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Case Study Three

Choosing Among Competing Technologies -A Study of Automatic Identification Technologies

EMGT 520

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Team 4

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Introduction

Someone once said that all the natural resources on earth are essentially free and the only reason it costs money to buy a barrel of oil or an ounce of gold is because of all the bother and expense of locating these things, extracting them from the earth, transporting them, purifying them, refining them, forming and packaging them, and distributing them. The same thing is true with technology. For most industries, all the technology that is required to make an individual company strongly competitive is already well developed and readily available. The problem is in locating the most suitable technology and, once it is located, adapting it to the need at hand. If all businesses were the same, most companies could play "follow the leader," with each business copying strategies and tactics of the leaders in its field. But, of course, things do not work that way. Each business' markets are unique. The challenge then is to find the most appropriate technology for a particular business [1].
"There is much feeling today that the selection and utilization of technology are not being done very well in the United States[1]." A 1983 article by John Baxter stated that the negative impact of poor equipment productivity was just as great as poor labor productivity [2]. This further illustrates the importance of selecting the proper technology.

Summary

The manufacturing industry's continued development has increased the need for development of new tools and methodologies to cope with the ever increasing complexities of the new manufacturing systems. However, the choice of a methodology can be just as complex as the proper selection of a new technology. The methodology used in case three applied a **four phase approach** to choose the appropriate technology for the identified problem. The engineer needs to first clearly define the problem and then identify any technologies that are even remotely plausible for solving the problem. In **Phase one** of the method, the engineer identifies all the characteristics or attributes of each technology. Next, **phase two** requires the engineer to rate the technologies relative to the other technologies assigning a numerical value. **Phase three** is in two steps. First, the initial group of engineers generates a short description of each attribute and why it is important. Then team #2 which is made up of engineers and managers assign a numerical value to the attribute. **Phase four** is the decision matrix calculation where the calculation yields a value that determines the best technology for the process [3].

Analysis

The entire outcome of the methodology is dependent on the thoroughness of the initial research in phase one to identify all of the existing technologies that are possible candidates in the solution of the stated problem and their complete list of attributes. The one technology that may be over looked could be the perfect solution[3].

Phase two requires the engineer to assign a numerical value to each technology relative to the other technologies. The engineer needs to be completely unbiased when assigning numerical values to the technologies that have been researched. However, their measurement process must be consistent. The values are from 0 to 5 and are as follows:

5	excellent technology for this attribute
4	above average
3	average
2	below average
1	poor
0	technology does not posses this attribute

These values are then placed in the upper portion of the cells in the matrix underneath their specific technology[3]. Please see Figure 1 [3].

The application evaluation of phase three is a two step process that attempts to eliminate bias. The initial group of engineers generate a short description of each attribute and why it is valuable. In this step it is important to generate attributes that are truly relevant to the technology and the mission being accomplished. In the next step another independent group of engineers and managers rank the attributes in order of importance. The second group reinforces an impartial decision as they would probably not had contact with vendors, etc. It also balances the technical knowledge with the business knowledge by including the engineers along with the managers creating an inter group discussion to bring out new ideas. It can be difficult to assign a numerical value to an attribute that may not be quantifiable, but this forces people to focus on the mission and assign a number. This team also assigns a value using the following rating system:

5	must have this attribute to solve problem
4	extremely important, but could do without it
3	important
2	not important, but would be beneficial
1	do not need
0	do not want to consider in the decision

The values are placed in the left side of the matrix in the column under Application Evaluation[3].

Phase four is the mathematical conclusion of the methodology. If an attribute was rated a zero by team one but team two rate the application as five then this technology has to be removed from the consideration in the matrix. The remaining values in the upper cells are multiplied by the corresponding number in the application evaluation column. The columns are then summed and recorded at the bottom of the column. See figure 1. The technology with the highest rating should be strongly considered for implementation.
The use of an example problem in case three was very helpful in clarifying the method and how it is applied.

