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Developing Supply Chain Management System Evaluation Attributes Based on the Supply Chain Strategy

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1. Introduction

Given constantly fluctuating market demands, short life cycles of products and global market trends, companies must effectively design, produce and deliver products and services (Christopher & Juttner, 2000). A Supply Chain Management (SCM) system involves managing and coordinating all activities associated with goods and information flows from those raw materials sourcing to product delivery and, finally, to the end customers. A SCM system incorporates numerous modules of supply chain planning and execution, e.g., supply chain network configuration, demand planning, manufacturing planning and scheduling, distribution planning, transportation management, inventory and warehouse management, and supply chain event management, etc. This is why more companies are seeing SCM systems as the key to enhance the transparency, sharing, and trust of their supply chains.

Min & Zhou (2002) postulated that information technology (IT) provides the impetus for supply chain cooperation and re-engineering. Here, a SCM system is defined as an integrated enterprise information system (EIS) to realize the integration and collaboration of different stages within a supply chain and owns analytical capabilities to produce planning solutions, strategic level decisions and executing tasks of supply chain. A lot of companies invest large money and efforts in SCM applications to increase their competitive advantages and improve overall supply chain efficiency. As a SCM system becomes more organizationally encompassing, so that its selection is complicated in nature rather than just traditional information system (IS) selection (Sarkis & Sundarraj, 2000). However, many companies install their SCM systems hurriedly without fully understanding the implications for their business or the need for compatibility with overall organizational goals and strategies. The result of this hasty approach is failed projects or weak systems whose logics conflict with organizational goals. However, the impact of bad decision can be high not only in system operations but in terms of its impact on management attitude.

Davenport (1998) emphasized the technical factors are not the main reason EIS fail, however, the biggest problems are business problems. The performance of a SCM system basically relates to the degree of match between the available system functionalities and the company's requirements and also between the logic assumed in the system and that of the

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supply chain. Companies need to reconcile the technological imperatives of SCM systems with the business needs. Additionally, the supply chain implications, high resource commitment, high potential business benefits and risks associated with SCM systems make the selection and adoption a much more complex exercise in business strategies and innovation than any other software package. It seems obvious that we can not solve the SCM selection problem simply by grinding through a mathematical model or computer algorithm. A SCM assessment approach needs to be developed to include both strategic and technical considerations.

This chapter presents a decision analysis process to select an appropriate SCM system considering the strategies and operation routines of supply chain to link with the supply chain objectives of a company. However, this process emphasizes on a systematic SCM objective discussion and evaluating attribute development process, not on the mathematical decision-making models. Then, the process provides a structured methodology to link the objective structure with the decision-making model for choosing the proper attributes and evaluation guideline. An empirical case in Taiwan is described to demonstrate the practical viability of the proposed method.

2. Information system selection problem

Several methods have been proposed for selecting an adequate SCM or IS. In practice, scoring (Lucas, H. C. & Moore, 1976) and ranking methods (Buss, 1983) are very simple to implement the IS selection so that they are popular and applied widely. However, the primary limitation of scoring and ranking methods is too simple to truly reflect opinions of decision makers (Santhanam & Kyparisis, 1996). Mathematical optimization methods such as goal programming, 0-1 programming, and non-linear programming methods are also applied to resource optimization for selecting an IT system. Santhanam & Kyparisis (1995, 1996) presented a nonlinear programming model to optimize resource allocation. It considered the interdependencies of resources related to the assessment indicators. Lee & Kim (2001, 2000) adopted the analytic network process (ANP) to 0-1 goal programming model to choose an appropriate IT system. Talluri (2000) categorized SCM systems into three domains, i.e., strategic, tactical and operational planning systems, and then created a 0-1 goal programming model to optimally combine the three domains. However, the applicability of these above mathematical optimization methods is often weakened by sophisticated mathematic models or limited attribute set to carry out in a real world. In an EIS selection decision, like Enterprise Resource Planning (ERP) and SCM, some attributes are not readily intangible and not easy to understand by managers. A narrow focus on the tangible measures usually hinders a thorough and accurate picture of the true value of strategic objectives to organizations.

Fuzzy set theory is developed for solving problems in which descriptions of activities and observations are imprecise, vague, and uncertain. Fuzzy set theory has been used in IS selection, since the characteristics of a suitable IS selection are descriptive and ill-defined. For example, Lee (1996a) built a structure model of risk in software development and evaluated the rate of aggregative risk by fuzzy set theory. He aggregated the fuzzy grade of risk and the fuzzy grade of importance to evaluate the rate of aggregative risk in software development phase. Next, Lee (1996b) extended his model to propose two algorithms to tackle the rate of aggregative risk in a fuzzy group decision-making environment during any phase of the life cycle. Later, Chen (2001) defuzzied the both grades first to simplify the heavy and complicated calculations in Lee's model to evaluate the rate of aggregative risk in software development. However, these studies focused their attentions on the risks in software development phase and did not discuss other important factors on IS evaluation. Wei & Wang (2004) proposed a comprehensive ERP selection framework to select an ERP system using fuzzy multi-attribute decision-making (FMADM) approach. Their method combined the objective ratings and subjective evaluations to aggregate a synthetic index to assess ERP alternatives. Wei et al. (2007) applied the fuzzy integral method to develop a SCM selection framework. These fuzzy assessment approaches provide good mathematical decision-making methods to deal with ambiguity of human judgments.

Strategic discussions of effective supply chain management play a very important role in constructing the supply chain and business model. Many researchers emphasized that it is necessary to consider the strategic factors for selecting a SCM system. Fisher (1997) offered a framework to help managers to understand the nature of the demand for their products and devise the supply chain that can best satisfy that demand. Jiang & Klein (1999a, 1999b) proposed that the selection of IT projects varies by strategic orientation. They used a questionnaire to assess the strategic relevance of IT systems in an organization and measure the important IT system selection criteria. Their research results allow managers to position selection criteria according to their strategic use of IT.

Generally, a SCM system selection is a group multiple-attribute decision-making (MADM) problem, in which, some measures are not easily quantifiable. But the technical challenges, however great, are not the main reasons which lead to a SCM project fail. The biggest problems are business problems (Ash & Burn, 2003). In the next section, a systematic procedure is proposed to construct the objective structure taking into account company strategies and thus extract the associated attributes for evaluating SCM systems. The method also can help decision makers to set up a consistent evaluation guideline and facilitates the group decision-making process.

