DEVELOPING AN ASSESSMENT FRAMEWORK FOR MANAGING SUSTAINABILITY PROGRAMS

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ABSTRACT

This paper applies a Fuzzy Analytic Network Process (FANP) in supplier selection based on the Triple Bottom Line (TBL). It shows that the use of FANP helps to capture the imprecision in human judgment while TBL enables the consideration of social development, environmental protection, and economic development issues. With TBL, a holistic view of the company is taken in the decision making process. A case study using ten company executives from an anonymous Taiwanese company is used to illustrate the framework. The results show that product design for sustainability and green supply chain management are the most important factors in supplier selection.

Keywords: Triple Bottom Line, Fuzzy ANP, Case Study

INTRODUCTION

Sustainable operations are needed to create value and customer care. Sustainable operations system may be implemented by focusing on: social development, environmental protection, and economic development. These three areas constitute what is known as the triple bottom line (TBL). Promoting and implementing executable plans toward the TBL was of paramount importance during the rapid growth of HP in the past decade. Enterprises of all sizes are now embracing TBL (Lee & Kim, 2009; Ciliberti et al., 2008). One of the challenges to modern enterprises is to analyze alternatives for improvement in TBL performance. Good strategic decision making is thus fundamental for achieving TBL. To this effect, it is important to choose the best set of decision making tools for both decision makers and stakeholders. The knowledge of critical TBL dimensions when developing sustainability programs thus is an important issue.

In this study, we adopt a Fuzzy Analytic Network Process (FANP) approach to empirically illustrate its potential on a supplier selection problem in the domain of sustainability management. The ANP is a model of choice when dealing with more complex decision making problems (Lin & Tsai, 2010). The use of numbers is needed as a quantitative expression of decision makers' judgment. Moreover, fuzzy set theory is used to provide a sound basis for a more effective expression of fuzziness and procedures for dealing with the situation where there is no certainty with respect to the experts' judgment. Therefore, a FANP application to TBL is needed to address the multi-criteria and the multi-stakeholders that are involved in reaching TBL decisions. To fully address this concern, a strategic decision framework for applying sustainable criteria to a supplier selection problem is proposed and illustrated in this study.

RESEARCH BACKGROUND

Dimensions of the Triple Bottom Line

The TBL model suggests that businesses should focus on: social development, environmental protection, and economic development. To address the sustainability of a firm, Hutchins & Sutherland (2008) display four fundamental flows in and out of a company: information, physical substances, human resources, and financial resources. Sustainability requires that enterprises maintain the integrity of social and environmental systems while reconfiguring information, physical substances, and human resources to maximize their financial performances. The development of environmental system focuses on Green Supply Chain Management (GSCM). Srivastava (2008) defines GSCM as "integrating environmental thinking into supply chain management including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life."

Using the Dow Jones Sustainability Indexes, Lo & Sheu (2007) prepared a list of corporate sustainability assessment criteria. In the area of social development, key items are corporate citizenship/philanthropy, stakeholder engagement, labor practice indicators, human capital development, knowledge management/organizational learning, social reporting, talent attraction and retention, standards for supplier, and industry specific criteria. For the environment cluster, major items include environmental policy, environmental performance, environmental reporting, and industry specific criteria. As for the economic development group, nine items are listed. They are codes of conduct, corporate governance, customer relationship mgt. financial robustness, investor relations, risk and crisis mgt. scorecards/measurement systems, strategic planning, and industry specific criteria. Kuei & Madu (2009) also offer their version of corporate sustainability assessment criteria. In total, ten items are considered in their study: competence trust, contractual trust, goodwill trust, supplier base, product design for sustainability, strategic and internal benchmarking, supply chain management, end-of-life management, lean system, and six sigma operations (see in Table 1).

Table 1 Dimensions considered in our Triple Bottom Model

Clusters	Dimensions	Sub-dimensions	Author(s)
Social Development	Competence Trust	Human Capital Development	Chen et al. (2009); Costantini & Monni (2008)
		Talent Attraction and Retention	Coldwell et al. (2008); Gardiner et al. (2003)
		Knowledge Management and Organizational Learning	Franz (2010); Liao et al. (2010)
	Goodwill Trust	Corporate Citizenship/Philanthropy	Lee & Kim (2009); Carroll (1991)
		External Trust	Ciliberti et al. (2008); Liu et al. (2008)
	Contractual Trust		Heffernan (2004); Madu & Kuei (2004)
Environmental Protection	Environmental Management	Green Supply Chain Management	Guide & Van Wassenhove (2009); Srivastava (2008)
		End-of-life Product Management	Ravi et al. (2007)
		Strategic and Internal Benchmarking	Kuei & Madu (2009); Madu (2006)
		Product Design for Sustainability	Knight & Jenkins (2009); Kasarda et al. (2007)
	Environmental Reporting	Environmental Reporting	Brown et al. (2009); Ciliberti et al. (2008)
		Supplier Base	Zhu et al. (2010); Hsu & Hu (2009)
Economic Development	Business Management	Corporate Governance	Windsor (2009); Centrone et al. (2008)
		Customer Relationship Management	Chalmeta (2006); Madu & Kuei (2004)
		Quality Management (QM)	Kaynak & Hartley (2008); McAdam et al. (2008)
	Financial Management	Risk and Crisis Management	Seuring & Muller (2008); Hoti et al. (2007)
		Investor Relations	Lee & Kim (2009); Lehavy & Sloan (2008)

