The final publication is available at

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Enhancing Enterprise Resilience through Enterprise Collaboration

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Abstract: Current environments, characterised by turbulent changes and unforeseen events, consider resilience as a decisive aspect for enterprises to create advantages over less adaptive competitors. Furthermore, the consideration of establishing collaborative processes among partners of the same network is a key issue to help enterprises to deal with changeable environments. In this paper both concepts, resilience and collaborative processes establishment, are associated in order to help organisations to handle disruptive events. The research objective is to identify collaborative processes whose positive influences assist enterprises against disruptions, reducing the effects of disturbances in dynamic environments.

Keywords: resilience, collaborative processes, enterprise collaboration, SME's

1. INTRODUCTION

Enterprise resilience is the capacity to withstand systemic discontinuities and adapt to new risk environments so that the enterprise can uncover and adjust to continually changing risks, endure disruptions and create advantages over less adaptive competitors (Starr et al., 2004). An enterprise is resilient in the face of whatever criticism if it has the agility, flexibility, speed and dynamism to change, quickly adapt and/or recover through aligning strategies, processes, technologies and people for achieving its objectives, in order to maximise the performance and ensure the enterprise ability to respond and adapt to continuous and increasingly severe environmental changes (Sanchis and Poler, 2011).

A new competitive environment has been developing for industries in recent years; this trend is forcing a change in the way how industries work, encourages building networks with greater adaptation and response and incites the establishment of collaborative partnerships with other companies globally extended. The success in a highly competitive and rapidly changing environment is associated with the improvement of organisations' skills in terms of dealing with new business models, strategies, management principles, processes and technologies in a collaborative way.

Soosay et al. (2008) define collaboration referring to the relationship between organisations in which the involved parties are committed to (i) invest resources, (ii) achieve mutual goals, (iii) share information, resources, benefits and responsibilities, (iv) make joint decisions and (v) solve problems in a collaborative way. Hence, establishing collaborative relationships within networked partners gives competitive advantages resulting in better performance than it would be without collaboration. In order to collaborate with other companies, SME's have to restructure their internal operations, information systems, production processes and strategies. According to Poler (2010) the benefits derived from network collaboration are leaded to (i) improve global competitiveness, innovation and adaptability of partners, (ii) enhance the exchanges between enterprises and create relationships, (iii) reduce costs by eliminating process inefficiencies, (iv) improve human resources work and skills, and clarify roles and responsibilities, (v) provide a better understanding of the dynamic processes, information flows and decisions and (vi) benefit end users, in terms of lead time and costs.

Partners' participation in collaborative networks has become today a key issue for any organisation that wants to achieve differentiated and competitive advantages (Camarinha-Matos and Afsarmanesh, 2005). In that way, the establishment of collaborative processes enhances partners' communication, coordination and cooperation, making things easy to cope with disruptive events. Therefore, collaborative management within the network is an important asset helping enterprises to gain competitive advantages in uncertain and dynamic environments (Camarinha-Matos and Afsarmanesh, 2005). Furthermore, collaboration allows enterprises to forecast disruptive events and have a more effective response against the effects of potential disruptive events (Shamsuzzoha et al., 2010).

This paper focuses on the enterprise resilience (section 2) through proposing a set of collaborative processes in order to proactively deal with consequences of disruptions (section 3). Section 4 provides an approach relating collaborative processes and conventional disruptions in order to allow enterprises to overcome the negative effects when disturbances take place. Specifically, three collaborative processes are outlined (sections 4.1-4.2-4.3). Finally, conclusions and future research are arranged.

2. ENTERPRISE RESILIENCE

Erol et al. (2010) define resilience as the ability of business organisations to reduce vulnerability, to change, adapt and quickly recover from the unexpected events. Through the literature review, Sanchis and Poler (2011) deduce that resilience is the response to unexpected and unforeseen

changes to disruptive events and disturbances, which is the ability for the company to adapt and respond to the environment and other enterprises' changes.

