Organisational Flexibility: a simulation model

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Abstract

Several theoretical and empirical studies identify main components of Organisational Flexibility (OF) and show the relations between them. However, comprehensive analysis of these interrelations over time through the implementation of organisational change remains a challenge. This article presents a simulation model of OF when change strategies are implemented confronting several states of environmental turbulence. Two models have been developed to analyse patterns of behaviours in a simulation environment. The first model represents the translation of the existing theory of OF. New understandings about the original theory were generated leading to a second model with new constructs to be considered. The second model incorporates the firm's ability to change conditioned by the effects of the resistance to change, the managers' perceptions of real environmental changes and, the delays originated by the implementation period of concrete changes at organisational level. The simulation experiments conducted with both models suggest that the impact of change strategies on organisational flexibility at different levels of environmental turbulence could be studied as a complex concept. As a consequence, a more robust theoretical model in Organizational Flexibility is provided.

Key words: Organizational Flexibility, Absorptive capacity, System Dynamics Modelling, Simulation.

1. Introduction

Organisational flexibility – as the ability to adapt quickly to new or changing environments - has received growing attention from both researchers and managers as a key driver for companies to survive and prosper in turbulent and unpredictable environments (Dreyer and Grønhaug, 2004) and it is becoming the new hallmark of organisational excellence (Volberda et al., 2007). However, scholars have stressed the complex nature and multidimensional structure of the organisational flexibility concept (Volberda 1996, Teece et al. 1997, De Toni and Tonchia 2005). According to Dreyer and Grønhaug (2004) one of the main problems managers face regarding flexibility is how to balance change and organizational stability. Suárez et al. (2003) suggest that the task is even more difficult because there are not models explaining the relationship between flexible capabilities, environmental turbulence and firm performance (Suárez et al. 2003) along the enterprise lifecycle (Volberda, 1998; Dreyer and Grønhaug, 2004; Verdú-Jover, et al. 2006).

The main motivation of the research is twofold. On the one hand, partial analysis of organizational flexibility and its components may cause change strategies to be misunderstood and not effectively implemented. On the other hand, the absence of temporal dimension in such analysis hinders the identification and evaluation of the core constraints affecting change at enterprise level. For example, strategies that seem to provide dynamism may become sources of rigidity at another stage without a temporal dimension (Oliver, 1991). Considering the complexity concerns and the lack of comprehensive modelling of the 'organisational flexibility' concept, this paper employs system dynamics modelling (Sterman, 2000; Sastry, 1997; Repenning, 2002) to develop a more robust theoretical description. In order to improve the understanding of existing explanations of organisational flexibility, we adopted an approach similar to Sastry (1997). The objective of the model is to offer a more robust description of organizational adaptation to changing environments validated with selected simulations. We present our contribution through a set of dynamic propositions to complement the guidelines to achieve different levels of Organizational Flexibility (OF) within diverse environment scenarios proposed by Volberda (1998).

This paper is divided into five sections. Following this introduction, we develop the theoretical arguments underlying the system dynamics model of Organisational Flexibility's framework. The third section will provide an in-depth exploration of the key variables of the simulation model. With these outputs, simulation experiments with both models will be run

and some dynamic propositions shall arise from this exercise. We conclude with interpretations for theory development, empirical inquiry and management practice around the topic Organisational Flexibility. Implications for future research lines will be slightly drawn additionally to these concussions.

2. Theoretical Background: Flexibility at Organisational Level

Currently, companies facing the new pressures from the environment are being compelled to improve their ability of continuously adapt to new competitive scenarios. The mentioned ability will depend not only on being efficient in their organisational routines but also on being innovative at the same time (e.g. Hayes and Abernathy, 1980; Tushman & O'Reilly, 1996). The notion of balance between exploration and exploitation activities (Benner and Tushman, 2001) represents a common topic in literature related to organizational adaptation. Raisch and Birkinshaw (2008) describe the different contexts in which the need to reconcile the two orientations have been discussed: organizational learning, technological innovation, organizational adaptation, strategic management and organizational design. Within the theory of organizational adaptation, organizational flexibility – as the ability to adapt quickly to new or changing environments - has received growing attention from both researchers and managers as a key driver for companies to survive and prosper in turbulent and unpredictable environments (e.g. Dreyer and Grønhaug, 2004; Verdú-Jover and Gomez-Gras, 2009). The literature around organisational flexibility has been associated to several organisational capacities (agility, versatility, adaptability, fit, responsiveness, etc.).

Volberda studies OF as a two dimensional concept: the managerial task of controlling the organisation and the managerial task of organisational design (both also known as *Extensiveness of flexibility mix* and *Responsiveness* respectively*)* (1998: 97). Figure 1 displays the core constructs and their relationships in Volberda's OF theory: *"This two-dimensional conception of flexibility creates a paradox. The challenge for management is to develop dynamic capabilities* [which can accommodate variety and speed] *that enhance flexibility and to have an adequate design* [technology, structure and culture] *to utilise those capabilities."* (Volberda and Rutges, 1999:101). Thus flexibility implies a paradox – accommodating change and organizational stability simultaneously [1]. The way in which both

[1] Volberda (1998: 103) says *"a flexible organization must possess some capabilities which enhance its flexibility to avoid becoming rigid, but it must also be anchored in some way in order to avoid chaos."*

tasks fit in with the level of turbulence in the environment[2] determines how flexibility paradox is resolved, resulting in different organisational forms, which Volberda defines as *flexible forms* along the enterprise lifecycle. When the firm is deploying the managerial task efficiently, the firm has a *"sufficient flexibility mix"* and when the organisational design task is well developed, it has an *"adequate organisational design"* (1998: 81). In addition to this argument, he also identifies another type of managerial flexibility, called *'metaflexibility'*. Metaflexibility represents the organisation's support monitoring or learning system (Volberda, 1998: 121). Metaflexibility involves the processing of information to facilitate or promote the continual adjustment of the composition of the management's flexibility mix and organisational conditions in line with changes in the environment. The level of a company's metaflexibility determines the ability to access new knowledge from outside the boundaries of the firm – absorptive capacity – to scan the environment and evaluate the implications for the organisation. These activities can be grouped together as Environmental Scanning (Ansoff, 1980).

Figure 1 Components of organisational flexibility (adapted from Volberda, 1998)

When the metaflexibility allows environmental changes to be assessed in order to adapt the configuration of the flexibility mix and responsiveness, four ideal types of organisations are defined: *rigid*, *planned*, *flexible*, and *chaotic* configurations (Volberda, 1998). These types of

[2] Volberda (1998: 211) also suggests *"...the sufficiency of the flexibility mix (managerial task) and the design adequacy of organizational conditions (design task) must be continuously matched with the degree of the environment turbulence to achieve effective flexibility."*

flexible forms enable firms to initiate or respond successfully to different levels of environmental turbulence in order to sustain their competitive advantage[3] We suggest the interaction of key variables within dynamic adaptation processes towards the desired adjustment is one of the areas that the OF's theory has not considered in detail. The lack of identification of dynamic adaptation processes can help to better understand the key components of the implementation of OF strategies and organisational changes. This study adds two new dimensions of organizational flexibility to capture the process of dynamic adaptation and complement the transition of change strategies along the enterprise lifecycle: firm's ability to change, which depends on resistance to change, and perception time related to the environmental turbulence changes. In that sense, organisational flexibility is considered as a dynamic process rather than a characteristic of the organization. Thus, the effects of the adaptation process can be interpreted as a path-dependent process involving an initial position, a future objective, and a transition over time leading to different flexible forms.

The Organizational Flexibility theory appears in a number of conceptual works and in a limited number of empirical studies facing its complexity and the interrelations between variables at organizational level (Table 1). Some of these empirical studies and others more theoretically focused have stressed the complex nature and multidimensional structure of such subject (e.g. De Toni and Tonchia 2005). This could be the reason that explains the few empirical studies which account for such complexity (Dreyer and Grønhaug 2004).

[3] *In this typology, each ideal type is a result of a deliberate or emergent configuration strategy of management regarding the composition of the flexibility mix and the design of the organizational conditions"* (Volberda, 1998: 211).

