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Justifying Strategic Alliances and Partnering: a Prerequisite for Virtual Enterprising

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The objective of this paper is to help define and introduce the concept of justifying strategic relationships and agreements among enterprises. When enterprises choose major strategic projects they go through a management decision process that includes planning, analysis, evaluation, implementation, and improvement (auditing) of these projects. Analytical and decision tools to aid in strategic decision making are relatively rare, tools to aid in strategic alliance formation, are almost non-existent. This paper presents the argument that strategic alliances and relationships among enterprises can be analyzed using a strategic justification approach which will require that each side of a partnership or alliance make a 'business case' that will justify such a relationship. Some of the pertinent managerial and research issues within the area of strategic alliances, along with a discussion on its evolution are presented. A tool that can support the strategic alliance management process is presented. An illustrative example for the tool and its supporting methodology will provide additional insights.

Key words—strategic alliances, virtual enterprises, analytical network process, multicriteria decision making

1. INTRODUCTION

THE 'AGILE' ENTERPRISE is one of the latest organizational paradigms. It is characterized by organizations with the ability to respond to frequent and unpredictable change, and is being promoted as the successful company of the future. As competitive forces in the manufacturing environment continue to intensify, agility is touted as a condition for success and even survival. The ability to respond rapidly to changing market opportunities by utilizing agile business practices is a key attribute of an agile enterprise. The determination of appropriate customer–supplier relationships is an important agile business practice for the formation of 'virtual enterprises'.

The concept of the virtual enterprise (VE) [1] has become more evident in recent years. Based on this concept, several independent enterprises join together emphasizing their particular 'core competencies' to form an *ad hoc* enterprise (the VE) that is able to compete in a given arena for a given product or service [2]. Without this merger of resources and capabilities, the separate companies may be unable to successfully compete in a given market niche. The competitive advantage that can be achieved by a VE depends on how well the individual firms complement each other and their ability to integrate with one another. A critical aspect of the VE is that the individual enterprises be agile (for a description of agile principles see [3]).

1.1. Strategic partnership/alliance formation models

As part of an overall strategy for agility and building virtual relationships, firms are gaining experience through formation of strategic alliances between customers and suppliers, within R&D consortia, or as equal partners. These relationships are an effective way for firms to develop new technologies and products, procure critical resources, investigate new markets and complement core competencies and incompetencies. Relationship theory has been considered as a way to filter the numerous possibilities of potential partners down to a manageable number of potential partners to assess [4] and may be used as a precursor to the evaluation activities. Partnering, strategic alliances, and virtual enterprises form a spectrum of relationships that may exist among enterprises, with the relationships of the inter-enterprise business processes becoming more unified along the spectrum [5].

Currently, the literature and case studies have focused on partnerships among suppliers and customers, with the literature focusing on strategic alliances is much less extensive. The qualitative literature has surpassed the quantitative decision modeling for the partnership selection problem. One of the more popular research areas (quantitatively) has been the vendor selection problem. A number of techniques have been used to solve this problem including matrix or weight approaches, mathematical programming, fuzzy set models, and the analytical hierarchy process (AHP) (see [6] for a review). The strategic alliance formation problem usually involves more strategic evaluations then most vendor selection models consider. A holistic systemic evaluation model, as the one proposed here, that considers strategic and operational factors, is needed for strategically oriented relationships.

The literature on forming strategic alliances has been qualitative, with few decision tools, and with a focus on methodological approaches [7–9]. For example, Lorange, Roos, and Bronn [10] suggest a two phase formation process. The initial analytical phase deals with assessing the match, whereas the more intensive phase addresses questioning partners on market potential, worst-case scenarios, and competitive advantages of the alliance. Another methodology is a four phase approach proposed in [11]: (1) strategic decision—includes situation analysis, identification of strategic cooperation potential, and evaluation of shareholder value potential, (2) configuration—decisions regarding the field of cooperation and intensity of cooperation, (3) partner selection—fundamental, strategic, and cultural fit, and (4) management—contract negotiations, coordination interface, learning, adaptation, and review. Dean and Schniederjans [12] do, however, present a mathematical modeling approach, based on linear goal programming, to be applied to the strategic acquisition analysis as organizations acquire, merge, or form joint ventures with other organizations. Their focus, based on mergers and acquisitions, may be closely related to strategic alliance formation.

Speckman [13] in his research on collaborative supplier relationships and formation of strategic alliances has determined four sequential steps in the alliance building process: strategy development, partner assessment, contract negotiations and control/implementation. Within his research of the strategic alliance process, a number of phases were identified. These phases included anticipation, engagement, valuation, coordination, investment, stabilization, and decision. This paper proposes to investigate the valuation and investment phases of a proposed strategic alliance.

The initial development of a strategy has certain complex issues which must be addressed. These issues include the identification of major strategic challenges, evaluation of business risks, and consideration of resource strategies in terms of production, technology and people. Furthermore, in assessing a partner numerous issues are involved ranging from understanding the partner's management style and organization to creative strategies in how to merge two different corporate cultures [9, 14–16]. A business case (justification) analysis is a useful tool in helping to evaluate the particular strategy a company should embark upon as well as determining a strategic partnership.

