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The Need and Tools for Successful Innovation

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The Need and Tools for Successful Innovation

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ETM 530/630 – Decision Making
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Acknowledgement

We would like to thank Kitty Deshmukh for allowing us to use Daimler Trucks North America as a case study on innovation and the process and tools used for innovation as part of the cost savings group at Daimler Trucks North America. In addition we thank Kitty for her support and valuable information she provided.

1. Executive Summary

Innovation is not a new concept, but the extent to which it is used is. Economies are shifting from industrial based to knowledge based innovation. Innovation has been effectively applied to product and manufacturing process innovation, but with the growth of innovation, more focus is being applied to improve management of innovation and information to effectively introduce the volume of innovation. This includes processes and tools used to manage innovation. Finally innovation is being applied to all areas and operations of businesses. Application of innovation to all parts of a business has been recognized as a crucial element to remain competitive.

This report examines some of the important components of innovation, works through an innovation case study at Daimler Trucks North America, and examines the potential application of Hierarchy Decision Method and the Kepner/Tregoe Decision Analysis method for innovation decision making.

The literature reviewed has revealed that innovation management techniques are growing and the characteristics of innovation management are becoming clearer. For companies to survive, core innovation is a must, adjacent innovation is strongly recommended for company growth, and transformational innovation, the riskiest of the three, brings the largest financial rewards. It is important to establish initiative priorities, especially in the core and adjacent innovations were there are typically more initiatives than available resources. To that end, the Hierarchical Decision Method and Kepner/Tregoe Decision Analysis are effective methods to establish innovation initiative priorities.

2. Introduction

The term innovation has permeated businesses, is often included in mission statements, and most companies say they are doing it. Is innovation only a buzz word loosely thrown about that will soon fall to the wayside? We think not. Following are three fundamental innovation trends.

- Economies are shifting from an industrial based economy to a knowledge and innovation based economy [15]. This shift is similar to the one from an agricultural economy to an industrial economy. It is not known to what degree the shift will occur, but by observing company activities, the shift is happening.

- Product innovation is estimated to contribute to 30% of innovation success, and managing innovation 70% [15]. The disproportionate distribution on the management side is most likely due to 2 factors, the complexity of managing innovation, and the relatively recent awareness that the current innovation management methods are a roadblock. The management of innovation needs to catch-up to the maturity of technical product innovation to improve the overall implementation of product innovation.

- In addition, innovation needs to go beyond the traditional product innovation and product manufacturing process innovation. Innovation needs to touch every area of an enterprise. This approach called Total Innovation Management [3] calls for innovation from all employees on a continuous basis.

This report takes a high level view at some of the general innovation concepts, includes a case study at Daimler Trucks North America and goes a bit deeper examining the Hierarchy Decision Method and Kepner /Tregoe Decision Analysis to establish innovation initiative priority.

3. Literature Review

3.1 Innovation Necessity

Innovation is the introduction of something new or significantly improved, like products or processes. Developing successful innovations is essential for sustaining a firm's competitive advantage. Successful innovation can increase profits, satisfy customer demand, obtain competitive advantage and gain new markets.

Most companies are comfortable with innovating at the core which means their existing customers and existing markets using existing technologies. It is very important to innovate in the core. Companies have spent years refining their practices for the success of the products in the markets. It is easier to innovate in the core as the customers know what the company is capable of. They have trust in the company's judgment and are willing to experiment with them [1]

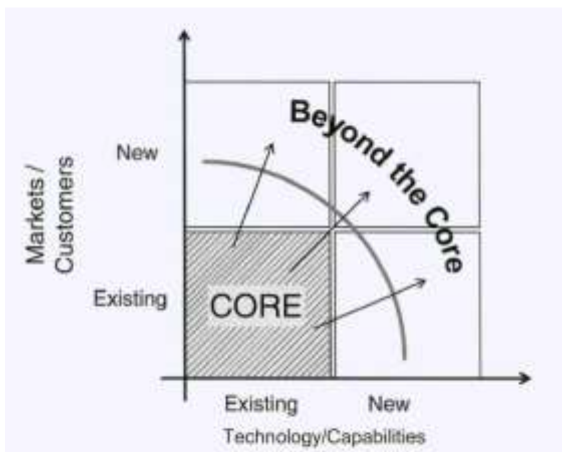

Figure 1: The core and what lies beyond [1]

Innovation beyond the core is difficult as it means acquiring new customers, and new markets. The company has no domain knowledge in this case and even the customers do not know the company since it is new in that domain. Using new technology always brings uncertainty as there are certain factors one is unsure about. Will the product be delivered in the required timeframe and will the technology be easy to adopt? A team at Bain and company [1] studied 181 adjacent innovations attempted by 154 companies in the US and Europe. They came up with some statistics which were: two steps away from the core decreases the chances of success, and a company attempting more than 2 steps should have a high tolerance for risk. However staying in the core cannot guarantee success. This is known from a study done by Laurie, Doz, and Sheer (2006) [1] regarding the fate of 93 companies that joined fortune 50. In the five years prior to entering fortune 50, the 93 companies had an enviable annual growth rate in excess of 13% and a year later a growth of 29%. But thereafter these companies did not achieve a growth of more than 2% even after having brand equity and market resources. Another study by CEB [1] shows that more than half of the companies in the fortune 100 faced market capitalization decay of more than 75%. These studies depict that sustaining growth is very difficult due to a competitive world and today's leader can become tomorrow's laggard. Hence delivering innovation beyond the core is necessary for every company [1].

3.2 Innovation Managing

3.2.1 Innovation Matrix

According to a Harvard business review (2012), Nagji and Tuff developed the Innovation Ambition Matrix (Figure 2). They divided innovative types into three levels, core, adjacent, and transformational innovation by the novelty of a company's offering (on the x axis) and the novelty of its customer markets (on the y axis). Core innovation initiatives requires effort to make incremental changes to existing products and incremental inroads into new markets. Adjacent initiatives mention innovation expanding from existing business into "new to the company" business. Thirdly transformational initiatives requires innovation developing breakthroughs and inventing products for markets that don't yet exist. The innovation ambition matrix offers no inherent prescription but gives two powerful points. First, it gives managers a framework for surveying all the initiatives like how much investment is going to be required for each type of innovation? Second, it gives managers a guideline to discuss the right overall ambition for the company's innovation portfolio. The research showed that companies that allocated about 70% to core initiatives, 20% to adjacent ones, and 10% to typical ones performed higher share price performance. They discovered in high-performing companies, the ROI ratio was the inverse of the resource allocation ratio. In other words, transformational level of innovation showed the highest total return (70%). However, the author didn't prescribe a golden ratio because the right balance will vary from firm to firm according to a number of factors such as different ambitions, and different allocations. The point is that managers should discover the gap between their current allocation and the ideal, and come up with a plan to decrease the gap [2].

