Unraveling the "black box" of Cross-Business-Unit Collaboration

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ABSTRACT

Extensive research identified the economic, organizational and social factors that configure the process of cross-business unit ("cross-BU") collaboration leading to the creation of cross-BU synergies. Yet, the inner workings of the "black box" determined by the multiple cause and effect relationships between these factors remains to be determined. Building from current theory, we studied the process of cross-BU collaboration through a simulation model. We found that the initial conditions and patterns of evolution of the different configurations of factors lead to significant differences in the performance of cross-BU collaboration initiatives. Our findings extend previous research, characterizing cross-BU synergy creation as a multidimensional and complex phenomenon, by identifying the drivers of such complexity and its effects on performance. We also shed light on the impact of business relatedness on performance and on the roles of the corporate level in multi-business firms. We finally discuss how managers should manage cross-BU initiatives under different organizational arrangements.

Keywords:

Cross-business unit collaboration, corporate strategy, synergy, system dynamics

Introduction

The concept of synergy has occupied a preferential place in the strategic management literature since its introduction by Ansoff (1965). Synergy is the effect that the combined return of a whole is greater than the sum of the returns of the individual parts. In the specific context of multi-business firms, cross-business unit (cross-BU) synergies have been associated to leveraging resources across related businesses (Markides and Williamson 1994; Palich, Cardinal and Miller 2000; Martin 2002; Collis and Montgomery 2008; Schmidt and Kiel 2010) as well as to market power (Hill 1994) and to the relative efficiency associated to the administrative coordination of certain activities (Williamson 1975; Hill 1988; Khanna and Palepu 1997). Yet, exploiting the economic benefits associated to leveraging resources across businesses is far from being a straightforward phenomenon. It demands putting in place specific organizational arrangements and mastering specific management capabilities (Mintzberg 1979; Hill and Hoskisson 1987; Hoskisson 1987; Chandler 1991; Bowman and Helfat 2001; Galunic and Eisenhardt 2001; Goold and Campbell 2002; O'Reilly and Tushman 2007; Krestchmer and Puranam 2008) as well as the existence of social relationships among BUs managers (Axelrod 1984; Ring and Van de Ven 1994; Tsai & Ghoshal 1998; Hansen 1999; Galunic and Eisenhardt 2001; Chackravarty et al. 2001; Kleinbaum and Tushman 2007; Martin and Eisenhardt 2010). While the taxonomy of the economic, organizational and social factors associated to the creation of cross-BU synergies is quite exhaustive and well understood, some issues need yet to be addressed. For example, how the factors interact within the "black box" of cross-BU collaboration contributing towards the success or failure of cross BU-synergy creation initiatives. Abundant empirical work reporting the frequent non-realization of value associated to cross-BU synergy initiatives (Christensen and Montgomery 1981; Grant and Jammine 1988; Davis and Thomas 1993; Stimpert and Duhaime 1997; Palich et al. 2000; Bowman and Helfat 2001; Kleinbaum and Tushman 2007) appears to call for

novel methodological approaches to the study of the multidimensional phenomenon of cross-BU collaboration. Unpacking the "black box" of cross-BU synergy creation calls for a research method that enables to capture, observe and analyze the interaction of the different factors characterizing the phenomenon of cross-BU collaboration in a formal way. In doing so, in this paper we present a formal, longitudinal and comprehensive model of the phenomenon of cross-BU collaboration in multi-business firms that captures the interdependencies between the economic, organizational and social factors associated to the phenomenon identified in previous research. We simulate a formal model considering different configurations of such factors and contrasted the different performance associated to each configuration, as well as the relative impact of the different factors across different configurations and over time. Results document the existence of non-linear relationships between the collective impact of the factors that drive cross-BU synergies and the performance of cross-BU collaboration. Moreover, the impact of specific individual factors on performance varies not only across different configurations of factors, but also over time within the same configuration. These findings contribute to the debate on cross-BU collaboration by adding new insights on the impact of business relatedness on the performance of these initiatives and shedding new light on the role of the corporate level on the process. We also contribute to practice by providing criteria on how managers should approach the phenomenon of cross-BU collaboration given the particular configuration of factors characterizing their firms.

The remainder of this paper is organized in the following way. First, we review extant literature on synergy creation through cross-business unit collaboration within multi-business firms. Second, we introduce a model of cross-BU collaboration that captures the interdependent relationships between a set of factors that have been associated by the

literature to the development of cross-BU synergy. We then analyze the model producing a set of computer simulations. Finally we discuss the insights derived from the model and their implications for the academic debate on cross-BU collaboration.

Literature Review

While research on corporate-level strategy of the firm has been one of the most prolific areas within the Strategy literature since the mid 1960s, the question of how synergies may be obtained out of cross-BU collaboration in multi-business firms is at the heart of the corporate strategy debate. Research on cross-BU collaboration has identified different factors associated to the pursuit of cross-business synergies, clustered around three categories: economic, organizational and social.

Economic drivers of cross-BU collaboration ("Opportunities"). The ability of a firm to achieve synergy through cross-BU collaboration is driven by the existence of *opportunities* to take advantage of economic factors associated to the pooling of some of the firms' activities across two or more BUs (Chakravarthy et al. 2001). Such economic benefits are associated to three different generic sources of synergy: operative, market power or governance advantages. Operative synergies (Panzar and Willig 1981) are associated to leveraging resources across related businesses. Such leverage can lead to two generic sources of synergy. First, operative synergies may result from the pursuit of efficiency advantages from sharing similar resources across businesses (Porter 1987; Eisenhardt and Martin 2000; Martin, 2002 Helfat and Eisenhardt 2004; Tanriverdi and Venkrataman 2005). This source of operative synergies has been characterized in the literature as *economies of scope* (Panzar and Willig 1981). Second, operational synergies may be developed out of market advantages associated to the combination of complementary resources across business-units (Milgrom and Roberts 1995; Harrison et al. 2001; Tanriverdi and Venkrataman 2005; Schmidt and Kiel

2010). Such synergies have been characterized as *demand-side economies of scope* (Henten and Godoe 2010).

The increase in market power derived from the coordinated commercial actions of two or more BUs is also a source of synergies (Hill 1994; Hughes and Oughton 1993; Martin 2002). Finally the hierarchical coordination of businesses under a corporation, as opposed to organizing these via market transactions (Coase 1937; Alchian and Demsetz 1972; Williamson 1975; Freeland 2001) may create synergies in the form of reduced corporate risk (Chatterjee and Lubatkin 1990; Lubatkin and Chatterjee 1994; Ross et al. 2004) or the establishment of internal capital markets (Williamson 1975; Hill 1988; Lang and Stultz 1994; Khanna and Palepu 1997).

Organizational and social factors that catalyze cross-BU collaboration. Empirical evidence on cross-BU collaboration suggests that synergies across BUs are hard to materialize (Davis and Thomas 1993; Goold and Campbell 1999; Stimpert and Duhaime 1997; Palich et al. 2000; Kleinbaum and Tushman 2007)). A body of literature gradually emerged shifting the attention from the economic drivers of cross-BU synergy towards the organizational and social factors that mediated their successful development.

Organizational factors ("Collaboration 'Mechanisms"). A stream of work focused on describing organizational arrangements firms may rely on in order to enable and facilitate the cross-BU collaboration (Bowman and Helfat 2001; Goold and Campbell 2002; Anand 2005; Collins and Smith 2006). Such arrangements include the creation of horizontal coordination mechanisms for collaboration such as liaison management positions, (Mintzberg 1979; Ashkenas and Francis 2000), cross-business committees coordinating knowledge and activity sharing (Mintzberg 1979; Goold and Campbell 2002), a corporate intranet, the cross-participation of executives in the strategic reviews of peer divisions (Chakravarthy *et al.* 2001), the remapping of business charters among divisions (Galunic and Eisenhardt 2001)

and the incentive system (Krestchmer and Puranam 2008), including the existence of "ad-hoc" acknowledgements that reward cooperative units for good citizenship (Galunic and Eisenhardt 2001. These factors can either help or hinder the implementation of economically sounded cross-BU initiatives and incorporate a dynamic perspective to the realization of the value from cross-BU initiatives.

Social factors ("Predisposition"). In addition to organizational factors, the realization of cross-BU synergies requires the existence of goodwill between the actors engaged in the process of collaboration (Axelrod 1984; Ring and Van de Ven 1994; Galunic and Eisenhardt 2001; Kleinbaum and Tushman 2007; Martin and Eisenhardt 2010). Such goodwill or *predisposition* (Chakravarthy et al. 2001) has been associated to the existence of network ties across BUs (Tsai and Ghoshal 1998; Hansen and Lovas 2004; Casciaro and Lobo 2006) and trust or relational quality (Tsai and Ghoshal 1998; Tsai 2000; Martin and Eisenhardt 2010). Such ties and trust resulting from previous experiences of cross-BU collaboration also lead to the development of specific learning (Nonaka and Takeuchi 1995) on how to manage these horizontal processes. The corporate level may also affect the social aspect of intra-firm cross business collaboration, as the specific *corporate style* (Goold and Campbell 1994) chosen by the firm may create common rules of behavior (Brown and Eisenhardt 1998; Galunic and Eisenhardt 2001) among the BU managers, leading to different degrees of predisposition towards cross-business collaboration. In sum, social factors can enable or hinder the process of economic value creation from cross-BU collaboration opportunities as these affect the predisposition of BUs to engage in such processes.

The multiplicity of economic, organizational and social factors characterizing the phenomenon of cross-BU collaboration configures the particular context in which specific relationships between BUs are embedded. In order to understand the inner working of such

configurations and how these evolve as the relationship between BUs evolves through time, we need to capture systematically the multiple cause and effect links between factors as well as their dynamics through time. We develop such model in the following section.