2. A STRATEGIC JUSTIFICATION PROCESS

A pervasive, activity based, business case tool organized into five phases: identify system impact, identify transition impact, estimate costs and benefits, perform decision analysis, and audit decision has been developed by the authors for use in technology justification [17]. This methodology considers both the traditional financial aspects of justification as well as non-traditional strategic issues. An integrated evaluation that considers both elements has been supported for use in justifying advanced manufacturing technology [18], and should be completed for most projects that have strategic implications. The impact of systems transition or implementation path is also addressed within the methodology. Provisions for 'after the fact' decision analysis for the continuous improvement of the justification process are also included. Figure 1 is an integrated computer aided manufacturing definition (IDEFO) functional diagram of the methodology.

The following is a brief overview of the five phases that are outlined in Fig. 1. An illustrative example of an enterprise using the process to justify a strategic alliance is included with this initial introduction. The actual methodology contains many detailed steps. For the sake of brevity only major steps are exhibited in this example.

3. IDENTIFY SYSTEM IMPACT

The objective of the identify system impact phase is to identify the enterprise activities and strategies which are impacted by the project, which in this case is the formation of a strategic alliance. It is assumed the enterprise has a vision, a vision-based set of strategies and objectives, and has determined the desire to form a strategic alliance. The system impact is determined by analyzing the relationship between the 'as-is' enterprise and the system (alliance) being considered. In effect, linkages are drawn between enterprise activities and the components of the alliance that interact with the activities. Linkages, shown in the form of a matrix, are also identified for enterprise strategies and the strategic attributes of the alliance. One output of this phase is a set of analysis matrices identifying the activities and strategies affected by the alliance. These matrices form the basis of analysis to be performed later. Related metrics, assumptions,

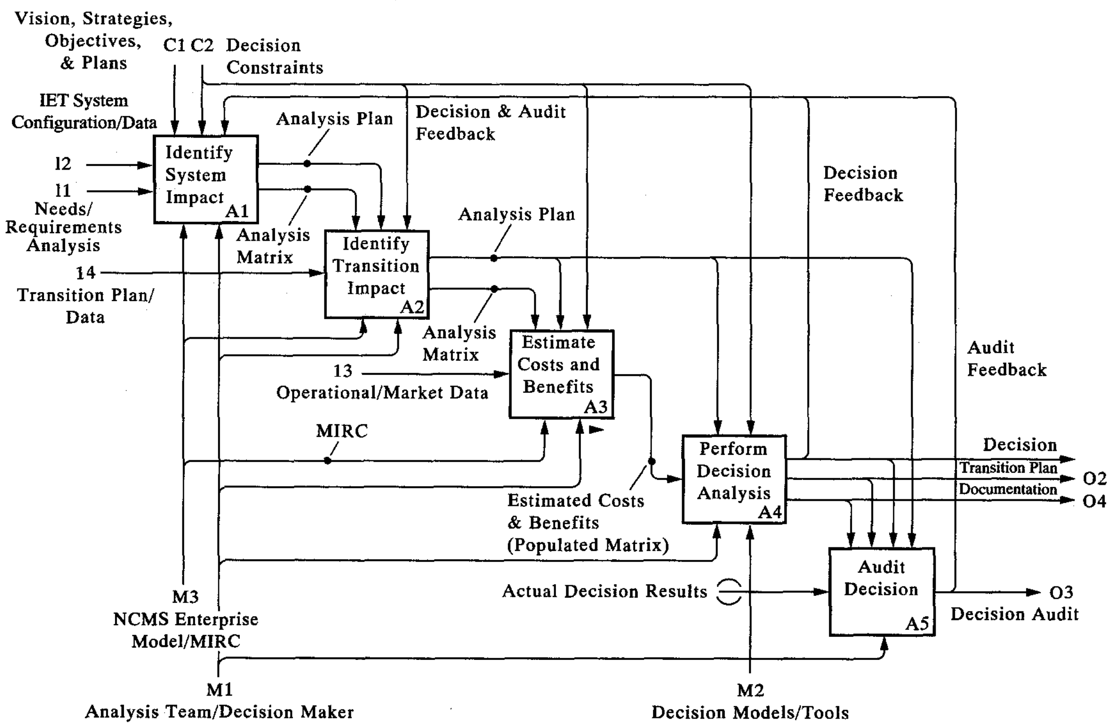

Fig. 1. An IDEFO functional model of the business case (justification) methodology.

Table 1. Strategies to objectives matrix

Enterprise	Objectives				
Strategies	Decrease R&D costs	Gain new product market share	Decrease development time	Decrease inventory and WIP	Maintain long-term profitability
Penetrate new markets		✔	✔	✔	✔
Share new product development costs	✔				✔
Fill product line gaps		✔			
Implement JIT supplier program			✔	✔	✔
Process cost improvement etc.			✔	✔	✔

and constraints are also documented. The following matrices are developed in this first phase: (1) strategies to objectives matrix, (2) strategic metric matrix, (3) activity-based traditional matrix, and (4) strategic analysis matrix.

The strategic nature of this justification methodology requires the decision analysis team (this technique and effort requires a team approach) to gain an understanding of the strategic direction of the firm. In the illustrative example the assumed, simplified, vision of the enterprise is to compete internationally. Some of the pertinent strategic corporate objectives are to decrease research and development costs, gain new product market share, decrease development time, decrease inventory and work-in-progress (WIP) and maintain long-term profitability. The program for obtaining these and other objectives will be to build a strategic relationship with a competitor and/or supplier.

