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An assessment of organizational resilience potential in SMEs of the process industry, a fuzzy approach

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ABSTRACT

In order to establish adequate tools for the modern business environment, and with a need for new mechanisms with the goal of overcoming crisis and emerging disorder, the concept of organizational resilience has emerged. A high level of organizational resilience represents one of an organization's target values during a normal period of operation. In a period of crisis, the presence of resilience is even more needed; this is emphasized in the process industry because in these conditions when one process fails it may cause significant problems in other processes. The contribution of this paper is shown through a fuzzy mathematical model for assessment of organizational resilience potential in SMEs of the process industry. The model is verified through an illustrative example where obtained data suggest measures which should enhance business strategy and improve organizational resilience factors. This study forms the basis for a survey that may include a significant number of organizations from one region and future improvement based on benchmark and knowledge sharing.

1. Introduction

Business practice shows that all potential risks (Spekman & Davis, 2004) and their consequences cannot be identified in organizations, no matter how big they are or how much profit they gain. On the other hand, modern business is becoming increasingly complex, this is caused by the development of new technologies, which include information and communication technologies (ICT). Complexity and variable business conditions present the sources of risk that need to be managed, in the long term, in order to ensure the sustainability of an organization (Afgan, Hovanov, & Andre, 2009). Mechanisms that are traditionally used by organizations to deal with these sources of risk, e.g. risk management (ISO 31000:2008) or Business Continuity Management (BS 25999:2006), seem to be insufficient because most of the organizations are often faced with serious issues and some of them cannot achieve long term sustainability. An important need is to open the possibility of organizational resilience potential assessment and to clearly define its indicators (factors) which should present a clear picture of the organization's position in the market. This allows the opportunity to compare organizations and to enable their benchmark. The final consequence of this should be the defining of appropriate measures to improve business performance and to enable long term sustainability.

Motivation for this research is inspired by the fact that there is no unique mathematical model for assessment of organizational resilience potential which is widely accepted (Bhamra, Dani, & Burnard, 2011). The existing assessment models treating resilience of organizations (Gibson & Tarrant, 2010; Stephenson, Vargo, & Seville, 2010) and supply chains (Pettit, Fiskel, & Croxton, 2010) are continuously improving. The reasons for this situation can be found in the fact that there is no unique taxonomy of risks that could endanger an organization, nor a single list of organizational resilience factors. Since organizational resilience potential is described by imprecise data, this paper proposes an assumption that the relative importance of organizational resilience factors and their values are uncertainties, and they may be described by linguistic expressions. Modeling of these linguistic expressions is based on the fuzzy set theory (Klir & Folger, 1988; Zimmermann, 2001). The fuzzy set theory supports the subjective natural language descriptors of organizational resilience and provides a methodology for allowing them to enter into the modeling process. The focus of this paper is on organizations from the process industry. The process industry may be seen as a production industry using (raw) materials to manufacture non-assembled products in a production process, where the (raw) materials are processed in a production plant, where different unit operations often take place in a fluid form, and where different processes are connected in a

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continuous flow. Having in mind the continuous flow and connected process, it is very important to achieve resilience of such organizations. The proposed industries to be included in the frame of the process industry are among others: mining and mineral, food and beverage, pulp and paper, chemical, basic metal and other process industries. Although some of the companies from the process industry are large and multinational with sufficient resources to keep their organizations able and resilient, a number of organizations from this sector are small and medium sized enterprises (SMEs). Many scholars have established definitions of what constitutes an SME (Deros, Yusof, & Salleh, 2006). The category of micro, small and medium enterprises is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding 50 million euros, and/or an annual balance sheet total not exceeding 43 million euros (Article 2 of the Annex of Recommendation 2003/361/EC). It is also clear that SMEs are recognized as an important sector in the process industry for developing countries (for instance food and beverage) or as the policy in developed countries aiming to stimulate entrepreneurship in Europe, creating more jobs in the process industries (more interesting and higher quality jobs), the research community (world class research) and high-tech SMEs (new eco-efficient process technologies) by creating new markets.

Communities and business organizations might be conceptualized as a complex system (Crichton, Ramsay, & Kelly, 2009). Sustainability of a complex system, in this case an organization, is obtained through the constant interaction of its integral parts and environment. Within a changing environment, capable of significant turbulence, an organization is required to change, adapt and be resilient, in response to environmental fluctuations. The main contribution of this paper is the introduction of a fuzzy model for assessment of organizational resilience potential. The model is based on fuzzy mathematical support which makes it a robust and reliable tool. Bearing in mind that a model for the assessment of organizational resilience potential is proposed, it is followed by an organizational reference model, a definition of relevant organizational resilience factors and, in the end, by a mathematical description of the model achieved by using the theory of fuzzy sets. The proposed model does not define a unique set of organizational resilience factors but a conceptual model, convenient for quantification that is reliant on existing work (Dinh, Pasman, Gao, & Mannan, 2012; Gunasekaran, Bharatendra, & Giffin, 2011; Stephenson et al., 2010).