3. The SCM system selection objective and attribute development method

This section provides a process to develop appropriate objectives, attributes and detailed evaluation contents for evaluating SCM systems. To clearly present the proposed SCM implementation objective and attribute development method, a stepwise procedure is first described.

Step 1. Create a SCM system implementation project team and identify the characteristics of the supply chain.
Step 2. Develop the strategic objectives of the supply chain.
Step 3. Construct the supply chain structure.
Step 4. Establish the fundamental and means objective structures of the SCM implementation project.
Step 5. Extract the suitable attributes to structure the attribute hierarchy and develop the detailed attribute identifications.
Step 6. Screen the unqualified SCM systems.
Step 7. Evaluate the SCM systems.

Figure 1 displays the comprehensive procedure of the proposed method.

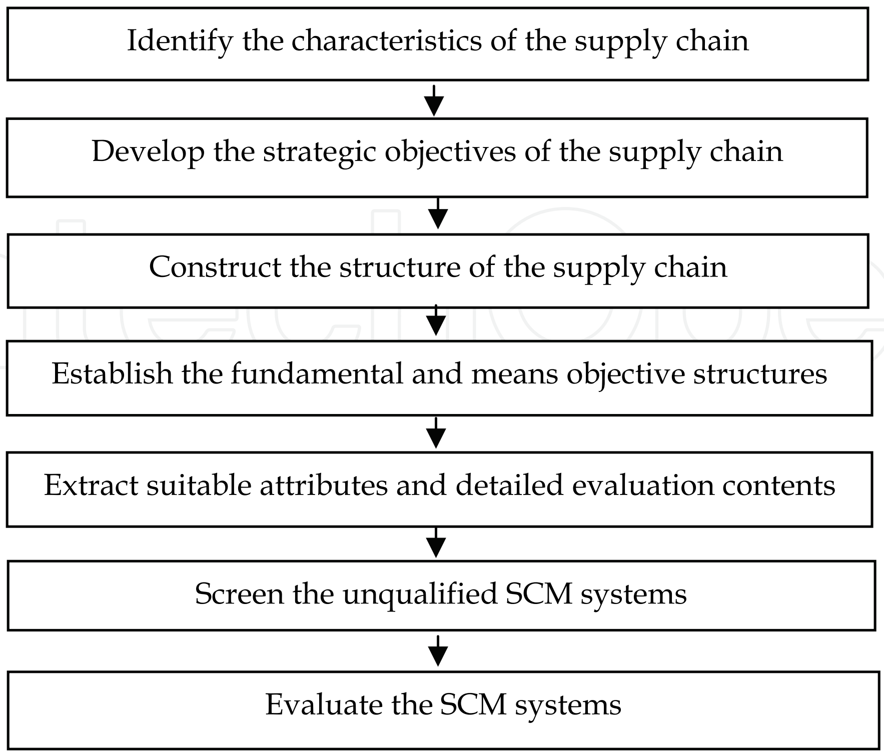

Figure 1. the SCM system evaluation attribute development and SCM system selection framework

3.1 Identify the characteristics of the supply chain

Elucidating the structure of a supply chain is necessary to model the supply chain links. To fully exploit the utmost benefits of these links, the project team should clarify the unique characteristics of each interconnected link (Min & Zhou, 2002). Correspondingly, the project team must identify the industry characteristics, client needs, product life cycles, as well as other crucial concerns to widely collect obstacles, information, and environmental trends of the current supply chain in order to develop the goals and network structure of the supply chain. Meanwhile, the company must perceive its current positions and influence in the supply chain. Such perceptions will help the project team in clarifying the scope of business process integration in the supply chain link model that the company can support and handle.

SCM system vendors and systems will significantly influence the long-term supply chain performance in the future (Talluri, 2000). As anticipated, the relationship with SCM system vendors should be also a long-term and close partnership. Thus, comprehensively accumulating information of related SCM system vendors and systems in the initial selection stage is essential, as well as ensuring that the survey includes less widely known vendors to avoid a situation in which more feasible projects are overlooked.

3.2 Develop the strategic objectives of the supply chain

Performance expectations of strategic objectives in the supply chain should correspond to the competitive strategies of the company. Three steps can be adopted in analyzing the elements of the supply chain and identifying the objectives to achieve strategy conformity

(Chopra & Meindl, 2001): (1) understanding the customers, i.e., the quantity of the product needed in each lot, the response time that customers are willing to tolerate, the diversity of the product line, the service level required, product price and the desired rate of innovation in the product (Fisher, 1997), (2) understanding the supply chain, i.e., effectively respond to broad consumer demands, meet short lead times, handle diverse products, create highly innovative products and strive for a high service level, and (3) achieving strategic fit, i.e., accommodate customer requirements and supply chain capabilities and ensure that all functions in the supply chain have consistent strategies that support the competitive ones. Other factors must be deliberated in developing the supply chain model, including the cooperativeness of major suppliers and customers, competitiveness of the industry and bargaining power of the company.

The strategic objectives of the supply chain offer a solid basis for decision-making and a stable reference point for ill-structured decision situations. The strategic objectives guide the ultimate goals that the project team should strive to achieve; thus they also serve as the mechanism to harmonize the opinions of different individuals within the project team.

3.3 Construct the supply chain structure

The significant emphasis on coordination and integration is strongly linked to the development of more effective and longer-term relationships between supply chain members. To fully exploit the benefits of the supply chain network, the project team should clarify the unique characteristics of each interconnected link. Making the scope of the SCM system implementation project clearly and recognizing applicable supply chain network are very important. Although there is no systematic approach to organize a supply chain structure, we suggest to follow the methods proposed by Lambert & Cooper (2000). Figure 2 indicates the supply chain network construction method.