Table 1: Research findings and challenges regarding organizational flexibility

Authors	Context	Outcomes	Future Research Challenges
Eppink (1978)	**Managerial Capabilities: Strategic Flexibility** Change can be operational, competitive, or strategic. Distinct types of flexibility for each type of change which minimize the vulnerability of organizations and their ability to respond	Suggests multi-dimensionality and hierarchical nature	Comprehensive modelling of relationships
Sanchez (1995; 2004)	**Managerial Capabilities and Organizational Design** organizational adaptation requires coordination flexibility and resource flexibility; **five modes of competences** reflect hierarchy of flexible capabilities	Suggests high level multidimensionality (managerial and organizational flexibility)	Comprehensive modelling of relationships
Volberda (1996/1998)	**Managerial Capabilities and Organizational Design (responsiveness)** Describes and develops a framework for OF. In this framework, steady-state, operational, structural, strategic flexibility, responsiveness of technology, structure, and culture are considered	Confirms hierarchical nature and multidimensionality of construct	Inclusion of Time factor
Lund, R. (1998)	**Flexible traits / Functional Flexibility** Operationalises flexibility as manifested in internal dimensions of structure, culture, processes, and external dimensions of technology and product market innovation.	Confirms flexibility is linked to performance: the fulfilment of customer expectations, integration of new technology.	Comprehensive modelling of relationships
Dreyer and Grønhaug (2004)	**Managerial capabilities: Flexibility from Resource-based view** volume flexibility, product flexibility, labour flexibility, financial flexibility, flexibility impact on performance	Confirms existence of different types of flexible capabilities and their role on achieving competitive advantage	Inclusion of Time factor
Anand and Ward (2004)	**Strategic Flexibility** mobility flexibility (alter production); range flexibility (product/process diversity)	Confirms multi-dimensionality at first-order level	Comprehensive modelling of relationships
Verdú-Jover, Lloréns-Montes & Garcia-Morales (2006)	**Managerial capabilities: operational, structural and strategic flexibility** different levels of flexibility and fit between real flexibility and that required by the environment have a positive impact on innovative capacity	Confirms existence of different types of flexible capabilities	Inclusion of Time factor
Hatum and Pettigrew (2006)	**Managerial capabilities and Organizational Design:** centralization and formalization; institutional embeddedness; environmental scanning; organizational identity	Confirms multi-dimensionality of organization design construct	Comprehensive modelling
Weihong XIE , Dan YE. 2008.	**Managerial capabilities:** Operational, structural & strategic flexibility	Confirms multi-dimensionality, the relationships between environment and managerial capacities and their impact on performance	Inclusion of Time factor

Literature is still waiting for models explicating relationships between flexible capabilities, environmental turbulence and firm performance (Suárez et al. 2003). Any change initiative that companies implement when they are looking for balancing stability and change (exploration and exploitation), should be accompanied by the concern of such complexity. Therefore, to address the complex nature of OF, the analysis of the interrelations between variables of OF and their consequences at organizational level is still needed in this research field. Additionally, the formula to accomplish organizational flexibility along the enterprise lifecycle (with a temporal basis) remains limited (Volberda, 1998; Dreyer and Grønhaug, 2004; Verdú-Jover, et al. 2006). Within the context of organizational adaptation, some authors start to investigate the temporal condition of that source of competitive advantage.

On Organizational Flexibility context, Volberda anticipated the possibility of modelling the adaptation process from a dynamic point of view: "Flexibility is not a static condition, but it is a dynamic process. Time is a very essential factor of organizational flexibility." (1998: 235). He settles the possibility to address such adaptation process as a sequence of stages allowing understanding of the key factors of organizational flexibility with different environmental turbulence levels. Dreyer and Grønhaug (2004) forecasted the important challenge of creating knowledge around the relationship between change and time concretely, understand when to change to remain competitive. Verdú-Jover et al. (2006) state that their findings capture the company behaviour at one moment of time and, as the companies operate in turbulent environments, the overall construct of flexibility condition should be studied throughout time. Recently, Tan and Zeng (2009) propose a stage-dependent model of resource utilization which contributes to dynamic capabilities and consequently, to firm performance due to such "time-varying dimension". They consider such flexibility is a key enabler since strategies that formerly provided systemic dynamism may become sources of system rigidity at another stage.

We therefore, first of all, describe the interactions between the variables that determine the dynamic behaviour to reach the desired OF level of the firm along different flexible modes of Volberda's typology during the enterprise lifecycle. Second, we consider explicitly, the non-linear dynamics of the positive as well as negative effects of resistance to change on the evolution of OF. This approach serves to explore how change strategies may lead to different patterns of organisational flexibility development at varying levels of ET.

3. A dynamic view of flexible organisation: model structure

Before presenting the results from the simulation modelling results, the model structure is described in this section under two views of the theoretical interpretation of Volberda's framework. First, variables that come from Volberda's theory shall be analysed based on their dynamic interactions within the system (Figure 2). And secondly, new variables shall be analysed and added to the initial model forming a new model called 'Extended Model' (Figure 3).

3.1 A Dynamic Model of Organisational Flexibility

Grounded on Volberda's arguments (Volberda, 1998), a preliminary model of OF was developed. This preliminary model represents the balance between its three main elements: Flexibility mix, Responsiveness and Metaflexibility which configure the type of Flexible Form that the firm is currently developing (rigid, planned, flexible or chaotic). The model focuses exclusively on the aforementioned variables as constituting of organisational flexibility; other processes such as for example, financial or commercial perspectives and, certain organisational characteristics such as for instance, size or type of organization, have not been considered in Volberda's research.

Figure 2 shows a stock and flow diagram that indicates flow variables as pipes with valves (Sterman, 2000) (see the Appendix for a detailed overview). Following this figure, the Metaflexibility level of the firm determines the information gathering capacity of the firm to understand and react to environmental turbulence. Then, the balance between the Extensiveness of Flexibility Mix and Responsiveness level determines the current Flexible Form; and the required flexibility level is determined by the Environmental Turbulence level. When required flexibility exceeds or defects from the current one, the increasing or decreasing level in Pressure to Change is accumulated until the two variables change as a consequence of change strategies.

There are a set of loops in Volberda's theory. Loop R1 involves the main feedback loop-absorptive-capacity management; for example, if the OF level increases due to a surplus in flexibility (required flexibility level by the environment is lower than the current flexible form) , this leads to a decrease in perceived ET and, depending on performance of absorptive capacity, to more accurate perception of the ET. The initial change thus tends to be

reinforced. Confronting a flexibility surplus, the firm's information processing capacity is activated only when market needs or new opportunities clearly appear. When Environmental Turbulence decreases, this capacity must be directed towards enhancing the receptiveness to new environments, for instance by using strategic planning processes. A similar example serves to understand the nature of the balancing loops (B1-A & B1-B): assume the Pressure to Change increases due to a deficit in OF; this leads the managerial and organisational tasks to rise, which in turn leads to an increased FF that fits with the required ET. These feedback loops balance the initial increase.

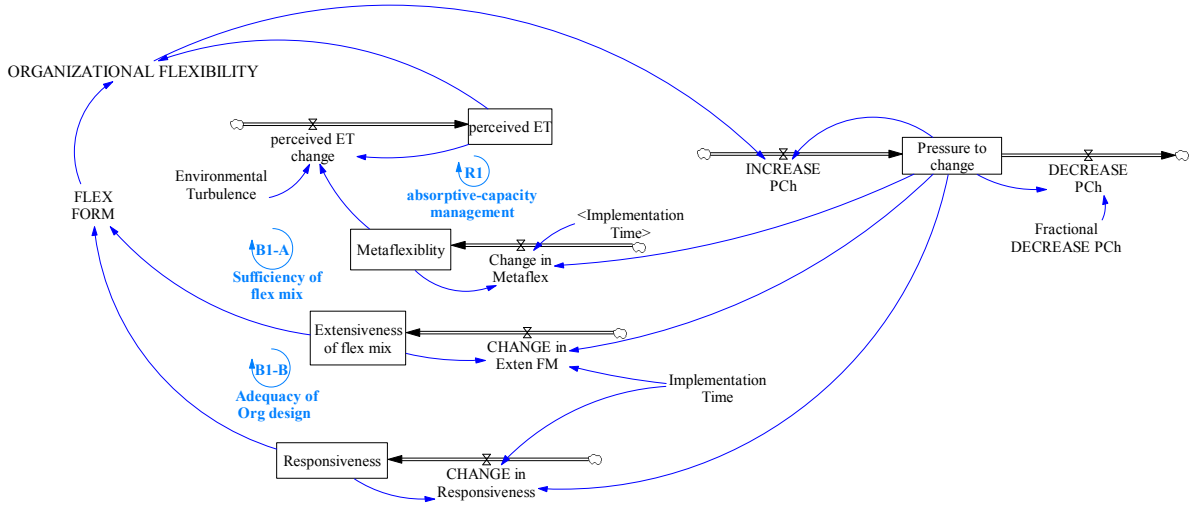

Figure 2: Flow and stock diagram of organisational flexibility according to Volberda's Theory