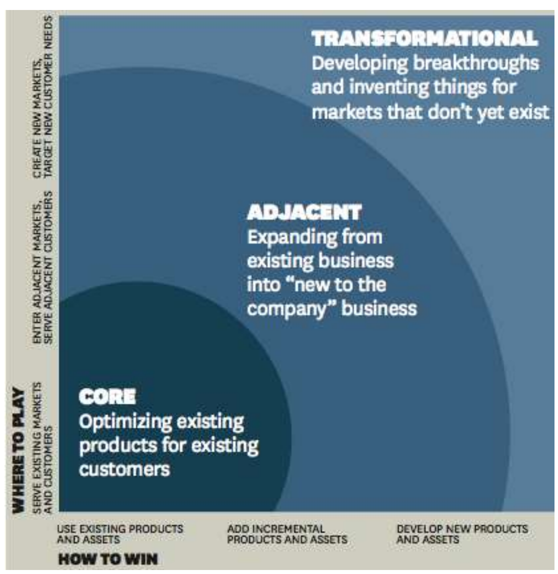

Figure 2. The Innovation Ambition Matrix

3.2.2 Innovation System

Many companies target a healthy balance of core, adjacent, and transformational innovation but few companies are good at all three. Also companies typically struggle the most with transformational innovation with high ROI but many research results indicate that mature firms attempting to enter new businesses often fail. It means that to achieve transformation innovation is difficult and an organization has to do things differently. There are five key areas to organize and manage the total innovation system [2].

Talent. The skills needed for transformational innovations differ from those needed for core and adjacent innovations. Transformational innovation skills typically employ a discovery and concept-development process to uncover and analyze the social needs driving changes, the basic market trends, and ongoing technological development while the skills for core and adjacent innovations required analytical capabilities.

Integration. It is true that right skills are critical but they are not sufficient. They must be organized and managed in the right way, with the right mandate, and under the condition to help their success. In most companies, the majority of people engaged in innovation are working on enhancements to core offerings but transformational innovation, as Samsung's move suggests, tends to show benefit when the people are independent on the core business.

Funding. Most efforts related to core and adjacent innovations are fairly small-scale projects but bold transformational efforts typically require significant investment. Firms might create a completely different funding structure for transformational innovation. This fund will contribute on components of an evolved future business model for the company.

Pipeline management. Usually any well-managed innovation process includes mechanisms to follow ongoing initiatives and assess projects periodically for recalculating their projected ROI according any changed conditions but traditional state-gate processes are dangerous if the innovation initiative involves an entirely new solution. Moreover, whereas pipeline management for core or adjacent innovation involved gradually finding a small best set from a vast number for ideas, the process of transformational innovation is very different. Namely transformational efforts are not generally managed with a funnel approach. They require a nonlinear process for a long period of time.

Metrics. Managers should discuss thoughtfully where external and internal metrics, along with economic and noneconomic metrics, are most appropriate for managerial measurements. Stage-gate systems operate at the intersection of economic and external metrics. They estimate how much money the company will make while its innovation is launched in the outside world whereas transformational efforts in the early state should use a combination of noneconomic and internal metrics. It is difficult for the company to learn and explore if the only hurdle an initiative must clear to receive continued investment. Therefore, a company must focus on the hard economics of a transformational project and wait until there's something ready to pilot and launch.

Key	Core & Adjacent	Transformational
Talent	Analytical	Discovery
Integration	Enhancements to core	Independent on the core
Funding	Related to core Small-scale	Different structure
Pipeline management	Funnel approach	Nonlinear process
Metrics	Economic, External metrics	Non-economic, Internal metrics

Figure 3. Innovation System Matrix

3.2.3 Innovation Culture

Successfully innovating beyond the core requires an innovative culture. It has been observed that strong innovative culture is the key factor which influences innovation in the enterprises.3M, a famous enterprise in the world, has a strong innovative culture of encouraging innovations and tolerating failures [3].

It has also been suggested that an organization culture is the single most sustainable source of competitive advantage. Some literature suggests that enterprise culture is the main management method on increasing enterprise performance. Some authors stated that in an enterprise when the effect of its culture is high, the road to the market is unobstructed. During the last two decades, corporate culture has been regarded as an important component of organizational success. More specifically, innovation culture refers to the shared common values and beliefs of organizational members that could facilitate the product innovation process. When an organization motivates the innovative capability of an individual and supports growth and development, the organizational culture may be labelled as an ‘innovation culture’ [4, 5, 6, 7].

Innovation culture can be built in following ways:

- Encourage introspection on the recent track record of innovation at all levels - group, corporate, division, region etc.

- Perform inter-firm comparisons and benchmarking on innovation against competitors.
- Carryout a survey of the existing organizational culture considering innovation:-
  - what forces **encourage** innovation
  - what forces **prevent** innovation
- The forces affecting innovation may be of several kinds:
  - Senior management attitude
  - Appraisal and promotion systems
  - Organization structure and roles
  - Communication, planning, decision-making and control processes
  - Employee skills and attitudes
- Convey the survey findings to the organization. Also encourage suggestions for improving the organizations culture.
- Act upon the suggestions and make necessary changes in the senior management's attitude to encourage innovation.
- Provide training to improve skills and knowledge base.
- Encourage and reward innovation [8].

3.2.4 Innovation Process and Decision-making

Engineering and technical innovation has becomes the main power for companies because innovation has become the key factor affecting project success and failure in the fierce market competition. The innovation process is a complex dynamic system but selective innovation approach and decision-making method process will improve the success and failure of innovation decision and innovation efficiency. A study provides a useful example of Demand-Pull Linear Innovation Model to present the process of methods integration in the stage of the technological innovation [9]. This model is able to promote technological and economic innovation and transformation because this approach provides the best combination of innovative method and decision-making methods. Engineering technological innovation process can be logically defined by following seven steps (Fig 4). Also the figure offers decision-making methods based on engineering technical innovation.

