

# Selecting management systems for sustainable development in SMEs: A novel hybrid model based on DEMATEL, ANP, and ZOGP

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## Abstract

In recent years, sustainable development strategy for enterprises has become an important issue around the globe. There are four management systems (i.e. ISO 9001, ISO 14001, OHSAS 18001, and SA 8000) that can help small and medium enterprises (SMEs) to create sustainable competitive advantages. In view of the fact that the shortage of resources – time, personnel, as well as money – rules most SMEs, this paper proposes a novel hybrid model for selecting optimal management systems under resource constraints, and illustrates the practical application of such a model through an example. This model first applies the Decision Making Trial and Evaluation Laboratory (DEMATEL) approach to construct interrelations among criteria that organizations require. The second step is to obtain the criterion weights through ANP. Lastly, ANP is integrated with a zero–one goal programming (ZOGP) model to obtain optimal alternatives with desired organizational benefits by fully utilizing limited resources. The purpose of this study is to present an integrated approach that could cope with the interdependencies among various criteria and deal with the constraints on resources, and to demonstrate how to select management systems for phased implementation. Therefore, the main contribution of this paper is to enhance the capacity of SMEs to effectively address the challenge of sustainable development through a novel model of prioritizing available management systems.

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## 1. Introduction

According to the Brundtland committee's report "Our Common Future", sustainability is defined as the ability to "meet the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). At the Rio Summit in 1992, the United Nations further expanded the above definition and adopted a set of principles to guide future sustainable development. The Declaration on Environment and Development defines the rights of people toward development, and their responsibilities to safeguard the common environment (Quaddus & Siddique, 2001). From then on, environmental and sus-

tainable development issues have been pushed to a higher priority on social agendas.

In taking a note from the "3 Ps" of Marketing, sustainable development can be said to have its own version of the "3 Ps", i.e. People, Planet, and Profit. All three aspects have to be satisfied before an entrepreneurial activity to be labeled as sustainable (Crals & Vereeck, 2005). Therefore, firms applying the concepts are often referred to as managing to the "triple bottom line" (Elkington, 1997). This approach to business – taking environmental, social and financial results into consideration in the development and implementation of a corporate business strategy – is a movement gaining momentum around the world. Many companies are evaluating and reporting on their social and environmental performance, in response to demands from consumers, employees and communities (Mowat, 2002).

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To achieve the goal of “triple bottom line of sustainability”, the implementation and certification of quality (ISO 9001), environmental (ISO 14001) and occupational health and safety (OHSAS 18001) systems has become an important activity (Zeng, Shi, & Lou, 2007). ISO 9001 has contributed to better quality, higher productivity, greater customer satisfaction, and greater profit. ISO 14001 has contributed to better environmental performance, greater eco-efficiency, greener products, and more transparency for and acceptance by external environmentally concerned stakeholders. OHSAS 18001 has contributed to safer and healthier workplaces, more efficient work processes, improved employee perceptions of the working environment, and greater recruitment attractiveness. SA 8000 has contributed to achieving higher social accountability and better employees’ quality of life (Robson et al., 2007; Rohitratana, 2002; Zwetsloot, 2003). In short, implementation of management systems would generate benefits for profit (quality), planet (environment) and people (health & safety and social accountability) to become sustainable entrepreneurs.

Today, these four management systems still have great potential for the companies those have not yet implemented them. While the gains of a whole range of sustainability certificates can be substantial in terms of risk control, improvement in business relationships with large companies, and good reputation, the question is being raised regarding how small and medium enterprises (SMEs) can achieve sustainable entrepreneurs. Shortage of resources – time, manpower, as well as money – is the rule for most SMEs (Crals & Vereeck, 2005). According to the resource-based view (Penrose, 1959), differences in resources should be utilized and lead to differences in sustainable competitive advantages. However, when SMEs brand themselves as sustainable entrepreneurs, they should be willing to devote time and effort to the project and select a simple, pragmatic and effective format that is tailored to their needs and compatible with their competitive strategies (Crals & Vereeck, 2005). Under the constraints of finite resources and budgets, SMEs cannot implement all the required management systems simultaneously. The decision-making involved in selecting appropriate management systems to create sustainable competitive advantages is a very important topic, which can be formulated as a multi-criteria decision-making (MCDM) problem.

There is still a lack of study regarding the integration of interdependent objectives of the SMEs and the allocation of the limited resources to selecting management systems so far; the paper thus presents a novel integrated model to solve this problem. To identify the interactions among evaluation criteria of alternative systems, the Decision Making Trial and Evaluation Laboratory (DEMATEL) approach (Fontela & Gabus, 1976) is used to construct a network structure with interdependent relationships. We could extract the mutual relationships of interdependencies among various criteria and the strength of interdependence (Tamura & Akazawa, 2005) by using this method. Since

these criteria are not independent, the conventional AHP, which is assumed as criteria independence, is not suitable to evaluate an MCDM problem in the real world. The ANP (Analytic network process) was proposed by Saaty (1996) to overcome the problem of dependence and feedback among criteria or alternatives (Liou, Tzeng, & Chang, 2007). Furthermore, the ANP approach is used to decide the relative weights of the criteria. It improves the visibility of decision-making processes and generates the priorities between the decision alternatives. In order to provide a systematic approach to set priorities among multi-criteria and trade-off among objectives, ANP is applied prior to goal programming formulation. The priorities obtained through ANP are then combined with a zero–one goal programming (ZOGP) model to handle the interactions between organizational objectives and the constraints on resources.

The purpose of this study is to present an integrated approach that could cope with the interdependencies among various criteria and the constraints on resources, and to demonstrate how to select management systems for phased implementation. Therefore, the main contribution of this paper is to enhance the capacity of SMEs to address the challenge of sustainable development more effectively through a novel model by prioritizing available management systems.

The rest of this paper is organized as follows. Sections 2 will review the literature on four management systems. Section 3 presents an integrated model for selecting management systems. An example for application has been illustrated in Section 4. Furthermore, several scenarios for different ANP priority weights and resources conditions are taken into account to verify the effectiveness of the model. Conclusions are presented in Section 5.

## 2. Management systems for sustainable development

Organizational sustainability is viewed as performance based on the triple bottom line (TBL) of economy, environment and social responsibility (Isaksson, 2006). The general objectives and basic principles of sustainable development may be understood through theories, but a consistent methodology to achieve sustainable development or maintain sustainability is practically difficult (Brent, Rogers, Ramabitsa-Siimane, & Rohwer, 2007). Crals and Vereeck (2005) point out that ISO 14001, EMAS, SA 8000, and AA 1000 can promote sustainable entrepreneurship in the perspective of management. Isaksson (2006) notes that total quality management (TQM) can improve sustainability.

On one hand, some academic studies focus on the benefits and effectiveness of standardized management systems (Boulter & Bendell, 2002; Briscoe, Fawcett, & Todd, 2005; Petroni, 2001; Poksinska, Eklund, & Dahlgaard, 2006; Robson et al., 2007; Rohitratana, 2002; Tsim, Yeung, & Leung, 2002; Zwetsloot, 2003). For example, Poksinska et al. (2006) demonstrate that the external benefit for the implementation of ISO 9001:2000 is like improved cus-

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