The OF variable represents how well the organisation matches the current 'Flexible Form' with the flexibility levels required by its environment. When both concepts coincide, the company is achieving the optimal level in OF which is referenced by cero; when OF is between 0 and 1, it means that a flexibility surplus exists; on the contrary side, between 0 and -1, there exists a deficit in flexibility. When OF is unbalanced, it activates the pressure to change managerial and organisational design tasks.

$$ORGANIZATIONAL\ FLEXIBILITY(t) = FLEX\ FORM(t) - perceived\ ET(t) \quad [1]$$

Unit: Dmnl

The *Flexible Form* (*FF*) is a combination of the level of *Extensiveness of Flexibility Mix* and *Responsiveness* in similar proportions and it changes when this combination varies over time. It represents the organisational type based on Volberda's typology. Variations in this variable can reduce the shortfall with respect to environment turbulence and the OF will be closer to the optimal value.

$$FLEX\ FORM(t) = (Extensiveness\ of\ flex\ mix(t) + Responsiveness(t))/2 \quad [2]$$
Unit: Dmnl

When managers face changing levels of ET, they may not be able to identify the changes or interpret correctly the threats arising from those changes. Many organisations perceive their environment as highly turbulent, while in fact they are confronted with a great number of small changes, which are mainly predictable (Voverda, 1998: 186-187). The stock *Perceived ET* represents the form managers understand the characteristics of the environment that the firm is facing. It has one inflow determining its change rate (accumulation and depletion over time) named as *Perceived ET Change* which refers to the corresponding changes in managers' perception of the ET.

$$Perceived\ ET(t) = Perceived\ ET(0) + \int_0^t perceived\ ET\ change\ (s)ds \quad [3]$$
Perceived ET(0)= 3; Unit: Dmnl

The change rate of this stock derives from the comparison between real *ET* and the analysis that results of environmental scanning activities. It changes when the *ET* changes but also depends on the influence of *Metaflexibility*, which means that the level of perceived turbulence varies as the firm uses its absorptive capacity.

$$Perceived\ ET\ change(t) = (Environmental\ Turbulence(t) - perceived\ ET(t))/ Metaflexibility\ (t) \quad [4]$$
Unit: Dmnl

Pressure to change is the stock that represents the accumulated level of pressure to change on the *Flexible Form* when OF is not at the optimal level. The larger the gap between the *Flexible Form* and the *Perceived ET*, the greater the level of this stock. It is the result of an increasing rate minus the outflow of a deceasing rate.

$$Pressure\ to\ Change\ (t) = Pressure\ to\ Change\ (0) + \int_0^t INCREASE\ PCh\ (s)ds - DECREASE\ PCh(s)ds \quad [5]$$
Pressure to Change (0)= 0; Unit: Dmnl

The decreasing rate represents the rate at which the system succeeds in approaching the *Flexible Form* towards the required level of flexibility during the period of changes (*DECREASE PCh*), and the increasing rate represents the rate at which the variables of *Flexible Form* need to be modified in a following period (*INCREASE PCh*). This increase could be positive or negative. We assume that a negative value of this variable means that there exists a surplus in flexibility and the appropriate correction comes from a routinization strategy (Volberda, 1998: 215) reducing *Extensiveness of Flexibility Mix* – for example,

because it is needed to concentrate the company's efforts on adapting new competitive advantages in order to prepare for the entry of competition- and *Responsiveness* – for example, because a greater standardisation and professionalisation of processes is needed (more mechanistic structure).

When pressure builds up, managers may have several choices to get the firm closer to desired form depending on the state of the environment. *ET* is the exogenous variable of the model. It is analysed by evaluating its dynamism, complexity and uncertainty level (competitive forces). A key causal relationship exists between *ET* and the perception of such turbulence. Accordingly to Volverda, every process of increasing flexibility starts by influencing the Metaflexibility level (1998: 198) -whether a real divergence in the OF level exists- before altering the other two main variables. This stock represents the range of activities in the information gathering process. When speaking about Metaflexibility, Volberda refers to "meta-capabilities", "management's absorptive capacity" or "high-order learning ability" (1998: 197). For this research, the adopted concept to represent such capability is what is named as environmental scanning (1998: 198). Variations in this variable can reduce the shortfall with respect to environment turbulence due to the *Perceived ET* is adjusted to a better interpretation of turbulence. It means the divergence in OF is more accurate allowing managers to recognise and respond to the need for an organisational change with the appropriate routinization or revitalization policies. The assumption for this research deals with how the firm carries out an extensive competitor analysis, monitors technological developments concerning our products/services and the production/service process or, systematically registers customers' needs and complaints.

$$Metaflexibility(t) = Metaflexibility(0) + \int_0^t CHANGE\ in\ Metaflexibility\ (s)ds \quad [6]$$

$Metaflexibility(0) = 3$; Unit: Dmnl

This stock has a unique inflow that is affected by the pressure to change and implementation time. This inflow variable represents the changes due to a routinization strategy (confronting a flexibility surplus) – the firm's information processing capacity is directed towards enhancing the receptiveness to new environments, for instance by using strategic planning processes – or when the firm implements a revitalization strategy (confronting a flexibility deficit) – by coding its limited and basic scanning procedures, the resulting increased *Metaflexibility* facilitates the development of dynamic capabilities which boosts the flexibility mix and makes the firm more responsive to new market forces.

$$CHANGE\ in\ Metaflexibility\ (t) = (Metaflexibility\ (t) * Pressure\ to\ change(t))\ /\ Implementation\ Time(t) \quad [7]$$
Unit: Dmnl

Once managers have a more accurate perception of the changes in the environment, the OF shortfall may still exist. The processes that bring the organisation back to the optimal level of OF are represented by balancing loop B1 & B2: after adapting Extensiveness of Flexibility Mix and Responsiveness the organisation achieves a FF that is well-suited to its environment.

Extensiveness of Flexibility Mix represents how the firm performs its managerial task related to flexible capabilities. A negative value of Pressure to change (there exists a surplus in the OF because of a lower level of ET) knocks the change rate of this variable. Whereas Pressure to Change is positive (a flexibility deficit exists), the change rate of this variable is positive due to the fact that an increase of dynamic capabilities is needed.

$$Extensiveness\ of\ Flex\ Mix(t) = Extensiveness\ of\ Flex\ Mix(0) + \int_0^t CHANGE\ in\ Extensiveness\ of\ Flex\ Mix(s)ds \quad [8]$$
$Extensiveness\ of\ Flex\ Mix(0) = 3$; Unit: Dmnl

In a routinization strategy, to reduce the *Extensiveness of Flexibility Mix* (Flexibility Gap loop (B1-A)) represents to concentrate the company's efforts on adapting new competitive advantages in order to prepare for the entry of competition. It generally implies refining existing core competencies and establishing more control over new flexible capabilities that allows the strategy to be focused in one direction. On the other hand, in a revitalization strategy, it is related to creating new capacities or activating those which may be unexploited. It implies unlearning 'old' routines, developing new core competencies, extending the firm's ability to change decision-making and communication processes and changing corporate strategy and/or the nature of business activities.

$$CHANGE\ in\ Extensiveness\ of\ Flex\ Mix(t) = (Extensiveness\ of\ Flex\ Mix(t) * Pressure\ to\ change(t))\ /\ Implementation\ Time(t) \quad [9]$$
Unit: Dmnl

Once the adequate mix of flexible capabilities has been achieved and established, the OF level still remains far from the optimal level so, the third stage of this change trajectory is related Responsiveness which represents the adequacy of organisational design conditions to effectively exploit the flexibility mix ('Adequacy of Organisational Design' (B1-B)).