Background of the Analytic Network Process model and Fuzzy ANP Models

The Analytic Network Process (ANP) can be used by decision and policy makers to present a non-linear network structure of multi-criteria decision making problem with possible interdependences and feedbacks (Saaty & Sodenkamp, 2008). A hierarchical structure, normally adopted by the widely used Analytic Hierarchy Process (AHP), is a special case of the ANP. Sarkis & Talluri (2002) applied ANP for decision making within the green supply chain. Sarkis (2003) points out that the major drawback to ANP application is the large amount of decision-maker input that is required. However, the ANP is a viable alternative to the AHP and other multi-criteria approaches since it allows decision and policy makers the flexibility to identify major interdependencies among many factors and clusters (Sarkis, 2003). The essential steps in the application of the ANP, according to Ayag & Ozdemir (2009), are (1) Model construction and problem structuring, (2) Pairwise comparison matrices between component/attribute levels, (3) Pairwise comparison matrices of interdependences, (4) Calculating consistency ratio for each pairwise comparison matrix, and (5) Super-matrix formation and analysis. The final outputs of this process include local weights and global weights for survey items. Tseng et al. (2008) conducted a field study in Taiwan to investigate the relevant variables that impacted the effectiveness of cleaner production implementation. They use the triangular fuzzy numbers as a pairwise comparison scale for deriving survey items' local weights and global weights.