A linkage matrix similar to the one shown in Table 1 is completed for linking the strategies employed to meet the objectives. Strategies are listed along the vertical axis (rows) and objectives along the horizontal axis (columns). For example, due to the increasing costs of developing new products and the shortening of the life-cycles of many products in mature industries, companies begin to think about alliances [19]. Therefore, to gain new product market share, two strategies are suggested to meet that objective; penetrate new markets and fill product line gaps. In Table 1 a check mark is placed in cells to indicate which strategies meet which objectives. This is a validation step in the linkage of strategies to objectives. If an objective does not have a cell marking, it means the strategies of an organization are incomplete in meeting the objective. If a strategy has no marking in its row, then that strategy is redundant. The objectives and strategies utilized in this example analysis are based on a literature and research concerning reasons why companies might decide to initiate a strategic alliance [19–22].

Table 2, the strategic metric matrix, is initially created in this phase. The strategies which were shown in Table 1 are included in the strategic metric matrix and analyzed. Financial, quantitative, and qualitative metrics are the three categories of metrics employed in the linkage between strategies and strategic metrics. The analysis includes traditional financial metrics such as net present value (NPV), payback, and return on investment (ROI). Quantitative metrics, such as the number of distribution channels created by the strategic alliance being considered, refers to metrics where numerical estimates can be obtained but are difficult to put into financial terms. Qualitative metrics, such as product recognition are used to measure the impacts difficult to measure in quantifiable terms. Qualitative metrics are often expressed in terms of categorical values such as better/same/worse. For example, product recognition will be rated on a scale of poor/bad/neutral/good/excellent.

Once metrics have been derived (the metric derivation process is a non-trivial task which may require organizations to have a performance measurement process that can aid in metrics development) their corresponding weights need to be calculated. Table 2 also represents the linkage matrix used for identifying and assigning weights to be used in the integrated strategic analysis matrix of this

Table 2. Strategic metric matrix

Enterprise		Financial			Quantitative					Qualitative		
Strategies	Stategy weight	NPV	Payback	RIO	No. of distribution channels	Product development costs	# of new products	inventory turns	Reduced WIP	Consistency Consistency of culture	Product recognition	Market intelligence
Penetrate new markets	0.194				0.3		0.2			0.1	0.3	0.1
Share new product development	0.213	0.1	0.1	0.1		0.4	0.1					0.2
Fill product line gaps	0.183						0.4			0.2	0.2	0.2
Implement JIT supplier program	0.197					0.1		0.4	0.3			0.2
Process cost improvement	0.213	0.8	0.1	0.1								
Strategic metric weight		0.192	0.043	0.043	0.060	0.100	0.100	0.080	0.60	0.040	0.080	0.120
Target		≥0	0	≥1	15	100	20	52	0	5	5	5
Upper		100K	3	5	15	100	30	48	1000	5	5	5
Lower		0	0	1	7	50	5	24	0	0	0	0
Type		I	D	I	I	D	I	I	D	I	I	I

justification methodology. Two factors are considered in assigning weights: the relative importance of each strategy to the overall objectives of the enterprise and the relative ability of each metric to measure the realization of each strategy. The importance of each metric is indicated by a numerical weight between 0 and 1. The sum of the strategic weights and the sum of the metrics weights for a strategy are normalized to 1. That is:

$$\Sigma Sw_i = 1 \text{ for all } i = 1 \text{ to } S, \text{ and}$$

$$\Sigma Mw_{ik} = 1 \text{ for all } k = 1 \text{ to } K \qquad (1)$$

where Sw_i denotes the relative weighting of strategy i (for all strategies S) and Mw_{ik} is the relative importance weight of strategic metric k for strategy i. A number of multiattribute utility techniques are available to help define these weights. A recommended technique to determine relative overall weighting structure and modeling for strategies and metrics is the use of the analytical network process (ANP), described in the next section. ANP is recommended because it takes into consideration the dynamic nature of the competitive environment (in this example the dynamic environment is modeled using the product life cycle of the product family to be produced by the strategic alliance).

3.1. Strategic weight determination using the ANP

ANP is a general form of the analytical hierarchy process (AHP) first introduced by Saaty [23]. Whereas AHP models a decision making framework that assumes a uni-directional hierarchical relationship among decision levels, ANP allows for more complex interrelationships among the decision levels and attributes. Typically, in AHP the top element of the hierarchy is the overall goal for the decision model. The hierarchy decomposes from a general to a more specific attribute until a level of manageable decision criteria is met. ANP does not require this strictly hierarchical structure. Interdependencies among attributes and attribute levels may be represented by two way arrows (or arcs) among levels or, if within the same level of analysis, a looped arc. The directions of the arcs signify dependence. Arcs emanate from an attribute to other attributes