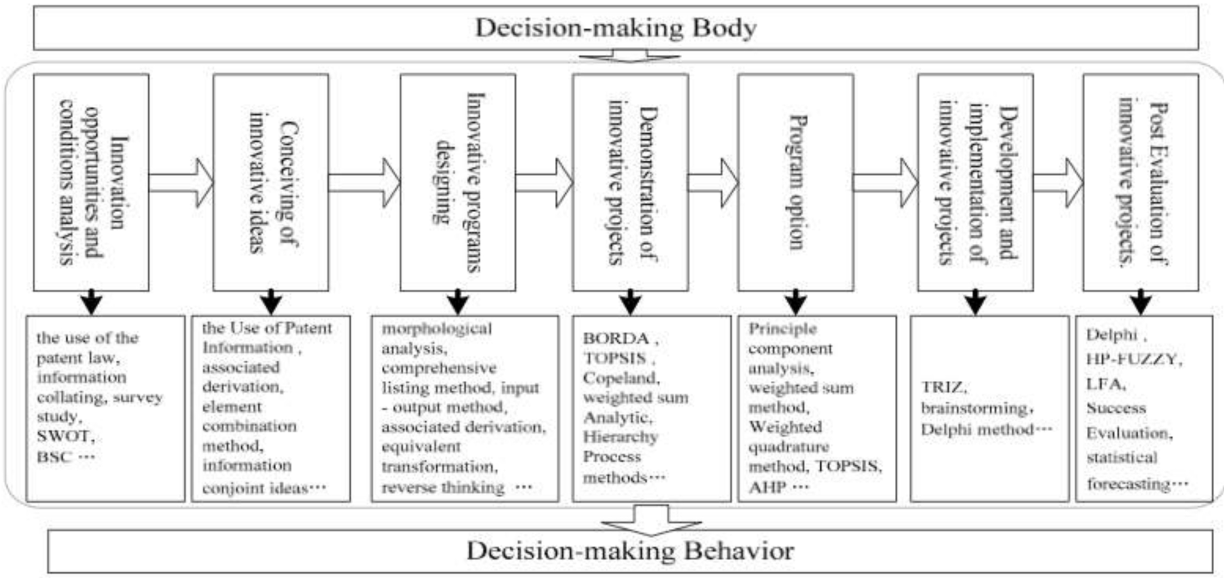

Figure 4. Integrated Approach of Innovative Method and Decision-Making Based on Engineering Technical Innovation [9]

3.2.5 Decision-making process

We have reviewed about the importance of innovation for an organization in existing literature; it also becomes important to prioritize innovative projects in an organization to utilize its resources properly. This paper focuses on creating multi-criteria decision making model based on Mission, Objectives, Goals, Strategies and Activities (MOGSA) model, developed by Kocaoglu et.al, to enable the management to relatively rank various innovative projects in a department [10].

The important aspect of developing a multi-criteria decision making model based on MOGSA is to identify relevant criteria to evaluate different projects. Existing literature that uses multi criteria decision making models such as Analytic Hierarchy Process (AHP) and ANP has been reviewed to find out criteria.

Calantone, Di Benedetto and Schmidt use Analytic Hierarchy Process for new product screening [11]. Their study speaks about the importance of initial screening of a new product idea to avoid significant investments being made to an unworthy idea. They use below model to select best new product idea, where they use Marketing Fit, Technology Fit – fit with firm's core marketing and technical competencies, and also Risk and Uncertainty of projects.

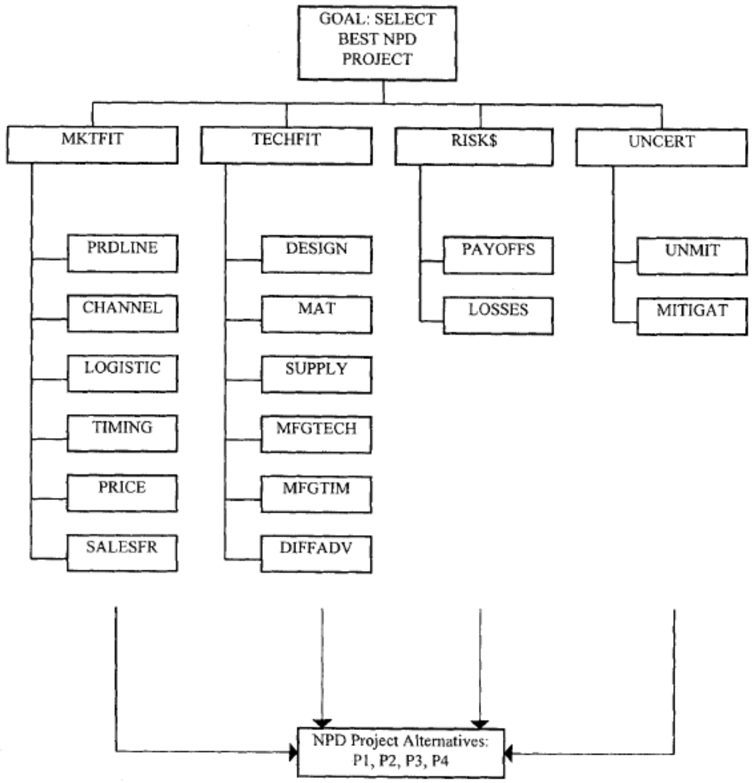

Figure 5. Analytic Hierarchical Model – New product screening [11, pg.no 70]

Meade and Presley use Analytic Network Process to select best R&D project [12]. This paper along with technical, strategic fit also considers profitability factor such as NPV.

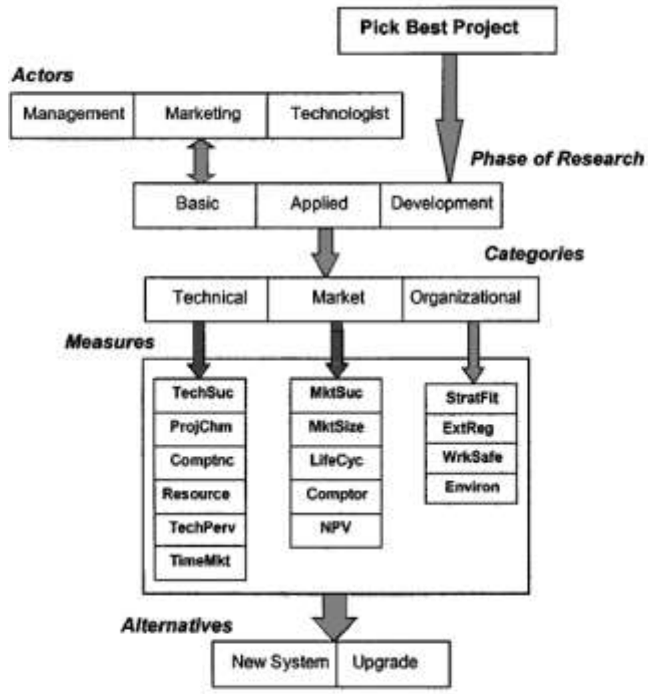

Figure 6. Analytic Network Process – R&D Product Selection [12, pg no. 61]

Kim et.al utilizes ANP model on information system to select a best project [13]. Their work also uses quantitative criteria such as DCF, payback and quantitative factors such as complexity, development time and strategic fit.