1) Members of the supply chain. Integrating and managing all business processes into a SCM system would be inappropriate and expensive. When constructing the supply chain network, identifying who the members of the supply chain are is a prerequisite. Allocating scarce resources to the key links involves determining which parts of the supply chain must be highly prioritized as major links that depend on the core competence and contributions of this supply chain member. Recognize operational roles and decision rights for different members to align the strategic objectives of the supply chain with them.
2) Structural dimensions of the supply chain network. To compromise the dilemma between the complexity of supply chain model and the practicing applicability of the SCM system, the managers should choose the suitable scope of partnerships for particular links. Two dimensions, horizontal and vertical structures, exist in the supply chain network. The horizontal dimension provides the number of tiers across the supply chain. Correspondingly, the vertical structure refers to the number of suppliers and customers represented within each tier. The managers need to scrutinize which aspects of the supply chain should be modeled and identify the crucial boundaries of the supply chain model. The degree of strategic and operational coordination determines the relationship between a specific sypply chain member and our company.
3) Characteristics of supply chain links. Traditionally, many companies regard their own firms as the focal companies in the supply chain (Verwijmeren, 2004). Actually, sometimes a company is a primary member for a specific organization, sometimes it is a

supportive role in the supply chain, and it more often performs both primary and supportive operations. The managers must understand their interrelated roles in the supply chain according to a networked organization perspective. According to supply chain strategic objectives and linkage patterns, the project team can confirm the requirements of major processes in the supply chain model, which will be converted into the specifications of SCM system fundamentals when developing and evaluating an adequate SCM system. After the major processes are selected, the screening will extend to generate internal and external supply chain requirements with the matrix of management priorities and resource allocation.

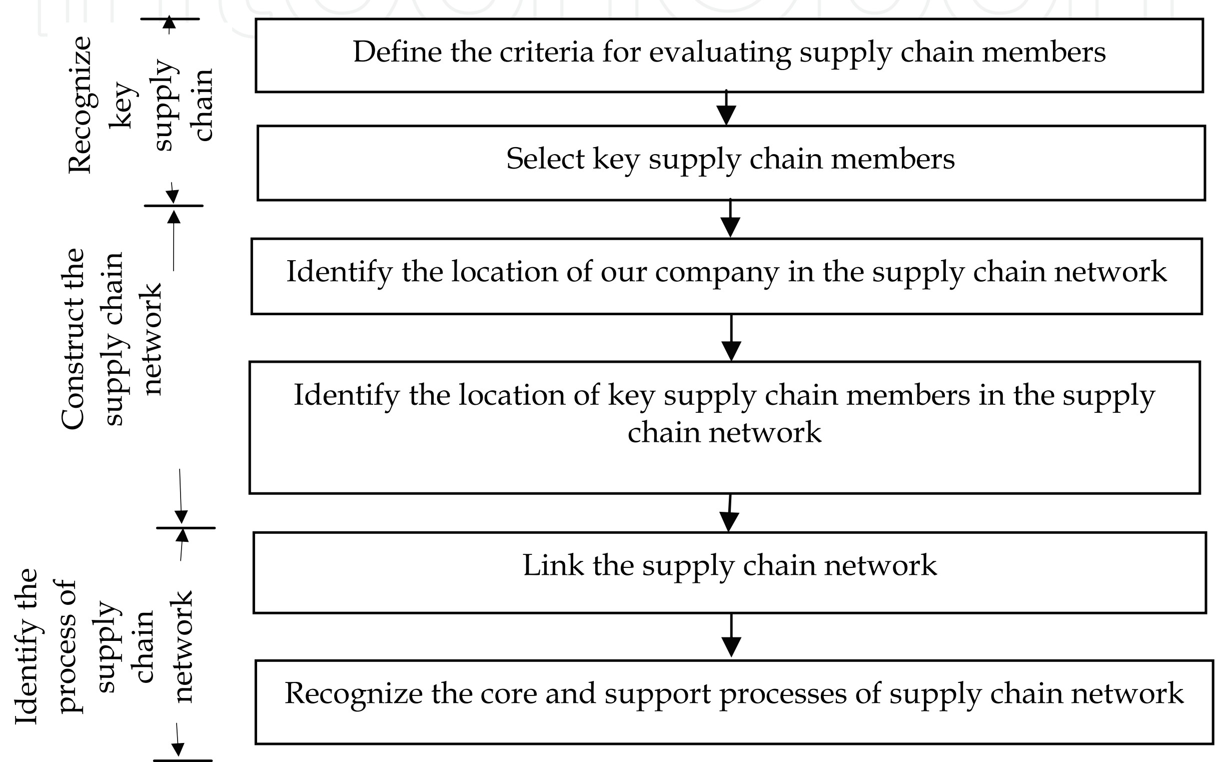

Figure 2 supply chain network construction process

According to supply chain strategic objectives and linkage patterns, the project team can confirm the requirements of major processes in the supply chain model, which will be converted into the specifications of SCM system fundamentals when developing and evaluating an adequate SCM system.

3.4 Establish the fundamental and means objective structures of the SCM implementation project

Structuring the objectives means organizing them so that the project team can describe in detail what the company wants to achieve and the objectives should be incorporated in an appropriate way into the decision model. Many different, even conflicting, objectives might be considered for developing a multiple objectives decision model to select a suitable SCM system. All objectives derived from the strategic objectives will be structured systematically. The objectives can be classified into fundamental objectives and means objectives (Clemen, 1996). The fundamental objectives are those that are important simply because they reflect what the decision makers really want to accomplish. The means objectives describe how they can help to achieve other important objectives.

The fundamental objectives are organized into a hierarchy and they indicate the direction in which the project team should strive to do better. The upper levels in the hierarchy refer to more general objectives and the lower levels comprise some important postulations of the upper objectives. Two methods can be used to establish the fundamental SCM objectives hierarchy, namely, top-down decomposition and bottom-up synthesis. By the procedure of top-down decomposition, the project team can ask, "What do you mean by that?". The answers reveal these lower-level fundamental objectives explain what is meant by the upper-level objective. On the other hand, team members can start from a lower fundamental objective upward by asking, "Of what more general objective is this aspect?" to find a more general objective by means of the bottom-up synthesis procedure. The upper levels in the fundamental objective hierarchy refer to more general objectives and the lower levels contain important elaborations of the upper objectives. As organizing the fundamental objectives hierarchy, the project team must keep in mind to pay attention to the limitation of decision elements and the alternation of business environment at any time.