In a routinization strategy, the *Pressure to Change* will take negative values and will reduce Responsiveness level, which generally implies the tendency to greater standardisation and

professionalisation of processes and the institutionalisation of information processing and decision making (more mechanistic structure). Furthermore, the varieties of cultures that exist in the organisation focus on avoiding deviations from the firm's vision. On the other hand, in a revitalization strategy it means less process regulation (e.g. less formalisation and specialisation), to lose the basic organisation form (more organic structure) and, a more open external orientation and a more innovative culture.

$$Responsiveness(t) = Responsiveness(0) + \int_0^t CHANGE\ in\ Responsiveness(s)ds \quad [10]$$
$Responsiveness(0) = 3$; Unit: Dmnl

$$CHANGE\ in\ Responsiveness(t) = (Responsiveness(t) * Pressure\ to\ change(t)) / Implementation\ Time(t) \quad [11]$$
Unit: Dmnl

The output on both tasks (managerial and organisational design tasks) because of *Pressure to change* variations is not immediate; there is a time lag between the moment at which managers realise the need to implement a change strategy and the actual moment of doing so. Volberda (1998: 201) names this time lag as *Implementation Time* which represents the reaction or implementation time of the new Flexible Form. As one of the causes for this delay, he identifies the organisational barriers in technology, structure and culture which can influence this implementation time. Such strategies explained above imply different levels of complexity which will affect the period of time in adjusting the flexibility mix and the organisational conditions.

3.2 Effects of resistance to change in organisational flexibility (OF)

In this section some new constructs are described that, joined with the first model in previous sub-section, will be the basis for the simulation analysis that is described in section 4.

Volberda anticipates that the implementation of a change trajectory towards more flexibility at organisational level can create dissatisfaction. He assures that organization members have to express their complaints with current state if they are to lose their inertia (1998:242-243). In line with this argument and within organizational change literature, there exists a huge research that stresses resistance to change as one of the main reasons for the failure many change initiatives (e.g. Armenakis & Bedeian, 1999 or more recently Gilley, Gilley & McMillan, 2009). Among other causes of employees' resistance, Vakola and Nikolaou point to stress caused by organizational change as an inhibitor of change since it can create negative attitudes toward change (Vakola and Nikolau, 2005: 163). In their comprehensive

literature review about the sources of resistance to change, Pardo del Val and Martínez Fuentes (2003) they cited, among others, embedded routines and lack of the necessary capabilities to implement change – capabilities gap. Sastry describes the negative relation between inertia (one of the sources of resistance to change) and ability to change: when inertia is high enough, organizational managers are less able to recognize and respond to the need for a change (1997: 244).

Figure 3 represents the extended model of the one presented in Section 3.1. The previous one represents the continuous process to achieve the desired form while the environment evolves, which is produced by two balanced and one reinforcing feedback loops (see figure 2). However, resistance to change hinders the firm's efforts to change as a result of a self-reinforcing process generated by the organisational reaction to changes (feedback loop R2).

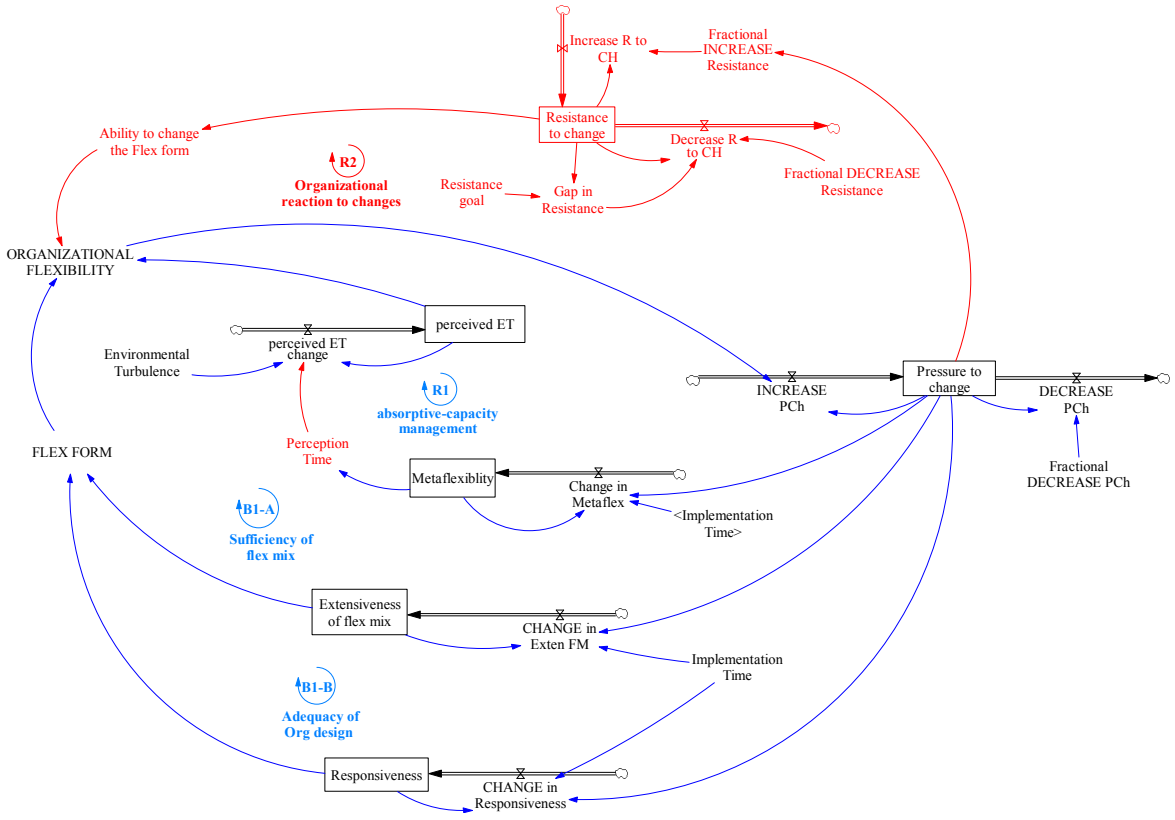

Figure 3 - A new Dynamic model for Organisational Flexibility

The effectiveness of the strategies to recover the optimal OF level by moving the FF to the desired level, will also depend on how the firm fosters the need for the proposed changes in the company, represented in the reinforcing loop 'Organisational reaction to changes' (R2). When 'Pressure to Change' has built up to a level high enough to activate the implementation of a change strategy, managers relieve the pressure by changing the FF but, in parallel, the

accumulated levels of 'Pressure to change' rises 'Resistance to change'. Some complaints from organisation's members should be expected when the firm is proposing new changes. As the resistance to change becomes higher, the 'Ability to change' falls and limits the efforts of strategies implemented (through B1-A & B1-B loops). The OF level achieved through the dominant balancing loops may be far from optimal due to the unintended effect of the reinforcing loop R2, which acts as vicious cycle to undercut the effect of adapting the firm's Extensiveness of flexibility mix and responsiveness. Here, we present the new changes originated by the addition of two new constructs.

The rate of change in the level of OF is given by the difference between Perceived Environmental Turbulence and the current FF plus the ability of the firm to change the FF. Thus, change in organizational flexibility is determined by two factors. First, the need to change results from the pressure originated when OF has not achieved the optimal level (zero) due to a deficit or a surplus of flexibility "*…sufficiency of the flexibility mix and the design adequacy of the organizational conditions must be continuously matched with the degree of environmental turbulence."* (Volberda, 1998: 204). Second, the effect of this need of change is counteracted by the organization's ability to effectively implement such decisions of change (variable *Ability to change the flex form*).

$$ORGANIZATIONAL\ FLEXIBILITY(t) = \\ \big(FLEX\ FORM(t) - perceived\ ET(t)\big) * Ability\ to\ change\ the\ Flex\ form \quad [1new]$$

Unit: Dmnl

The component *'Ability to Change the Flexible Form'*, represents the firm's ability to achieve the optimal OF through the control of emerging opposing forces to impose the new changes in organisational conditions or in the management of flexibility capacities efficiently. Thus, this variable is represented by a function of the resistance to change. This variable has a positive impact in the OF level, in the sense of, higher values on this variable will make OF level closer to the optimal value (zero). Ability to change is inversely related to *'Resistance to Change'*.

$$Ability\ to\ change\ the\ Flex\ Form\ (A) = \ f(Resistance\ to\ change) \quad [12]$$

Unit: Dmnl

$$f_A(1) = f_A^{min} > 0;\ f_A(0) = f_A^{max} = 1$$

When resistance to change is at low levels or 0, ability to change has the maximum level 1. When resistance to change is high enough, organizational managers are less able to effectively implement change strategies so, ability to change decreases and OF remains far

from the optimal value. The minimum level of Ability to change is not zero due to the assumption that the highest level of inertia is not enough to preclude the desired change.