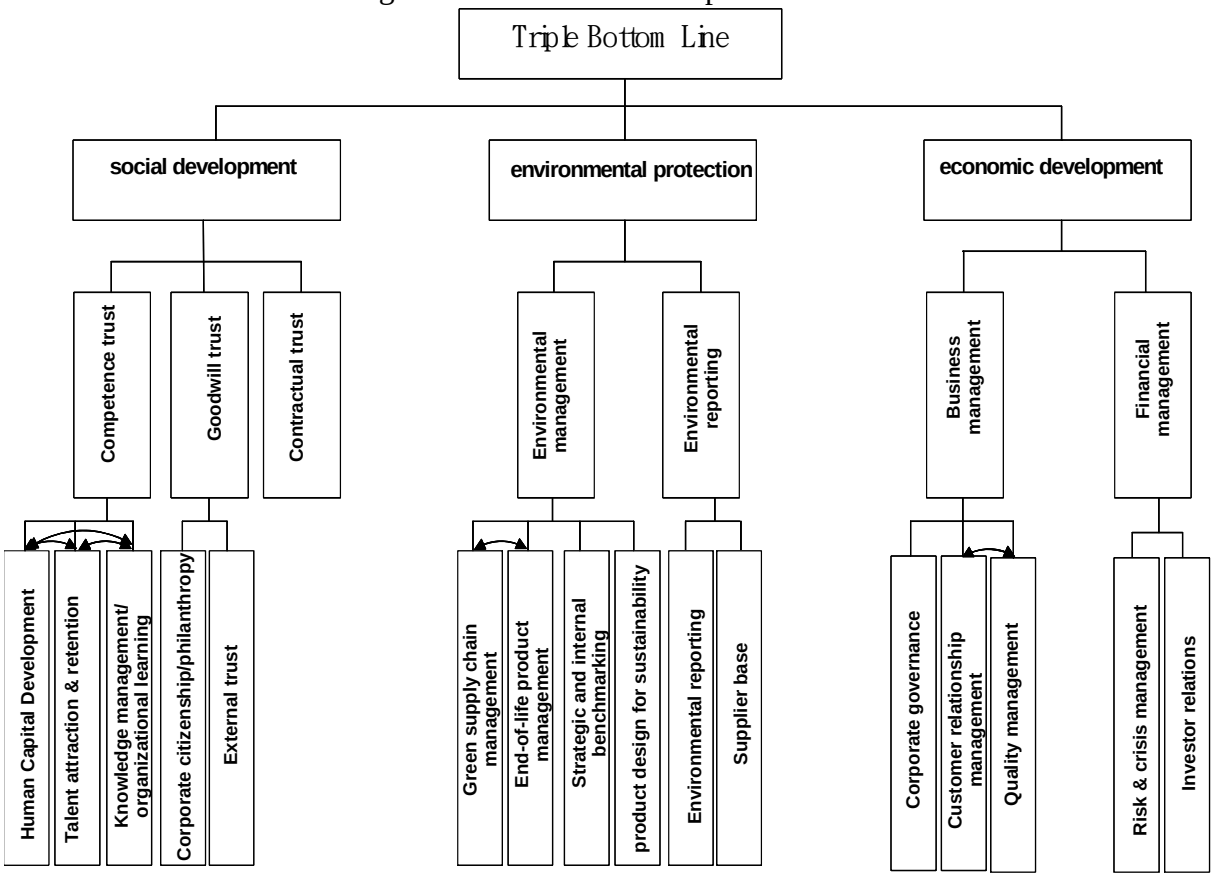
AN INTEGRATED DECISION-MAKING PROCESS FOR SUSTAINABLE SUPPLIER ASSESSMENT

An Integrated Decision-making Process

The steps to achieve our supplier selection goal are as follows:
First, decision and policy makers must pay attention to the elementary constituents of the ANP model. In our study, we use the following three terms along the hierarchical structure of our model: clusters, dimensions, and sub-dimensions. Table 1 shows the literature review in line of the TBL concept.

Second, researchers and/or decision makers need to prepare a graphical summary of the ANP model. In this model construction process, survey items and possible interdependencies in the network need to be identified. To reflect interdependencies in the network, two-way arrows are normally adopted in the ANP graphical representation. In this study, our ANP-based conceptual model is shown in Figure 1.

Figure 1 ANP-based Conceptual Model



Third, a decision support system (DSS) needs to be used to determine both the local weights and the global weights for each survey item. In our illustration, our empirical findings are presented in Table 2. Fourth, when final weights of our survey items are present, an instrument for supplier assessment can be designed and used. This procedure will be tested by using a multinational firm in the electronics industry in Taiwan.

Table 2 Local and Global Ranking

Clusters	Dimensions	Sub-dimensions	Local Rank	Global Rank
Social Development	Competence Trust	Human Capital Development	3	16
		Talent Attraction and Retention	2	12
		Knowledge Management and Organizational Learning	1	15
	Goodwill Trust	Corporate Citizenship/Philanthropy	2	13
		External Trust	1	4
	Contractual Trust			5
Environmental Protection	Environmental Management	Green Supply Chain Management (GSCM)	2	2
		End-of-life Product Management	4	11
		Strategic and Internal Benchmarking	3	3
		Product Design for Sustainability	1	1
	Environmental Reporting	Environmental Reporting	2	8
		Supplier Base	1	6
Economic Development	Business Management	Corporate Governance	3	14
		Customer Relationship Management	2	8
		Quality Management (QM)	1	10
	Financial Management	Risk and Crisis Management	1	7
		Investor Relations	2	17

3.2. An ANP-based Conceptual Model

As noted by Saaty (2005, p.47), the ANP "provides a general framework to deal with decisions without making assumptions about the independence of higher-level elements from lower level elements and about the independence of the elements within a level as in a hierarchy." In other words, the modeling of dependencies among elements of the problem is possible. In order to identify potentially critical elements that interest enterprises the most in terms of the TBL, in this study, we first look to the existing TBL literature. Our findings are shown in Table 1. We also contacted four experts from the high-tech industries in Taiwan to verify the findings of our earlier content validation. As shown in Figure 1, the top most components (or clusters) in the ANP are social development, environmental protection, and economic development. Each of them is further decomposed into dimensions and sub-dimensions. In the case of social development, for example, three dimensions are considered, namely, competence trust, goodwill trust, and contractual trust. Within each of these dimensions, there are sub-dimensions that may be used in their evaluation. Interviews with the corporate executives were conducted to incorporate interdependent relationships in our model. As shown in Figure 1, at the conclusion of our interview session, we found that no interrelationships exist at the upper component levels. However, three groups of dependencies are identified. Two-way arrows are used to describe these interdependent relationships. This new structure may affect our collection of source data. In the case of our second group (Green Supply Chain management vs. End-of-life Product Management), for example, those two survey items need to be viewed as controlling components for one another. As a result, additional pairwise comparison matrices need to be introduced in the process of field data collection. The ultimate goal of this network model is to identify survey items' local and global priorities. This will be illustrated with our case study.