Means objectives are organized into networks. Having formulated these means objectives, the project team can assure the ways to accomplish the preceding fundamental objectives. In addition, they can narrow the set of SCM candidates and develop the detailed specifications of attributes to evaluate the SCM systems. The project team can create a means objective apart from fundamental objectives by asking, "How could you achieve this?". The answers identify the corresponding means objectives and describe the linking relations among them. Then, asking the question, "Why is that important?", can help to distinguish the fundamental and means objectives and composite the means objectives toward fundamental objectives. Table 1 summaries the fundamental objective hierarchy and means objective network construction method.

	Fundamental objectives	Means objectives
To move: *Ask:*	Downward in the hierarchy *"What do you mean by that?"*	Away from Fundamental objectives *"How could you achieve this?"*
To move: *Ask:*	Upward in the hierarchy *"Of what more general objective is this aspect?"*	Toward Fundamental objectives *"Why is that important?"*

Table 1. Objective structure construction method (Clemen, 1996)

3.5 Extract the suitable attributes to structure the attribute hierarchy

After creating the structure of objectives, the project team can derive the attributes pertinent to evaluating each SCM system. Both quantitative and qualitative attributes that satisfy the strategies and goals of the company should be involved. Proper attributes guide to fulfill key requirements of a company such as strategic concerns and operational needs for assessing a SCM system and mapping out the project characteristics. After the factors addressed in previous studies are organized, we suggest to categorize SCM system selection attributes into four domains, including strategy, project, software system, and vendor factors. Some suggested attributes are introduced below.

1) Strategy factors: attributes that concern with the strategic objectives of the supply chain, for example, customer demand support, supply chain capability, domain knowledge support, and supply chain model design
   i. Customer demand support. A SCM system should support the needs for each targeted segment, like product position in the market, customer segments, product cycle, and service level, etc.
   ii. Supply chain capability. There are many types of supply chains, each of which is designed to perform different tasks well. According to Fisher (1997), it includes the responsibility of the supply chain and the efficiency of the supply chain. A SCM system must satisfy the charecteristics of the supply chain.
   iii. Domain knowledge support. Traditional SCM packages are generic in design, but they also need to meet a company wants to work specially. However, different industries may have different processes, operations, and other considerations. These systems are expected to provide the functional and domain knowledge fitness with the company's business processes. That is, the software should be designed to support the industry of the company.
   iv. Supply chain model design. The SCM system should be able to support the design of the supply chain model, including the plant and warehouse location, supply chain member choice, and supply chain membership formulation, etc
2) Project factors: attributes involved in managing the SCM system implementation project, such as total costs, implementation time, expected benefits, and project risks.
   i. Total costs. Usually, direct costs are easily measurable, while indirect costs require considerable effort to appraise. However, it is crucial to have comparative data across alternatives for evaluation purpose. These costs includes cost per module, total package cost, customization cost, annual maintenance cost, planning and implementation cost, consulting cost, installation and training cost, cost of upgrades and special hardware cost, etc.
   ii. Implementation time. Most of SCM systems failure originates in long implementation time and cost overspending. The project team should negotiate with the system vendors to estimate the implementation time of the SCM adoption project. A deliberate and detailed schedule is necessary to be planned and followed up.
   iii. Benefits. Like total costs, estimating the benefits exactly is difficult before the SCM adoption. Nonetheless, it is necessary to obtain comparative values on the benefits for evaluation purpose, as in the case of total costs. Many benefits can not calculated using monetary values, like enhancing operation efficiency, integrating and sharing information with supply chain members, improving the quality of decision-making, increasing the speed of response to customers. They are the main factors which attract companies to adopt a SCM system. Decision makers need to evaluate these benefits.
   iv. Risks. The project risk emanates basically from the budget of investment, the complexity of the system and the skill of project management. Many of these risks

stem from the intrinsic package design and the vendor's technology and experience, so should be carefully assessed during the evaluation process.

3) Software system factors: features of the SCM software system, including the system functionality, system flexibility, system integration, system reliability, user friendliness, and security.
   i. Functionality. Generally, this factor is the most significant attribute for most of companies. Different SCM software systems offer different functionalities and modules to meet the requirements of a company. Project team needs to examine whether the functionalities of a SCM system satisfies the requirements and operations. However, a lot of customization will lead to much cost and implementation time. Reducing the degree of customization is the main purpose to assess this attribute. In the Web era a SCM system needs to support Internet, network and e-commerce setups. High technology support for business integration is essential in broadening the marketing network.
   ii. Flexibility. The size of a company and its business process are hardly static and fluctuate with time. Flexibility offers the capability of a SCM system to support the needs of the business over its lifetime. The absence of flexibility will render the system corrupt and even obsolete. Firstly, the SCM system must be platform independent. All operating systems, communication systems and database servers should be implemented freely. Secondly, ease of customization and ease of development in house are critical factors whether the system can support the needs of the business in the future.
   iii. System integration. As mentioned above, a SCM system should be easily integrated with databases, data warehouses, operating systems and communication systems. Additionally, a SCM system must be easily integrated with other expanding SCM modules and EIS, like ERP, Manufacturing Execution System (MES) and Product Data Management (PDM), etc. System integration allows for the creation of one set of code that can be applied across a heterogeneous network without requiring users to have knowledge of where the components are physically resident.
   iv. Reliability. Moreover, faults occurred in the system run not only decrease productivity, but also diminish the confidence of users. Then the reliability of the system cannot be overemphasized during the evaluation process. The commonly used reliability measures are: number of faults in a fixed time interval and time between two faults. Additionally, the system recovery ability can complement the reliability issue.
   v. User friendliness. Employees cannot afford to spend a lot of time to learn a new software. User interface of the system has to be intuitive and reflect the mental picture of the business activities with which users are familiar. Easy to learning and easy to operating are very important factors which affect the success of a SCM system.
   vi. Security. The security of the databases and SCM system must be inviolable and information must be guarded from competitors and hackers. Security of the databases and of the SCM processes must be inviolable.
4) Vendor factors: attributes that pertain to vendors, like vendor's ability, implementation and maintenance ability, consulting service, and vendor's reputation.