Representing the causal structure of the theory

In order to represent cross-BU collaboration systemically and dynamically we developed a System Dynamics model (Forrester 1968; Sterman 2000). The model captures the interdependencies between the economic, organizational and social factors identified in the literature as associated to the creation of cross-BU synergy. System Dynamics enables to represent the feedback processes responsible for organizational processes and provides a simulation method able to represent organizational change processes (Davis *et al.* 2007). A System Dynamics model allows to identifying state variables which represent properties of the organization resulting from organizational processes over time and their rates of change, which reflect the effect of organizational processes (Sastry 1997; Repenning 2002; Bradley Morrison et al. 2009). System Dynamics models have been applied recently in the field of strategic management (Gary 2005; Sterman et al. 2007; Bradley Morrison et al. 2009; Kunc and Morecroft 2007; 2010).

We run a set of simulation experiments based on different configuration of the factors affecting the phenomenon of cross-BU collaboration in order to analyze the dynamics embedded in the phenomenon. Simulation experiments are particularly effective for research questions involving fundamental organizational tensions or trade-offs (Davis *et al.* 2007). Such tensions often result in nonlinear relationships that are difficult to discover through inductive cases and difficult to explore using traditional statistical techniques. Furthermore, the use of simulation enables the development of logically precise and comprehensive theory especially when the theoretical focus is longitudinal, nonlinear or processual.

Formalizing the interaction between economic, organizational and social factors

In order to develop our dynamic model, we first identified the constructs and relationships that describe the organizational dynamic related to the process of cross-business collaboration. This task has been performed by conducting a textual analysis of the literature on synergy creation through cross-BU collaboration in multi-business firms, identifying and allocating statements into the categories required by the simulation model (Sastry 1997). The resulting dynamic theoretical model of cross-BU collaboration arises from statements describing causal relationships and from descriptions of organizational processes and their expected dynamics existing in the literature. Table 1 describes the constructs of the model, how these are measured and how these affect the dynamics of the model.

Insert Table 1 about here

Next, we explain the formal mechanisms governing the interactions between the economic, organizational and social factors explained in Table 1.

Opportunities for cross-BU collaboration **(OC_t)** is a state variable representing the number of opportunities for cross-BU collaboration available between two BUs. These opportunities may either be the result of corporate mandates or generated independently by the BUs (Panzar and Willig 1981; Eisenhardt and Martin 2000; Martin 2002; Helfat and Eisenhardt 2004; Tanriverdi and Venkrataman 2005). The value of the variable is equal to the initial number of opportunities available for cross-business unit collaboration less the number of opportunities already explored by the BUs (**cr_t**). The process of collaboration (**cr_t**) depends on the existing opportunities for collaboration (**OC_t**), the predisposition to collaborate **(pc_t)** (Tsai and Ghoshal 1998; Hansen and Lovas 2004; Casciaro and Lobo 2006; Martin and Eisenhardt 2010) and the existence of organizational mechanisms to catalyze collaboration between the

BUs (**mc_t**) (Mintzberg 1979; Ashkenas and Francis 2000) representing the organizational factors affecting the realization of synergies. Formally;

$$\mathbf{OC_t = OC_0 + \int - cr_t} \quad (1)$$

$$\mathbf{cr_t = OC_t *\cdot pc_t * mc_t} \quad (2)$$

The execution of collaboration initiatives generates a process of *Learning from Collaboration* **(LP_t)**, which increases the level of knowledge of the BUs on how to manage cross-BU collaboration. As BUs go through the process of engaging in successive cross-business initiatives, they learn gradually how to run such process through better organizational mechanisms (Hamel 1991; Nonaka and Takeuchi 1995). We capture this phenomenon through the variable **LPt.** Such experiential learning on how to run cross-BU collaboration processes is reflected in the increased effectiveness of the horizontal mechanisms for collaboration supporting these initiatives (Martin and Eisenhardt 2010), as well as in their levels of trust and relational quality (Tsai and Ghoshal 1998; Martin and Eisenhardt 2010). In this way, learning increases the likelihood of achieving success from collaboration (**cbu_t**). Such process of learning is affected by the ability of the BUs to absorb the lessons from each opportunity (**α)** (Nonaka and Takeuchi 1995). The ability of the BUs to learn from experience (**α)** ranges from zero (no learning ability) to one (every collaboration initiative generates a "lesson" which is fully absorbed by the BUs). In turn, learning was modeled to increase up to a maximum level, from which new initiatives do not increase the existing stock of knowledge. It is also important to highlight that the variable **LP_t** may have different initial states (**LP_0)**, reflecting different levels of initial knowledge. The influence of learning on the mechanisms of collaboration (**mc_t**) is a non-linear function of the accumulated learning (**LP_t**). Formally;

$$\mathbf{LP_t = LP_0 + \int cr_t \,.\, \alpha} \quad (3)$$

$$\mathbf{Max\ LP_t = 100}$$

$$\mathbf{mc_t} = f(\mathbf{LP_t}) \quad (4)$$

$$\mathbf{cbu_t} = f(\mathbf{LP_t}) \quad (5)$$

Predisposition to collaborate (**PC_t**), is a social factor, representing the willingness of the BUs to engage in cross-BU collaboration initiatives (Axelrod 1984; Ring and Van de Ven 1994; Galunic and Eisenhardt 2001; Kleinbaum and Tushman 2007; Martin and Eisenhardt 2010). The level of this state variable ranges from zero (no predisposition) to 100 (maximum predisposition). The predisposition to collaborate varies according to the outcome of previous **cross-BU collaboration initiatives** (**rc_t**). Previous experiences of success or failure impact on the willingness of the BUs to engage in further collaboration (Martin and Eisenhardt 2010). Moreover, the predisposition to collaborate may decrease if the performances associated to previous collaboration initiatives are negative (variable **η**). In the model, such negative effect could be limited (variable **η** is equal to zero) or amplified (variable **η** is equal to one). Finally, a very low initial level of predisposition to collaborate (**PC_0**) may hamper the realization of cross-BU collaboration as BUs do not have the minimum "critical mass" of predisposition required to trigger the whole process. Formally;

$$\mathbf{PC_t} = \mathbf{PC_{to}} + \int f(\mathbf{rc_t}) \quad (6)$$

where $\mathbf{Max\ PC_t = 100;}\ f(\mathbf{rc_t}) = \mathbf{rc_t}\ \{\mathbf{rc_t} \geq 0\}$;

$$f(\mathbf{rc_t}) = \mathbf{rc_{t^*(1+\eta)}}\ \{\mathbf{rc_t} < 0\} \quad (7)$$

$$\mathbf{pc_t} = f(\mathbf{PC_t}) \quad (8)$$

The variable *Performance of cross BUs collaboration initiatives* (**rc_t**) captures the value created or destroyed out of the opportunities for collaboration that have already been explored by the BUs (**or_t**). Such value depends on the capability of the BUs to improve the results obtained from collaboration initiatives (**cbu_t**) and the impact of the complexity of the

opportunity realized **(**ß). The impact of the complexity of the opportunities **(**ß) on the value created from a specific collaboration initiative is determined by a normal random distribution in which the initial mean and standard deviation reflect an average level of complexity in the opportunities for collaboration (see table in appendix for values). The mean will increase and the standard deviation will decrease as the capability of the BUs to generate value out of each collaboration initiative increases due their better management skills (**LP_t)**

$$\mathbf{rc_t = cr_t * [\ (ß_\mu + cbu_t) + (ß_\sigma + cbu_t)\ ]} \quad (9)$$

Figure 1 is a system dynamics diagram (Sterman 2000) representing the model and the relationships between the variables characterizing it. Stocks represent the state variables that accumulate or deplete over time. The stock variables are "*Opportunities for cross-BU collaboration"* **(OC_t)**, "*Predisposition to collaborate"* **(PC_t)** and "*Learning from collaboration"* (**LP_t).** Additionally, the model has four feedback processes (Sterman, 2000) driving the long-term dynamics of collaboration initiatives.

Insert Figure 1 about here

The first feedback process is a balancing process (B1) which represents the dynamics affecting the stock of opportunities for cross-BU collaboration (OC_t) that the BUs may pursue. The initial value of OC_t represents the number of activities of the BUs that could benefit from cross-BU synergies provided that such activities were managed in a collaborative way. For instance, BUs could benefit from pooling their purchases, the joint contracting of outsourced IT services or by merging their treasury departments. In the model, as BUs gradually explore these opportunities to collaborate, the stock of opportunities available for cross-BU collaboration declines and eventually exhausts. The second feedback process (R1) is a reinforcing process that comprehends the *Predisposition to collaborate* **(PC_t)**. The

performance associated to previous collaboration initiatives impacts on the value of $\mathbf{PC_t}$. Previous positive results will increase the value of $\mathbf{PC_t}$**, while** negative ones will reduce it. (see Figure 1). In turn, the degree of predisposition to collaborate affects directly the aggregate number of opportunities for cross-BU collaboration that are actually explored. A substantial drop in the value of **PCt** leads BUs to cease on their cross-BU initiatives, regardless of the availability of further opportunities of collaboration. The third feedback process (R2) is another reinforcing process and represents the learning process taking place within the BUs as they engage in cross-BU collaboration initiatives. Each collaboration initiative represents an opportunity to learn how to manage cross-BU initiatives ($\mathbf{LP_t}$). The capability to manage cross-BU initiatives developed through such learning process enables BUs to increase the effectiveness of the organizational mechanisms for cross BU collaboration, (e.g. task forces, cross-BU meetings and information flow, choice of staff involved in cross BU initiatives, etc.), that reinforce collaboration between BUs leading, in turn, to further learning. The final feedback process (R3) involves the impact of such learning processes on another outcome: the ability of BUs to obtain a positive performance from the cross-BU collaboration processes. As learning accumulates, increasing the BUs' capability of managing cross-BU collaboration initiatives, the performance associated to collaboration initiatives is also likely to increase. In turn, these positive outcomes improve the predisposition to collaborate among BUs facilitating the development of further collaboration processes that improve learning and performance, reinforcing the whole process.