3.3. Evaluating the FANP Model

The general approach of the FANP data collection and Super-matrix formation procedure described by Ayag & Ozdemir (2009) is adopted and followed here. Specifically, a systematic approach consisting of seven steps was used to deal with group decision making scenario:

1. Preparing pairwise comparison matrices based on the proposed ANP model,
2. Collecting field data by employing fuzzy scales, instead of Satty's crisp 9-point scale,
3. Finding the defuzzified value,
4. Converting group defuzzified values to a single value,
5. Obtaining the local weights for each pairwise comparison matrix,
6. Constructing the initial Super-matrix, and
7. Using the SuperDecisions software to obtain the global weights for each survey item.

EMPIRICAL ASSESSMENT

Sample– Enterprise H in the Electronics Industry in Taiwan

Ten experts from Enterprise H in the Electronics Industry in Taiwan were contacted to test our ANP conceptual model. Enterprise H, a member of Taiwan TFT LCD Association (TTLA), is engaged in the development, manufacture and sale of low-radiation, low energy consumption TFT-LCD. It makes full use of the supply of key components from its subsidiaries located in China. Enterprise H has introduced sustainable initiatives during the last ten years. Enterprise H has globally accepted social and environmental standards, as evident from its numerous certifications ISO 9001, ISO 14001, and ISO/TS 16949. Other certifications held by Enterprise H include OHSAS 18001, and IECQ QC08000. The ten participants in this study have three basic qualities that qualified them for the study: (1) they were enthusiastic about TBL, (2) they had prior exposure to TBL, and (3) they have extensive work experience in global supply networks.

The FANP Methodology

The FANP methodology is applied to this case study as follows:

1. Preparing pairwise comparison matrices based on the proposed ANP model

We note that the FANP is still based on a pairwise comparison of items by using the fuzzy intervals to assign the experts' judgment. The first step is thus to prepare pairwise comparison matrices. As shown in Figure 1, for example, the top most components in our ANP model are social development, environmental protection, and economic development. Given these three items, the corresponding pairwise comparisons are calculated. Similar matrices need to be prepared according to the proposed ANP model.

2. Collecting field data by employing fuzzy scales, instead of Satty's crisp 9-point scale

In order to determine the relative importance of lower level items given their 'controlling' item, we collect field data. Lower level items as shown in Figure 1 are social development, environmental protection, and economic development. Using the triangular fuzzy scales and triangular fuzzy reciprocal scales suggested by Ayag & Ozdemir (2009, p.371), ten experts from enterprise H were then asked to conduct pairwise comparison on the TBL factors.

3. Finding the defuzzified value

In the third step, we select a suitable defuzzification method. As noted by Klir & Yuan (2005), the purpose of defuzzification is to convert a fuzzy input, expressed in terms of a particular fuzzy set, to a single number. For the purpose of our study, we select the center of maxima

(CM) method. The defuzzified value (d_{CM}) is defined as the average of the smallest value and the largest value in a fuzzy interval. The CM method can be applied to both the triangular fuzzy cases and triangular fuzzy reciprocal cases.