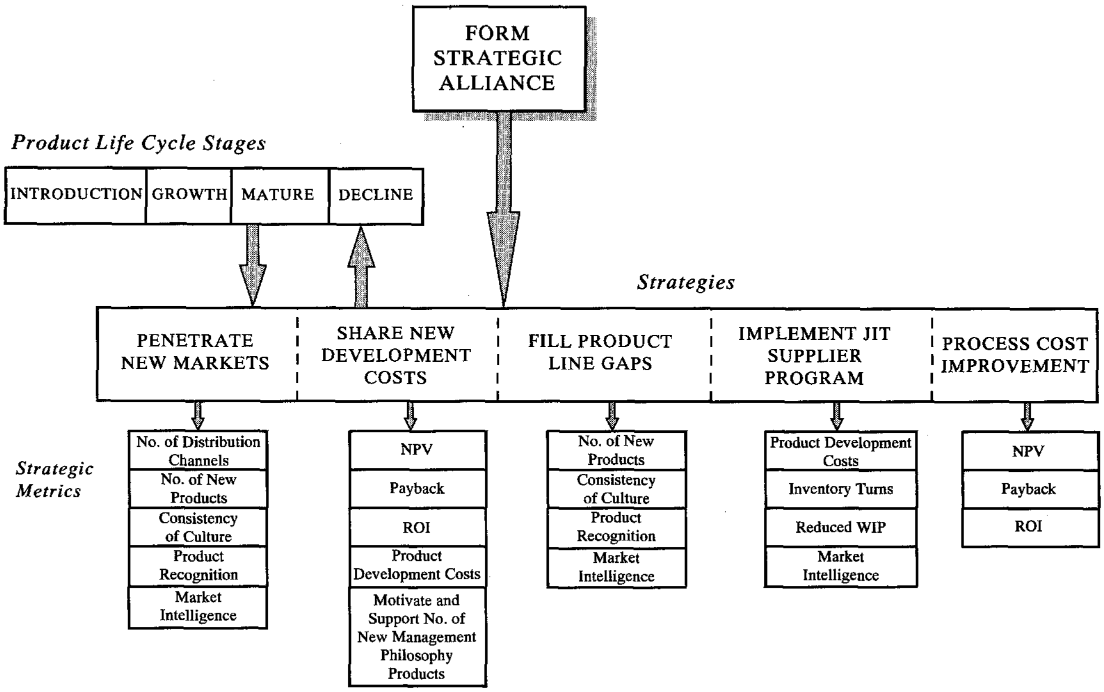

Fig. 2. ANP network framework for weight determination for strategic alliance formation.

that may influence it. The relative importance or strength of the impacts on a given element is measured on a ratio scale similar to AHP. A priority vector may be determined by asking the decision maker for a numerical weight directly, but there may be less consistency, since part of the process of decomposing the hierarchy is to provide better definitions of higher level attributes.

The ANP approach is capable of handling interdependence among elements by obtaining the composite weights through the development of a 'supermatrix'. Saaty [23] explains the supermatrix concept as a parallel to the Markov chain process. The supermatrix development is shown in the next section. In this example, the only interdependencies identified are the product life cycle stage and the strategic alliance strategies. This allows for a temporal (and dynamic) evaluation of the strategies used by the justification methodology. The approach for building and analyzing the ANP model are now detailed in a series of sub-steps. The values used in this example are assumed, in an actual application of this model an iterative approach is recommended, one designed to elicit the data from the 'minds' of one or more strategic planners. Gathering input from sources outside the immediate enterprise, to include customers and suppliers, should be attempted.

3.2. ANP analysis and solution methodology

An easy method to explain the ANP approach is by documenting it in a series of steps. In this case the ANP process is slightly modified to only four steps necessary for use in developing weights for the justification methodology.

3.2.1. Step 1: model construction and problem structuring. The first step is to construct a model to be evaluated. The illustrative example will use the network model summarized in Fig. 2. The goal here is the formation of a strategic alliance, this is to be accomplished by considering the strategies delineated in the previous matrices. Metrics that can be used to measure the strategy progress (those that have been marked in previous matrices) form the next level. In this example, interdependence or feedback occurs between the product life cycle stage and the various strategies. That is, the roles and weights of the strategies may be different depending on the stage of the product life cycle.

3.2.2. Step 2: pairwise comparisons matrices of interdependent component levels. Eliciting preferences of various components and attributes will require a series of pairwise comparisons where the decision maker will compare two components at a time with respect to an upper level 'control' criterion. In ANP, like AHP, pairwise comparisons of the elements in each level are conducted with respect to their relative importance towards their control criterion.

Saaty [23] has suggested a scale of 1 to 9 when comparing two components, with a score of 1 representing indifference between the two components and 9 being overwhelming dominance of the component under consideration (row component) over the comparison component (column component). If a component has a weaker impact on the control criterion, the range of scores will be from 1 to 1/9, where 1 represents indifference and 1/9 an overwhelming dominance by a column element over the row element. When scoring is conducted for a pair, a reciprocal value is automatically assigned to the reverse comparison within the matrix. That is, if a_{ij} is a matrix value assigned to the relationship of component i to component j, then a_{ji} is equal to $1/a_{ij}$ (or $a_{ij}\ a_{ji} = 1$). Since many of these values are strategic, additional strategic group decision making tools such as scenario planning or the Delphi approach can be utilized to assign meaningful values to the pairwise comparisons.

Within this illustrative example the relative importance of the strategy for strategic alliance formation with respect to a specific product life cycle stage (i.e. introduction to decline) is first determined. A pairwise comparison matrix is required for each of the four major stages of the product life cycle for calculation of impacts by each of the strategies. In addition, five pairwise comparison matrices are constructed for calculation of the relative impacts of the strategy by each stage of the product life cycle. To fully describe these two-way relationships, nine pairwise comparison matrices are required.