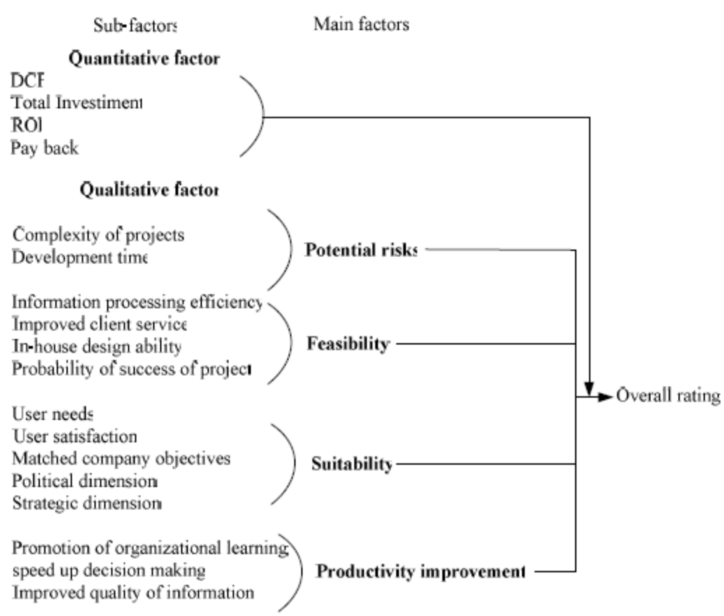

Figure 7. ANP – Information Systems selection [13 ,pg. no. 412]

Dey utilizes AHP to select best cross-country oil pipeline project in India. This work is relatively different from selecting a new product, but the usage of criteria used to measure technical risk can be considered for our study [14]. Dey uses below AHP model for evaluation of different pipeline projects.

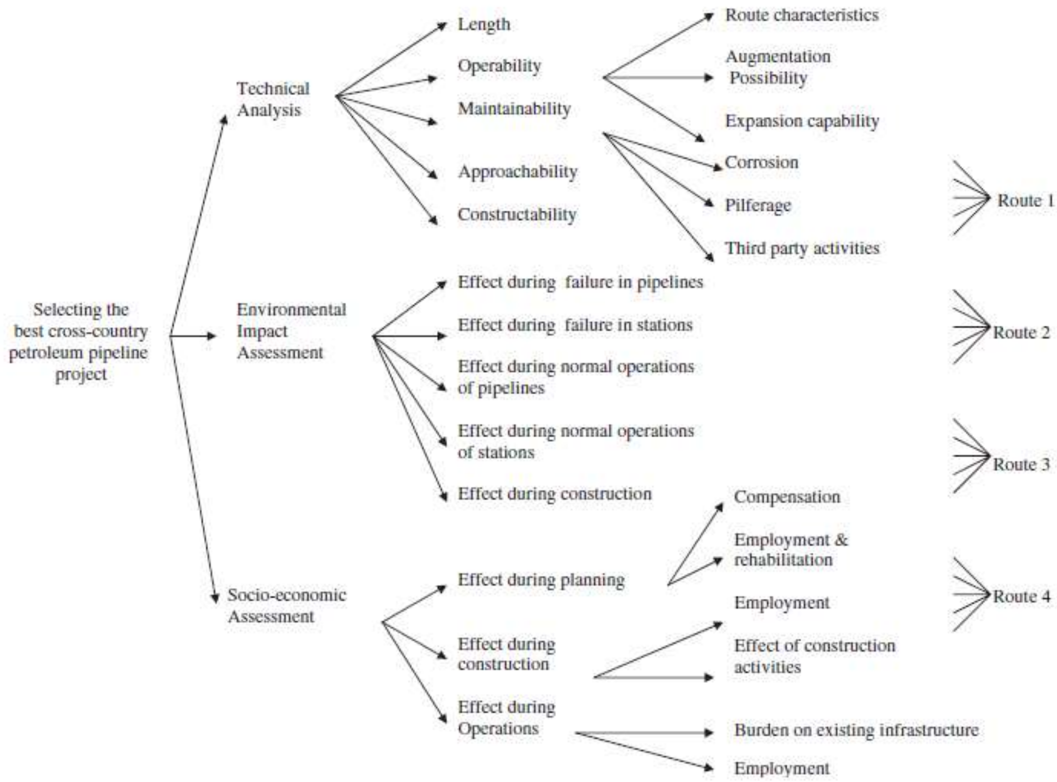

Figure 8. Analytic Hierarchical Model – Pipeline project evaluation [14, pg.no 98]

Other than literature review, expert opinion also been considered to include few department specific criteria in the model to evaluate different projects. Criteria derived from literature review and expert opinion can be summarized as shown below in Figure 9. Criteria are then converted into HDM model using web application provided by ETM department [link: http://research1.etm.pdx.edu/hdm2/].

Criteria	References
Profitability	[12]
Annual Savings	Expert opinion
Lifecycle Savings	Expert opinion
Breakeven	[12], [13]
Technical Risk	[11], [12], [13], [14]
Technical Maturity	Expert opinion
Technical Expertise	[12]
Time to implement	[12], [13]
Complexity	[11], [12], [13]
Customer benefit	Expert opinion
Product Strategy	[11], [12], [13]

Figure 9. Source of Criteria

4. DTNA Case Study

4.1 Introduction

This case study examines innovation at Daimler Trucks North America (DTNA) as it applies to cost savings. Innovation applied to cost savings can be for the most part considered a core technology innovation. The cost savings program at DTNA will be examined in terms of the following:

- Top Management Leadership
- General Cost Savings Group Organization
- Alignment to 'Core' Type Innovation System
- Innovation Culture

4.2 Top Management Leadership

Successful innovation starts at the top of the organization leadership and needs to be supported throughout the organization. Top leadership is typically engaged by identifying how an initiative such as cost savings fits into the some form of a MOGSA (Mission – Objectives – Goals – Strategy – Action). At DTNA innovation is identified by top management as a means for profitability. As shown in figure 10, innovation is applied to various areas of the company, with cost savings (CCI) being one of them. The cost savings initiative also has cost savings goals and strategic direction. One portion of the MOGSA action is carried out by the Cost Savings group.