Resistance to Change represents the extent to which the organisation's participants disagree with incremental or radical changes (which alter their current working conditions in the organisation). It is a state variable which is modified over time by changes in Resistance to change. At the beginning of the simulation, it is equal to 0 due to the OF is in the optimal level and no pressures to change exist. It affects the firm's ability to implement the change strategies chosen by the managers.

$$Resistance\ to\ Change(t) = Resistance\ to\ Change(0) + \int_0^t INCREASE\ PCh\ (s)ds - DECREASE\ PCh(s)ds \quad [13]$$

$Resistance\ to\ Change(0) = 0$; Unit: Dmnl

Resistance to change is increased as a result of a *fractional increase rate* which is determined by the pressure of change. According to Volberda, the levels of resistance with revitalization strategies will be higher than in routinization strategies due to totally new values and norms are required and past experience may not provide any advantage (1998:242). The effect of a high level of pressure, coming from higher gap in flexibility, modifies the inflow into the *Resistance to Change* stock. If pressure to change achieves the highest value (2) the trajectory of change implies to move the Flexible Form twice so, too many efforts will be required by the staff and the resistance will achieve the highest level. The decrease in *Resistance to Change* is the result of the firm's ability to control or manage such resistance by, for example, effective communication of the necessity of change and its consequences. The *Fractional Decrease rate* and the value of the *Gap in Resistance* set the outflow to the stock. If the difference between desired and real resistance (positive gap) is positive, the firm will influence over the resistance. A negative gap indicates low levels in resistance to change and therefore no efforts are needed to reduce it. The *Fractional Decrease rate* represents how the firm is following the recommendations from Volberda in the transition process.

Another change introduced in the previous model is the consideration of delays in the perception of the changes by the managers. That means *Perceived ET* will also depend on an estimated *Perception Time*. The variable *Perceived ET change* is proportional to the difference between the current value of Perceived ET and the current ET. The greater the difference, the more distant will be managers' perceptions of the reality of their competitive environment. Each quarter, a fraction of this difference is added to the Perceived ET average.

The fraction is inversely related to the. Thus, the updating process is modelled as a change every time period equal to a given fraction of the difference between current perceived ET and current ET; it is an exponential adjustment process. The smoothing is necessary to capture the effects of perception and measurement delays.

$$perceived\ ET\ change\ (t) = (Environmental\ Turbulence\ (t) - perceived\ ET(t))\ /\ Perception\ Time(t) \quad [4new]$$

Unit: Dmnl

In the next section, we will analyse the change strategies regarding the implementation of change within the OF theory using the comparison of simulation findings from both models.

4. Simulation Findings

None of the flexible forms is a permanent solution to solve the flexibility paradox and that is because Volberda proposes different trajectories for coping with competitive change within the categories of the routinization of entrepreneurial firms and revitalization of established firms (Volberda, 1998: 215). Following the implementation of a strategy, what would happen if the new combination fails to achieve an optimal OF level? Does this mean that the performance of managerial and organisational design tasks is unsuitable?

Having a formal model developed simulations tests are conducted in this section while the strategies of change are implemented. A systematic approach is used to explore the simulation model by comparing the two models outlined before. First, the base case, or 'OF model' is introduced and examined under the implementation of the change strategies. The OF model shows the dynamic behaviour that Volberda predicts. In a second step, the second model is tested by comparing its behaviour over time with the output in the 'OF model'. With the second model, we explore new conditions under which a particular structure plays a key role in determining the dynamics of the system and thus, some dynamic propositions are proposed. To be able to capture short-term as well as long-term patterns, the model is simulated over a period of 60 units of time (month). In all simulation experiments, the system begins in a steady state in which the inflow in each stock equals its outflow. In the present model it implies that Flexible Form coincides with the flexibility required by the environment and consequently, the OF achieves the optimal level, zero.

The base case model

The simulation starts with the third type of organizational form proposed by Volberda, the *Flexible* type. To understand the behavior of the system in a non-steady state, the model was tested using a variety of changes in ET that originate the need for adopting a change strategy accordingly. In order to resolve flexibility paradox, Volberda proposes two types of change strategies which adjust the FF, allowing the firm to move towards the optimal level of OF.

On the one hand, when stability is needed, a *routinization strategy* is the most appropriate strategy in moderately competitive environments where the firm faces decreasing levels of environmental turbulence (the exogenous variable in the model) and stability needs to be introduced**.** The company suffers a surplus of its 'extensiveness of flexibility mix' and the firm's 'responsiveness' level is superior to what is needed with respect to the environment. In a period of decreasing levels of turbulence, the firm may pass through the four types of Flexible Forms (mentioned in section 2) as far as the routinization strategies are implemented.

In the following figure (Figure 4), an example of transition from *Flexible* to *Planned* form due to decreasing environmental turbulence is represented.

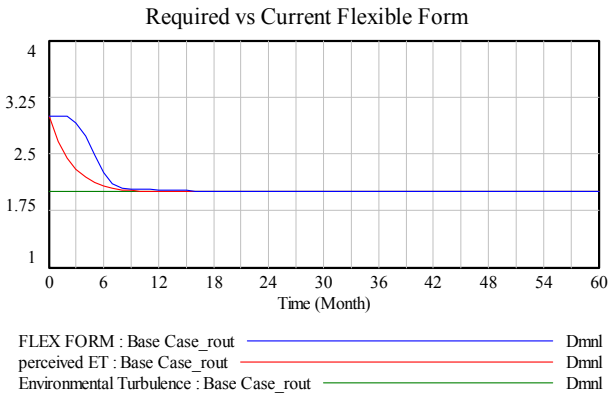

Figure 4 Example of Maturation transition-Flexible to Planned form

A routinization strategy is implemented due to in a lower level of ET (dynamic and competitive environment) the only source of a firm's survival is represented by the success on efficiency through the implementation of a *Maturation* trajectory (Volberda, 1998; 218) which pushes the firm from *Flexible* to *Planned* type. For example when an innovative organisation overcomes its earliest stage of activity, and the level of growth and success in a scenario of perfect competition starts to dismiss. In the new ET, the firm is not able to retain its competitive advantage and, difficulties to limit the entry of competitors to its market share

appear as the level of turbulence decreases (higher level and quality of competitors). As Figure 5 shows the need of *Maturation* strategy is illustrated by a positive gap in OF which represents a flexibility-surplus; the OF level is above its optimal value (zero) and 'Pressure to Change' may represent the flexibility gap to be covered by the corresponding strategy change that in this case, is represented by a routinization strategy.

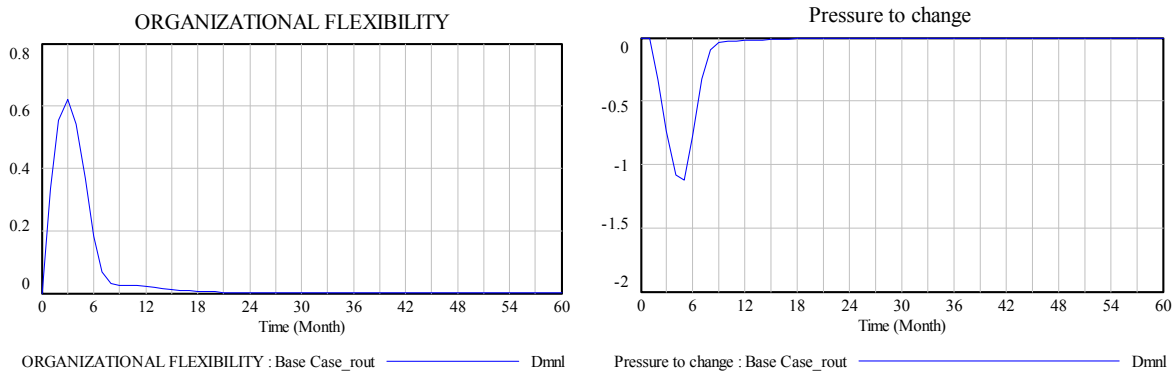

Figure 5 - Example of Maturation transition-Flexible to Planned form

In this case, the optimal level in OF is achieved by month 31. OF follows the predicted path in order to achieve the desired FF as the environment turbulence decreases. Lower levels of 'Extensiveness of flexibility mix' imply reducing or controlling uncontrolled capabilities and lower levels of 'Responsiveness implies tightening organisational conditions.