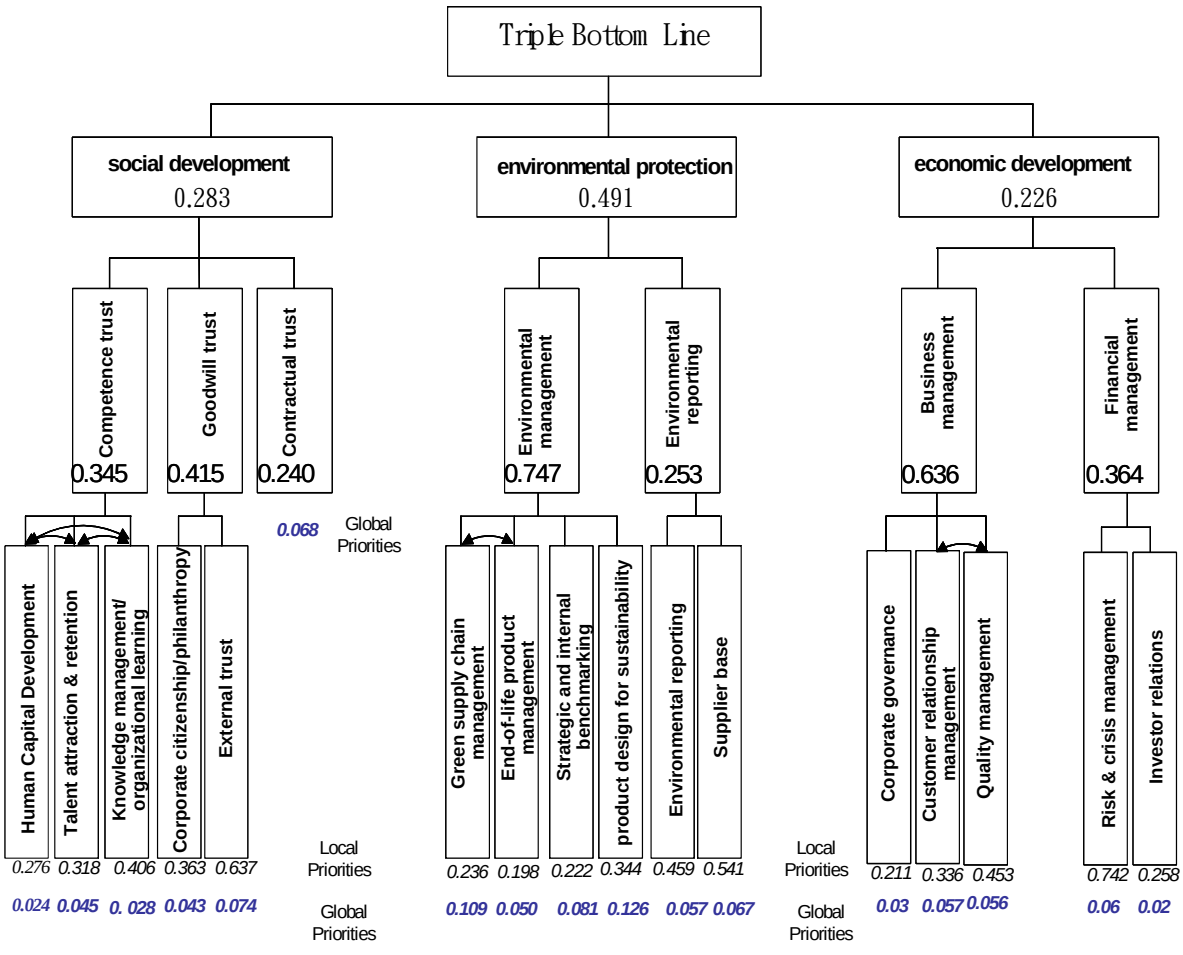
4. Converting group defuzzified values to a single value

One of the main objectives of this work is the handling of group inputs. When dealing with judgments from a group of individuals, researchers can use one of the following approaches: consensus, vote or compromise, and the geometric mean of the individual judgments. In this study, the geometric mean is calculated to obtain the final decision value.

5. Obtaining the local weights for each pairwise comparison matrix

In the fifth step, we find the initial weights for each pairwise comparison matrix. The initial weights, also known as the local weights, are used to form the Super-matrix. The M.S. Excel or DSS such as Expert Choice or SuperDecisions may be used for the computation of weights. The local weights associated with social development, environmental protection, and economic development, are calculated. The participants from Enterprise H gave the highest priority (0.491) to 'environmental protection' cluster, followed by the 'social development' cluster (0.283). There were no inconsistencies in the judgment of the experts. Figure 2 presents a graphical diagram that shows the local weights for the TBL.

Figure 2 Empirical Results



6. Constructing the initial Super-matrix

If we consider all survey items in the network (see Figure 2) and present them using a matrix format, then we have our initial Super-matrix. Ayag & Ozdemir (2009) call this a partitioned matrix, where each sub-matrix is composed of a set of local weights derived from step 5. Researchers can use the initial Super-matrix as a check list to ensure that everything is in order.

7. Using the SuperDecisions software to obtain the global weights for each survey item

The final step of the FANP analysis is to derive the global weights for each survey item. These global weights are obtained by raising the Super-matrix to a sufficiently large power, normally the power 2^{k+1} (k is an arbitrary large number), until the weights can remain stable. The final product at the conclusion of this calculation is called the synthesized or limiting Super-matrix. A DSS called SuperDecisions is used to obtain the global weights for our proposed model. The graphical model with those lower level survey items' global weights is also shown in Figure 2. Table 2 also shows the order of importance of the survey items that are identified.

Selecting the Best Suppliers

One of the critical challenges faced by supply chain experts from Enterprise H is the selection of strategic partners that will help the entire supply network achieve the goals outlined by the TBL. To complete our analysis, five experts from enterprise H were thus asked to evaluate three potential suppliers. They are labeled as supplier 'A', supplier 'B', and supplier 'C'. The original average scores for this exercise are shown in Table 3.