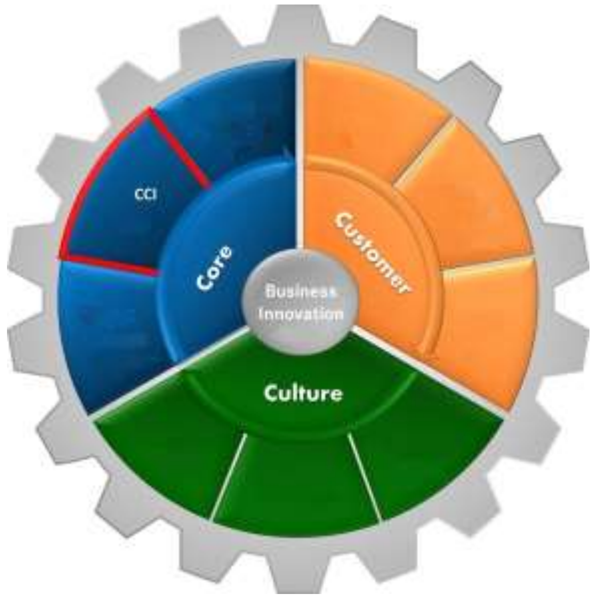

Figure 10 – DTNA Innovation Initiatives

4.3 Cost Savings Department Organization

There is a dedicated team focusing on product cost savings. The team is cross functional with representation from functional areas needed to support the goal of managing initiatives from initial idea generation to implementation. The cost savings group does not carry out the engineering, validation activities, but rather manages these activities. See figure 11 for the organizational structure.

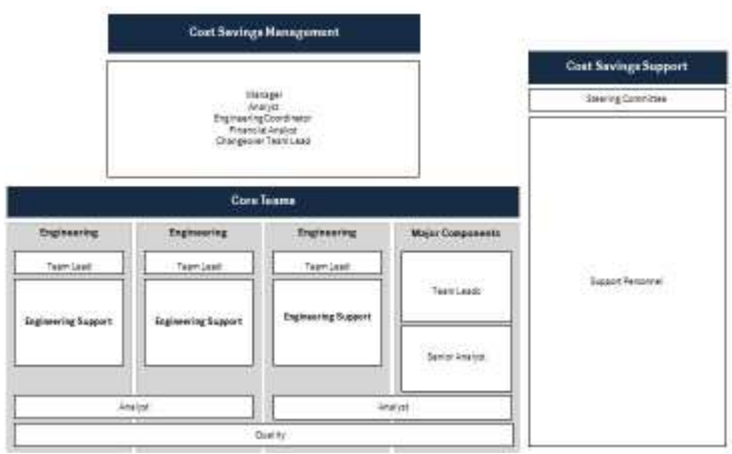

Figure 11 – Cost Savings Group

All areas needed to advance cost savings ideas to production are included. This includes engineering, manufacturing, sales, finance, quality and various other company groups. The decision to advance or reject an initiative is made by an executive steering committee.

A process map, as is shown in figure 12, guides the cost savings group to successfully achieve the group goals. There are six stages L0 through to L5. Following briefly outlines each stage.

L0 – Initiatives are submitted and a high level review is conducted. If an initiative is rejected at this point, an explanation for the rejection is prepared.

L1 – Initiatives that pass the initial review move on and have a business case developed. The business case includes technical feasibility, validation requirements, cost savings potential, development cost, timing and impact to the customer. If the initiative has a 2 year or less payback and does not have an undesirable customer impact, the initiative advances to the next stage.

L2 – Initiative is reviewed by the executive steering committee. The committee rejects, approves or requests further evaluation. If the initiative is approved, the initiative moves to L3.

L3 – The initiative is developed, validated if necessary, and launched into production.

L4 – The initiative is verified to gage customer impact and verify cost savings. If these both prove positive, the initiative is moved to L5 – initiative implemented and verified.

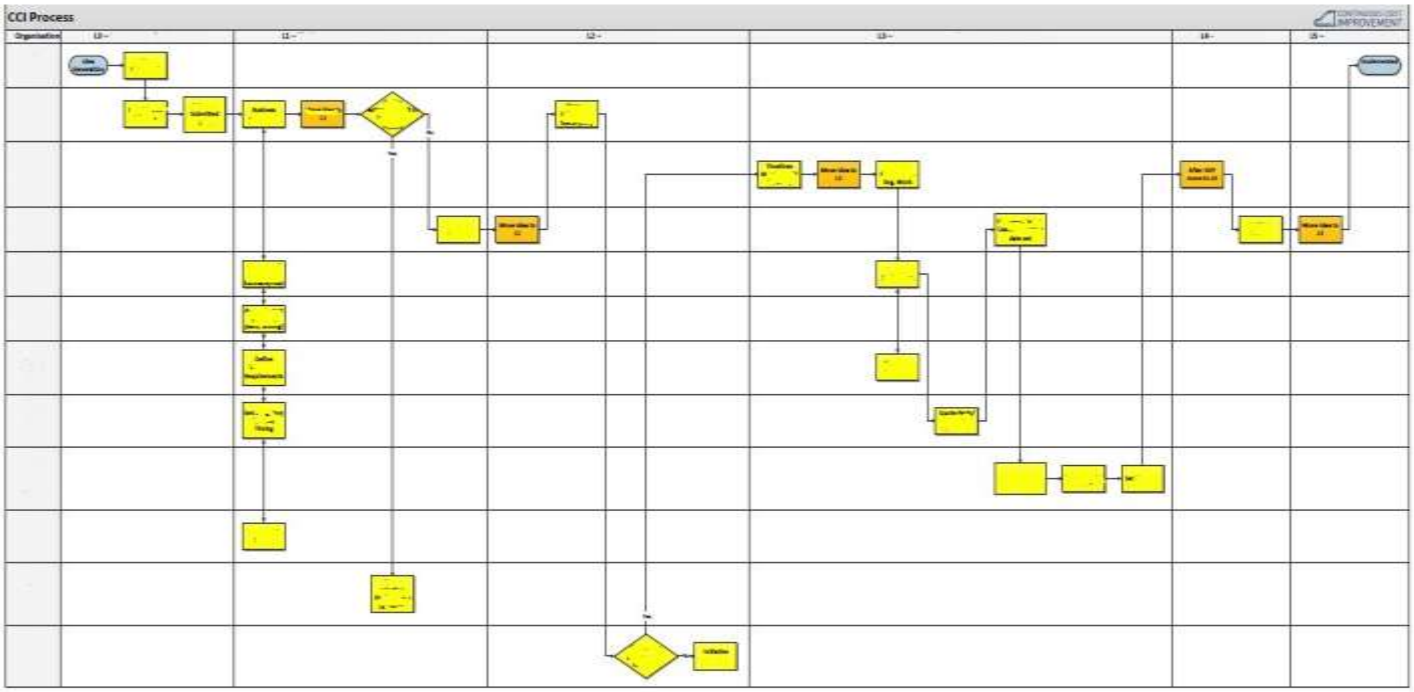

Figure 12 – Cost Savings Process Map

4.4 Alignment to 'Core' Type Innovation System

Core type innovation is innovation applied to core company technologies and products. For the most part, this is the type of innovation applied to cost savings. This type of innovation is analytically focused, highly integrated in the overall organization, requires smaller scale funding, uses the funnel approach for idea creation, and has robust economic and external metrics. All these characteristics are solidly in place by the cost savings group at DTNA.