On the other hand, if the organisation requires change, a revitalization strategy allows the transition to be controlled towards increasingly competitive markets. Generally speaking, this type of transition is initiated when the firm wants to address new market tendencies, new business models, new competitive advantages and it will be more effective under hyper-competition). The following figure (Figure 6) shows an example of transition from *Flexible* form to *Chaotic* form due to increasing levels of ET.

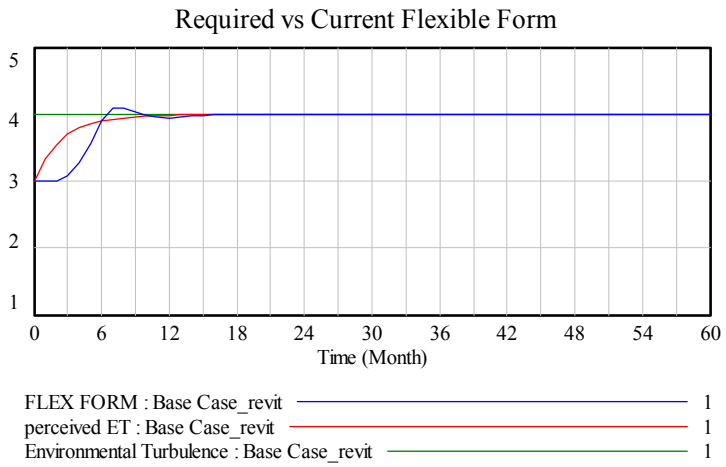

Figure 6 Example of entrepreneurial revitalization transition-Flexible to Chaotic form

For example, when firms operate in a very innovative business and face an Environmental Turbulence of extreme turbulence. The transition towards *chaotic* arises from the environmental forces. The environment is turning off too many variables and uncertainty and the firm is developing an excess of flexibility which could result in chaos and it is very difficult to control. While the first simulation (decreasing levels ET) showed the adaption process without overcome the expected values of FF and Perceived ET, this time the FF begins the expected change although it overcomes the required value. This pattern of behaviour fits with Volberda assumption that the firm must be ready to achieve competitive advantage and return to the flexible form in order to avoid chaos. According to Volberda (1998: 222), if the environmental scenario evolves and the OF level does not match the required one, the firm runs the risk of managers using wrong information to make inappropriate decisions. Consequently, the environmental forces can turn the firm in any direction. According to Volberda, if the environmental scenario evolves and the OF level does not match the required one, the firm runs the risk of managers using wrong information to make inappropriate decisions (1998: 222). Consequently, the environmental forces can turn the firm in any direction. A '*strategic neglect'*, lack of administrative stability, can result in a lack of decisiveness about research priorities, a fragmented structure and a loose constellation of subcultures. As Figure 7 shows the need of revitalization strategy is illustrated by a negative gap in OF which represents a flexibility-deficit; it implies that the firm's flexible form is inferior to what environment is requiring and consequently, the OF level is below its optimal value (zero) and 'Pressure to Change' shall represent the flexibility gap to be covered by the corresponding strategy change.

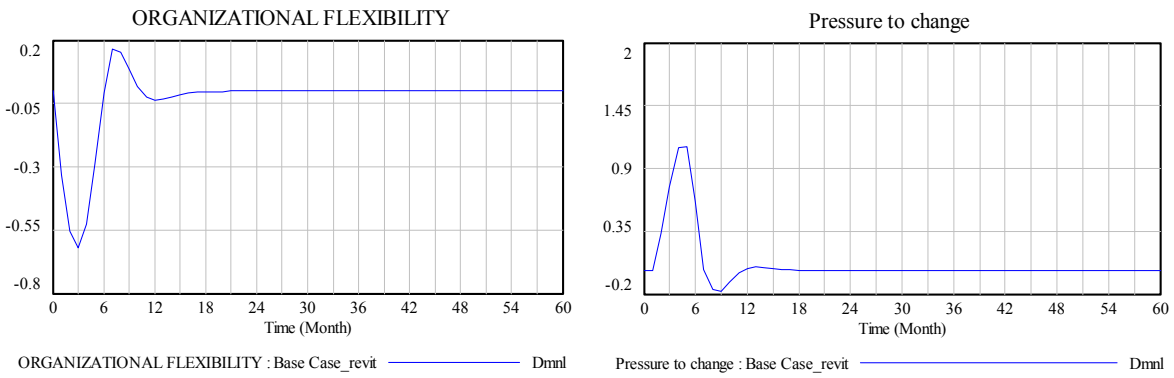

Figure 7 Example of entrepreneurial revitalization transition-Flexible to Chaotic form

The negative gap in OF is reduced by a revitalization strategy and it achieves its optimal level by month 29. In this simulation exercise, OF follows the predicted path to achieve the desired FF as the environment turbulence increases until between month 7 and 11 in which the OF overcomes the level 0 representing a surplus of flexibility. Initially, FF was under required level of flexibility to result in negative values in OF, so pressure to change immediately began to accumulate. Increased levels in Metaflexibility resulted in higher perceived ET, making the reinforcing loop R1 stronger. Pressure to change quickly built up to a level high enough initiate the balancing processes of B1-A and B1-B, by which the organization reoriented in response to sustained negative OF. The R1 reinforcing loop dominates over the balancing process and impulse the system to an inappropriate reorientation leading to for example, the chaos. If the revitalization strategy is not rooted in stability, the change trajectory can collapse.

The following table (Table 2) gathers the main outputs of the simulation in the base case, 'OF model'. The discrepancies between routinization and revitalization strategies looking for optimal level in OF is the result of a gap in the original theory described by Volberda. Although the theory explains how to strive organizational adaption to decreasing or increasing levels of ET it fails in not providing guidelines to overcome unexpected difficulties. The simulation results with additional assumptions presented in the following section will serve to correct unexpected trajectories in the OF or the FF.

Table 2: Simulation results

Initial Conditions	Change in ET	Result	Loop dominance
Equilibrium: required flexibility (ET=3) coincides with the FF (=3); OF is in the optimal level	Decreasing level in ET (2) routinization strategy is needed (Figure 4 & 5)	OF initially increases until the Pressure to change is low enough to activate the change in FF	Loop B1A-B1-B – balance
Equilibrium: required flexibility (ET=3) coincides with the FF (=3); OF is in the optimal level	Increasing level in ET (4) revitalization strategy is needed (Figure 6 & 7)	OF initially decreases until the Pressure to change is high enough to activate the change in FF	Loop R1 dominates

Extended model – validating the dynamic propositions

According to the research proposal of this paper, new variables have been added (see figure 3) to Volberda's framework and the simulation model could help to underlie or reject the dynamic propositions of this research work. We have introduced Ability to Change, Resistance to Change and Perception Time to the base case model (see figure 3). We aim to represent through these variables the firm's ability to effectively control the resistance coming from staff and manager's perception of the changes in the ET as it has been identified by Sastry (1997); Volverda (1998); Armenakis & Bedeian (1999); Pardo del Val and Martínez (2003); Vakola and Nikolau (2005); Gilley, et al. (2009).

In the first model, Perceived ET depends on the absorptive capacity (Metaflexibility) of the firm without considering that this perception is not immediate. If this variable is adjusted to a better interpretation of turbulence through introducing a delay with 'Perception time', the divergence in OF is more accurate allowing managers to recognise and respond to the need for an organisational change with the appropriate revitalization policy. Loop R1 provides the reinforcing dynamic by which "metaflexibility" builds an accurate perception of turbulence.