The research developed by Sheffi and Rice (2005) divide disruptive events in 8 different phases: (i) *preparation*: stage of companies anticipation and proactive attitude, (ii) *disruptive event*: any situation that threatens the daily operation of a company, (iii) *first response*: first decision after reaction, (iv) *initial impact*: immediately disruption repercussion, (v) *total impact*: the immediate or long term effects, once the disruptive event fully impacts on the company; in this phase the performance decreases significantly, (vi) *preparation for recovery*: starts in parallel with the first response, (vii) *recovery*: the stage in which the company returns to the state before the disruption and (viii) *long-term impact*: the time companies need, after a disruptive event, to recover depending on the severity of the consequences (Figure 1).
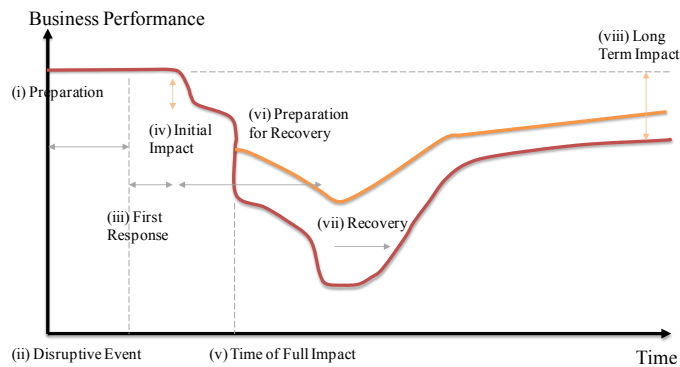

Fig. 1. Disruptions Phases (Sheffi and Rice, 2005)

The main purpose for companies is to anticipate to the effects of possible environment disturbances, improving their resilience and being more capable to recover them. Collaborative processes establishment allows enterprises to improve their abilities in order to (i) dialogue within networked partners about resilience priorities and (ii) allow better communication between organisations on common issues and resilience strategies (Sanchis and Poler, 2011).

This paper proposes a set of collaborative processes to allow companies to have a proactive behaviour in the *preparation phase*, in order to take appropriate decisions to minimise disruptions negative effects. Proactive actions contribute to obtain softer performance curves, and therefore generate lower impacts on the enterprise and network operation (figure 1, orange line). Therefore, the establishment of collaborative relationships among companies is a key issue to consider in order to overcome the disturbances' results. In light of this, section 3 develops the idea to collaboratively perform the processes done within the networked partners.

3. COLLABORATIVE PROCESSES AND ENTERPRISE RESILIENCE

In today's highly dynamic markets, the SME's absence of participation in collaborative processes provides important inefficiencies in networks operation, implying a lack of enterprise readiness and preparation to cope with possible

disruptions that may occur in the turbulent environment. The succeed against any disruption is carried out through companies change, adaptation and/or quickly recover, by aligning strategies, processes, technologies and people, in order to achieve their goals, maximise performance and ensure its ability to respond to changes in current environment (Sanchis et and Poler 2011). Organisations are increasingly exposed to possible disruptive events; hence, this paper focuses on the establishment of collaborative processes among companies of the same network to deal with this problem. Barroso et al. (2011) note that disruptions can cause interruptions in information, material and/or financial flows in one or more networked partners. Therefore, through the participation in collaborative processes, companies can, efficiently, overcome the negative effects of disturbances caused by the environment dynamicity.

Andrés and Poler (2012) identify the most relevant processes to establish collaborative relationships within partners of a network and classify them according to the decision making level: strategic, tactical and operational (see table 1). Considering the investigation of Lin and Shaw (1998) and the research of Andrés and Poler (2012), this paper provides a list of collaborative processes in which companies can participate in to reduce damages resulting from the effects when disruptive events occurs in the network environment. In light of this, the settlement of strategies involving collaborative processes within a supply network must include (i) coordination management policies, (ii) information exchange strategies (iii) synchronisation of materials' flow and availability of capacity, (iv) dynamic allocation of resources and (v) combination and alignment of networked partners' strategies (Lin and Shaw, 1998).