4.5 Culture

The difference between success and failure of an activity often hinges on the culture as it pertains to the activity. Culture is reflected by how a company provides the necessary resources and structure. Culture is determined by how a company recognizes, rewards, and communicates the goals. Finally the general attitude towards the activity rounds out the general characteristics of culture. The communications of the cost savings group activity is to a large part inherent in the process by being very integrated with the main departments of the company. Many of the positions in the cost savings group are held by people who rotate through the group. This has people at the working level sharing information across the company and the managers of these personnel are also engaged by virtue of providing personnel from their department. In addition, the various group managers communicate the department cost savings goals/target to their staff. Recognition is supported by the functional area managers with 'one pagers' posted around the company identifying cost savings initiatives that have been achieved by their respective department. In addition to this recognition, there is an annual recognition event involving executives recognizing group and individual cost savings achievements.

4.6 Filling the Pipeline

With all the fundamentals in place, filling the pipeline is of course a key action item. Groups in engineering and throughout the company participate in workshops, brainstorming, focus groups to come up with cost savings ideas. Some groups go to the production plants to observe the truck build and determine if there are design features for assembly that add cost but aren't serving the intended purpose. Throughout the year employees can continuously submit ideas. This all results in many ideas, more than there are resources to implement.

The over loading of ideas can make it challenging to identify which initiatives to focus on. Which initiatives should receive the limited resources? One option for this situation is to assign ranking to the ideas and establish a priority. The next section takes a sampling of 5 initiatives and establishes a ranking for the initiatives.

5. Methodology

We have developed a methodology as shown in Fig 13 to obtain relative ranking for each innovative project. Projects would then be executed by the management based on the ranking obtained from the HDM model.

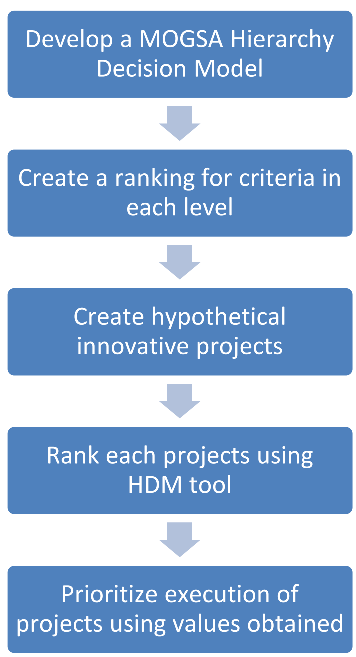

Figure 13. Methodology

The first step of methodology is to create decision model based on MOGSA decision model. The decision model can be developed by following the steps outlined below [10].

Mission: What business are we in? What business do we want to be in?

Objectives: What achievements should we have in order to satisfy our mission?

Goals: What are the targets to reach in order to fulfill our objectives?

Strategies: What pathways should we follow in order to meet our goals?

Actions: What projects should we have in order to develop our strategies?

Once we have developed the decision hierarchy model, the criteria at one level were compared to each other to develop a ranking based on knowledge of available experts. The next step is to evaluate the hypothetical projects and assign them ranking using pairwise comparison based on expert opinions. Using the ranking obtained for different criteria and project, the relative ranking of each project is obtained from the HDM software. The inconsistency measure is also considered and necessary steps were taken to keep it below 0.1 while evaluating the relative ranking of each project.

5.1 HDM Model and Results

Below HDM model represents relation between different criteria as well as levels. Weighting of each criterion towards upper level is also included in the model.

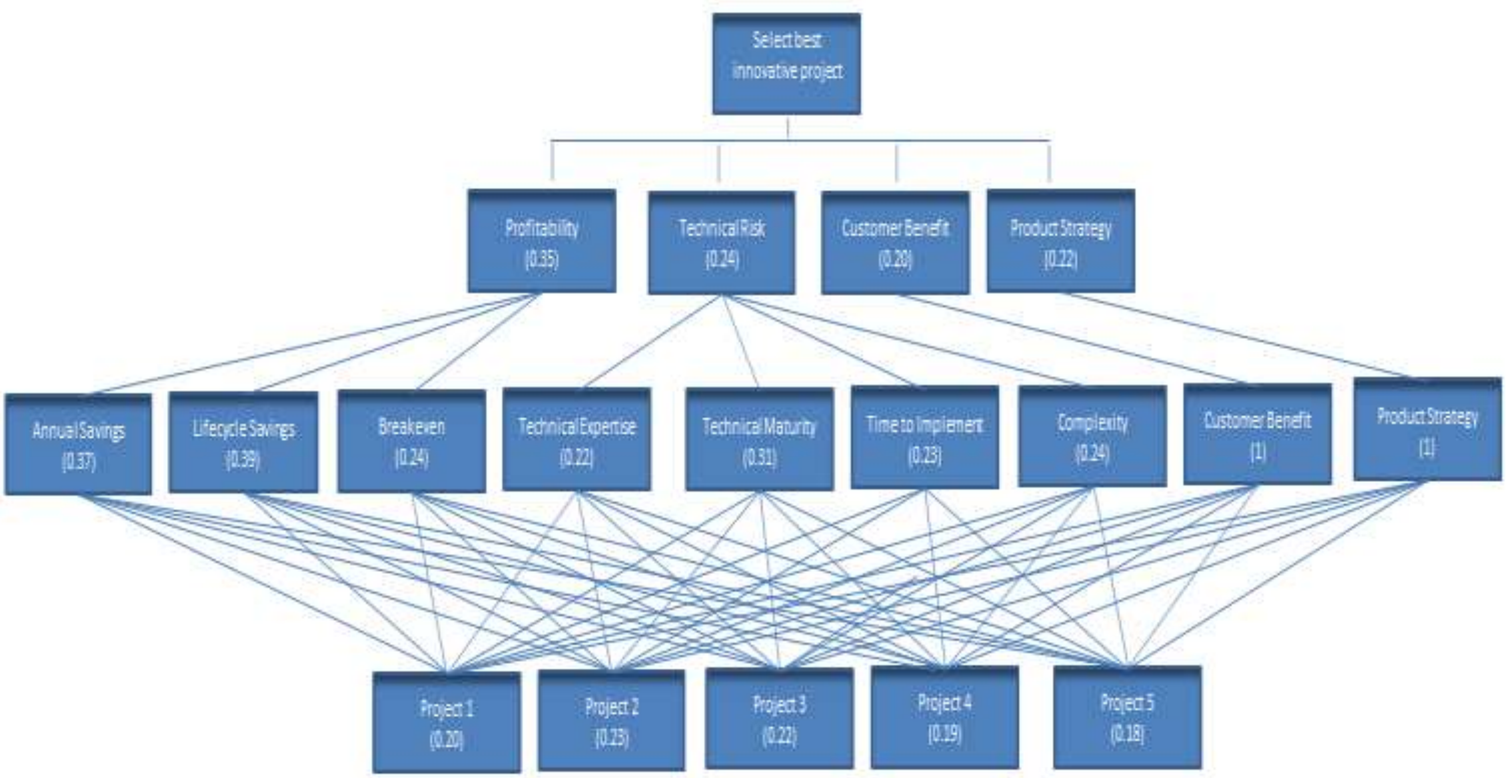

Figure 14. HDM Model and Results

Our mission is to select a best innovative idea among alternatives in cost savings department.