i. Vendor's ability. In view of the expected longevity of a SCM system, the commitment of the SCM vendor to the product and his capability to support the system constitute crucial parameters. The system vendor should be able to support the global implementation missions and service jobs in the future. A SCM system requires technical maintenance support from the vendor. The pre-sales support, automated Web-based support and documentation support are accounted. Moreover, the vendor's R&D technology and the trainings that the vendor offers for users should also be evaluated.

ii. Implementation & maintenance ability. A SCM system requires sophisticated hardware and software system adoption during the implementation process. It may not only fit with the requirements of the company, but also support its complicated supply chain process. A good implementation methodology and experience of the vendor are crucial to adopt the SCM system successfully. More importantly, the maintenance and upgrade services would influence the life and performance of a SCM system after the implementation.

iii. Consulting services. Due to lack of understanding these SCM systems and their implications, management's difficulty in evaluating SCM alternatives and examining related projects imperatives is increasing at this early stage. For implementing the SCM system successfully, consulting service is a critical factor. The consultants facilitate the process of modules adoption, stabilize the applications and provide valuable experiences with the best practice. The experience of consultants, the cooperation degree between consultants and internal employees and the input resources density of the consultants constitute the quality and performance of consulting services.

iv. Vendor's reputation. Unless the vendor has a sustainable earning stream, the capability could be assessed like the market share, earning profile and the general health of the vendor's balance sheet. The vendors are asked to provide information which would enable the project team to assess them against basic commercial selection criteria, e.g. number of years in business, turnover, number of employees, research and development expenditure, product lines, industrial knowledge and experience, etc. Past performance and experience of the vendor as well as product are also considerable issues.

The project team can make reference to these attributes of prior studies. However, the fundamental objective hierarchy points out the important things that managers want to attain according to the strategic objectives of their supply chain. They had better developed their own critical objectives structure and select the appropriate attributes, which are measurable and be extracted from the fundamental objectives hierarchy, based on the current business environment and the requirements of the company. According Keeney (Keeney & Raiffa, 1993), the project team can examine and modify the attributes continually by some principles, e.g. the attributes should be complete, decomposable, non-redundant, operational and measurable, and minimal. Thus, the managers can perceive that these attributes are consistent with the company's objectives and strategies.

3.6 Screen the unqualified SCM systems

A large number of alternatives would be collected initially; hence we need a filtering mechanism to shorten the list of SCM candidates. The characteristics of the SCM implementation project, which the company wants, can be developed over a course of many meetings. The characteristics that reflect the requirements are transferred to a questionnaire or a checklist of the system specifications. Examining the means objectives network can help to scrutinize the system specifications and ensure these requirements can support the company's fundamental objectives. The listed vendors are requested to provide information in response to these specific questions. The project team can assess the information to eliminate the clearly unqualified vendors.

3.7 Evaluate the SCM systems

Many decision-making methods can be adopted to evaluate the various SCM or IS alternatives, like Delphi method, score method, ranking method, Analytic Hierarchy Process (AHP), fuzzy set theory, 0-1 programming method, etc. Despite the project team adopts any decision-making method to evaluate the SCM alternatives, the proper objectives and attributes development is the most critical process. Even if the project team does not employ any quantitative assessment method, a deeply and scrupulous examination or discussion can select an adequate SCM system. The development process of fundamental and means objective structure and decision-making model are summaried in Figure 3.

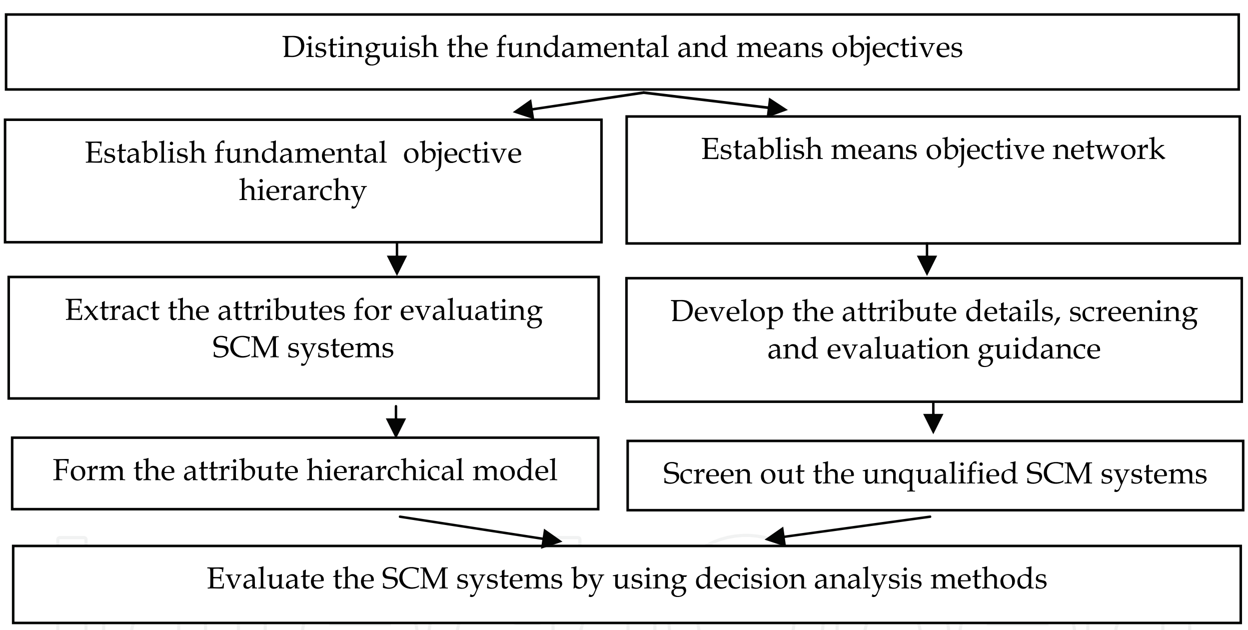

Figure 3. The objective structure and decision-making model development process

4. An actual evaluation

The proposed framework was applied to select an appropriate SCM system at a steel mill in Taiwan. This integrated steel mill produces plates, bars, wire rods, semi-finished products, and other steel products. After implementing the ERP system, the top management desired to enhance the effectiveness of its global supply chain by adopting a SCM system. The process of selecting the adequate SCM is described below.