The final step in the construction of the model is to define the values of its constants, the initial values of the state variables and the distributions for the random variable. The table of parameter values and initial conditions used in the 'base case' simulation experiment are summarized in the Appendix. The set of parameters presented for the Base Case simulation represent an ideal situation in which the two BUs included in the model have high

management capability to run cross-business collaboration processes, they show a high predisposition to collaborate and they share a large number of rather simple (i.e., low complexity) opportunities for cross-BU collaboration. This Base Case is complemented by seven additional simulation experiments, to be discussed below, in order to test how cross-BU collaboration performs under diverse configurations of factors.

Cross BU-Collaboration under different Organizational Configurations

In this section, we report the results from the set of simulation experiments. As explained in Table 2, we experimented with eight different configurations, each of these characterized by diverse sets of parameters. Our aim was to represent a rich variety of situations in terms of the relative attractiveness of the economic opportunities for cross-BU collaboration and the degree of suitability of the organizational and social contexts for collaboration, and analyze the impact of this variety on performance.

The different combinations of initial conditions and the multiplicity of interdependent factors characterizing the different situations represented in the model provide a clear indication of the complexity associated to the phenomenon of cross-BU collaboration.

Insert Table 2 about here

Analysis

Our experiments were initially divided in two groups. In the first group, BUs benefit from the existence of a high number of opportunities for cross-BU collaboration (Configurations 1-5 and 7). In the second (Configurations 6 and 8), such number is low.

Accumulated performance of cross-BU collaboration initiatives realized

Figure 2 shows the accumulated performance for Configurations 1 and 2. It is clear that BUs with the relevant capabilities and predisposition to collaborate engaged in cross-BU collaboration initiatives that are relatively simple to manage are more capable of materializing the potential for synergies (Configuration 1). However, BUs with similar capabilities and social capital dealing with initiatives characterized by a higher level of complexity will show lower performances than in the previous case (Configuration 2). In both configurations, the BUs dealt with all the opportunities available. Yet, the impact of complexity led them to different performances regardless of having an equal level of capabilities.

Insert Figure 2 about here

Configurations 3 to 8 represent organizational contexts where the impact of complexity introduced in Configuration 2 is exacerbated by less favorable values for the other organizational factors, such as lower capabilities (Configuration 3), lower capabilities and predisposition to collaborate (Configuration 4) and still less favorable contexts where BUs do not have neither the capabilities nor the predisposition to collaborate (Configuration 5) or enough opportunities to develop (Configuration 6). In the final two simulation experiments, BUs are induced to engage in collaboration through corporate mandates, even though they are not predisposed and/or lack the capabilities to perform cross-BUs collaboration initiatives (Configuration 7 and 8). Results from experiments described in Configurations 3 to 8 show a lackluster performance of cross-BUs' collaboration initiatives, a situation widely reported in the literature on cross-business collaboration(Christensen and Montgomery 1981; Grant et al. 1988; Davis and Thomas 1993; Palich et al. 2000; Kleinbaum and Tushman 2007).

The differences in performance between the Configurations 3 to 8 are presented in figure 3. Interestingly, the poorest performances were achieved when the BUs had incentives

to continue developing cross-collaboration synergies regardless of their poor levels of, both, capabilities and predisposition to collaborate (Configuration 7). In short, the corporate mandates aimed at intensifying cross-BU collaboration, far from strengthening the performance of the BUs on their cross-BU initiatives, worsened it by forcing them to engage repeatedly on processes for which they were too ill equipped organizationally and socially. Under this scenario, the higher the number of opportunities available, the more damaging is the impact on performance of corporate mandates, as BUs' learning through experience is not strong enough to counterbalance the highly unfavorable initial conditions. Ceteris paribus, in the absence of corporate incentives (Configurations 5 and 7), BUs "choose" to limit the number of opportunities they engage in, hence, limiting the negative impact of failed collaboration on performance.

Insert Figure 3 about here

It is worth noting that corporate mandates only damage performance under rather adverse organizational and social contexts characterized by the existence of BUs with low capabilities for cross-BU management as well as a low predisposition to collaborate. Contrarily, as shown in figure 4, when cross-BU collaboration initiatives are straightforward, the impact of corporate mandates on performance is positive as the ongoing collaboration fostered by such mandate contributes to the development of learning on how to manage the cross-BU collaboration process more effectively.

Insert Figure 4 about here

The Dynamics of Cross-Business Collaboration Processes

Figure 5 shows the dynamic behavior of two of the factors impacting the performance of cross-BU collaboration processes: *predisposition to collaborate* (**PC_t**) and *learning from collaboration* (**LP_t**). The predisposition to collaborate is strongly influenced by a history of past positive performance and achieves its maximum level under favorable conditions (Configuration 1 in Figure 5a). Inversely, negative performances damage the predisposition to collaborate, hindering the process of collaboration. Such results could be associated to the high complexity characterizing the cross-BU opportunities (Configuration 2) or the lack of capabilities to manage effectively complex projects (Configurations 3 to 8 - see Figure 5b). A strong enough reduction in the predisposition to collaborate interrupts the process of collaboration, capping the negative accumulated performance (Configuration 5). Oppositely, the existence of a corporate mandate to persist in the development of cross-BU initiatives, inducing BUs to collaborate at any cost, may exacerbate the amount of accumulated losses (Configuration 8).

Insert Figure 5 about here

The realization of successive collaboration initiatives increases the accumulated learning of BUs on how to manage the process (see figure 6a and feedback process R2 in Figure 1). Such learning leads to higher capabilities to achieve better performances from cross-business collaborations (reinforcing feedback process R3). However, when low levels of predisposition to collaborate and learning are combined, the number of collaboration initiatives explored is reduced, keeping in turn the levels of learning low. For example, Configuration 3 shows a slight increase in learning due mainly to the existence of a strong level in predisposition to collaborate. However, if the predisposition to collaborate is low (Configuration 4) or there are not enough opportunities to collaborate (Configuration 6), learning barely increases (see Figure 6b). In an extreme situation where the BUs lack both

capabilities and predisposition to collaborate, learning develops at a very slow pace even if the number of opportunities is high (see Configuration 5 in Figure 6b), as the reinforcing (or "virtuous") feedback processes develop too slowly for these to be relevant. Under these circumstances, the use of corporate mandates to promote cross-BU collaboration may generate capabilities for cross-BU management within the BUs (compare Configuration 5 with Configuration 7 in Figure 6b). Configurations 6 and 8 reflect the impact of a reduced number of opportunities which curtails the development of the learning process.

Insert Figure 6 about here

Discussion

Our formal and systemic approach to the study of cross-BU collaboration enabled to expose some important characteristics of the phenomenon only partially acknowledged in previous research. We found that once the different economic, organizational and social factors characterizing the phenomenon are analyzed systemically and longitudinally, its complex dynamics emerge clearly. Such complexity is manifested in the non-linear impact on performance resulting of grouping the factors under different configurations. Moreover, as BUs engage in successive cross-BU initiatives the interdependences between the factors under a particular configuration evolve under different patterns, resulting in an alteration of the individual weight of such individual factors on performance. For instance, similarly attractive economic opportunities for synergy creation or similarly effective cross-business committees created to coordinate the cross-BU relationships will have varying impacts on the performance of a certain cross-BU initiative under different configurations of factors and, within the same configuration, at different moments in time.

Our findings highlight that, while generic patterns of evolution can be observed (as discussed below) it is critically important to know and understand the context in which cross-

BU collaboration is being attempted before making any prescription of how to manage such process. This exposes the limitations of cross-sectional research designs that intend to isolate the relationship between economic factors and the performance of cross BU synergies and derive prescription out of its results. Such limitations have been previously exposed by qualitative work focused on the organizational and social factors related to cross-BU synergies (Galunic and Eisenhardt 2001; Kleinbaum and Tushman 2007; Martin and Eisenhardt 2010). Yet, our formal design enabled to study the phenomenon systematically under controlled conditions, identifying the drivers of the complexity and its effects on performance.