Criteria for the HDM model are

Objectives are Profitability, Technical Risk, Customer benefit, and Product Strategy. Goals for profitability are annual savings, lifecycle savings and breakeven, whereas for Technical risk are technical maturity, expertise, complexity and time to implement. We have five alternative projects in the department (project details are attached in the appendix). Expert opinions were registered in the software to evaluate projects based on different criteria included in the model.

6. Results & Discussion

Our team members registered their expert opinion about criteria and projects based on details about five projects. Table containing project details were attached in appendix table 1. We obtained the following results from HDM software.

Select best innovative product	Project 1	Project 2	Project 3	Project 4	Project 5	Inconsistency
Henry Janzen	0.21	0.28	0.18	0.15	0.19	0.02
Purva Chhatre	0.17	0.2	0.28	0.19	0.17	0.02
Sridhar Kumar	0.2	0.2	0.21	0.22	0.17	0.04
Yongjun Lee	0.11	0.13	0.12	0.11	0.07	0.02
Mean	**0.17**	**0.2**	**0.2**	**0.17**	**0.15**	
Minimum	0.11	0.13	0.12	0.11	0.07	
Maximum	0.21	0.28	0.28	0.22	0.19	
Std. Deviation	0.04	0.05	0.06	0.04	0.05	
Disagreement						0.05

Figure 15. HDM Results

Project 3 and Project 2 were top-ranked with both of them receiving mean rating of 0.2. Project 5 was least ranked with a mean rating 0.15. Inconsistency and disagreement levels were below 0.1. Individual expert results also show project 2 or project 3 are preferred alternatives, with project 5 always receiving a lower rating.

Level-1 -Select best innovative product	Henry Janzen	Purva Chhatre	Sridhar Kumar	Yongjun Lee	Mean
Profitability	0.39	0.48	0.22	0.29	0.35
Technical risk	0.2	0.15	0.36	0.24	0.24
Customer benefit	0.2	0.23	0.14	0.24	0.20
Product Strategy	0.2	0.14	0.29	0.24	0.22
Inconsistency	0	0	0.06	0	

Figure 16. Level 1 Pairwise Comparison

Profitability criteria as shown in figure 16 had the higher weighting in the model compared to other criteria, with technical risk getting second highest weighting among alternative. Inconsistency levels were also below 0.1 for level 1 comparison.

Results tend to show project 2 and project 3 can be given priority in execution stage and project 5 implementation can be delayed in case the department faces constraint in resources.

Kepner- Tregoe

Kepner-Tregoe methodology is also used validate results generated from HDM model. All five projects pass through must criteria of "positive payback period within 2 years" and "No negative customer impact". Then weighting is developed for all criteria that are used in HDM model. Each project is weighed against each criteria based on their importance. Negative weighting also factored in the model related to risk factor associated with implementation of projects. See appendix table 5 & 6 for scores and ranking using the Kepner-Tregoe method. The results of the Kepner-Tregoe method are shown in figure 16. Some similarities can be found between results of both HDM and Kepner-Tregoe. Project 3 is top ranked among 5 alternatives and project 5 is least ranked, which is similar to HDM results. However, projects 4, which was ranked second in HDM model, has got the third ranking in Kepner-Tregoe.

Project	Adjusted Score
Project 1	611
Project 2	681
Project 3	774
Project 4	709
Project 5	590

Figure 17. Kepner-Tregoe Results

7. Pitfalls and Limitations

Several pitfalls and limitations were realized through literature study and analysis of the case study as follows:

Direction

- Unclear goals, strategy and criteria can lead to dead ends and innovation malaise.

Product, Process and Human Resource Landscape

- Lack of company and competitor product awareness will hamper success. Inadequate innovation process understanding will result in inefficient innovation.

Sprinting out of the Gate

- Due to innovation complexity, risk and uncertainty, sprinting out of the gate without the correct tools, resources and knowledge can result in unnecessary failed attempts.

One limitation of the case study HDM and Kepner-Tregoe results implementation is:

- Priorities may rank ideas that require resources in areas that are resource limited.

8. Conclusion

- Innovation is critical for a company's success. Core innovation is a minimum, adjacent innovation is strongly suggested, transformational innovation brings highest ROI.
- The innovation process is a complex dynamic system. Dedicated innovation resources, organizational structure and management tools geared for innovation are key.
- Employees need to have the right mindset and expertise to engage in meaningful innovation. Start innovation with smaller focused efforts and then grow building on successes and spreading throughout to the entire organization.
- The HDM and Kepner/Tregoe methods provide effective means to prioritize innovation ideas.

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Appendix

1. Project details

Project	Annual Savings	Lifecycle Savings	Complexity	Complexity Comments	Technical Maturity	Technical Maturity Comments
1	$ 460,609.90	$ 1,842,439.60	2	many parts	5	Mature technology
2	$ 444,604.45	$ 4,446,044.54	3	moderate change to existing design	5	Mature technology
3	$ 359,982.00	$ 3,599,820.00	5	simple removal of part- validation is complete	5	Mature technology
4	$ 321,893.64	$ 3,218,936.40	3	changing type of rubber - some risk	5	Mature technology
5	$ 90,852.11	$ 908,521.08	3	changing from welded assy to cast part	5	Mature technology

Time to Implement	Technical Expertise	Technical Expertise Comments	Customer Benefit	Customer Benefit Comments	Product Strategy	Product Strategy Comments	Breakeven
2	5	Full in house technical expertise	4	more durable, lower failures	4	improved reliability	1.10
3	5	Full in house technical expertise	4	better fit	3	neutral	1.20
5	5	Full in house technical expertise	3	neutral	3	neutral	0.02
3	5	Full in house technical expertise	3	neutral	3	neutral	0.34
3	5	Full in house technical expertise	5	better durability	4	improved reliability	1.10

2. **Level 1 – Pairwise Comparison**

Level-1 -Select best innovative product	Henry Janzen	Purva Chhatre	Sridhar Kumar	Yongjun Lee
Profitability	0.39	0.48	0.22	0.29
Technical risk	0.2	0.15	0.36	0.24
Customer benefit	0.2	0.23	0.14	0.24
Product Strategy	0.2	0.14	0.29	0.24
Inconsistency	0	0	0.06	0

