially build theory. An important limitation specific to our study is our inability to include the integration cost of formerly separated business units.

We see four promising directions for future research. First, while we analyzed the interdependencies between business models in a quite sophisticated way, we believe that there is room for further exploration to elaborate the idea of "business model relatedness" (Sohl and Vroom 2014, 2017; Sohl et al. 2020), an idea that would help to re-connect our research with diversification research as one key area within the strategic management field (Ahuja and Novelli 2017). For example, Lüthge et al. (2021) proposed a taxonomic approach for operationalizing relationships between business models. Applying such an approach in the present context could help us explore alternatives to the simple substitute/complementary interdependencies distinction and identify those interdependencies that are most critical regarding their performance implications. Second, we need to further explore the factors that influence the optimal organizational structure in managing two business models simultaneously. Our paper has made a start in this direction but more work is needed. Third, more work needs to be done on the "integrating mechanisms" that a firm might use to manage the separation approach. Again, our paper has explored a few of them but a lot more work is needed in this area. And fourth, we need to explore what business-level strategies a firm can implement to manage two (or

more) business models simultaneously. Over and above deciding on the organizational arrangements that would allow it to manage the two business models, what specific strategies can the firm adopt to compete successfully against its competitors in each market? How do these strategies address moves or reactions from other competitors? These are issues that a future research project might explore in more detail.

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Declarations

Conflict of interest H. Harren, D. zu Knyphausen-Aufseß and C.C. Markides declare that they have no competing interests.

Ethical standards For this article no studies with human participants or animals were performed by any of the authors. All studies mentioned were in accordance with the ethical standards indicated in each case. **Consent for publication:** Not applicable.

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