Step 1. A project team involved seven senior managers was formed with the responsibility to formulate the project plan, integrate project resources, and select a suitable SCM system. Representatives of different user departments, information experts and consultants were also chosen to participate in the project team. The project team discussed the goals of the SCM system implementation project, the project scope, organizational strengths and weaknesses, potential alternatives, and other major concerns at the regular project team meeting. The team gathered information such as problems of the existing supply chain, industry characteristics, and client demands to recognize the characteristics of the supply chain. In addition, the project team held several promotional workshops to encourage employee engagement and support. These meetings produced numerous valuable recommendations, to which the project team responded during the project implementation to reduce resistance to the project.

Step 2. Because the steel industry is based on make-to-stock manufacturing principle, stock and cost are the most critical considerations. Following discussion among team members, the strategic objectives of their supply chain were defined as follows:

1) Supply the market demands at the lowest price under meeting quality requirements;
2) Minimize inventory in the entire supply chain to reduce the total holding cost;
3) Maximize productivity and turnover rate of equipments to lower the operating cost;
4) Select the adequate suppliers based on cost and quality;
5) Adopt the low cost logistics technologies;
6) Develop new products under the minimizing cost constraint.

Step 3. Determining which parts of the supply chain deserve management attention must be weighed against the capabilities, contributions, and priorities of the supply chain members to the steel mill. Based on the importance and priority to the steel mill, suitable supply chain network members were selected for consideration. The major links were the tier-1 key direct suppliers and clients, warehousing vendors and distributors in the supply chain. Some crucial operations of the other tiers, including indirect suppliers, customers and organizations in the supply chain, formed the monitoring links.

Step 4. The project team constructed the fundamental objective hierarchy and the means objective network. Figure 4 indicates the fundamental objective hierarchy. The ultimate goal was to "select an appropriate SCM system". This goal were divided into four lower-level objective factors, namely strategy, project, system and vendor factors. For example, the project team discussed "What does choosing the most appropriate SCM system mean?" in the system factor aspect. Their answers included that the system has satisfied functionality and technology, high system flexibility, and system integration ability. The members further discussed "What does the complete functionality and technology mean?" to drill down the objectives of system functionality and technology. The answers lay in module functionality, system user friendliness, system reliability and quality, and system security. Similarly, the top-down decomposition method found the other objectives in level 3 and level 4 and established the practical meanings of these objectives.

Simultaneously, the project team synthesized the lower-level objectives into more general objectives to verify the consistency of the fundamental objective hierarchy and thus refined the hierarchical structure previously derived from the top-down decomposition method. Indeed, this process was iterative and the structure was not unique.

On the other hand, Figure 5 and 6 show the means objective networks of the SCM adoption project in the software system factors and vendor factors. For example, the project team started from an objective, functionality, the bottom of a system fundamental objective by asking the question, "How can the suitable module functionality be acheived?". They