Table 3 Desirability Index

	Global Weight	Supplier A*	Supplier B*	Supplier C*
Human Capital Development	0.024	4.50	6.84	5.83
Talent Attraction and Retention	0.045	6.19	5.69	6.55
Knowledge Management and Organizational Learning	0.028	4.26	5.75	5.37
Corporate Citizenship/Philanthropy	0.043	2.61	4.28	3.81
External Trust	0.074	4.99	7.02	5.19
Contractual Trust	0.068	5.30	7.43	5.50
Green Supply Chain Management (GSCM)	0.109	4.87	6.38	5.86
End-of-life Product Management	0.050	2.37	5.86	6.47
Strategic and Internal Benchmarking	0.081	5.81	7.51	6.67
Product Design for Sustainability	0.126	6.21	6.48	7.26
Environmental Reporting	0.057	2.62	5.43	5.71
Supplier Base	0.067	5.33	6.41	6.21
Corporate Governance	0.030	3.19	6.69	6.28
Customer Relationship Management	0.057	4.51	5.99	7.92
Quality Management (QM)	0.056	6.25	7.61	7.19
Risk and Crisis Management	0.060	5.08	6.76	6.21
Investor Relations	0.020	5.09	6.67	5.73
Desirability Index		4.87	6.45	6.20

*:original score

In this study, we also adopt the Desirability Index (DI) determination procedure proposed by Sarkis & Talluri (2002) to obtain the final assessment value for each supplier. The DI for each case is computed as follows:

$$\text{Desirability Index} = \sum_{i=1}^{n} I_i * S_i \quad (1)$$

, where I_i = individual survey item's global weight, and S_i= original score (i=1,...,17). The desirability indices are computed as shown in Table 3. Our results show that for this exercise supplier 'B' should be selected since it has the highest overall score (i.e. 6.45).

MANAGERIAL IMPLICATIONS AND FUTURE WORKS

Multinational enterprises aspiring to achieve the TBL confront two challenges: (1) understanding/improving the selection process of sustainability programs and projects, and (2) making the right decision by employing the right decision science tool. This paper is an attempt to address these two concerns by presenting an assessment framework for managing sustainability programs based on a FANP approach and empirically illustrating its applicability to problems involving supplier selection. This integrated approach assists policy and decision makers in managing three most critical issues facing modern organizations: social development, environmental protection, and economic development. One of the objectives of this work has been to select the best supplier by using our integrated approach. Experts from a multinational firm in Taiwan were used to illustrate the FANP decision making process. There are several observations from our results:

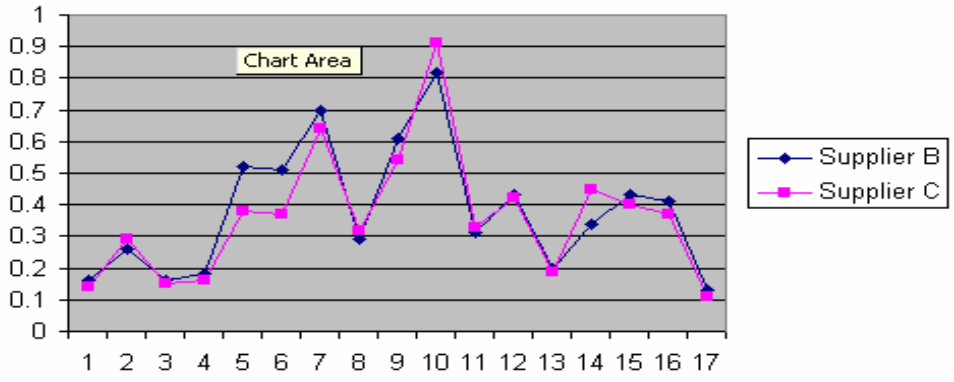
First, the network structure of the problem needs to be developed by deciding the survey items and checking the types of relationships between any two levels in order to form a graphical ANP model. In determining the survey items and independencies, the views of experts must be taken into consideration. This is an inexpensive but important step to improve the quality of the network structure. The findings in this study are shown in Figure 1. It is worth noting that the software called SuperDecisions can also be used for forming the graphical model.

Second, since it would be hard to obtain crisp data from the experts, it is important to use fuzzy scales. As noted by Liu & Lai (2009), "fuzziness originates from the qualitative nature of human thinking." The experts' judgments "are usually expressed as in linguistic terms that are inherently fuzzy (Liu & Lai, 2009)." The use of the fuzzy extension of the ANP therefore can help a facilitator who is knowledgeable about the problem at hand to deal with imprecise human judgments. The fuzzy-based decision making process, however, takes considerable amount of time if it is not effectively moderated. The overall acceptability of FANP approach should also be tested from the end users' perspectives in future works to ensure its practical values.

Third, in conducting self-assessments in terms of the TBL, Dow Jones Sustainability Indexes provide a robust set of criteria for achieving such feat. The Dow Jones Sustainability Indexes indicate which category/items are evaluated to realize sustainable management and development. This set of recommended criteria, however, comes with fixed weights. For example, a criterion such as environmental reporting, the assigned weight is 3. It addresses a key concern facing modern organizations today. In this paper, we adopt a more flexible approach to obtain the priorities for each survey item. Our approach integrates stakeholders' perceptions on the TBL issues and is specific to the industry of concern. Our FANP enables policy and decision makers to find their own set of weights for survey items. This is one of the most valuable benefits for the participants of our project.

