



## Evaluating supplier development programs with a grey based rough set methodology

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### ABSTRACT

Supplier performance management and continuous improvement play an important role for organizational and supply chain development. Many broad-based empirical studies have provided insights into the relationships of supplier development practices to supplier performance. Yet, specific tools available for organizations to internally evaluate such relationships are limited. To help further the research and development of decision tools in this area, we introduce a multi-method approach relying on grey system theory and rough set theory that can help organizations identify the important practices and programs related to suppliers' performance. Our contribution includes introduction of a methodological approach for evaluating supplier development programs and identification of effective programs and relationships. Implications and results interpretation of the methodology, limitations and future research directions, further expanding the methodology and its applications, conclude the paper.

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### 1. Introduction

Supplier management and development have been critical issues for organizational strategic and competitive advantage. As globalization, outsourcing, and core competency management philosophies become more pervasive the supplier–buyer relationship has become more central to organizational strategy. Managing the performance of suppliers and furthering their continuous improvement efforts is no longer a luxury and feel-good measure, but is a necessary investment for the long-term survival of organizations. Supplier development approaches and practices have been extensively proposed and documented in the literature. These studies incorporate and investigate a broad variety of supplier development programs. Organizations do not view these programs as trivial operational activities and may invest significant resources in them. Yet, not all supplier development programs contribute equally to the development and improvement of a particular organizational supply chain and supply partners. Aiding organizations to more easily identify effective supplier development programs can save time, money and resources.

Numerous studies have sought to determine which practices and programs effectively contribute to supplier development. Many of these studies are broad-based and provide insights into the rela-

tionships of these programs to supplier performance. But, these general theoretical relationships will vary depending on idiosyncratic industry and organizational characteristics. Thus, there is significant opportunity for formal models and decision support and expert system tools that organizations can utilize to help them improve and systematize their supplier development and improvement practices and programs (Gunasekaren, Macbeth, & Lamming, 2000; Simatupang & Sridharan, 2004). Interestingly, a critical aspect of strategic supplier development is the use of formal models and data driven approaches to help identify suppliers that need development support and the types of practices to include (Gunasekaren et al., 2000; Hartley & Choi, 1996). Yet, in industry it has been found that the level of implementation of these formal modelling practices to identify and manage supplier development programs has been very limited (Krause, Handfield, & Scannell, 1998). Researchers have also lagged in development of formal supplier development models (albeit supplier selection models have proliferated over the past two decades). Even today the extant literature has not considered any prioritization to address the “locus of investments” for supplier development initiatives (Narasimhan, Mahapatra, & Arlbjørn, 2008).

To help further the research and development of formal modeling and decision aid tools in this area, we introduce a multiple stage multi-method approach that can help organizations identify which organizational practices and programs relate to suppliers performance. This unique methodology integrates grey system with rough set theory. The methodologies, one used for intangible decision making (grey system), and one used for data mining

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(rough set) purposes, utilize previous performance results and practices that were implemented for given suppliers. With this methodology, the existence of quantitative, clearly defined data is not a necessity. Various types of captured data, qualitative, quantitative, tangible, intangible, and perceptual can be analyzed. The paper contributes to the literature by jointly linking these two techniques introducing and developing an approach for an under-served application area that is critically important to industry and supply chain management researchers. The practical outcome of this modelling approach provides organizations insights into supplier development practices and programs in which they should invest their available resources.

We begin by identifying previous research within the supplier development field to help identify important practices and programs used to aid suppliers. We also briefly identify some formal models in this area and provide an overview comparison between these models and the methodology proposed here. The two basic methodologies, grey systems and rough set theory are introduced with some general principles provided as background. An illustrative case application example sets the stage for describing the methodology in detail. Evaluation of the results in a follow-up discussion provides some practical interpretation. A final summary and conclusion incorporates additional discussion and identifies limitations and future research directions.

## 2. Supplier development practices

We first begin our background and developmental discussion with an overview of supplier development and then describe various methods and factors for its management.

One common definition of supplier development is “any set of activities undertaken by a buying firm to identify, measure and improve supplier performance and facilitate the continuous improvement of the overall value of goods and services supplied to the buying company’s business unit” (Krause et al., 1998).

