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ANALYSIS OF INTANGIBLE FACTORS IN WASTE MINIMIZATION PROJECTS

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Abstract - Continual population growth and rising standards of living that accelerate the consumption of limited resources, are forcing society to encourage conservation of these resources. These resources not only include raw material, but also the areas to dispose of the wastes. As a result, communities are driving industries towards waste minimization by limiting waste generation and landfill availability. Within this changing environment, firms utilizing appropriate environmentally friendly strategies can create competitive advantages by leading in sound environmental practices. This advantage emanates from the reduction of risk of environmental regulatory overreaction, as well as improved asset utilization and landfill utilization. However, these intangible benefits are difficult to identify and evaluate particularly with tools that were developed when intangibles were less critical.

Many firms simply institute policies that force the tactical decision-makers to make environmentally friendly decisions. However, these policies can commit the firm to act in ways that are not in their best interest, since actions that absorb too many of the firm's resources without sufficient beneficial impact, can generate competitive disadvantages.

This paper surveys the available analytical tools that are available to support effective decision-making dealing with intangible costs and benefits. It provides ways to identify some of the intangible benefits and address the value they generate. This paper also looks at a current case study where there was an opportunity to reuse a large volume of refractories (oven bricks). This case study shows how two companies addressed this opportunity.

I. INTRODUCTION

Traditional financial tools were developed during the Industrial Age and they appropriately focused on capital and its effective use. Now in the Knowledge Age intangible issues are becoming more critical to the generation of competitive advantage and effective decision-making. Knowledge assets are becoming a greater determinant of enterprise success as they provide key competitive advantages [1]. These knowledge assets such as customer relationships, internal business processes, employee learning, and community goodwill are often intangible, and traditional decision-making tools are not designed to deal with them. These intangible issues become key criteria for decision-making for a growing set of decision-making situations. These include investments in new technologies, information technology decisions, and waste management.

Criteria used for decision-making [2] can be categorized as:

1. **tangible** criteria that can be directly measured by traditional financial instruments and methods,
2. **intangible quantitative** criteria that can be directly measured by non-financial measures, such as CPU speed or tons of landfill reduced, and
3. **intangible qualitative** criteria that are difficult to capture with any measurable metric.

II. DECISION MAKING APPROACHES

There are many approaches that can be taken to make decisions. However, to address decision-making with complex intangible issue, it is useful to group these into three basic approaches.

1. **Judgment-based** approaches depend on the implicit knowledge, experience and judgment of the decision maker, who makes the decision based on his or her judgment. It is the fastest and cheapest approach, and is appropriate when the impact of the decision is not critical, when the decision-maker is experienced with similar situations, when the issues are simple enough to be considered by one individual, or when time is not available for other methods.
2. **Information-based** approaches depend on explicit and detailed analysis of the relevant factors, using the most pertinent analysis methods. These approaches are sometimes referred to as operations research approaches. These are appropriate when the pertinent variable and analysis have been determined, pertinent data is quantifiable, and analytical methods exist to analyze the situation. It fits well in structured organizations in which informed managers have the power to

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implement appropriate solutions. However, significant time and resources are often required for this approach, but the results are verifiable and can often facilitate follow-on analysis.

3. **Communications-based** approaches depend on explicit interaction among pertinent individuals, focusing on individual and organizational learning and communication, sometimes referred to as soft systems approaches [3,4]. These approaches are not as rigorous as the information-based approaches, but provide greater clarity to the participants, allows for a more thorough search for pertinent objectives, variables and analytical methods. It is appropriate when the pertinent variables and analysis have not been determined, or are not quantifiable, when the complexity requires the active participation by many, when there is not enough time or resources to perform a detailed analysis, when there is little experience with this type of problem, and when organizational support is required to support the resulting actions.

There are also fundamental organizational challenges related to waste reduction programs. It is the executive level decision-maker who is aware of the potential costs associated with traditional methods and the benefit that can be generated with more environmentally friendly activities. Strategic executives are also the ones who are chartered to focus on strategic issues that are not currently critical. However, they are generally not involved in the decisions that actually change those traditional behaviors, since the executives deal only in major transactions that warrant their involvement. The tactical decision makers, on the other hand, are faced with the many relatively small decisions that in combination do affect the organization's overall performance. Yet they are likely to make decisions based on direct costs and not appreciate the importance of some intangible benefits and the strategic need for a different decision. This means that in addition to selecting appropriate methods to analyze intangible benefits, the organizational structure of the organizations should be considered so that the right individuals are involved. If this does not occur, the organization will likely ignore the possibility.

III. METHODS AVAILABLE

The decision-making approach dictates the scope of the problem that is under question, the focus of the resulting investigation and many of the methods, techniques and tools that are used. However, many of these tools and methods can be utilized with either the information-based or communications-based approaches. Since it is more challenging to properly address the analysis of intangible factors, more creativity and flexibility is required, as well as a large toolkit of methods that can be used for the wide range of individual situations that exist. This way it is more likely that the right tool is used for the right situation. The following list and description of methods available provides some of these tools that can enhance the analysis and decision-making processes.