Fourth, a benchmarking process could be used to compare potential suppliers based on the TBL. Figure 3 shows how this can be done by comparing top two suppliers identified in our study. It is observed from Figure 3 that four strategic items separate supplier 'B' and supplier 'C' in terms of individual desirability index. They are: contractual trust, external trust, product design for sustainability, and customer relationship management. While supplier 'B' positions itself well against supplier 'C' with respect to contractual trust and external trust, it needs to make efforts in the fields of product design for sustainability and customer relationship management. Enterprise H can provide such a feedback to both suppliers. Through this exercise, it is possible for both suppliers to select their own set of operating initiatives to work on and implement the continuous improvement plans effectively.

Figure 3 Performance comparison chart between top two suppliers



∗ Item 5: external trust; Item 6: contractual trust; Item 10: product design for sustainability; Item 14: customer relationship management

Although our empirical study cannot be generalized beyond its scope, the general framework and research procedures shown in this paper can offer good guidance in effectively managing sustainable organizations and their supply networks.

CONCLUSIONS

Best efforts need to be guided by good, solid strategies. As stated earlier, our integrated assessment framework for managing sustainability programs can be used to guide enterprises' TBL strategies and policy deployment. In this study, we identify seventeen survey items. They are validated and tested for usability by experts in a high-tech industry in Taiwan. Current advances in the field of multi-criteria decision-making also point out the difficulties to assign the relative importance of survey items by using precise numbers. The fuzzy method is thus adopted to express experts' judgments. To guide policy and decision makers on the initiation of TBL-driven supplier assessment, we also employ the ANP. We have described a seven-step process on the evaluation of the global weights for each survey item. Top eight survey items are presented on the Pareto chart for a quick reference. In this study, we also emphasize the importance of developing a group decision-making system in achieving team collaboration. To ensure that the FANP tool is easy to implement and applicable to any type or number of network structures, we adopt a Decision Support System called SuperDecisions. The availability of DSS is essential to the future development of FANP models. Using our proposed assessment framework for managing sustainability programs and the DSS helps policy and decision makers in modern enterprises to focus their TBL strategies and resource allocation efforts in the era of sustainable development.

REFERENCES

Ayag, Z., and Ozdemir, R. G. (2009). A hybrid approach to concept selection through fuzzy network process. *Computers and Industrial Engineering*, 56(1), 368-379.

Brown, H. S., M., J., and Levy, D. L. (2009). Building institutions based on information disclosure: lessons from GRI's sustainability reporting. *Journal of Cleaner Production*, 17(6), 571-580.

Carroll, A. B. (1991). The pyramid of corporate social responsibility: Towards the moral management of organizational stakeholders. *Business Horizons*, July/August, 39-48.

Centrone, G., Coslovich, L., Pesenti, R., and Ukovich, W. (2008). Social responsibility and sustainability in motorway corporate governance. *International Journal of Environment and Sustainable Development*, 7(1), 94-113.

Chalmeta, R. (2006). Methodology for customer relationship management. *Journal of Systems and Software*, 79(7), 1015-1024.

Chen, C. J., Shih, H. A., and Yang, S. Y. (2009). The role of intellectual capital in knowledge transfer. *IEEE Transactions on Engineering Management*, 56(3), 402-411.

Ciliberti, F., Pontrandolfo, P., and Scozzi, B. (2008). Logistics social responsibility: Standard adoption and practices in Italian companies. *International Journal of Production Economics*, 113, 88-106.

Coldwell, D., Billsberry, J., Van Meurs, N., and Marsh, P. (2008). The effects of person-organization ethical fit on employee attraction and retention: Towards a testable explanatory model. *Journal of Business Ethics*, 78(4), 611-622.

Costantini, V., and Monni, S. (2008). Environment, human development and economic growth. *Ecological Economics*, 64, 867-880.

Franz, P. (2010). Knowledge spill-overs for knowledge-based development: Progression in theory and obstacles for empirical research. *International Journal of Knowledge-based Development*, 1(1/2), 25-38.

Gardiner, L., Rubbens, C., and Bonfiglioli, E. (2003). Big business, big responsibilities. *Corporate Governance*, 3, 67-77.
Guide, V. D. R., and Van Wassenhove, L. N. (2009). The evolution of closed-loop supply chain research. *Operations Research*, 57(1), 10-18.

Heffernan, T. (2004). Trust formation in cross-cultural business-to-business relationships. *Qualitative Market Research: An International Journal*, 7(2), 114-125.