Supplier development has garnered greater importance since the advent of international competition that exemplified, through automotive companies such as Toyota, how critical supplier networks were to global competition (Hartley & Choi, 1996). Much of the early supplier development focus was in reaction to crises that might arise with basic performance requirements. These programs evolved to involve joint efforts to improve both the competitive positions of the buyer and supplier, or the supply chain. One reason for this is a fact that the value of purchased parts and components in products may contain 80% of the value of the product (Hartley & Choi, 1996). It is thus a wise strategy that organizations implement effective supply chain management and development practices to manage this supplier contributed value associated with their products.

The supplier development process begins even before a product is manufactured and may relate to the design specifications of the products. Initially, the supply chains need to be constructed and is heavily reliant on the strategic capacity of the organization which sets the foundation for the supplier selection process and supplier network design (Sha & Che, 2005). Later in the supplier development process organizations need to determine which suppliers to include in the development process, the practices that will be followed, and the maintenance of these programs and suppliers. Part of the later maintenance activity may actually require that there is either growth or reduction in suppliers, which may include termination of relationships. Supplier development typically includes an evaluation of current supplier performance and expected performance as well as the type of relationship (strategic, commodity, etc.) that might exist (Dunn & Young, 2004). Strategically, supplier development should be closely aligned with an organiza-

tion’s corporate strategy which can range from a cost leadership to a product differentiation strategy (Harrison & New, 2002; Wagner, 2006). Thus, supplier development programs and their purpose further supports the need for effective evaluation benchmarking, whether internal or competitive, of supplier development practices and programs.

General studies have shown various practices such as supplier quality management programs can improve not only quality, but costs and other performance metrics associated with supplier development (Kuei, Madu, & Lin, 2001). Included among these general studies are the relationships between general groupings of practices such as trust building, financial investment, relational norms development, knowledge transfer, collaborative communication, bilateral management involvement, internal & external supplier integration, and socialization mechanisms (Das, Narasimhan, & Talluri, 2006; Giannakis, 2008; Lawson, Cousins, Handfield, & Petersen, 2009; Modi & Mabert, 2007; Narasimhan et al., 2008). Supplier development practices may also be grouped based on their sequence in the process. For example groupings based on early practices in identification of suppliers and performance areas, supporting suppliers, and later practices such as continuously improving suppliers (Krause et al., 1998). Even though there may be buyer managed development practices and supplier managed development practices that can be used for supplier development, in this paper we will focus on the supplier development practices of the buyer firm.

In a review of the literature on supplier development practices we came across numerous categorizations. Overall, we found that these practices can fit into four major categories as presented in Table 1, Knowledge Transfer, Investment and Resource Transfer, Feedback and Communication, and Management and Organizational Practices. These categories are not meant to be exhaustive or even mutually exclusive. There may be overlaps and relationships within and between factor groupings. Since the purpose of this study is to help develop a methodology to evaluate the performance of these supplier development practices, we will not delineate the strengths and weaknesses of each of these factors and practices. The purpose of this summary is to show the potential number and variety of programs that exist to help in supplier development programs and practices. Given the large number of potential practices firms can adopt, it is reasonable to assume that not all firms can afford to incorporate all these practices, or to determine the ‘locus of investment’ (Narasimhan et al., 2008). Thus, a firm with limited resources would seek to prioritize the investments to be made in these supply management practices. Decision models that help organizations in this prioritization or evaluation of supplier development practices are not extensively covered in the research literature. Most of the studies on supplier development practices, their antecedents, and outcomes (performance) have been studied either conceptually or in broad-based empirical surveys. These studies provide good overviews of relationships and their strengths and relationships in broad-based studies. Specific formal analytical models that help to evaluate how well specific supplier development practices are executed and to help organizations make decisions related to possible investments in these practices do not exist.

## 3. Supplier development models

In a review of the literature supplier development decision models that exist have primarily focused on evaluation and selection of suppliers (recent examples include: Amin & Razmi, 2009; Li, Tang, Luo, & Xu, 2009; Zhang, Zhang, Lai, & Lu, 2009), rather than on the evaluation of practices for supplier development. We shall not focus on the very broad research area of supplier selection models which usually centre on the very early steps of the supplier

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