2. Literature review

Resilience has been widely examined in the context of ecosystems (Folke, 2006) and socio-ecological systems (Adger, 2000). From the socio-ecological perspective, scholars have agreed that studying organizational resilience requires an interdisciplinary approach and that a system approach represents an adequate solution. Within a system approach, resilience and its components are defined differently in varying perspectives (Bhamra et al., 2011). In the field of engineering, resilience is seen as the ability to sense, recognize, adapt and absorb variations, changes, disturbances, disruptions and surprises (Hollnagel, Woods, & Leveson, 2006).

If resilience is the focus of an organizational perspective (Hamel & Valikangas, 2003), it conveys the properties of being able to adapt to the overall requirements of the business. Organizational resilience implies the ability of an organization to withstand systematic discontinuities as well as the capability to adapt to new risk environments (Starr, Newfrock, & Delurey, 2003). Different definitions of resilience have an influence on its constituent elements and its assessed values in real business organizations. The mentioned issues have not allowed the creation of a scientific consensus on the constituent elements of organizational resilience nor an appropriate methodology for its comprehensive assessment.

Globalization has significantly increased clients' expectations all over the world. SMEs have to be innovative and be able to adapt to new challenges (Lee, Shin, & Park, 2012). In order to achieve this, SMEs have to combine old and new business models and to improve their resilience. This is very important because SMEs form the backbone of the EU economy – accounting for 99.8 per cent of non-financial enterprises in 2012, which equates to 20.7 million businesses (Wymenga, Spanikova, Barker, Konings, & Canton, 2012). In employment terms, SMEs provided an estimated 67.4 per cent of jobs in the non-financial business economy in 2012 which is very significant for the EU economy.

When SMEs are the focus, achieving resilience is determined by the market and by the SMEs own properties. SMEs have a limited approach to resources (Vossen, 1998) which makes them open and vulnerable to the external environment, so they have to define an appropriate strategy and assure the resources for achieving resilience. Potential for organizational resilience can be developed and managed through a business strategy. Defining the business strategy, aligned with strengthening resilience, may have an influence on sustainability of an SME and have an impact on longer term business performance (Lengnick-Hall, Beck, & Lengnick-Hall, 2011). If human involvement within organizations is in resilience focus, organizations should possess the resilient qualities of human resources since an organization is composed of the business and the people who are running it. Improvement in the field of HR may result in developing a capacity for organizational resilience which may lead to an effective analysis and response to different disruptions.

Besides relying on human resources in an organization, many scholars have appointed tools for improving organizational resilience, such as defining resilience antecedence (Demmer, Vickery, & Calantone, 2011), or have proposed a conceptual framework for resilience improvement as a continual change process (Ates & Bitici, 2011). The continual change and improvement go in favor of the philosophy of quality and the process approach which is one of the basic assumptions of this paper.

The concept of resilience is not new for the process industry, especially for large and multinational organizations. One of the key issues in resilience is the ability to perform continuous monitoring of a system and to follow indicators (factors) to identify the limits and the position of the system (Vidal, Carvalho, Santos, & dos Santos, 2009). The oil and gas industry use process oriented analysis such as HAZOP to enhance resilience, and complex organizations such as a power plant may conduct incident analyses (Carvalho, dos Santos, Gomes, & Borges, 2008). On the other hand, there is a wide range of SMEs with the need for a simple and reliable tool for assessment of organizational resilience, having in mind that different processes are connected in a continuous flow.

Organizational resilience might be analyzed as a fuzzy issue (Pendall, Foster, & Cowell, 2010) since a lot of events described with insufficient data, such as shocks, or "slow burns", have an influence on it. The concept of organizational resilience potential may seem to be an intangible one, but there can be identified appropriate organizational features which can reflect the overall size of it (Somers, 2009). In order to keep the measurement consistent, the assessment should be done on the level of organizational units with assets that can be influenced by managers. If industrial processes are the focus, contributing factors of resilience (Dinh et al., 2012) may be assessed, which can give a clear picture of the state of the processes and their ability to bounce back if disturbance occurs. Since there are a lot of variables that may influence resilience of critical processes (Carvalho et al., 2008) and the overall resilience of an organization, it may be helpful to employ a fuzzy approach while