Hoti, S., McAleer, M., and Pauwels, L. L. (2007). Measuring risk in environmental finance. *Journal of Economic Surveys*, 21(5), 970-998.

Hsu, C. W., and Hu, A. H. (2009). Applying hazardous substance management to supplier selection using analytic network process. *Journal of Cleaner Production*, 17(2), 255-264.

Hutchins, M. J., and Sutherland, J. W. (2008). An exploration of measures of social sustainability and their application to supply chain decisions. *Journal of Cleaner Production*, 16, 1688-1698.

Kasarda, M. E., Terpenny, J. P., Inman, D., Precoda, K. R., Jelesko, J., and Sahin, A. (2007). Design for adaptability (DFAD) - a new concept for achieving sustainable design. *Robotics and Computer-Integrated Manufacturing*, 23(6), 727-734.

Kaynak, H., and Hartley, J. L. (2008). A replication and extension of quality management into the supply chain. *Journal of Operations Management*, 26(4), 468-489.

Klir, G. J., and Yuan, B. (2005). *Fuzzy Sets and Fuzzy Logic: Theory and Applications*. Taiwan: Pearson Education Taiwan Ltd.

Knight, P., and Jenkins, J. O. (2009). Adopting and applying eco-design techniques: a practitioners perspective. *Journal of Cleaner Production*, 17(5), 549-558.

Kuei, C., and Madu, C. (2009). Sustainable operations management. *International Journal of Commerce and Strategy*, 1(1), 2-18.

Lee, K. H., and Kim, F. W. (2009). Current status of CSR in the realm of supply management: the case of the Korean electronics industry. *Supply Chain Management*, 14(2), 138-148.

Lehavy, R., and Sloan, R. (2008). Investor recognition and stock returns. *Review of Accounting Studies*, 13(2), 327-361.

Liao, S. H., Chang, W. J., and Wu, C. C. (2010). An integrated model for learning organization with strategic view: Benchmarking in the knowledge-intensive industry. *Expert Systems with Applications*, 37(5), 3792-3798.

Lin, C., and Tsai, M. (2010). Location choice for direct foreign investment in new hospitals in China by using ANP and TOPSIS. *Quality & Quantify*, 44, 375-390.

Liu, K. F. R., and Lai, J. H. (2009). Decision-support for environmental impact assessment: A hybrid approach using fuzzy logic and fuzzy analytic network process. *Expert Systems with Applications*, 36(3), 5119-5136.

Liu, Y., Yuan, L., Tao, L., and Wang, Y. (2008). Relationship stability, trust and relational risk in marketing channels: Evidence from China. *Industrial Marketing Management*, 37(4), 432-446.

Lo, S. F., and Sheu, H. J. (2007). Is corporate sustainability a value-increasing strategy for business? *Corporate Governance*, 15(2), 345-358.

Madu, C. N. (2006). *House of Quality in a Minute*. Fairfield, CT: Chi Publishers.

Madu, C. N., and Kuei, C. (2004). *ERP and Supply Chain Management*. Fairfield, CT: Chi Publishers.

McAdam, R., Leonard, D., Henderson, J., and Hazlett, S. (2008). A grounded theory research approach to building and testing TQM theory in operations management. *Omega*, 36, 825-837.

Ravi, V., Shankar, R., and Tiwari, M. K. (2008). Selection of a reverse logistics project for end-of-life computers: ANP and goal programming approach. *International Journal of Production Research*, 46(17), 4849-4870.

Saaty, T. L., and Sodenkamp, M. (2008). Making decisions in hierarchic and network systems. *International Journal of Applied Decision Sciences*, 1(1), 24-79.

Sarkis, J. (2003). A strategic decision framework for green supply chain management. *Journal of Cleaner Production*, 11, 397-409.

Sarkis, J., and Talluri, S. (2002). A model for strategic supplier selection. *Journal of Supply Chain Management*, 38(1), 18-28.

Seuring, S., and Muller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, 16(15), 1699-1710.

Srivastava, S. K. (2008). Network design for reverse logistics. *Omega*, 36(4), 535-548.

Tseng, M. L., Lin, Y. H., Chiu, A. S. F., and Liao, J. C. H. (2008). Using FANP approach on selection of competitive priorities based on cleaner production implementation: A case study in PCB manufacturer, Taiwan. *Clean Technologies and Environmental Policy*, 10(1), 17-29.

Windsor, D. (2009). Tightening corporate governance. *Journal of International Management*, 15(3), 306-316.

Zhu, Q., Dou, Y., and J., S. (2010). A portfolio-based analysis for green supplier management using the analytical network process. *Supply Chain Management: An International Journal*, 15(4), 306- 319.