Once the pairwise comparisons are completed, the local priority vector $\boldsymbol{w}$ (defined as the eVector in the example figures) is computed as the unique solution to:

$$A_w = \lambda_{\max} w , \tag{2}$$

where $\lambda_{\max}$ is the largest eigenvalue of $\boldsymbol{A}$. Saaty [23] provides several algorithms for approximating $\boldsymbol{w}$. In this paper a two-stage algorithm was used that involved forming a new $\mathbf{n} \times \mathbf{n}$ matrix by dividing each element in a column by the sum of the column elements and then summing the elements in each row of the resultant matrix and dividing by the $\mathbf{n}$ elements in the row. This is referred to as the process of averaging over normalized columns. This is represented as:

$$w_i = \frac{\sum_{i=1}^{I} \left(\frac{a_{ij}}{\sum_{j=1}^{J} a_{ij}} \right)}{J} \tag{3}$$

where:

w_i = the weighted priority for component i

J = index number of columns (components)

I = index number of rows (components)

In the assessment process a problem may occur in the transitivity or consistency of the pairwise comparisons. For an explanation on inconsistencies in relationships and their calculations see [23]. It is assumed that the pairwise comparisons are consistent in these examples.

An example of the strategic alliance strategy pairwise comparison matrix within the introductory (new) stage of the product is presented in Table 3. In the new stage, the strategy of forming a strategic alliance to share development costs is viewed as slightly more important

Table 3. Strategic alliance strategies principles pairwise comparison matrix for the introduction (new) stage in the product life cycle and eigenvector (relative importance or impact weights)

NEW	New markets	Dev costs	Fill gaps	JIT supp	Cost imprv	eVector
New markets	1.000	3.000	3.000	0.333	0.500	0.207
Dev costs	0.333	1.000	3.000	1.000	0.250	0.144
Fill gaps	0.333	0.333	1.000	3.000	0.333	0.123
JIT supply	3.003	1.000	0.333	1.000	3.000	0.237
Cost imprv	2.000	4.000	3.000	0.333	1.000	0.099

Table 4. The **A** matrix formed from eigenvectors (relative importance weights) for strategic alliance strategies impacts on product life cycle stages

A matrix	New	Growth	Mature	Decline
New markets	0.207	0.192	0.178	0.181
Dev costs	0.144	0.145	0.386	0.285
Fill gaps	0.123	0.134	0.244	0.355
JIT supply	0.237	0.239	0.123	0.112
Cost imprv	0.289	0.291	0.069	0.067

than the JIT supplier strategy ($a_{12} = 3$). The weighted priorities for this matrix are shown as the last column in Table 3. The weighted priorities for each of the strategy relationships matrices (four in all) are combined to create a matrix **A** with four columns and five rows (see Table 4).

The local priority weights for the relative impact of the product life cycle given a strategy are calculated. The procedure detailed above is repeated and each of the strategies will have an eigenvector of priority weights. Together these vectors form a matrix (**B**) with four rows and 5 columns shown in Table 5.

3.2.3. Step 3: supermatrix formation. The supermatrix is a partitioned matrix, where each submatrix is composed of a set of relationships between two levels in the graphical model. Three types of relationships may be encountered in this model: (1) independence from succeeding components, (2) interdependence among components, and (3) interdependence between levels of components. In this illustrative example, the same level impacts are not deemed to be significant. Thus, in the supermatrix, all the values in the 'diagonal' submatrices will be assigned a value of zero.

The two compiled matrices **A** and **B**, are now combined to form the supermatrix **M** shown in Table 6. Raising the supermatrix to the power $2k + 1$, where k is an arbitrarily large number, allows convergence in weights of the interdependent relationships between strategies and product life cycle stages. In this example, convergence is reached at $\mathbf{M}^{31}$. The 'long term' stable weighted values to be used in the analysis are shown in Table 7. Table 7 shows that the most significant strategies, over the life of the product produced by the strategic alliance, are sharing new product development costs and improving process costs (each with a weight of 0.213). The least significant strategy is filling product line gaps (0.183). These final weights are placed in the 'Strategy weights' column of Table 2.

3.2.4. Step 4: obtain metric weights. The relative measurement capabilities for each of the metrics on the corresponding strategies can be determined using the simple pairwise comparison matrix approach. For this illustrative example there are five pairwise comparison matrices. The relative importance weights for each metric on a strategy are placed in the corresponding cells for each strategy in Table 2.

These four steps conclude the use of the ANP approach for the calculation of the weights. We shall now return to the discussion on the Identify System Impact phase of the methodology.

The strategic metric weight for metric $k(SMw_k)$ is calculated by summing the product of strategy weight and individual cell values for each column. Or analytically:

$$SMw_k = \sum_i Sw_i Mw_{ik} \text{ for each } k \tag{4}$$

Since the sum of all the metric weights and strategy weights is equal to one, this will guarantee that the sum of the strategic metric weights is also normalized to one. The final values will be used in the yet to be developed integrated strategic analysis matrix.