Difficulties that enterprises can find when decide to participate in collaborative processes, are caused by the inter-organisational barriers and the lack of capabilities to perform their activities in a collaborative way. In order to overcome these difficulties and deal with the collaborative processes, Andrés and Poler (2011) propose a set of solutions, divided into models, guidelines and tools addressing the most important enterprises' obstacles in the establishment of collaboration. Considering an approach offering solutions (Andrés and Poler, 2012) to the encountered barriers when SME's collaborate is essential for maintaining their performance against disturbances. Consequently, this paper provides an approach through the establishment of collaborative processes to enable enterprises to proactively deal with disorders resulting of any disruptive event. The main aim is to reduce enterprises' vulnerability through (i) the development of proactive actions to improve business resilience, (ii) the definition of strategies and action protocols, and (iii) seeking on solutions to address the possibility that a company can be affected by a disruptive event.

4. AN APPROACH TO DEAL WITH DISRUPTIONS

Currently, companies are increasing their awareness of the need to be prepared for interruptions (Steckel et al., 2004); thus, they have to take the appropriate decisions to mitigate the impact and consequences stemmed from the lack of enterprise resiliency.

Sheffi and Rice (2005) distinguishes between nine different types of conventional disruptions: (i) variability of networks, (ii) variability in the constraints capacity (iii) variability in the quality of products, (iv) variability on production performance, (v) uncertainty in demand, (vi) global competition, (vii) complexity in supply chains, (viii) greater variety in production and (ix) shorter delivery times.

In light of this, the paper provides an approach to help organisations to overcome conventional disruptions, defined by Sheffi and Rice (2005), in a more quickly and effectively way, through establishing collaborative processes and therefore, providing more rooted relations among companies. Thus, each identified collaborative process is associated with each of the disruptions. Thus, the companies' participation in collaborative processes implies a proactive solution to deal with possible disruptions.

So far, the way how organisations manage their business does not guarantee a rapid, effective and efficient response to unexpected situations. In that way, companies must identify what collaborative processes they should participate in, considering this participation as a supporting tool to avoid negative effects regarding the disruptions that arise in dynamic markets. Considering, that a company always operates within a network by acquiring the role of supplier, manufacturer or client, a disruptive event can result in partial loss of network components, disabling some of the connections among the partners (Hu et al. 2008). In order to address the loss of relations, collaborative processes participation enable networked partners to establish stronger relationships for obtaining advantages derived from both the collaboration and resilience improvements.

A set of collaborative processes that must be adopted by the companies for allowing them a major advantage so as to cope with the disruptions' appearance are arranged in table 1.

Table 1. Collaborative Processes (Andrés and Poler, 2012)

Strategic	Tactical	Operational
• Network Design • Decision System Design • Partners Selection • Strategy Alignment • Partners Coordination • Product Design • PMS Design • Coordination Mechanisms Design	• Forecast Demand • Operational Planning • Replenishment • Performance Management • Knowledge Management. • Uncertainty Management. • Negotiation Contracts among partners • Share costs/profits • Coordination Mechanisms Management	• Scheduling • OPP • Lotsizing Negotiation • Inventory Management • Information Exchange • Process Connection • Interoperability

For each type of disruption defined by Sheffi and Rice (2005) there are a number of specific collaborative processes that enable companies to overcome the situations arising in highly dynamic environments. Nevertheless, amongst the collaborative processes three of them are considered to be the common and prevalent ones to face up to disruptions. This collaborative processes are (i) interoperable processes, (ii) collaborative mechanisms and (iii) information exchange processes. Each of the above collaborative processes is developed below in next 3 sub-sections.

From the aforementioned processes, the contribution of this paper is to present an overview of the most relevant ones that

the SME's have to consider to regularly perform their activities even if a conventional disruption occurs. Apart from the three collaborative processes above said, other collaborative processes, identified by Andrés and Poler (2011), can be specifically used to overcome the disruptions identified and allow SME's, through the participation of each collaborative process, to achieve higher levels of enterprise resilience and maintain a balanced performance level both within the network and enterprise, even when a disruption appears (table 2).