There are a number of methods and tools developed to support decision-making with intangible factors. These can be categorized as those that use weight factors to deal with diverse criteria, those that convert all the factors to financial estimates, those that provide other methods of comparisons and those that support group analysis and decision making. The largest group of tools use weight factors to allow for multi-variable analysis and include the following methods.

- In the expected utility [2] approach a quantitative scale is developed that relates to all the tangible and intangible factors. First the decision-making criteria is established and arranged in order of importance. Each alternative is rated against this scale. A decision is made based on the ratings of each alternative taking into account the relative importance of each criterion.
- The multi attribute decision model (MADM) [5] allows comparison of financial and non-financial data, and also takes probabilities of occurrence into account.
- A more rigorous and versatile version of MADM is the analytical hierarchy process (AHP) developed by Thomas Saaty. It provides a well-defined methodology to check the weight factors for consistency [5].
- Riggs [6] developed the objectives matrix (OMAX) and its associated implementation practices as a performance-indicating tool that motivates as it measures. It deals with the key intangible issues as group exercises that encourage group learning.
- Information economics [7] is a system of weights and measures that quantifies the intangible benefits and risks of alternative decisions, and ranks them based on business performance. This tool was originally developed to aid information technology purchases by the federal government, but is now also utilized by private firms.

The advantage of methods that converts the factors to financial estimates is that they are easy to interpret, facilitate discussions and enable traditional financial management tools to be applied. This approach highlights one of the fundamental difficulties with intangible factors. The value or cost of these factors is specific to individuals or groups. That is, different individuals and organizations value intangibles differently. For example, a firm that has a poor ecological reputation, and requires agency approvals for effective operations will place much greater value to design "green" processes than an organization that is not subject to agency approvals to perform their basic operations. This makes the evaluation more complex, since it is critical to identify the appropriate point of view for the analysis. The operational manager of a facility will value simplicity and certainty, while the corporate strategic manager will value the long-term relationship with the community and regulatory agencies as well as potential risks associated with landfills and the depletion of natural resources. Although this analysis can be extremely valuable, it can be subjective and it can introduce a high level of uncertainty to the estimates.

It has been suggested that intangibles can always be made tangible if one puts enough time and effort into the determination of dollar of other quantitative values and if one is willing to accept a large enough risk and uncertainty as to the accuracy of the estimates [2]. For example, the value created by Michael Jordan in his prime was estimated to be approximately $10 billion, and that analysis could be very valuable if a firm was planning to hire a superstar to improve its visibility and image, even if the estimate was not very precise [8].

Real options [9-11] is a current technique to identify the value created for an enterprise from increased capabilities. It uses tools developed for the analysis of options trading in the securities market, and adds the value of flexibility to traditional valuation tools such as net present value. Aldrich [12] developed a technique for quantifying the eventual cost of contamination from landfills. Based on the probability and expected timing of the contamination from landfills and the expected clean-up costs, a relevant cost can be developed that helps make appropriate waste management decisions.

Another approach has been to value the intangible benefit, as an asset, and Mullen [13] describes four principal methods to quantify these intangible assets. The value of the asset can be derived from the premium profit that accrues to the owner of the asset. It can also be considered the residual value of a firm that is not included by its tangible assets. The relief from royalty-forgone approach tries to estimate the licensing value that could be earned to exploit the asset. Once these profits or cash flows accruing to the intangible assets have been separately identified, a net present value calculation can be performed to estimate its present value. In addition, the market transaction comparatives approach looks at actual transactions in intangibles similar to the one being valued. Sustainable competitive advantage results from the recognition and management of these intangible assets [14].

Other tools have been developed to help make comparisons among intangible criteria. The paired comparison approach [15] is designed to identify the tradeoff between two different objectives based on a specific value base, by exploring conditions in which paired comparisons become equivalent. It makes use of graphic scaling techniques and probabilities to frame these comparisons. The R&D approach [5] regards the intangible benefits of investment projects as a research and development project. The results of the initial phase of the investment, like an R&D project can support the value of a specific technological advance. These results determine whether the subsequent phases should be implemented. Similar to Real Options, it identifies value for the learning that occurs in the early phases of technology implementation. It also makes explicit the possibility that these projects could be terminated based on their early experience. The equal cost approach [2] deals with one intangible criterion at a time. For alternative methods to attain the intangible benefit the costs are calculated and the ratio of cost to benefit can be generated. From this ratio, the alternatives can be compared. Some other approaches use a matrix to clarify the intangible benefits of certain activities. Scenario planning is a well-documented long-range planning procedure [16]. Its power lies in its ability to deal with radical change and uncertain future events in a way that encourages discussion and group participation. It can be used to identify potential end-states, and help understand and analyze the tangible and intangible benefits of that scenario, based on the associated discussions. Financial decision models allow for explicit assumptions and then provide the ability to compare alternatives by modeling the potential results [17]. Carlson, Grove and Kangun [18] developed a matrix to analyze the types and frequency of environmental claims in advertising, and proposed a method to assess the extent to which the public perceived the advertising to be deceptive. This article was particularly interesting since the case study that follows tries to assess the value to the firms involved with environmentally correct actions.