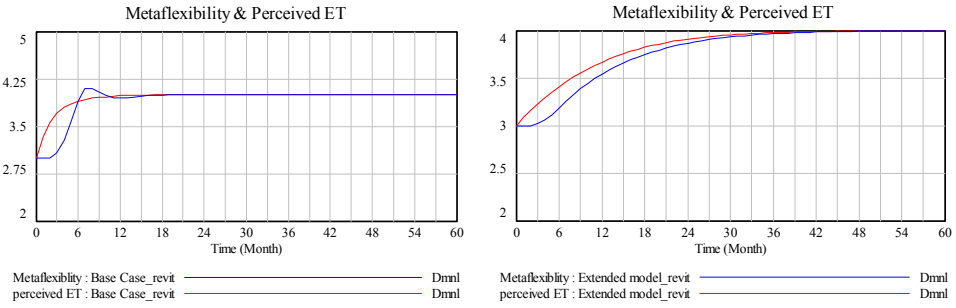

Figure 8 Metaflexibility and Perceived ET in both models

Figure 8 shows that when implementing a revitalization strategy because mature organisations search for business opportunities to survive, managers have to focus efforts on adjusting (increase) the absorptive capacity (meta-flexibility) and thus, guaranteeing the aforementioned strategies to be based on existing environmental turbulence to which the firm faces. The results of the simulation in the base case model again show that metaflexibility is changing over the required increase.

Volberda mentions that the results of the implementation of such strategies are not immediate and introduces the concept of 'Implementation Time'. However, the delay in the consecution of expected results is superior than the managers could predict. We have conducted a so-called STEP change in Environmental Turbulence at the start of the second in the simulation, implying a structural increase of ET from the initial-equilibrium level to a new level (revitalization). All responses in stepping up OF or FF involve structural increases 6 months later than the ET change in the case of the Extended model and 4 months later in the case of base case.

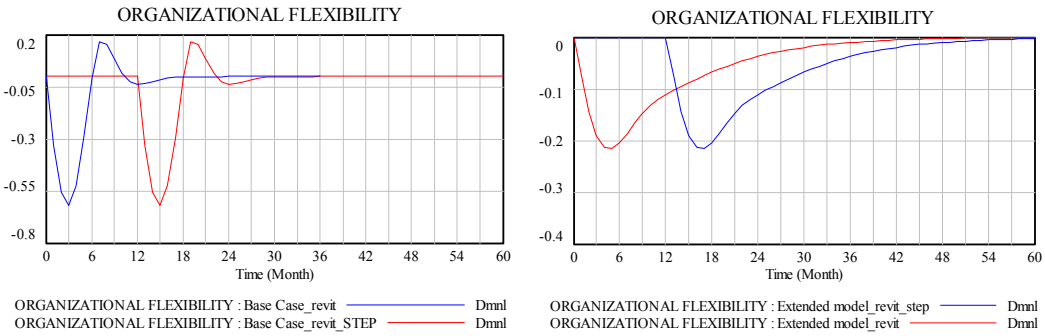

Figure 9 Response to a step input in the base case and the extended model

Figure 9 shows the impact on OF if ET is stepped up with increasingly higher volumes: the later the increase in ET, the later the equilibrium in OF. When revitalization strategies are implemented by focusing the company's efforts on increasing the Extensiveness of flexibility mix and increasing the responsiveness level, extra time will be needed to transmit the need to change and re-design the organisational conditions efficiently to the organisation's members.

Dynamic Proposition 1:

When routinization or revitalization strategies are implemented by focusing the company's efforts on decreasing/increasing the Extensiveness of flexibility mix and/or decreasing/increasing the responsiveness level, extra time will be needed to transmit the need

to change and re-design the organisational conditions efficiently to the organisation's members.

In the extended model, the growth of resistance to change is the consequence of the reinforcing loop (R2). Figure 10 represents the comparative analysis of both models in a revitalization strategy. Initially, pressure to change builds up rapidly and continues to build at a decreasing rate, exhibiting a pattern of goal seeking behavior until it reaches a fairly steady level by month 30. This pressure to change is accumulated and translated to the managers. The staff's resistance appears when organizations aim to implement the corresponding changes in responsiveness and extensiveness of FF. In revitalization strategies, this pressure is depicted as some routines and some process regulations which are implemented. For instance, both *chaotic* and *flexible* forms lack administrative stability due to the deliberate tendency of managers not to pay attention to the administrative structure.

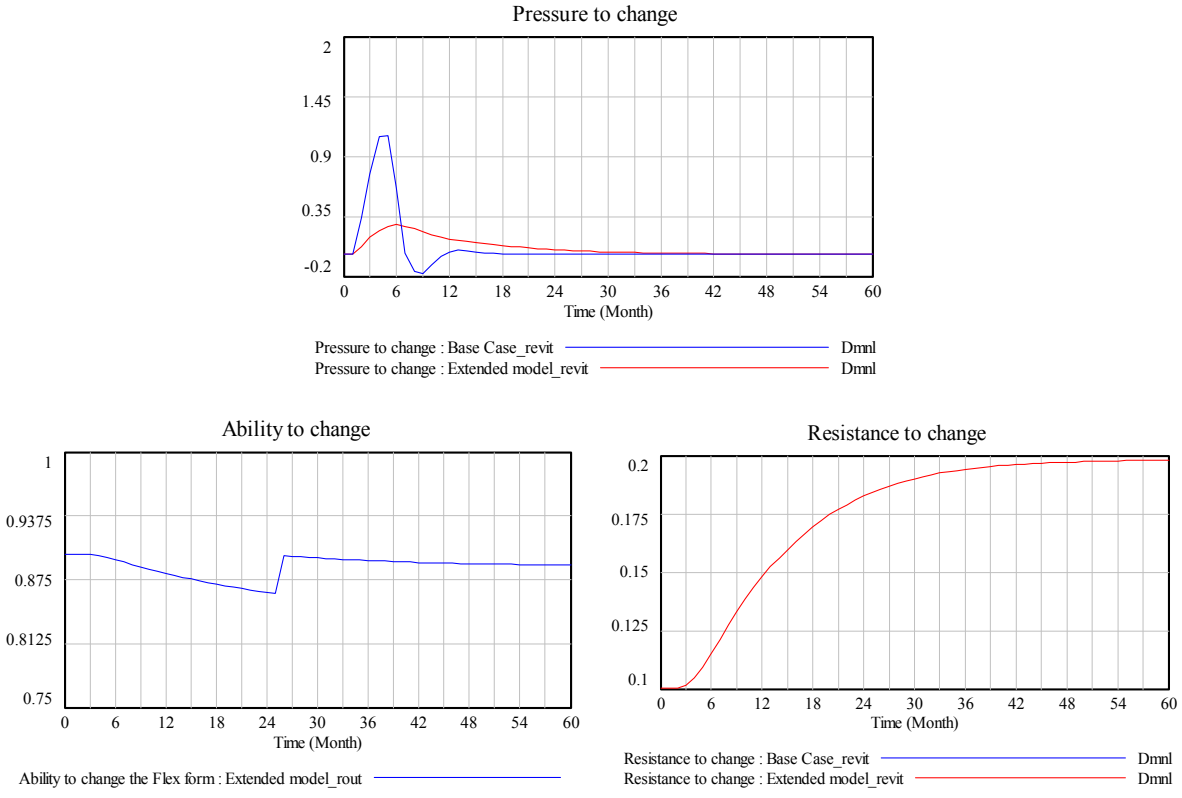

Figure 10 - Pressure to Change, Ability to change and Resistance to change in the extended model

Subsequently, excessive 'pressure to change' amplifies the 'resistance to change' when some routines are established and some process regulations are implemented. Growing levels of 'resistance to change' may lead to severe and disruptive administrative problems and the firm's 'Ability to Change' decreases because staffs do not want extra efforts in bureaucratic

statements. The achieved OF level through the dominant balanced loops may remain far from optimal. Figure 10 shows how the Pressure to change takes higher values in Base Case than in the Extended model once ability to change and resistance to change are introduced in the model. Resistance to change follows the predicted path of a "S-shaped growth" – growth is exponential at first and gradually slows until the state of the system reaches the equilibrium level.