Level-1 - Select best innovative product	Henry	Purva Chhatre	Sridhar Kumar	Yongjun Lee
Project 1	0.21	0.17	0.2	0.21
Project 2	0.28	0.2	0.2	0.22
Project 3	0.18	0.28	0.21	0.2
Project 4	0.15	0.19	0.22	0.19
Project 5	0.19	0.17	0.17	0.18
Inconsistency	0.02	0.02	0.04	0.02

3. Level 2 - Pairwise Comparison

Level-2	Henry Janzen				Sridhar Kumar			
	Profitability	Technical risk	Customer benefit	Product Strategy	Profitability	Technical risk	Customer benefit	Product Strategy
Annual Savings	0.2	0	0	0	0.32	0	0	0
Lifecycle savings	0.4	0	0	0	0.53	0	0	0
Breakeven	0.4	0	0	0	0.15	0	0	0
Technical maturity	0	0.25	0	0	0	0.15	0	0
Technical expertise	0	0.25	0	0	0	0.47	0	0
Time to implement	0	0.25	0	0	0	0.1	0	0
Complexity	0	0.25	0	0	0	0.27	0	0
Customer Benefit	0	0	1	0	0	0	1	0
Product Strategy	0	0	0	1	0	0	0	1
Inconsistency	0	0	0	0	0	0.04	0	0
	Purva Chhatre				Yongjun Lee			
Annual Savings	0.33	0	0	0	0.62	0	0	0
Lifecycle savings	0.33	0	0	0	0.3	0	0	0
Breakeven	0.33	0	0	0	0.07	0	0	0
Technical maturity	0	0.25	0	0	0	0.22	0	0
Technical expertise	0	0.25	0	0	0	0.27	0	0
Time to implement	0	0.25	0	0	0	0.33	0	0
Complexity	0	0.25	0	0	0	0.18	0	0
Customer Benefit	0	0	1	0	0	0	1	0
Product Strategy	0	0	0	1	0	0	0	1
Inconsistency	0	0	0	0	0.28	0	0	0

4. Level 3 – Pairwise Comparison

Level-3	Annual Savings	Lifecycle savings	Breakeven	Technical maturity	Technical expertise	Time to implement	Complexity	Customer Benefit	Product Strategy
	Henry Janzen								
Project 1	0.28	0.13	0.29	0.2	0.2	0.13	0.13	0.18	0.23
Project 2	0.26	0.32	0.31	0.2	0.2	0.19	0.19	0.4	0.18
Project 3	0.22	0.26	0.01	0.2	0.2	0.31	0.31	0.19	0.18
Project 4	0.19	0.23	0.09	0.2	0.2	0.19	0.19	0.05	0.18
Project 5	0.05	0.06	0.29	0.2	0.2	0.19	0.19	0.19	0.23
Inconsistency	0	0	0	0	0	0	0	0.21	0
	Purva Chhatre								
Project 1	0.3	0.11	0.04	0.2	0.2	0.12	0.12	0.19	0.23
Project 2	0.23	0.35	0.07	0.2	0.2	0.19	0.19	0.17	0.18
Project 3	0.12	0.25	0.68	0.2	0.2	0.31	0.31	0.2	0.18
Project 4	0.21	0.22	0.13	0.2	0.2	0.19	0.19	0.18	0.18
Project 5	0.14	0.06	0.08	0.2	0.2	0.19	0.19	0.26	0.23
Inconsistency	0.11	0	0.09	0	0	0	0	0.01	0
	Sridhar Kumar								
Project 1	0.35	0.14	0.06	0.2	0.2	0.29	0.06	0.19	0.25
Project 2	0.32	0.36	0.07	0.2	0.2	0.21	0.2	0.16	0.15
Project 3	0.15	0.26	0.46	0.2	0.2	0.08	0.45	0.11	0.15
Project 4	0.13	0.11	0.34	0.2	0.2	0.22	0.22	0.1	0.36
Project 5	0.05	0.13	0.07	0.2	0.2	0.21	0.07	0.45	0.09
Inconsistency	0.01	0.17	0.02	0	0	0	0.03	0.01	0.25
	Yongjun Lee								
Project 1	0.28	0.13	0.17	0.2	0.2	0.16	0.16	0.21	0.22
Project 2	0.26	0.32	0.17	0.2	0.2	0.2	0.2	0.21	0.18
Project 3	0.22	0.26	0.26	0.2	0.2	0.24	0.24	0.17	0.18
Project 4	0.19	0.23	0.21	0.2	0.2	0.2	0.2	0.17	0.18
Project 5	0.05	0.06	0.17	0.2	0.2	0.2	0.2	0.25	0.22
Inconsistency	0	0	0	0	0	0	0	0	0

5. Kepner Tregoe Results

MUSTS		Project 1		Project 2		Project 3	
Positive payback within 2 years		Go		Go		Go	
No Negative Customer Impact		Go		Go		Go	

Criteria	Weight	Info	Score	Weighted Score	Info	Score	Weighted Score	Info	Score	Weighted Score
Lifecycle Savings	15		8	120		8	120		7	105
Annual Savings	10		5	50		8	80		8	80
Breakeven	15		4	60		4	60		8	120
Technical Maturity	8		9	72		9	72		9	72
Technical Expertise	10		9	90		9	90		9	90
Complexity	10		5	50		7	70		9	90
Time to Implement	10		5	50		6	60		9	90
Customer Benefit	12		7	84		7	84		6	72
Product Strategy	10		8	80		7	70		7	70
				0			0			0
				0			0			0
TOTAL	100	Weighted Score		656	Weighted Score		706	Weighted Score		789
		Risk Factor		-45			-25			-15
		Adjusted Score		611	Adjusted Score		681	Adjusted Score		774

6. Kepner Tregoe Results - Continued

MUSTS		Project 4			Project 5		
Positive payback within 2 years		Go			Go		
No Negative Customer Impact		Go			Go		
WANTS	**Weight**	**Info**	**Score**	**Weighted Score**	**Info**	**Score**	**Weighted Score**
Lifecycle Savings	15		7	105		4	60
Annual Savings	10		8	80		4	40
Breakeven	15		8	120		4	60
Technical Maturity	8		9	72		9	72
Technical Expertise	10		9	90		9	90
Complexity	10		7	70		7	70
Time to Implement	10		6	60		6	60
Customer Benefit	12		6	72		9	108
Prodcut Strategy	10		7	70		6	60
				0			0
				0			0
TOTAL	100		Weighted Score	739		Weighted Score	620
			Risk Factor	-30			-30
			Adjusted Score	709		Adjusted Score	590