Our findings also contribute to the debate on the roles of the corporate level on cross-BUs collaboration initiatives. The abundance of studies on the failure of firms to achieve synergies successfully (Christensen and Montgomery 1981; Grant and Jammine 1988; Davis and Thomas 1993; Goold and Campbell 1999; Stimpert and Duhaime 1997; Palich et al. 2000; Kleinbaum and Tushman 2007) led recent scholars to explore the organizational and social dimensions of cross-BU collaboration initiatives. Some case-based studies suggest that BUs are likely to be more successful in the pursuit of cross-business synergies if they run the process autonomously in the absence of corporate intervention (Goold and Campbell 1999; Chakravarty et al. 2001; Martin and Eisenhardt 2010). Studies intended to isolate the business, industry and corporate effects on performance also disagree on the relative importance of “corporate effects” (Rumelt 1991, Brush and Bromiley 1997; McGahan and Porter 1997, 2002; Chang and Singh 2000; Bowman and Helfat 2001, Ruefli and Wiggins 2003). Our experiments show, however, that the desirability and impact of corporate influence is contingent to the "literacy" of the BUs on how to manage the organizational and social aspects associated to the process of cross-business collaboration. BUs with a certain experience in managing cross-BU collaboration initiatives are likely to both, have developed

the capability to do so effectively as well as showing a higher degree of predisposition to engage in further collaboration provided that a history of previous successful collaboration exist. Yet, in the absence of such experience and predisposition, only exogenous factors such as corporate mandates to engage in collaboration or the appointment of new managers from outside the firm with specific expertise or predisposition to engage and persevere in these processes (i.e., "buying in" the capability that BUs would otherwise take some time to develop) can lead BUs to engage in cross-BU collaboration. Eventually, the virtuous cycles resulting from increased knowledge and predisposition would reach a threshold level from which BUs would engage voluntarily in cross-BU collaboration without the need of further inducements. However, our model shows that if the particular configuration of factors characterizing the specific situation is quite adverse for the development of cross-BU collaboration (i.e., complex opportunities for collaboration coupled with low predisposition to collaborate, and a severe shortage of organizational capabilities) corporate mandates would lead to counterproductive outcomes: the more the corporate level induced BUs to persevere on trying new cross-BU collaboration initiatives, the worst would be the accumulated performance of the effort. In these cases corporate interventions should be focused only on strengthening the social and organizational factors by introducing managers embodying those skills or by providing advice. Thus,

Proposition 1. Autonomous cross-BU synergy creation can only be successful when the collaborating BUs have a minimum threshold of organizational capabilities for cross-BU collaboration as well as the predisposition to do so.

Proposition 2a. Corporate mandates to engage in cross-BU collaboration may help BUs lacking a minimum threshold of capabilities and/or predisposition to persevere beyond the

level they would if left on their own. Eventually, such perseverance would lead to the development of the increased capabilities and predisposition.

Proposition 2b. If the shortage of predisposition and management capabilities of the BUs for cross-BU collaboration surpasses a critical level, the impact of corporate mandates leading to further initiatives damages performance.

Our findings also shed light on the importance of business relatedness on the performance of cross-BU collaboration. Relatedness of activities between business units, leading to economies of scope, has been widely reported as a factor that increases the success of cross-BU collaboration (Rumelt 1974; Bettis 1981; Markides and Williamson 1994; 1996). Our results suggest that the ability of BUs with highly related activities to develop cross BU-synergies successfully is not exclusively associated to the underlying economic rationale for collaboration but also to the reinforcing impact of organizational and social processes associated to cross-BU collaboration. BUs with several related activities are likely to find more abundant and sources of potential synergies associated to cross-BU collaboration. As the BUs pursue these opportunities, the virtuous cycle of increasing predisposition and capability is reinforced, increasing the odds of success. In this way, the traditional economic foundation of relatedness is complemented by the not less relevant organizational and social ones, creating a configuration that is rather prone to success. However in cases in which highly relatedness is not accompanied by the right organizational and social environment, i.e., the case of two BUs recently twined by an acquisition that barely know each other, the mere abundance of opportunities for collaboration will be less likely to lead to positive outcomes.

The opposite applies to BUs with few related activities. The relatively low number of opportunities for cross-BU collaboration available among non-related BUs, the likelihood that

these will be less simple to accomplish and the normal absence of corporate incentives for cross-BU collaboration among BUs deemed to offer little synergy potential (Porter 1987; Goold and Campbell 1994) are not conducive to the development of a virtuous cycle of increasing organizational capabilities and social predisposition. All in all, this leads to a configuration of factors hardly conducive to the development of synergies. As mentioned above, in cases in which the capability and the predisposition are sufficiently low, our experiments show that, even in the presence of corporate mandates, successful collaboration is hard to develop. Such factor could be mitigated, as mentioned in Proposition 2b above, by an exogenous "boost" of the variables that form the virtuous cycle of cross-BU collaboration.

Proposition 3. Successful cross-business collaboration among BUs with highly related activities does not result uniquely from the economic relatedness of the activities, but are also the outcome of the organizational and social capabilities for cross-BU collaboration likely to flourish among BUs that previous successful collaboration initiatives had helped to develop.

Proposition 3b. BUs with few related activities are less likely to develop successful cross-BU collaboration initiatives autonomously, as capabilities and the predisposition to collaborate are less likely to be developed through experience.

While our model captures the dynamic relationships between several variables which have been reported in the literature as relevant for the phenomenon of cross-BU collaboration, it is not free from limitations. First, our experiments are limited to two BUs. Second, the factors related to cross-BU synergy creation are assumed to evolve symmetrically in each of the BUs, conducing to symmetric performances. Third, we did not model the cost of corporate

intervention but just limited ourselves to assess the impact of these on the behavior of the BUs and its subsequent impact on the performance of the cross-BU collaboration initiatives.

Our findings also have implications for the practice of cross-BU collaboration. Our model reveals the importance of organizational as well as social momentum on the success prospects of cross-BU initiatives. Being those factors strongly linked to experience, the tactical advice for successful cross-BU collaboration is to start with straightforward initiatives in order to build the virtuous cycle that, eventually, may enable the BUs to approach more challenging initiatives with better prospects of success. Starting with high profile, yet riskier, initiatives would lead to a volatile scenario of notable success or failure at the beginning of the relationship. The latter situation could cripple the predisposition to collaborate further even in simpler projects, therefore damaging the future prospects of the cross-BU relationship even in presence of abundant and rather straightforward opportunities for collaboration.

In addition, we mentioned that any prescriptive approach on how to approach cross-BU collaboration needed to be contingent in nature. On Table 3 we explain which should be the rationale and the associated actions related to different configurations of factors. In our framework, configurations vary in terms of the level of predisposition to collaborate, the abundance of economic opportunities for cross-BU collaboration and the degree of organizational capabilities of BUs to manage this kind of process. Our prescribed actions take into account the complexity of the initiatives and suggest roles for the corporate level of the firm. It must be noted that our framework includes advice for situations of collaboration leading to asymmetric payoffs. As mentioned above when discussing the limitations of this work, we did not address the possibility of asymmetric payoffs in our model. Yet, we found important to contemplate such scenario in our practical framework.

Conclusion

Empirical evidence reporting the difficulties faced by firms at the time of managing the successful development of cross-BU synergies led as to develop a dynamic formal model comprehending a set of economic, organizational and social factors characterizing those processes. Our simulations of different configurations of factors showed that a systemic and longitudinal approach can capture the varying impact of each of the factors on performance across different configurations and within the same configuration across different moments of the relationships between the BUs. Such differences resulted from the initial conditions faced by the different BUs and from their varying ability to develop capabilities and social skills as the relationship among them unfolded. These results enabled us to revisit and extend our understanding of how of business relatedness and corporate intervention may affect the performance of cross-BU initiatives. Our analysis led to the development of a set of theoretical propositions that summarize the contribution of this paper where a contingency perspective on how to approach cross-BU collaboration in practice is suggested.

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APPENDIX

Set of parameters for the simulation model

Parameter	Initial values	Description
OC_0	High: 50 Low: 10	Initial number of opportunities for cross-BU collaboration
ß	Low complexity Mean (μ) 1 Std Dev (σ) 0.1	The value of this variable reflects the impact of the complexity embedded in the cross-BU collaboration initiative in the outcome (performance) obtained from collaboration. Low complexity leads to positive results with low variation. The average value is 1 and the standard deviation is 0.1, which implies that 95% of the outcome of collaboration will fall between 0.8 and 1.2.
	High complexity Mean 0 Std Dev 0.5	High complexity implies a mean performance equals to zero and increases variability (0.5) so 95% of the outcomes will fall between –1 and 1.
α	1	Represents the ability of the organizations to transform the experience obtained from each collaboration initiative into organizational learning (Martin and Eisenhardt, 2010). It starts with a value of 1, which represents a highly capable organization able to learn substantially from each collaboration initiative.
LP_0	50	Initial level of organizational learning is assumed to be 50, which represents BUs that, having some experience on these process, are not experts in cross-BU collaboration.
PC_0	50	Initial level of predisposition to collaborate is assumed to be 50 indicating that BUs are moderately inclined to collaborate.
η	1	The impact of negative outcomes from previous collaboration initiatives in the predisposition to collaborate is augmented (Ariño and de la Torre, 1998).
Corporate mandate	0	This variable represents the corporate mandate (Puranam and Krestchmer, 2008) aimed at promoting collaboration among BUs. In the initial run, we assume that there are not mandates.

mc_t	f(LPt)	$f(LP_t) = 1$ $\{LP_t \geq 80\}$; $f(LP_t) = 0.7$ $\{60 < LP_t < 80\}$; $f(LP_t) = 0.6$ $\{50 < LP_t \leq 60\}$; $f(LP_t) = 0.5$ $\{40 < LP_t \leq 50\}$; $f(LP_t) = 0.1$ $\{LP_t \leq 40\}$ The nonlinear relationships represent the existence of organizational thresholds (Quinn and Cameron, 1983) that affect the impact of the state variables on the process of cross-business collaborations. Sensitivity tests have been performed on the function (Sterman, 2000).
cbu_t	$f(LP_t)$	$f(LP_t) = 1$ $\{LP_t \geq 90\}$; $f(LP_t) = 0.7$ $\{70 \leq LP_t < 90\}$; $f(LP_t) = 0.5$ $\{40 \leq LP_t < 70\}$; $f(LP_t) = 0.1$ $\{10 \leq LP_t < 40\}$; $f(LP_t) = 0$ $\{0 \leq LP_t < 10\}$ The nonlinear relationships represent the existence of organizational thresholds (Quinn and Cameron, 1983) that affect the impact of the state variables on the process of cross-business collaborations. Sensitivity tests have been performed on the function (Sterman, 2000)
pc_t	f(PCt)	f(PCt) = 1 $\{PCt \geq 80\}$; f(PCt) = 0.5 $\{50 \leq PCt < 80\}$; f(PCt) = 0.1 $\{40 \leq PCt\}$ The nonlinear relationships represent the existence of organizational thresholds (Quinn and Cameron, 1983) that affect the impact of the state variables on the process of cross-business collaborations. Sensitivity tests have been performed on the function (Sterman, 2000)