A potential problem with the method could occur if there were a large number of attributes. One technology possesses the essential attribute and it is rated a five while the other technology possesses the essential attribute but it is rated a one. Then there are thirty other attributes that are helpful and important and they are rated zero and one respectively. See Figure 2. The technology with the high rated essential attribute would have a final value of twenty-five, while the technology with the essential attribute rated as a one would have a final value of thirty. This would be an extreme case, but it does conceptualize a potential problem with a large list of attributes.

Research

There are a wide variety of methodologies for choosing a new technology for a manufacturing environment. A few are briefly described in the following paragraphs.

KBES

Another approach would be knowledge based systems. They are used to solve problems that are too complex for mathematical formulation or too difficult for optimization. The knowledge-base expert systems provide aid or direction using computer programs that model human behavior. There are six basic parts in the KBES system.

1. Knowledge base - the software that contains the facts and rules based on the knowledge and experience of the experts.
2. Inference engine - uses the knowledge base to solve the problems.
3. Working memory - the information being used on the problem at hand.
4. KBES user - the person using the program to resolve the potential cell parameters and inputting the data on the problem at hand.
5. Domain experts - the people who create the system with their expert or special knowledge.
6. Knowledge engineer - uses the knowledge from the domain experts to create the computer program.

The KBES systems are becoming increasingly popular. They are especially useful when expertise is not available on a regular bases or is too expensive. Also, the KBES system is of great use when dealing with expensive, useful or sensitive material that could be lost. The user is able to back up all of the material and it can be used again. The success of this system depends on the soundness of the principles and knowledge on which it was built. Creating a computer program that emulates human behavior is difficult, but if done properly will be of great advantage to a company that uses it effectively[4].

PAMS

Performability of automated manufacturing systems (PAMS) is another method that has been widely developed. Performability evaluation involves combining the structure state model and the performance models using some computational procedures. The performance and competitiveness of an automated manufacturing system (AMS) can be captured by certain generic performance measures. Viswanadham and Narahari [5] have listed the following generic measures:

1. Manufacturing Lead Time - the total time required to process the product through the manufacturing plant.

2. Work-In-progress - the amount of semi-finished product currently on the factory floor.

3. Throughput - the production efficiency of a manufacturing plant.

4. Capacity - the maximum possible output of the manufacturing process over a specific time period.

5. Quality - an attribute required to enhance competitiveness.

6. Flexibility - a system that is able to respond effectively to change.

7. Machine Utilization - the time a machine is producing useful work.

8. Performability - a measure the combines the performance and reliability of a system.

The number of activities in an AMS is large, and numerous interactions are involved among these activities. The performance model would reveal the behavior and quantitative performance of the AMS. There are two types of models: simulation and analytical. A detailed representation of the system operation is developed in the simulation model. However, simulation can require lengthy simulation runs that lead to lengthy computations. Analytical models are more efficient than simulation if complex details of the system operations are not required to be modeled. This is a lengthy and time consuming process that requires a long computational process [5].

DEA

A new method to select equipment is the utilization of Data Envelopment Analysis (DEA). DEA is a relative method which measure the efficiency of a widget. The main goal of DEA is to compare different widgets in order to find the most efficient one. Inputs and outputs characterize the widgets and an efficiency score in percentage is calculated [6]. If the input is investment cost and the output is number of products created in an hour, the most efficient machine will be those which for the same cost produce more. During the last 20 years a theory of efficiency classification has been developed and many articles deal with product, or equipment selection [7]. Inputs and outputs can be multiple, and they can be weighted to give them more or less importance. DEA is a another tool the engineering manager can use to solve his or her selection problems.

Conclusion

After looking at several different methodologies, the evaluation method discussed in the summary and analysis is the most user friendly. It is easily understood and it takes little time to grasp the concepts. However, the list of attributes must be created with a conscious effort placed on the relevance of the attribute to the mission. The attributes must then be quantified in a consistent way that makes the resulting data pertinent to the solution of the problem and remove all biases. The evaluation methodology is easy to use, but there has been considerable additional development done in the area of technology selection. Many of these methods have considerable theory and work behind them. They are an important part of the industry and valuable in solving problems. They should not be neglected. Their application may be difficult, but could be well worth the time and effort to obtain meaningful data. Each problem is unique and the proper selection of a method can be as important as the selection of the technology itself.

References

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