3.3. Traditional analysis

Another matrix which is initially set up in the Identify System Impact phase is the activity-based traditional matrix which is shown in Table 8. The traditional metrics are identified and linked to the strategies created earlier through their corresponding activities. The activities for this example are based on Porter's

Table 5. The **B** matrix formed from eigenvectors (relative importance weights) for product life cycle stages impacts on strategic alliance strategies

B matrix	New markets	Dev costs	Fill gaps	JIT supply	Cost Imprv
New	0.411	0.476	0.484	0.436	0.303
Growth	0.265	0.241	0.245	0.275	0.160
Mature	0.185	0.198	0.162	0.177	0.258
Decline	0.140	0.085	0.108	0.112	0.279

Table 6. Initial supermatrix M compiled from matrices A and B for product life cycle stages and strategic alliance strategies

Super matrix	New	Growth	Mature	Decline	New markets	Dev costs	Fill gaps	JIT supply	Cost imprv
New	0	0	0	0	0.411	0.476	0.484	0.436	0.303
Growth	0	0	0	0	0.265	0.241	0.245	0.275	0.160
Mature	0	0	0	0	0.185	0.198	0.162	0.177	0.258
Decline	0	0	0	0	0.140	0.085	0.108	0.112	0.279
New markets	0.207	0.192	0.178	0.181	0	0	0	0	0
Dev costs	0.144	0.145	0.386	0.285	0	0	0	0	0
Fill gaps	0.123	0.134	0.244	0.355	0	0	0	0	0
JIT supply	0.237	0.239	0.123	0.112	0	0	0	0	0
Cost imprv	0.289	0.291	0.069	0.067	0	0	0	0	0

value chain which include: inbound logistics, operations, outbound logistics, marketing and sales, and service [24]. This selection of activities keeps the analysis at a relatively generic level. More specific activities may be used if the impact of the alliance is more profound on a specific business process (e.g. manufacturing). The 'components' in this case represent various organizational functions and elements of the strategic alliance that are expected to generate benefits or costs. General traditional metrics such as inventory cost, time to market for new products, and development time are used in this analysis. These metrics can help identify the cost drivers for calculating costs and benefits. The cost/savings categories are traditional categories and represented here because many accounting systems currently do not have activity based allocation. The actual estimation of costs for populating the matrix is left for the estimation phase of the methodology.

The final matrix constructed in the Identify Systems Impact phase is the strategic analysis matrix which is shown in Table 9. The primary inputs are the metrics (financial quantitative, quantitative, and qualitative) developed in the traditional analysis matrix and strategic attributes. These attributes are derived from the strategies developed earlier. A check mark indicates that the strategic attributes relate to the strategic metrics. Columns are added for the utility functions, the estimated and normalized values for metrics, and a total value for the metric.

Phase 1 Identify System Impact is concluded when the four matrices have been created. The following phases explain how these matrices will be embellished as well as how the relevant data is acquired.

4. IDENTIFY TRANSITION IMPACT

The objective of the Identify Transition Impact phase is to identify the activities and strategies impacted by the transition plan. It is expected that a transition plan exists for the alliance formation. Special attention is required of the transition plan because it is usually the most critical and complex stage of any strategic project. Transition is defined as the implementation process required to evolve from the 'as-is' to the 'to-be' environment. The impact created by the transition can effect the product, process, organization, culture, or technology of an enterprise. Impact is determined by analyzing the relationship between the as-is enterprise and the transition to creating a strategic alliance. This enterprise integration effort promotes the comprehensive consideration of the transition plan. The outputs of this are matrices identifying the activities and strategies affected by the transition plan.

In the example, the transition to creating a strategic alliance will have impacts on the enterprise's culture, product, process, and

Table 7. Supermatrix convergence to "Long Term" weights at M^{31}

Super matrix	New	Growth	Mature	Decline	New markets	Dev costs	Fill gaps	JIT supply	Cost imprv
New	0	0	0	0	0.420	0.420	0.420	0.420	0.420
Growth	0	0	0	0	0.236	0.236	0.236	0.236	0.236
Mature	0	0	0	0	0.197	0.197	0.197	0.197	0.197
Decline	0	0	0	0	0.147	0.147	0.147	0.147	0.147
New markets	0.194	0.194	0.194	0.194	0	0	0	0	0
Dev costs	0.213	0.213	0.213	0.213	0	0	0	0	0
Fill gaps	0.183	0.183	0.183	0.183	0	0	0	0	0
JIT supply	0.197	0.197	0.197	0.197	0	0	0	0	0
Cost imprv	0.213	0.213	0.213	0.213	0	0	0	0	0

Table 8. Activity-based traditional analysis matrix

Stategic Alliance 1	Components					Metrics				Cost/Savings Categories					
Activities	Legal	Processes	Cultural	Technology	Vision of Partnership	Inventory cost	Time to market for new product	Development time	Transition time	Labour	Materials	Travel	Facilities	Infrastructure	Activity Total
Inbound logistics	X	X		X	X				X	6.7	1.1			−0.5	7.3
Operations	X				X		X		X	4.8	0.6				5.4
Outbound logistics					X		X		X	22.5		5.9			28.4
Marketing and sales			X	X	X	X	X	X	X	71.0		15.8	0.5	−0.4	86.9
Service		X			X					32.0	0.5	7.0	0.3	−1.0	38.8
Grand total															$166.8