Table 1. Constructs and Elements of the Model

Construct	Key element	Description	Measures	Dynamic Behavior
Opportunities for cross-BU collaboration already explored	Number of opportunities for cross-BU collaboration already explored	Represents the opportunities for cross-business-unit collaboration that have already been explored by two BUs over a period of time. See economic drivers of cross-BU collaboration	Projects under development related to cross-business-unit collaborations	As opportunities for cross-business-unit collaboration get materialized, the stock of outstanding opportunities falls until exhaustion
Predisposition to collaborate	The predisposition or goodwill of BUs to collaborate	Reflects the extent of the predisposition of BUs to engage in new cross-business-unit collaboration initiatives. See social drivers of cross-BU collaboration	Level of motivation of BU management to collaborate.	The predisposition to collaborate is dependent on the results from previous cross-business initiatives Successful experiences increase the predisposition, while failures decrease it.
Opportunities for new cross-BU collaboration	Number of opportunities to create cross-BU synergies	It represents the number of opportunities available to develop new synergies out of cross-business-unit collaboration. See economic drivers of cross-BU collaboration	Number of opportunities for cross-business-unit collaboration available	The number of opportunities mey be determined either by the initiatives induced from the corporate-level or from the Bus themselves. This is strongly influenced by the corporate style
Performance of cross business-unit collaboration initiatives	Performance of the initiatives aimed at developing cross-business synergies from the point of view of the BUs	This variable reflects the accumulated performance of all the cross-business-unit initiatives already explored by the BUs. See economic drivers of cross-BU collaboration	Value created or destroyed by cross-collaboration projects	It depends on the, level of predisposition of the BUs to collaborate, the complexity of the initiative, the knowledge of the BU developed through previous experience on collaboration and on the existence of incentives
Learning from collaboration (organizational factor)	It captures the learning processes occurring at the BU level as a result of engaging in cross-business initiatives.	This state variable accumulates the learning occurring between BUs, i.e. the learning curve related to cross-business collaboration. See organizational drivers of cross-BU collaboration	Number of best practices/activities identified from cross-business collaborations	It increases from each cross-collaboration project between BUs to an extent contingent to the absorptive capacity of the BUs. It influences the collaboration mechanisms employed during cross-collaboration projects, as well as the capabilities to obtain value from specific cross-business-unit collaboration initiatives.
Capability to improve results from collaborations	It represents the ability of the BUs to extract value from initiatives	This variable reflects the organizational capability to manage the level of complexity of the cross-collaboration initiatives. See organizational drivers of cross-BU collaboration	Value created from different type of collaboration initiatives	It increases as the level of learning from collaboration increases. It affects the mean and variability of the performance obtained from each collaboration.
Accumulated economic performance of cross-BU collaboration initiatives	It captures the accumulated profits/losses derived from the set of cross-BU initiatives that have already been explored	This variable represents the final economic performance of the realization of opportunities for synergies over a period of time. See economic drivers of cross-BU collaboration	Accumulated economic performance obtained by the multi-business firm.	It simply accumulates positive and negative economic performances from collaboration initiatives over time.

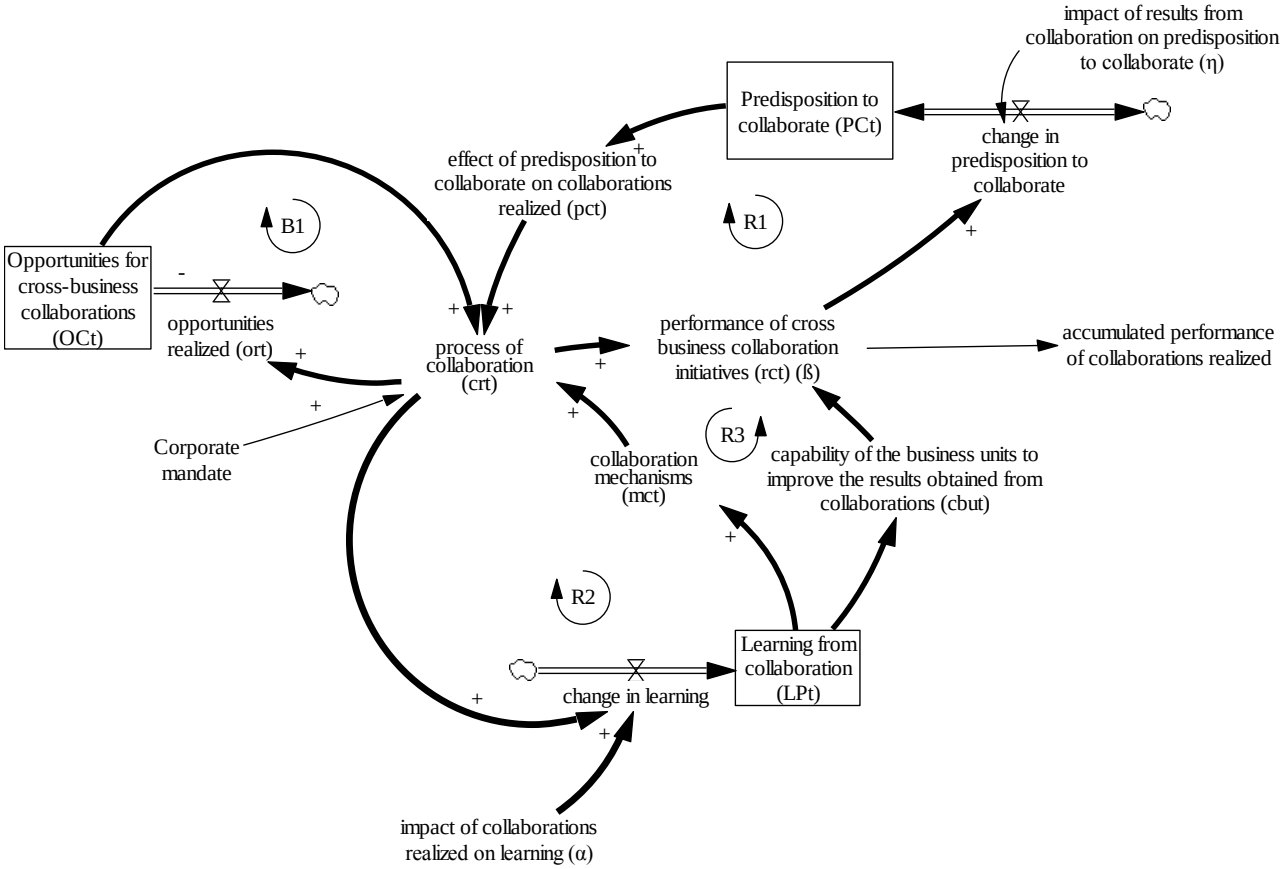
Table 2. Characteristics of the configurations modeled in the simulation experiments

	Name of Configuration	Number of opportunities available(OCt)	Complexity of opportunities (β)	Predisposition to collaborate (PCt)	Capabilities for cross-BU collaboration (LPt)	Corporate Incentives
1	Base case	High	Low	High	High	None
2	Managing complexity	High	High	High	High	None
3	Managing complexity with low capability	High	High	High	Low	None
4	Managing complexity with low capability and social capital	High	High	Low	Low	None
5	Managing complexity with no capability nor social capital	High	High	None	None	None
6	Configuration 4 with few opportunities	Low	High	Low	Low	None
7	Configuration 5 with corporate mandate	High	High	None	None	Yes
8	Configuration 5 with few opportunities and corporate mandate	Low	High	None	None	Yes

Table 3. Managerial actions to boost cross-BU collaboration under different scenarios

		Number of opportunities			
		Low		High	
		Predisposition			
		Low	High	Low	High
Cross-BU Organizational Capabilities	Low	LOW RELATEDNESS/NO PROCESS Rationale: seize scarce valuable opportunities Actions: Bring in external "ad hoc"support to overcome lack of organizational and social support for cross-BU initiatives. Corporate interest in initiatives needs to be clearly communicated Complex-high profile inititiaves might benefit from corporate leadership altogether	LOW RELATEDNESS/NO ORGANIZATIONAL SKILLS Rationale: seize scarce valuable opportunities Actions: Bring in external "ad hoc" help (internal or external consultants) to develop BUs capabilities Corporate interest need to be clearly communicated. Well predisposed BUs lead, with corporate oversight	HIGH RELATEDNESS/NO PROCESS Rationale: relatedness justifies long term effort to build process leading eventually to autonomous collaboration Actions: Bring in external help to remedy lack of managerial capabilities (eg: internal or external consultants, liaison manager) Encourage development of low complexity cross-BU initiatives ("quick wins") in order to let predisposition pick-up.	HIGH RELATEDNESS/NO ORGANIZATIONAL SKILLS. Rationale: support BUs willingness to collaborate with management skills that they can internalize leading eventually to autonomous collaboration. Actions: Bring in external help to remedy lack of managerial capabilities (eg: internal or external consultants, liaison manager). More important in case of complex initiatives.
	High	LOW RELATEDNESS/NO GOODWILL Rationale: seize scarce valuable opportunities taking advantage of existing organizational processes. Actions: Simple initiatives led by Bus under corporate oversight Complex initiatives demand corporate involvement to overcome poor social links among units	LOW RELATEDNESS/WELL PREPARED BUs Rationale: allow competent local management to manage the process, with corporate oversight Actions: Top-down approach with strong BU input. Consider letting cross BU-collaboration develop autonomously, unless great asymmetry exists on the balance of mutual benefits. Asymmetries would require corporate inducements for the highest contributing BU	HIGH RELATEDNESS/NO GOODWILL Rationale: Low predisposition under strong long term strategic interdependence and cross-BU capabilities will hinder development of synergies leading to a conglomerate Actions: Strong top-down mandate from corporate center. Change dysfunctional BU leadership if necessary	BUs PARTNERSHIP Rationale: allow local management of cross BU-collaboration Actions: Let cross BU-collaboration develop autonomously, unless great asymmetry exists on the balance of mutual benefits. Asymmetries would require corporate inducements for the highest contributing BU