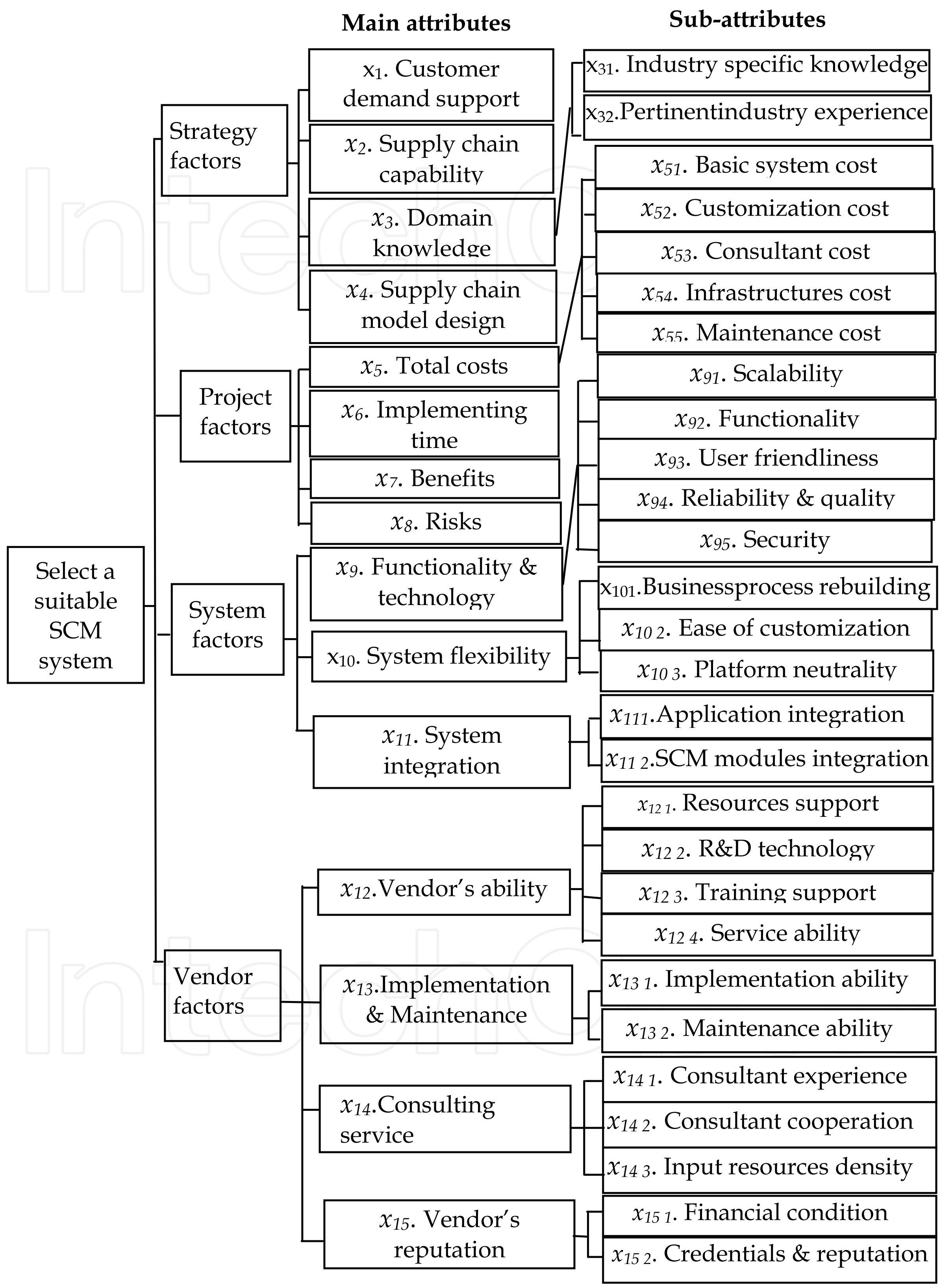

Figure 4. The fundamental objective hierarchy

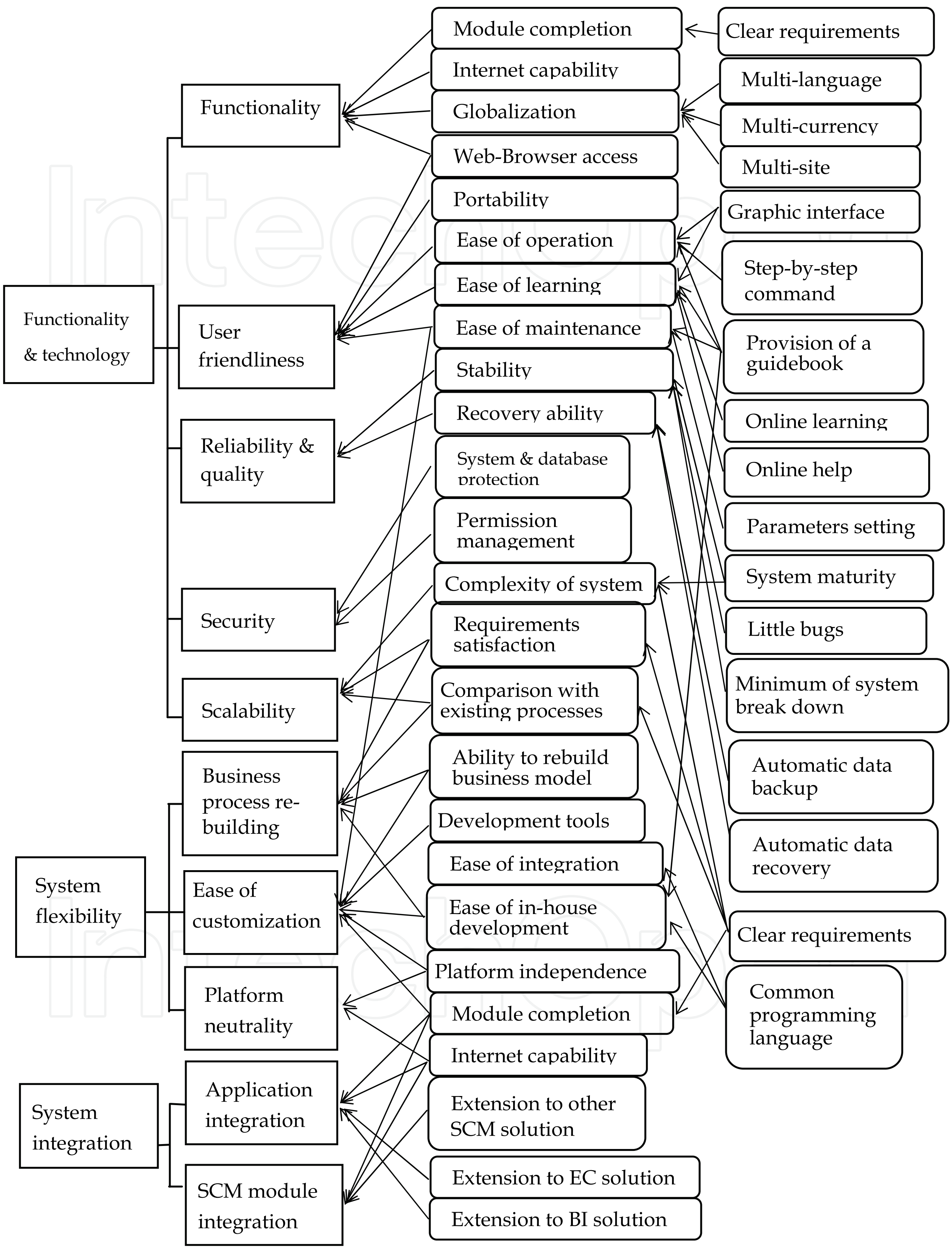

Figure 5. The means objective network of system factors

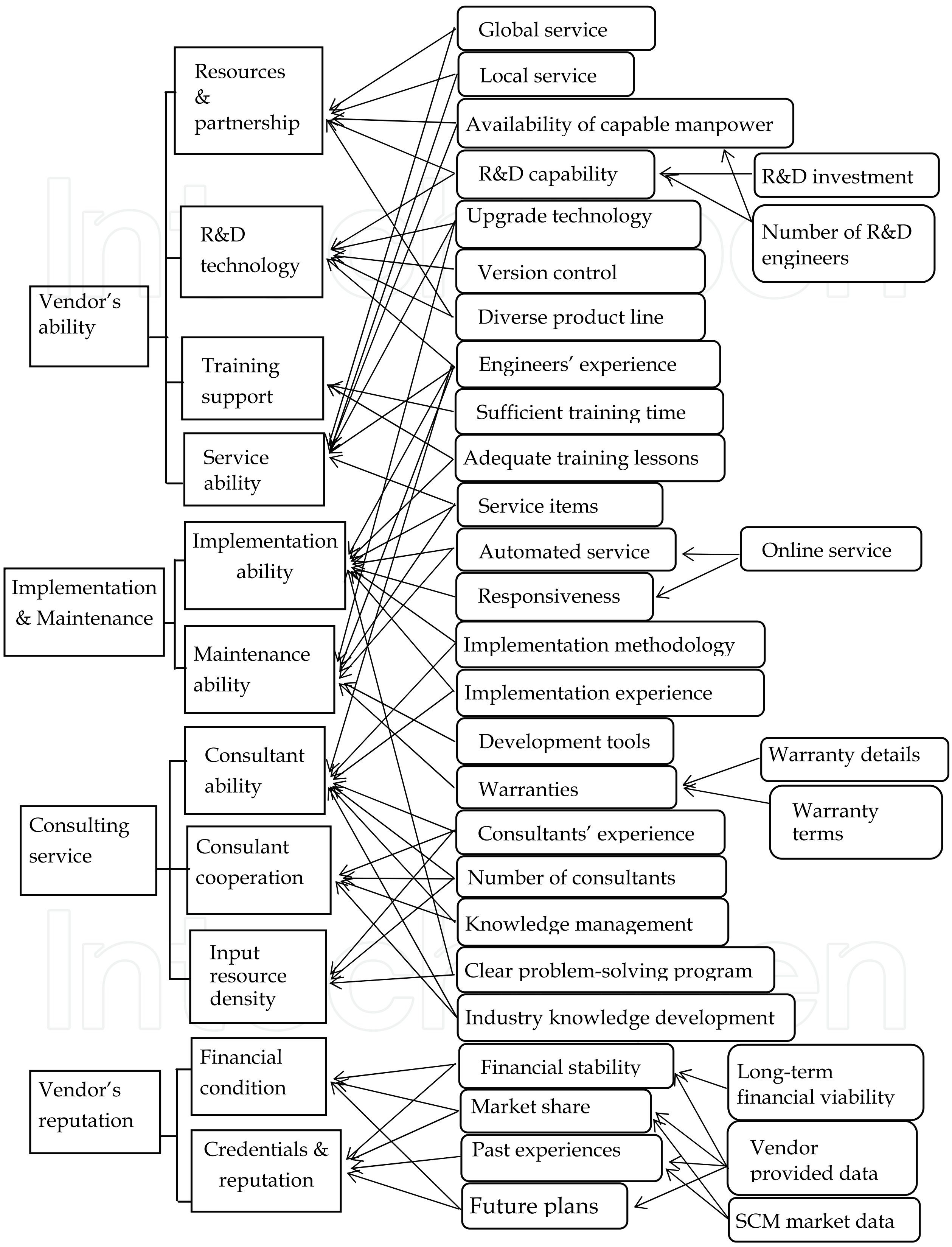

Figure 6. The means objective network of vendor factors

concluded that the system can provide complete modules, has good Internet capability, support global operations, offer Web-Browser access, and satisfy the requirements of existing processes. Futhermore, if they wanted to attain the means objective, module completion, they needed to recognize and offer clear requirements about the SCM system. Following similar approach, we systematically elaborated the cause–effect relationships among all the means objectives into a complete network. Similarly, the project team incorporated other means objectives into the network in a logical way. Also, the project team repeatedly examined all means objective linkages in order to confirm every relationship was reasonable. The process was iterative and diagnostic.

Step 5. The fundamental objective hierarchy was translated and modified to generate an attribute hierarchy for evaluating various SCM systems. In Fig. 4, level 3 consists of the main attributes that are used to measure various SCM systems and vendors. Level 4 contains the sub-attributes of some main attributes. Using the means objective network, the project team established the evaluation criteria and specific requirements. This process can ensure that everyone follows the same criteria in the evaluation process consistently.

Step 6. Information about SCM systems and vendors were widely surveyed from industry magazines, exhibitions, the Internet, and yearbook. Unfavorable alternatives were eliminated by asking the listed vendors a few questions, which were formulated according to the means objective network. After preliminary screening, three vendors PA, PB, and PC, were remained for further evaluation. Intensive interviews and meetings were scheduled with each vendor. Core business flow and special features were assessed by running demo scenarios and examining the capacity of each system to fulfill key demands. Finally, user representatives conducted unit tests to evaluate system feasibility.

Step 7. The company evaluated the three SCM alternatives using the fuzzy multi-attribute decision-making method. Readers can refer to Wei et al. (2007). After the decision makers' quantitative and qualitative assessing and methematical aggregating, the ranking order was P_A, P_B, and P_C. The most suitable SCM project was P_A. The project team thus recommended SCM system P_A as the most suitable selection for the company.