Table 2. Collaborative Processes as a solution to deal with Enterprise Resilience

Collaborative Processes		Disruptions
Interoperable Processes Collaborative Mechanisms Exchange of Information Processes	Network design Decision system design Partners selection Strategy alignment	(i) Variability of Networks
	Negotiation contracts among partners Forecast demand Operational planning Replenishment Lotsizing negotiation Inventory management Order promising process (OPP) Scheduling	(ii) Variability in the Constraints Capacity
	Negotiation contracts among partners Product design Partners coordination	(iii) Variability in the Quality Of Products
	Process connection Scheduling Negotiation contracts among partners PMS design OPP	(iv) Variability on Production Performance
	Forecast demand Operational planning Replenishment OPP	(v) Demand Uncertainty
	Strategy alignment Partners coordination Partners selection Decision system design Share costs/profits	(vi) Global Competition
	Network design Decision system design Partners selection Strategy alignment	(vii) Complexity in Supply Chains
	Partners coordination Strategy alignment Product design Scheduling OPP Lotsizing negotiation Inventory management Process connection	(viii) Greater Variety in Production
	Scheduling OPP Lotsizing negotiation Inventory management Process connection	(ix) Shorter Delivery Times

4.1. Interoperable Processes

Interoperability refers to the ability of systems to exchange information and services in a heterogeneous organisational and technological environment (Chen et al., 2006). Systems' interoperability is one of the important pillars in the scope of business resilience due to facilitates the transfer of events and information flows at data, processes and services level among networked partners. Generating better responses against disruptions or even preventing the disruptions negative effects due to the greater communication fluency.

In order to deal with enterprise interoperability different architectures are developed in the literature to address it between organisations, such as Levels of Information Systems Interoperability (LISI) (Architecture Working Group, 1998), IDEAS (IDEAS, 2002), European Interoperability Framework (EIF) (Chen et al, 2005), INTEROP (Chen et al., 2006), and ATHENA (ATHENA, 2006).

Methodologies and tools to cope with interoperability are based on the application of different standards, in order to control the information systems. Conceptual frameworks, such as Collaboration Interoperability Framework (CibFw) aim to achieve interoperability in coopetitive business environments (Chituc et al., 2009). The Mediation Information System Engineering Project (MISE) is also a framework to support interoperability within the collaborative network (Bénaben et al., 2010).

Tools that facilitate the data exchange and information management to support interoperability are mostly based on service oriented architectures (SOA), enterprise service bus (ESB), web services, standards, UEML, Process Specification Language (PSL) and Semantic Web Services (SWS) (Elvesæter et al., 2006; Bénaben et al., 2010). Current trends, are adopting SOA patterns, enabling collaborative platforms to combine extended business processes management approaches jointly with oriented architectures to properly support interoperability requirements in collaborative networks, in order to facilitate the access to interoperable systems and enhance interoperability processes, services and data (Franco et al., 2009).

4.2. Collaborative Mechanisms

Network collaboration provides a reduction of risks and costs what means an increase of value, resources access and ultimately a competitive advantage. Collaborative mechanisms are cooperation forms to solve distributed problems, which consider both the distribution of tasks and the exchange of results (Smith and Randall 1981). Coordination mechanisms allow the networked partners to coordinate the operations against any disruption. Thus, collaborative mechanisms should be designed based on (i) the type of network, (ii) the type of decision-making, (iii) the type of collaborative partners, (iv) the sort of relationships and (v) the behaviour and knowledge of the networked partners (Fugate et al., 2006).

According to Fugate et al. (2006) coordination mechanisms can be classified into: (i) *price coordination*: quantity discounts, two part tariffs and return policy repurchase, (ii) *no price coordination*, flexibility in the amount, allocation rules, promotion and cooperative advertising, exclusive agreements and exclusive territories and (iii) *flow coordination*: vendor management inventory (VMI), quick response (QR), collaborative planning forecasting and replenishment (CPFR) and postponement. Most of the coordination mechanisms are built through models and methodologies. A brief summary is provided taking into account the results of the literature reviewed. So that, coordination mechanisms can be based on contracts negotiation, negotiation rules defined and verified by mediators (Fink, 2004), incentives or penalties (Chu and Desay, 1995), game theory (Smith and Randall, 1981), quantity discount policies (Sarmah et al., 2006), return policies, revenue-sharing policies -simple and two parts (Giannoccaro and Pontrandolfo, 2004), procurement policies, inventory control (Schneeweiss and Zimmer, 2004), tasks distribution, exchange of results (Smith and Randall, 1981), unified pricing policy (Lal and Staelin, 1984). Moreover, Camarinha-Matos and Afsarmanesh (2005) summarises a number of coordination mechanisms to consider in collaborative networks- distributed workflow, WfMC Reference Model, Modeling distributed business processes, PSL and WS-Coordination.