Table 9. Strategic analysis matrix

Strategic Alliance 1	Strategic attributes					Utility Functions				Values		Calculations	
Metrics	Complementary Markets	Low cost developer	Complementary Products	Proven JIT capability	Low variability of key characteristics	Target	Upper	Lower	Type (I, D, P)	Estimated value	Normalized value	Weight	Strategic Metric Total
Financial quantitative													
NPV	✔	✔	✔	✔	✔	⩾0	100K	0	I	100K	5	0.260	1.30
Payback	✔	✔	✔	✔	✔	0	3	0	D	1.64	3	0.050	0.15
ROI	✔	✔	✔	✔	✔	⩾1	5	1	I	2.85	3	0.050	0.15
Quantitative													
No of distribution channels	✔	✔	✔	✔	✔	15	15	7	I	15	5	0.060	0.30
Product development cost	✔	✔	✔		✔	100	100	50	D	50	5	0.100	0.50
# of new products	✔	✔	✔	✔	✔	20	30	5	I	6	1	0.100	0.10
Inventory turns	✔	✔	✔	✔	✔	52	48	24	I	48	5	0.080	0.40
Reduced WIP	✔			✔	✔	0	1000	0	D	325	4	0.060	0.24
Qualitative													
Consistency of culture	✔	✔	✔		✔	5	5	0	I	4	4	0.040	0.16
Product recognition			✔		✔	5	5	0	I	4	1	0.080	0.08
Market intelligence		✔		✔		5	5	0	I	5	5	0.120	0.60
Total													3.09

technology. Partnering is very people oriented and the relationship between operating managers must be conducive to an alliance. Complementing cultures are also extremely important to the success of the relationship [21]. Culture influences the behavior, values, and goals of the employees. Cooperating enterprises need to discourage norms that conflict with the vision of the enterprise. Therefore the qualitative metric consistency of culture is added to the Strategic Analysis Matrix (Table 9). Another aspect of the transition is the amount of time it will take to complete the formation of the strategic alliance. This is reflected in the creation of the metric entitled transition time on the Activity-Based Traditional Matrix (Table 8).

The analysis for this second phase may be conducted concurrently with the first phase. The remaining phases, however, are completed in sequential order.

4.1. Estimate cost and benefits

The objective of the Estimate Cost and Benefits phase is to populate the analysis matrices with the cost, benefit and evaluation data necessary to perform the analysis. Some organizational data may already be in a usable form and should be analyzed for validity. Other data may be generated through some form of estimation procedure and data aggregation or segregation. Activity based cost data can be used to accurately represent costs and benefits of a strategic alliance. Strategic data may need to be quantified through approaches such as relative importance ranking, ordinal ranking, or some form of multivariate utility modeling. Forecasting approaches may be employed in the absence of complete data. These include simple moving average approaches to advanced econometric techniques. Various effects such as learning, synergy of systems, inflation, and others could be included in the calculation of estimates. After the data have been acquired, generated and validated, they must be documented. The estimates should then be written in the appropriate locations on the analysis matrices. We do not provide specific operational data estimation models for this step since organizational data may be in many forms.

The traditional values (costs) are assigned by cost drivers effecting each activity. This step assumes that an activity based costing reporting system may be needed to provide this information. If an activity based costing system does not exist, a number of procedures for transforming traditional cost data to activity based cost data have been proposed (see [11,25–27]). The cash flow total values from the traditional analysis matrix are aggregated for calculation of traditional metric performance on NPV and ROI measures.

As we have seen, the strategic metrics may be expressed in different units or scales (dollars, volume, percentages, good/bad). In order to combine these differing scales, the values of the metrics need to be 'normalized' to a common scale. Utility theory is a convenient method for translating values to a common scale.

In this methodology three basic types of linear utility functions are used:

1. Increasing (I) functions are used when a higher value is preferred, as with NPV. It is assumed that anything equal to or less than the lower value receives a normalized utility value of 0, anything equal to or

Table 10. Alternatives comparison matrix

Metrics	Weight	Alternative 1	Alternative 2	Alternative 3
Financial quantitative				
NPV	0.260	1.30	1.30	1.30
Payback	0.050	0.15	0.15	0.30
ROI	0.050	0.15	0.15	0.30
Quantitative				
No. of distribution channels	0.060	0.30	0.24	0.30
Product development cost	0.100	0.50	0.40	0.10
# of new products	0.100	0.10	0.40	0.30
Inventory turns	0.080	0.40	0.32	0.24
Reduced WIP	0.060	0.24	0.30	0.18
Qualitative				
Consistency of culture	0.040	0.16	0.12	0.04
Product recognition	0.080	0.08	0.24	0.40
Market intelligence	0.120	0.60	0.12	0.12
Weighted total		3.98	3.74	3.58

greater than the upper value receives a normalized utility value of 5. Values in between receive a linearly proportionate score. That is:

$$U(x) = \begin{cases} 0 & \text{if} \qquad\qquad\quad x \leq \textit{Lower} \\ y & \text{if} \quad \textit{Lower} \leq \; x \leq \textit{Upper} \\ 5 & \text{if} \qquad\qquad\quad x \geq \textit{Upper} \end{cases}$$

$$\text{where } y = \frac{x - \textit{Lower}}{\textit{Upper} - \textit{Lower}} \times 5 \qquad (5)$$

where $U(x)$ is the utility value associated with a given value of x.