5. Conclusion

In this chapter, we proposed a framework to select an adequate SCM system based on the decision-analysis process. By the proposed procedures, the company can identify the elements of SCM project selection problem and formulate the fundamental objectives hierarchy and means objectives network, which are aligned with the goals and strategies of the company. The pertinent attributes for evaluating a variety of SCM systems and vendors can be derived according to these objectives structures. Some suggested attributes also were introduced.

The development process of the SCM fundamental objectives and means objectives are the most critical step in a SCM system selection project. The objective development method can fit to any quantitative and qualitative decision-making method. Additionally, the objectives structure of SCM selection can be developed and refined by the decision analysis process. The method can fully reflects the decision makers' cognition, the requirements of company, and the proper direction to achieve the objectives, even if the project team does not use any quantitative evaluation method.

In addition, using the proposed framework is very flexible to accommodate additional attributes or new decision maker in the evaluation. It is found that the framework can reduce the time taken to obtain the consensus of multiple decision makers.

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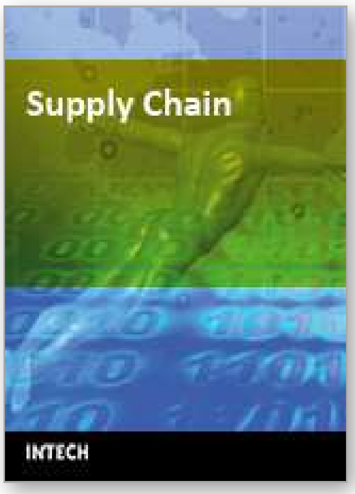

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Traditionally supply chain management has meant factories, assembly lines, warehouses, transportation vehicles, and time sheets. Modern supply chain management is a highly complex, multidimensional problem set with virtually endless number of variables for optimization. An Internet enabled supply chain may have just-in-time delivery, precise inventory visibility, and up-to-the-minute distribution-tracking capabilities. Technology advances have enabled supply chains to become strategic weapons that can help avoid disasters, lower costs, and make money. From internal enterprise processes to external business transactions with suppliers, transporters, channels and end-users marks the wide range of challenges researchers have to handle. The aim of this book is at revealing and illustrating this diversity in terms of scientific and theoretical fundamentals, prevailing concepts as well as current practical applications.