Networks evolution towards collaboration is a fact. Accordingly, collaboration has become a vital mechanism to cope with the global solutions that customers demand and deal with dynamic and turbulent environments. As a result, organisations must implement collaboration mechanisms to achieve collaborative relationships. In consequence, collaboration provides competitive advantages enabligh all the networked members to grow and obtain better results and achieve higher levels of resilience (Sahay, 2003).

4.3. Information Exchange Processes

Current manufacturing industrial environments require an intensive exchange of information and a strong support of information technology (IT) in order to establish common goals and achieve integrated solutions for providing visibility, agility and interoperability within the network to coordinate their joint activities and therefore reduce disruptions' effects. The exchange of information improves networks' efficiency, reduces costs by increasing the value of the performed activity (Corbett et al., 2004) and allows companies to have a rapid response to disturbances. Information management is characterised by the variety of the types of information sharing, access and visibility levels.

Networked SME's must implement collaborative mechanisms to support the exchange of information in order to overcome the consequences derived from the disruptions. The critical success factors for successful collaborative data sharing networks are classified in: (i) trust, (ii) common concepts and terminology, (iii) common principles and value systems, and (iv) harmonization of external socio factors (Sayogo and Pardo, 2011). In order to achieve that, different approaches defining guidelines for sharing information are provided in the literature, such as Open System for inter-enterprise information Management in dynamic virtual envirOnmentS European project (OSMOS) (Rezgui et al., 2000). On other

hand, tools are considered the most significant solutions to support the information exchange, providing the access through a Virtual Private Network (VPN). Moreover, specific platforms, such as the Net-Challenge ICT Platform (Carneiro et al., 2010), are presented to support firms in trust achievement among partners, share information and knowledge, manage network capacity and respond to events.

A summary of technological infrastructures for supporting information exchange is listed (Rabelo, 2008): computer supported cooperative work, workflow systems, "My" System, application service provider, component-based model, knowledge search & sharing, enterprise 2.0 & web 2.0, SOA (Kazem y Wentland, 2010), UDDI registries (Świerzowicz y Picard, 2010) and software-as-a-service (Saas) utility models, which helps collaborative customers to have more confidence when accessing to the services of the collaborative network members (Cancian et al., 2010; Perin-Souza and Rabelo, 2010). Particularly, Universal Description Discovery and Integration (UDDI) consists of a set of web-services providing information access of business or other entity and its technical interfaces (Świerzowicz and Picard, 2010). On the other hand, MAS are also used to address the information exchange problem. An example for distributed networks is the Social Behaviour Network tool (SoBeNet), a distributed multi-agent system which uses internet for allowing organisations to update the changed states after the agent executions (Jiang et al., 2010).

5. CONCLUSIONS

Companies find significant their capability to be resilient, which is the ability to reduce the level of vulnerability when they face with interruptions or adapt to disruptions. Furthermore, enterprises have to deal with the issue of how to adapt in the current environment to recover, as quickly as possible, from the consequences derived of the impact generated by a business interruption. This paper proposes a proactive solution to deal with the possible disruptive events through the SME's participation in collaborative processes. The proposed approach is a simple but effective one to be used by organisations in order to proactively address potential systemic discontinuities and thus increase their resilience. The participation in collaborative processes will allow the companies to increase the performance obtained comparing with the scenario in which collaborative proactive measures are not taken within the organisation. Companies' involved in collaborative processes have major advantages in order to respond to unexpected changes in extreme situations; providing greater resilience to recover against disruptions.

Future research is aimed at the approach application in order to diminish disruptions' consequences arising from the turbulent and dynamic environment the enterprises belong to. In the approach application collaborative processes have to be identified and applied. The implementation of standards and guidelines within the enterprises is other work to be done to achieve both collaboration and business resilience. However, the enterprises' participation in collaborative processes typically entails a number of difficulties that must be overcome to perform them correctly. The adoption of different tools and best practices to take part in collaborative processes is also a further work to be developed. Finally,

determine how collaborative processes improve enterprise resilience is an issue to address trough numerical examples.

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