Once Pressure to Change starts to increase the reinforcing loop R2 works as virtuous direction decreasing the Ability of the firm in balancing OF with the environment requirements. Through revitalization strategies, company efforts on achieving the OF optimal level generates resistance to change which may stop the adaptation process. The firm may lose its competitive advantage due to an excess of administrative structures or due to the totally new values and norms that are required and past experience may not provide any advantage. Consequently, as Figure 11 represents, the disequilibrium is higher in the Base Case due to the fact that there aren't any control over the resistance from staff. They have to be well informed about the change in order the firm achieve the desired results.

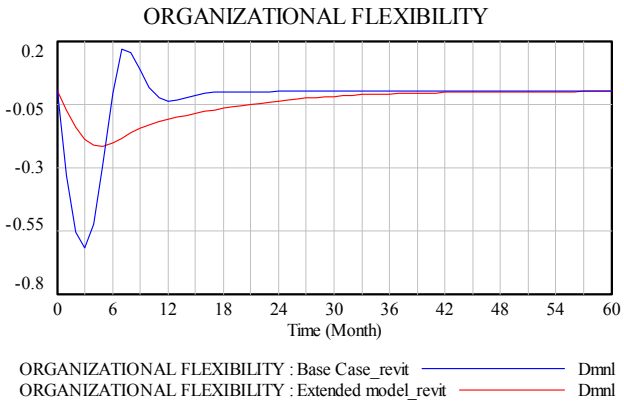

Figure 11 Comparison of Organisational Flexibility in both models

Dynamic Proposition 2:

Through routinization or revitalization strategies, company efforts on achieving the OF optimal level generates resistance to change which may stop the adaptation process. The firm may lose its competitive advantage due to an excess of administrative structures or due to the totally new values and norms that are required and past experience may not provide any advantage.

The second simulation tests and their results are gathered in the following table (Table 3).

Table 3: Summary of Propositions Generated from Simulation Experiments

Proposition	Firm's characteristics	Impact on OF
P1	Considering a Perception time which affects change rate of Metaflexibility	Favours more accurate perception of ET.
P2	Extra time will be needed to effectively implement and transmit the changes.	Allows to predict the changes by considering the delay
P3	Ability to change is influenced by the resistance to change	Some change strategies cannot be implemented or are implemented without success

5. CONCLUSIONS

This paper describes the first causal model of Volberda's theory applying System Dynamics. Based on the content analysis of the theory, Volberda's theory has been completed including variables that are important for organisational change but they were not included in the original text. The main aim of this research is to contribute towards a more robust organisational flexibility theory by uncovering flaws in the original development. In particular, we explore the impact of ET on the level of Organisational Flexibility along different lifecycle stages. The model developed in this paper incorporates some constraints arising from the implementation of change strategies.

The simulation model allows us to elaborate dynamic propositions related to several strategies of organisational change. Dynamic propositions developed by the authors support Volberda's framework as they illustrate the behaviour implied in his model but also, complement the transition guidelines proposed by Volberda. The simulation experiments conducted with the models demonstrate that the impact of change strategies on organisational flexibility is non-linear and complex in nature.

Initial findings suggest that these strategies can fail to manage change successfully. Failure can come from an anticipated decision of transformation when the environmental threats are not understood properly, when the implementation of new values, systems or processes take longer than expected, if the transformation in organisational design is delayed and when the resistance to change is big enough to inhibit any flexibility initiative.

Future research involves using real case studies to validate our dynamic propositions quantitatively. It is expected that the results propose several additions to existing explanations of the organisational change process, for instance, integrating new variables in the framework and evaluating the organisational response time to such strategies. In a further step, empirical

validation of both models, the first model and the extended one, will be provided by a longitudinal industrial field study of seven engineering enterprises during the period 2004-2011. This field study is undertaken to search for evidence of the implementation of flexibility practices. A qualitative analysis of the empirical data and SD simulation results on such an empirical data will be compared to support the contribution of SD modelling to the dynamic analysis of an organisational theory.

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Appendix: model documentation

The model was developed in Vensim, software for system dynamics (SD) modeling. The main abbreviations are:

OF: Organisational Flexibility

ET: Environmental Turbulence

FF: Flexible Form

PCh: Pressure to Change

R to CH: Resistance to Change

Equations of the extended model

$$ORGANIZATIONAL\ FLEXIBILITY(t) = \big(FLEX\ FORM(t) - perceived\ ET(t)\big) * Ability\ to\ change\ the\ Flex\ form \quad [1]$$

Unit: Dmnl

$$FLEX\ FORM(t) = (Extensiveness\ of\ flex\ mix(t) + Responsiveness(t))/2 \quad [2]$$

Unit: Dmnl

$$Perceived\ ET(t) = Perceived\ ET(0) + \int_0^t perceived\ ET\ change\ (s)ds \quad [3]$$

Perceived ET(0)= 3; Unit: Dmnl

$$perceived\ ET\ change\ (t) = (Environmental\ Turbulence\ (t) - perceived\ ET(t))\ /\ Perception\ Time(t) \quad [4]$$

Unit: Dmnl

$$Pressure\ to\ Change\ (t) = Pressure\ to\ Change\ (0) + \int_0^t INCREASE\ PCh\ (s)ds - DECREASE\ PCh(s)ds \quad [5]$$

Pressure to Change (0)= 0; Unit: Dmnl

INCREASE PCh = IF THEN ELSE (ORGANIZATIONAL FLEXIBILITY<0, (–1*(ORGANIZATIONAL FLEXIBILITY)), MAX((Pressure to change– ORGANIZATIONAL FLEXIBILITY), (–1*ORGANIZATIONAL FLEXIBILITY)))

DECREASE PCh = Fractional DECREASE PCh*Pressure to change

Fractional DECREASE PCh = GRAPH (ABS(OF))
GRAPH: (0,1),(1,0)

$$Metaflexibility(t) = Metaflexibility(0) + \int_0^t CHANGE\ in\ Metaflexibility\ (s)ds \quad [6]$$

Metaflexibility(0)= 3; Unit: Dmnl

$$CHANGE\ in\ Metaflexibility\ (t) = (Metaflexibility\ (t) * Pressure\ to\ change(t))\ /\ Implementation\ Time(t) \quad [7]$$

Unit: Dmnl

$$Extensiveness\ of\ Flex\ Mix(t) = Extensiveness\ of\ Flex\ Mix(0) + \int_0^t CHANGE\ in\ Extensiveness\ of\ Flex\ Mix(s)ds \quad [8]$$

Extensiveness of Flex Mix(0)= 3; Unit: Dmnl

$$CHANGE\ in\ Extensiveness\ of\ Flex\ Mix(t) = (Extensiveness\ of\ Flex\ Mix(t) * Pressure\ to\ change(t)) \ /\ Implementation\ Time(t) \quad [9]$$

Unit: Dmnl

$$Responsiveness(t) = Responsiveness(0) + \int_0^t CHANGE\ in\ Responsiveness(s)ds \quad [10]$$

Responsiveness(0)= 3; Unit: Dmnl

$$CHANGE\ in\ Responsiveness(t) = (Responsiveness(t) * Pressure\ to\ change(t)) \ /\ Implementation\ Time(t) \quad [11]$$

Unit: Dmnl

$$Ability\ to\ change\ the\ Flex\ Form\ (A) = f(Resistance\ to\ change) \quad [12]$$

$$f_A(1) = f_A^{min} > 0;\ f_A(0) = f_A^{max} = 1$$

Ability to change the Flex form = GRAPH (Resistance to change)
GRAPH: (0,1),(0.1,0.9),(0.5,0.75),(0.75,0.5)

$$Resistance\ to\ Change(t) = Resistance\ to\ Change(0) + \int_0^t INCREASE\ PCh\ (s)ds - DECREASE\ PCh(s)ds \quad [13]$$

$Resistance\ to\ Change(0)$= 0; Unit: Dmnl

Increase R to CH = Resistance to change*Fractional INCREASE Resistance

Fractional INCREASE Resistance = GRAPH (ABS(Pressure to Change))
GRAPH: (0,0),(0.5,0.1),(1,0.5),(2,0.75)

Decrease R to CH = IF THEN ELSE (Gap in Resistance>0.1, Resistance to change*Fractional DECREASE Resistance, 0)

Gap in Resistance = Resistance to change – Resistance goal

Parameters of the Base Case:
Environmental Turbulence: 4
Implementation Time: 12 months
Fractional DECREASE Resistance: 0.5
Resistance goal: 0.1