IV. CASE STUDY

A case study is provided to show how some of the decision-making approaches and available tools presented in this article can be applied in a real case in which intangibles are important. The situation is as follows. Researchers at the University of Missouri-Rolla investigated the technical viability of using spent refractories from anode baking pits as raw material for the portland cement manufacturing process [19].

Refractory materials are the primary materials used by the metals industries as the internal lining of furnaces and transfer vessels, and landfilling is the most common method of disposing of used refractories [20]. Nationally, over 3.0 million metric tons of refractory materials are produced annually [21], yet currently less than 10% of the overall refractory production is recycled. In Missouri the level of refractory recycling was surveyed and their estimate is even lower, approximately 1% of production [22]. However, landfills are becoming subject to more stringent state and federal environmental regulations [23] and since they will become scarcer, other alternatives are being investigated [24-26].

The Missouri research team [19] found that the spent refractories from the anode baking pits precisely fit the requirements for the portland cement process. As a result, a specific aluminum manufacturer was contacted that was generating approximately 44,000 pounds per day of these spent refractories, which were being disposed at a local landfill. Simultaneously, a local portland cement manufacturer was found that could utilize these refractories. In addition, this recycling process could reduce their need for special clay that was hundreds of miles away.

The tangible benefits in this relationship include the reduction in overall transportation cost, landfill tipping fees, energy consumption and raw material purchase. However, it adds additional control in the handling of the spent refractories to avoid contamination with other substances and the inclusion of metal parts that could damage the grinders at the cement processing facility.

The intangible benefits include the reduction of landfill. This reduction eliminates additional liability for future clean-ups and extends the life of their current landfill location. The reduced liability can be estimated by estimating the timing of the claim, and the cost of eventual clean up, as described by Aldrich [12]. The extension of life for the landfill can be analyzed measuring the refractories as a percentage of the total usage to estimate the impact of the recycling program to the expected capacity of the landfill. Then the cost of alternative landfills can be determined with a probability that it would have to be used. The cost savings can then be estimated. In addition, the cement producer can reduce their total emissions, which include the water removed from the clay that doesn't doesn't come with the refractories. Publicity from these ecologically friendly activities could improve the firm's reputation with the government regulatory agencies and the local community. To estimate this value, other activities that are funded for this purpose can be compared based on their cost and effectiveness. This improved reputation can facilitate the recruitment of professionals that value working for a firm with environmental objectives. Since one of these firms has strategic plans to transform itself into a more ecologically minded firm, this is an important value to them. To estimate the value, the recruiting cost can be used and compared to the cost and effectiveness of the recycling program. The cement company has limited sources for a type of clay required for production, and this recycling process can extend the life of this refractory clay source. These costs can be analyzed similarly to the depletion of landfill capacity. The costs and benefits from this recycling operation can be estimated, including the tangible and intangible factors. Based on this result, the common costs and potential revenues from the program can be distributed in a way that provides a long-term motivation to continue with the recycling program.

In this case, as predicted by the fundamental organizational challenges, neither of the firms that were contacted with this recycling opportunity investigated its viability. The executives were not involved, and the operational managers did not give it sufficient priority. However, a local broker was able to convince the two firms to participate, and create a process that generated sufficient benefits for all. Even though the tangible benefits were not sufficient to justify the efforts required to start this new process, the broker was able to identify the key intangible benefits and explain them well enough to entice the executives in both firms to support the effort. Because of this support the operational professionals who were originally against this plan, were encouraged to work with the broker and give the process a chance. This recycling program began its operation at the beginning of 2000.

V. SUMMARY

Intangible benefits often provide the real value for many activities. However, traditional accounting and management policies focus on the tangible data and often-profitable activities are subsequently ignored. There are numerous approaches to decision-making and analytical methods for these circumstances. However, considerable judgment is required to understand if the activity is justified, and in a more basic level, if the opportunity is worth the analysis. This is one of the reasons that such a variety of tools and judgment are required. Some are appropriate for strategic and summary analysis while other more rigorous methods are more suitable for repetitive, high value, situations for which sufficient information is available. However, it is also clear that this decision-making environment has much room for improvement. This situation reflects the transition from the Industrial Age to the Knowledge Age, in which the new tools, paradigms and methods that will effectively support decision-making are not yet fully developed.

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