Figure 1. Dynamic model of cross-BU collaboration processes[1]



[1] Accumulation processes into the state variables, which are represented as boxes in the figure, are identified using flow rates, e.g. the variable 'change in learning'. Arrows indicate the direction of the causal relationship between two variables (Repenning, 2002). The signs at the arrowhead define the type of relationship: either positive or negative. A positive relationship implies that an increase or decrease in the independent variable causes a change in similar direction in the dependent variable (increase or decrease respectively) ceteris paribus (Repenning, 2002). A negative relationship indicates that a change in the independent variable (increase or decrease) will generate a change in the opposite direction in the dependent variable (decrease or increase respectively) (Repenning. 2002). The loop identifier R1 identifies self-reinforcing feedback processes. The loop identifier B1 denotes balancing feedback processes. See Sterman (2000) for additional information on feedback processes.

Figure 2. Accumulated performance for cross-business collaborations (Configurations 1 and 2)

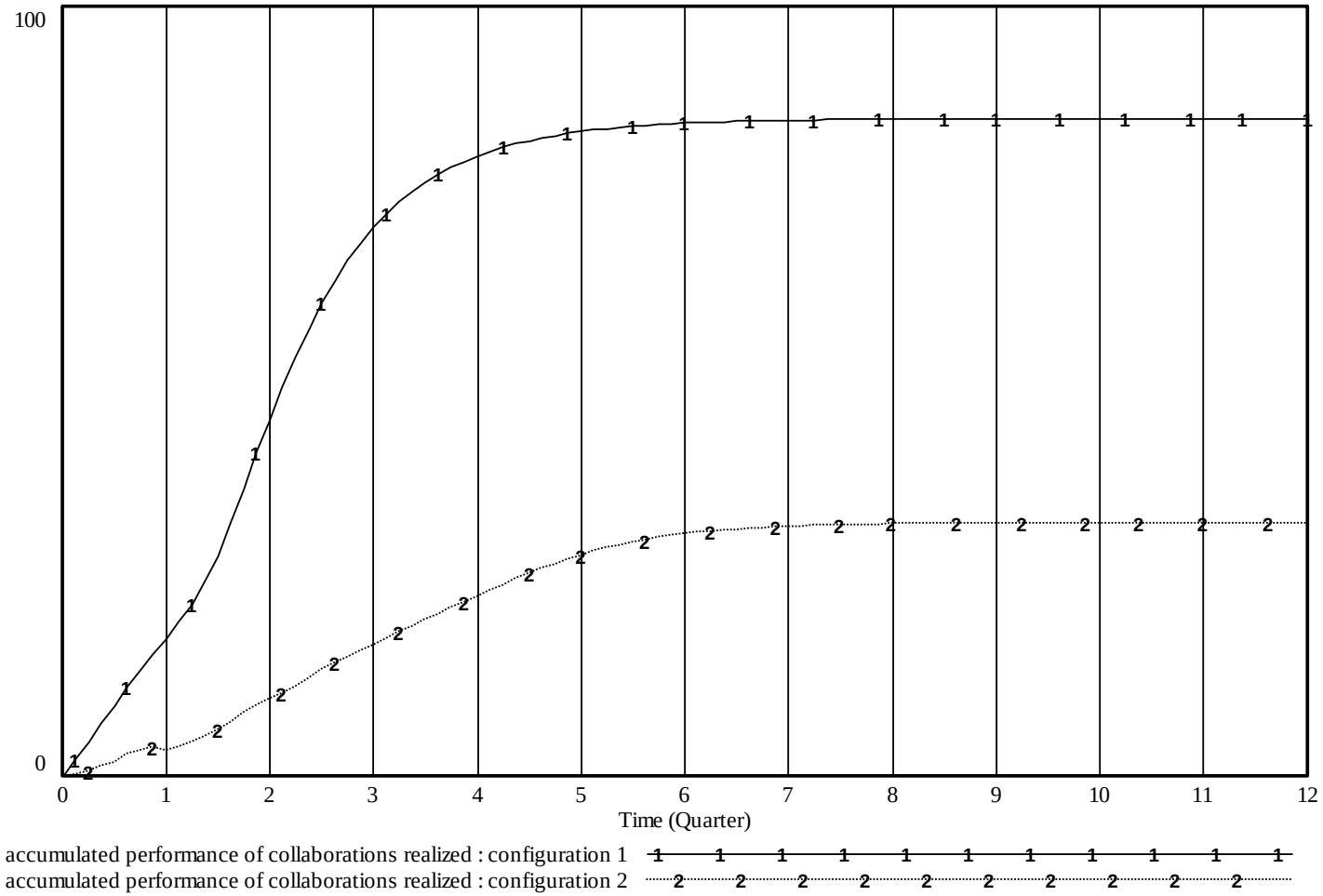


Figure 3. Accumulated performance for cross-business collaborations (Configurations 3 to 8)