2. Decreasing (D) functions are essentially similar but with lower values preferred, as with a metric such as lead time. For a type D utility function:

$$U(x) = \begin{cases} 5 & \text{if} \qquad\qquad\quad x \leq \textit{Lower} \\ y & \text{if} \quad \textit{Lower} \leq \; x \leq \textit{Upper} \\ 0 & \text{if} \qquad\qquad\quad x \geq \textit{Upper} \end{cases}$$

$$\text{where } y = \frac{\textit{Upper} - x}{\textit{Upper} - \textit{Lower}} \times 5 \qquad (6)$$

3. Peaked (or target) utility functions (not shown among these metrics) aims for a value at a specified target, with deviation in either direction resulting in a lesser score. An example might be a delivery date metric, where orders arriving too early or too late are both undesirable. For the peaked utility function the expression is described as:

$$U(x) = \begin{cases} 0 & \text{if} \qquad\qquad\quad x \leq \textit{Lower} \\ y & \text{if} \quad \textit{Target} \geq \; x \geq \textit{Lower} \\ 5 & \text{if} \qquad\qquad\quad x = \textit{Target} \\ z & \text{if} \quad \textit{Target} \leq \; x \leq \textit{Upper} \\ 0 & \text{if} \qquad\qquad\quad x \geq \textit{Upper} \end{cases}$$

where y and z in the peaked utility function are linearly proportional functions.

The metrics are converted on a zero to five utility scale (five being the highest). The target values for each metric are assigned based on the enterprise's objectives.

The illustrative example uses two types of utility functions: 'I' indicates a constantly increasing and 'D' indicates a constantly decreasing function. More complex utility functions may also be developed.

A final output of the integrated strategic analysis matrix will be a composite, overall 'score'. This score is obtained as a sum of the impacts for each of the metrics.

5. PERFORM DECISION ANALYSIS

The objective of the Perform Decision *Analysis* phase is to perform the traditional and strategic analyses based upon the previously documented impact of the strategic alliances. Estimated costs and benefits which have been collected and validated are organized for analysis. The traditional and strategic approaches are integrated in a meaningful manner with the results documented and presented to the decision maker.

It is in this phase where various alternatives can be evaluated. For example, determining a prospective partner or determining a certain type of strategic alliance (joint ownership, joint venture, formal cooperative venture or informal virtual enterprise) to pursue. Table 10 shows the alternatives comparison matrix. The strategic weights and strategic metric totals which are calculated in the strategic analysis matrix are entered into the alternatives comparison matrix. The final step in this phase is to make a decision recommendation. The recommendation may be on the acceptability of a single alternative relative to a baseline or a ranking of several alternatives.

As can be seen in this example alternative 1 is considered to be excellent in the areas of distribution, product cost and inventory turns, and not so good at the number of new products produced. Alternative 2 is considered to be excellent at the number of new products produced and product recognition, and not so good at market intelligence. Alternative 3 is considered excellent in the areas of financial, distribution channels and product recognition, and not so good at product development cost and consistency of culture. Due to the weights which were placed on the different metrics alternative 1 is the first choice. Even though alternative 3 ranks the best in the financial areas, the weights assigned to other metrics result in alternative 3 being ranked the lowest overall.

6. AUDIT DECISION

The objective of the Audit Decision phase is to perform an audit of the decision process some time after the decision has been made and the alliance formed and operating. The purpose of the audit is to review the justification process so it can be improved. When and how often the audit takes place may vary depending on the complexity of the alliance. The audit determines whether the parameters and metrics chosen in the decision process accurately predicted how the alliance supports the firm's strategic goals. The values of the estimates made and the procedures used to arrive at the values are also reviewed. The methodology itself is reviewed to determine what, if any, modifications are required for a specific enterprise in making future alliance decisions. The auditing procedure may also serve to monitor the performance of the alliance based on the metrics selected for the justification process.

7. CONCLUSION

Justifying strategic relationships is a critical step in their formation. Deciding with whom to form an alliance can be a risky endeavor for most companies. To help reduce this risk an extensive justification approach is presented. Clearly, alliance formation should be driven by corporate strategy. This business case methodology presents a mechanism that aids the linkage of strategy to tactical and operational factors in forming a strategic alliance. Few analytical models exist for the purpose of evaluating strategic alliances. The methodology presented here is a structured approach with supporting tools identified. A number of strategic analysis techniques were provided within this framework including the use of the ANP and utility theory.

The purpose of this paper was to present an overall systemic methodology for making a 'business' case for strategic alliance formation. Clearly, there are a number of limitations, and extensions can be introduced to make this a more robust approach. For example, development of metrics, tools for estimation of data, and an activity based allocation methodology are all considerations for extending this approach. A weakness of this approach is the length of time for practical implementation. Data acquisition will be a very time intensive process for this methodology. Yet, if an organization seeks to form a strategic alliance, which may potentially have implications for survival of the organization, a decision analysis technique that can reduce the risk of the decision, will be worth the investment. In addition, after initial implementation of the methodology, additional justifications will require a fraction of the time.

The methodology, if used by more than one partner in a strategic alliance, has the potential as a negotiation tool, where factor importance could possibly be used for 'win–win' negotiations. This application also needs further investigation.

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