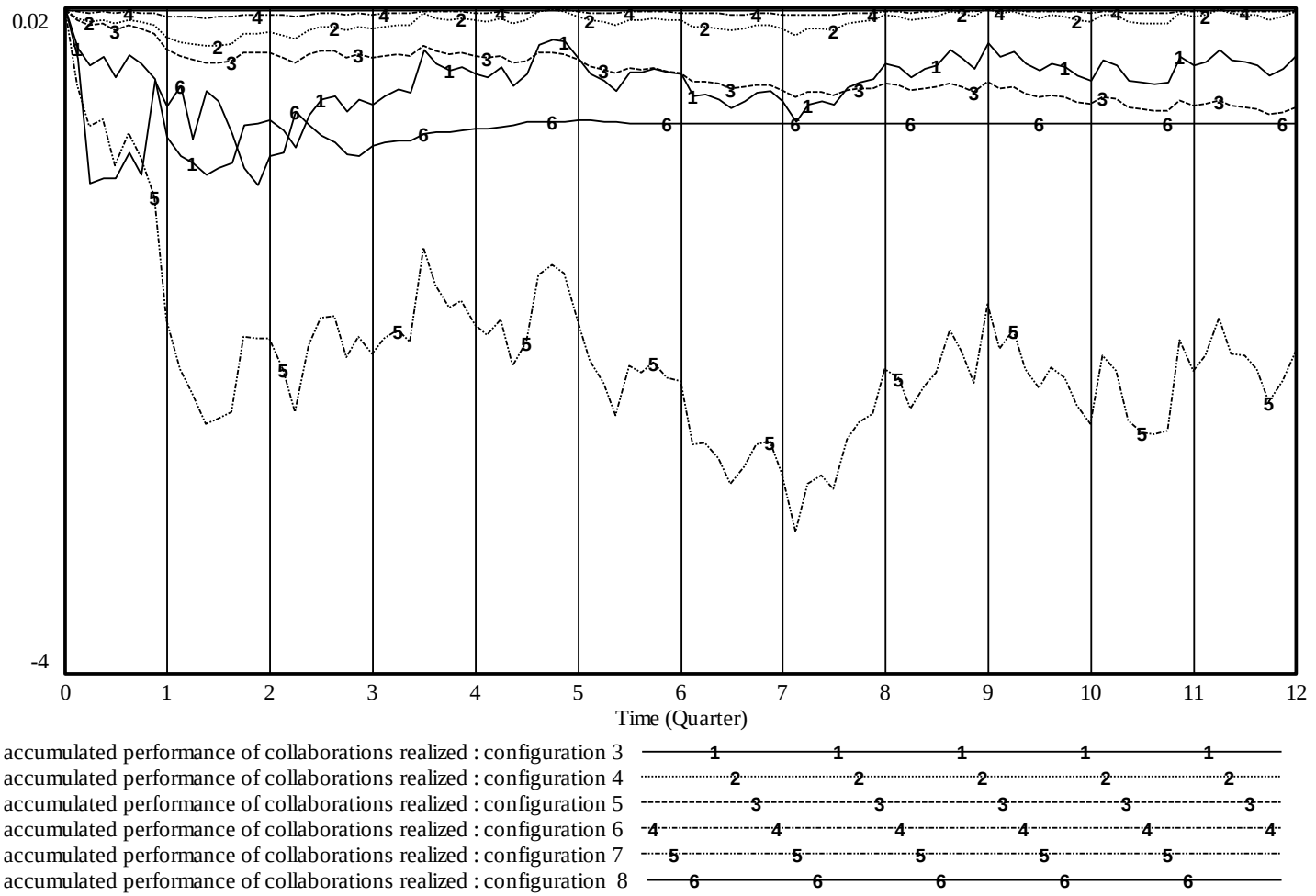


Figure 4. Accumulated performance for Simple cross-BU collaboration initiatives

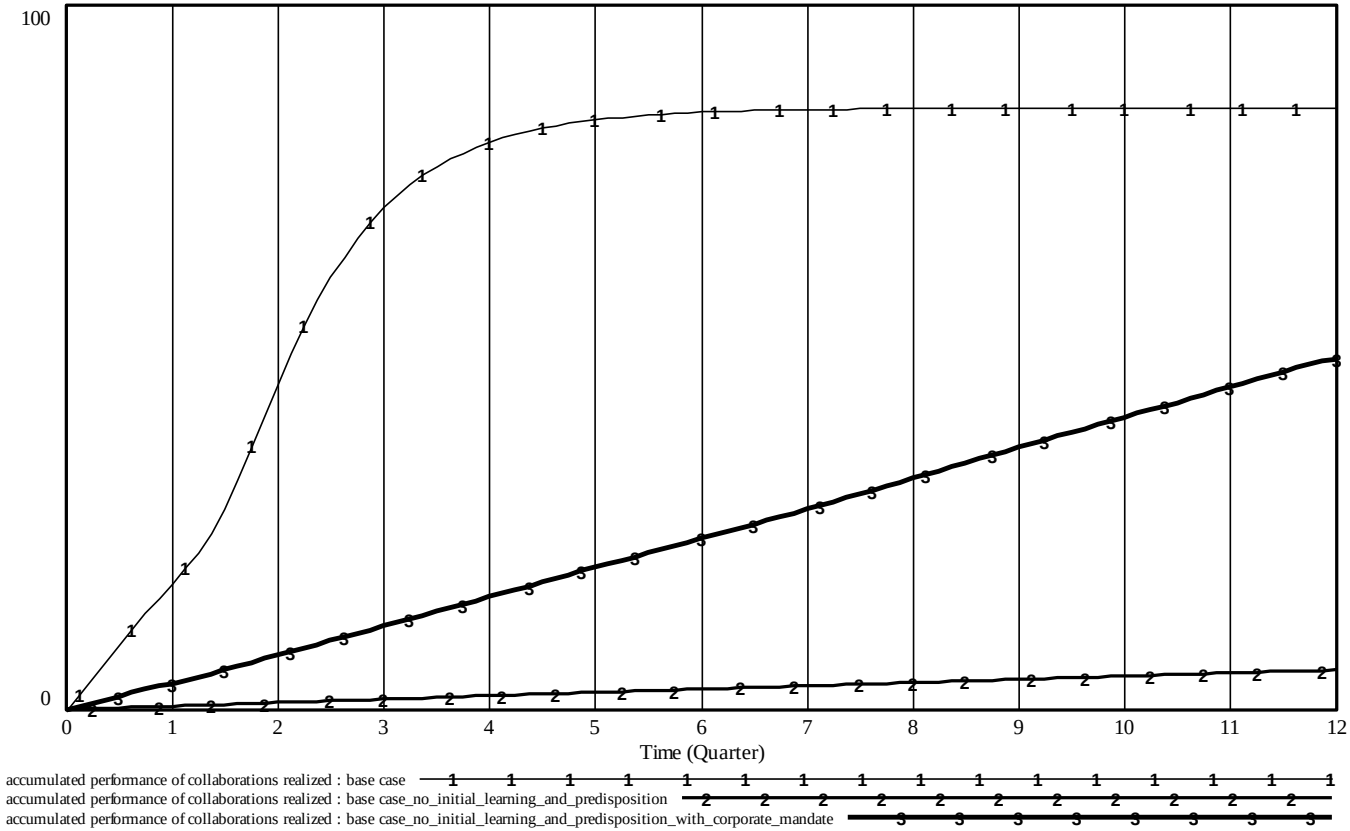
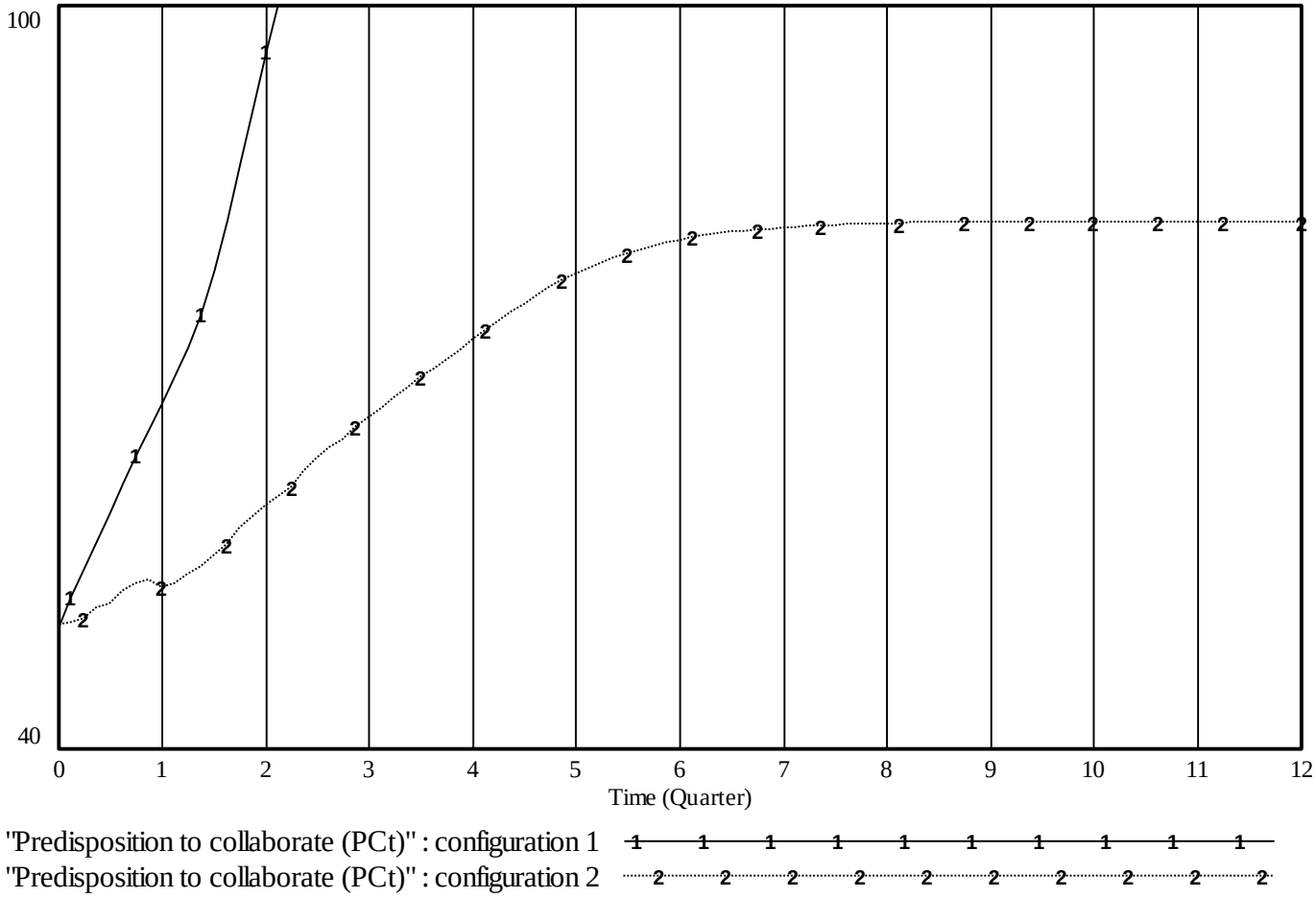
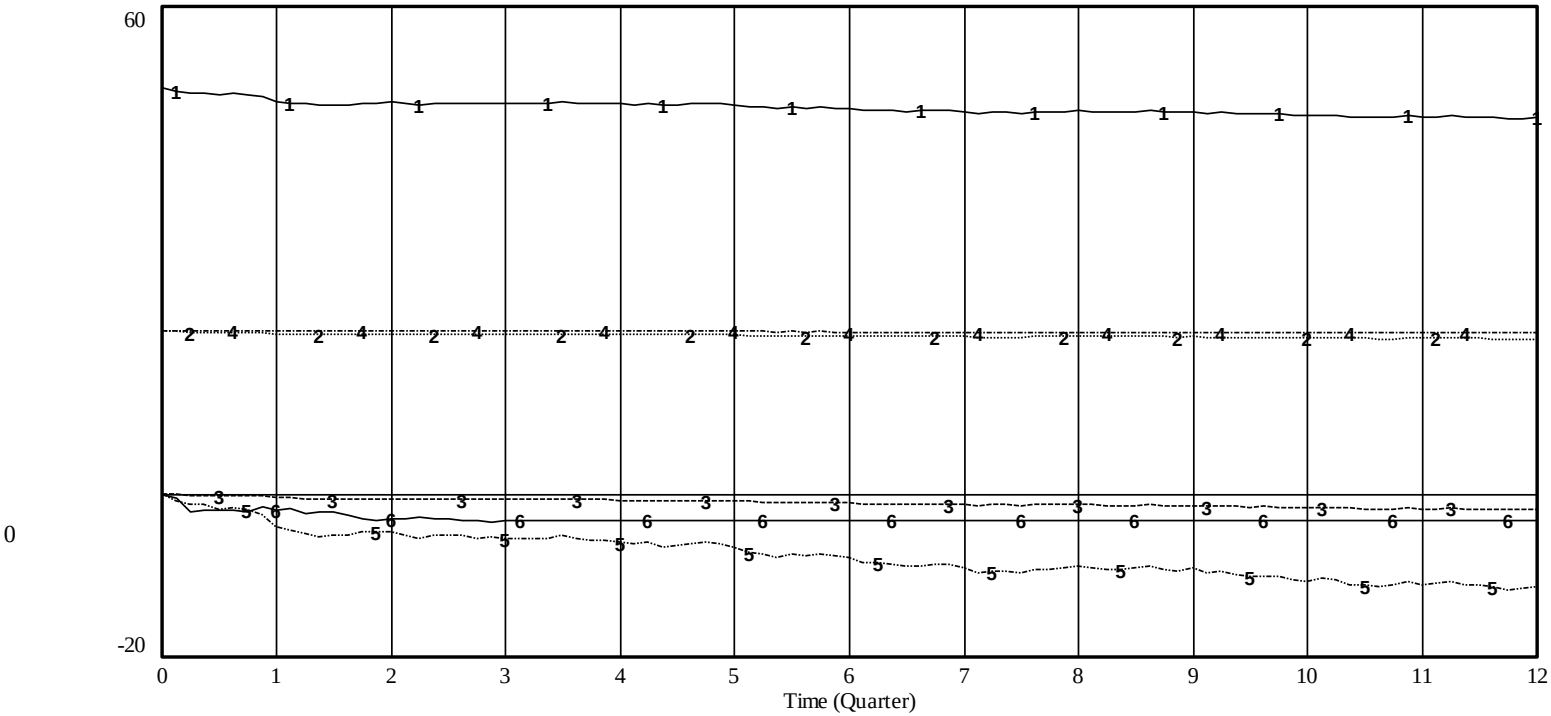


Figure 5. Predisposition to Collaborate



(a)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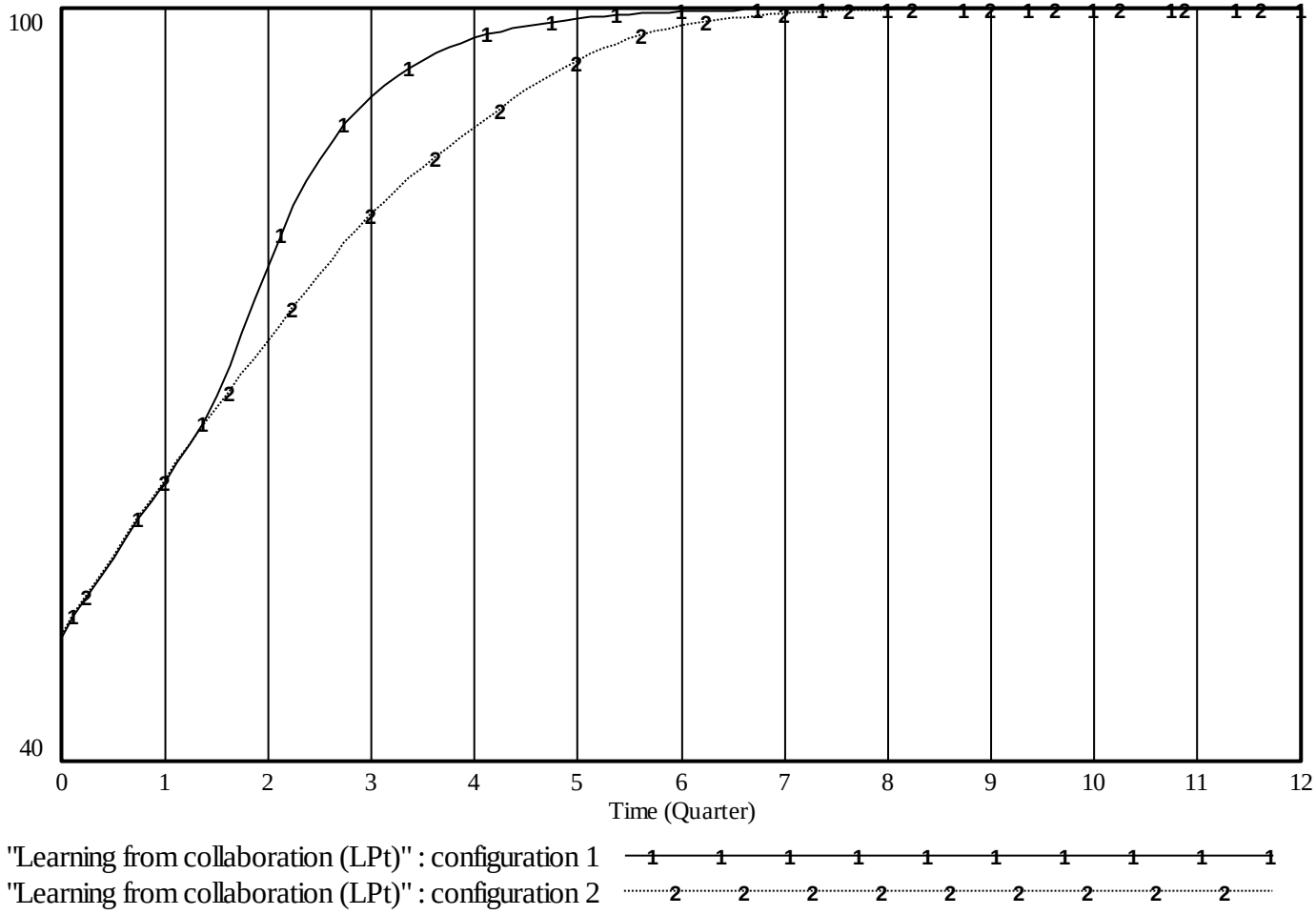
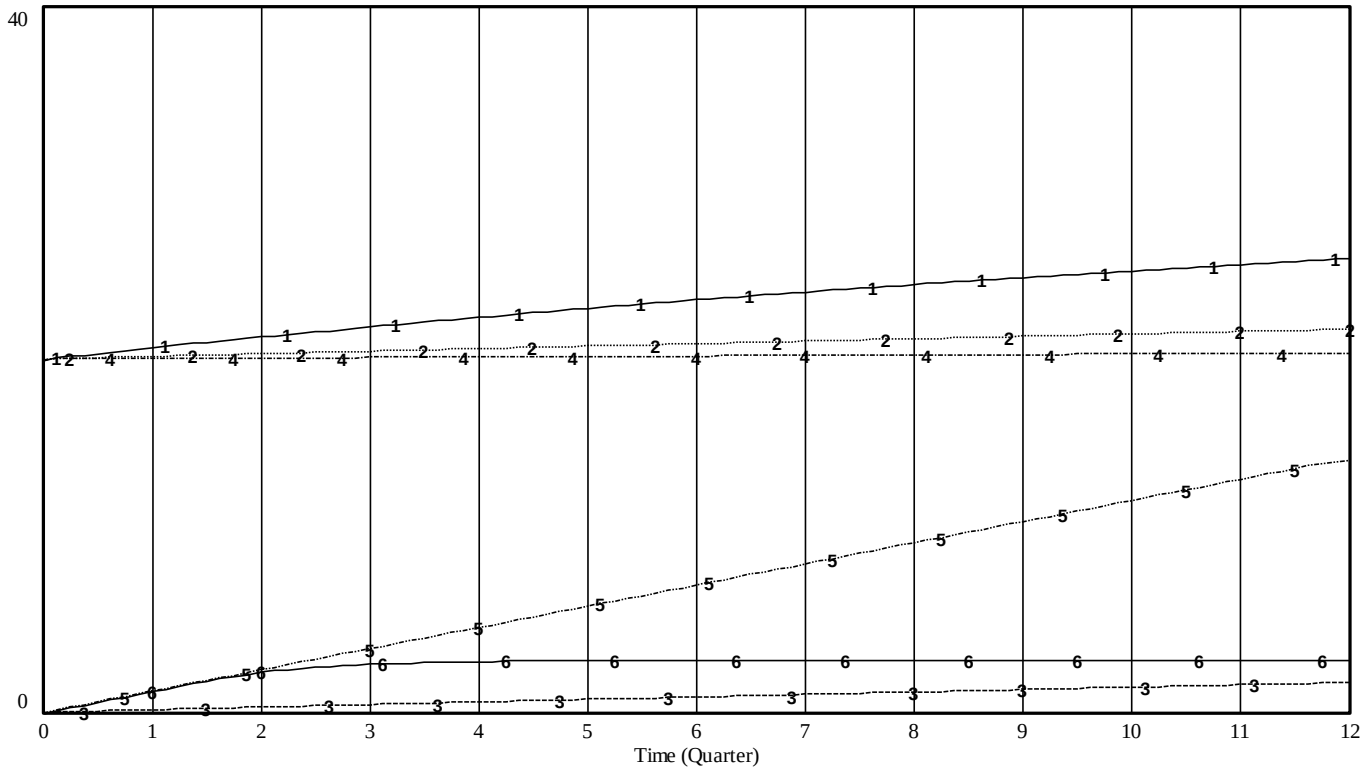
Time (Quarter)
"Predisposition to collaborate (PCt)" : configuration 3
"Predisposition to collaborate (PCt)" : configuration 4
"Predisposition to collaborate (PCt)" : configuration 5
"Predisposition to collaborate (PCt)" : configuration 6
"Predisposition to collaborate (PCt)" : configuration 7
"Predisposition to collaborate (PCt)" : configuration 8

(b)

Figure 6. Learning from Collaborations – Dynamic Behavior



(a)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Time (Quarter)
"Learning from collaboration (LPt)" : configuration 3
"Learning from collaboration (LPt)" : configuration 4
"Learning from collaboration (LPt)" : configuration 5
"Learning from collaboration (LPt)" : configuration 6
"Learning from collaboration (LPt)" : configuration 7
"Learning from collaboration (LPt)" : configuration 8

(b)