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# A method of identifying suitable manufacturing system (Cellular) for automotive sector using Analytical Hierarchy Process

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**ABSTRACT**

Manufacturing produces real wealth for any country and constitutes the back bone for the service sector. The objective of any organization is to earn profit. Usually the market fixes the selling price of the manufactured components. Unless there is focus on the manufacturing strategy of reducing manufacturing cost, it is very difficult to sustain in this ever competitive world. A suitable manufacturing system will help in minimizing the cost of production. The suitable manufacturing system should focus on customer satisfaction by finding out the customer's requirement in terms of quantity, quality, and schedule. A survey of existing literature on evaluation of advanced manufacturing systems indicates that the traditional manufacturing approaches are inadequate for the purpose. Typically new technologies require very high investments, so it is important to identify and justify the manufacturing system suitable for the particular manufacturing industry. In this paper an attempt has been made to overcome the deficiencies of traditional manufacturing system by presenting an approach to determine and account for the justification of the cellular manufacturing system using Analytical Hierarchy Process (AHP).

***Keywords*:** Cellular Manufacturing, Advantages of CM, AHP, Justification, Manufacturing System.

## 1. INTRODUCTION

The manufacturing industry has gone through successive periods of great changes, new materials; new technologies and advanced technology have always been at the root of these changes. Manufacturing has thus become highly competitive, and companies have had to focus their resources, capabilities, and energies on building a sustainable competitive advantage. Such an advantage may be derived for example from lower cost, from higher product performance from more innovative products or from superior service. This requires the application of some profoundly new concepts related to production process organization of work and technology.

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Manufacturing is a transformation process by which raw material, labor, energy and equipment are brought together to produce high quality goods. The goods produced naturally should have an economic value greater than that of the inputs used and should be salable in the presence of competition. The transformation process generally involves a sequence of steps called production operations. Each production operation is a process of changing the inputs into outputs while adding value to the entry, Figure 1 shows the typical manufacturing system: input- output model, here the inputs are shown as material, labor, energy and technology. The recent trend is to automate most of these functions and elevate the role of the human operator to one of a monitor and supervisor.

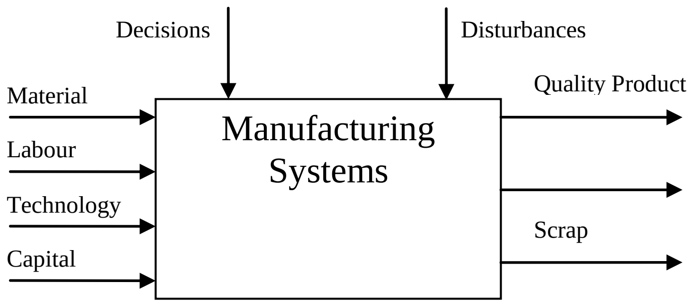


Figure 1 Manufacturing system: input-output model

A Manufacturing system can be manual or fully automated; highly dedicated or fully flexible; a collection of isolated machine tools or a fully integrated production system. It is the level of technology that determines whether a given system is a mass production system, Job shop, batch production system or a fully flexible manufacturing system. Selecting the suitable manufacturing system is a multi-criteria decision making situation where many factors are to be considered. With the help of AHP the suitable manufacturing system can be identified (Section 3 gives the methodology and section 4 identifies the manufacturing system). The justification of identified manufacturing system is dealt in section 5.

Manufacturing companies are constantly striving to improve their competitive capability by investing in advanced manufacturing technologies in today's international and local competition. Advanced manufacturing systems have been identified as tool which can provide that competitive capability. However the traditional economic analysis does not have a facility to incorporate strategic requirements to choose suitable Advanced Manufacturing systems.

Manufacturing companies are looking for directions to improve their performance, compared to their competitors, by investing in advanced manufacturing systems. Improving the performance of a company by achieving technological competitiveness is a necessary condition to ensure market competitiveness; otherwise the company will be fighting a losing battle. Competitiveness is derived from many factors including increased productivity, being responsive, proactive and innovative, quality, flexibility and reduced inventory. Selection of manufacturing system to increase the competitiveness, based on optimal resources allocation, offers a unique challenge to manufacturing managers, since the selection and optimization process to achieve the strategic objectives is a complex process because of many trade –offs among conflicting factors and it has serious implications. In addition, the selection and optimal allocation process should consider tangible and intangible factors associated with each manufacturing system and the technical complexity of the equipment. Traditionally the selection of equipment relied on assessing the financial return by the investment on that equipment and it is considered only as a stand-alone investment disregarding functional inter-relationships and attributes associated with it.

## 2. LITERATURE SURVEY

Eric Molleman (2002) analyzed the arguments on the design of cellular manufacturing system in a medium sized company and he indicated that interrelated things like market and manufacturing technology places a key role in decision to change the system and the arguments were made on market development, new manufacturing technology, and production control system as a constraint in the application area of cellular manufacturing. Charlene Yauch and Harold Steudel (2002) exploits the eight key cultural factors that impact CM conversion for an organization converting to cellular manufacturing.

A comprehensive review of implementation literature was undertaken and a multi-phase model was developed and evaluated through a case study by Fraser, Harris and Luong (2007) the framework recognizes the importance of both technical and human aspects of CM.

The Limitation of Group technology based cellular manufacturing is compared with the virtual cellular manufacturing in routing flexibility, material handling etc by Vijay R. Kannan (1998). Proposed a method for introducing the cellular manufacturing in a small scale industry to produce part families with similar manufacturing process and a stable demand and he also outlines the method for assessing, designing, implementing CM. Irit Alony and Michael Jones (2008) reviewed the human related and organizations factors in lean manufacturing and identifies the gap. The principles of lean manufacturing the organizational shifts required are also given in their work.

The deficiencies of the traditional manufacturing system are account for the justification of manufacturing system based on AHP by tacking account into intangible factors; the proposed approach is demonstrated through the case situation by Vinay Datta and Sambasivarao (1992). The potential benefits derived from Flexible Manufacturing system implementation and a method to quantify these benefits for use in engineering economy studies with the help of AHP to determine the best manufacturing system is given by Roger (1987). The Japanese manufacturing methods and production management are introduced including flexible automation, group technology and Toyota production system with the financial aspects of Japanese companies by Katsundo Hitomi (1985).

One of the important contributions to the world class manufacturing by the Japanese is Just-In-Time (JIT) a philosophy and a set of methods for manufacturing emphasizes waste reduction, total quality control and devotion to the customer. JIT is a manufacturing system whose goal is to optimize processes and procedures by continuously pursuing waste reduction. Cellular manufacturing effectively implements the JIT procedures and principles thereby it becomes the value added manufacturing system for the manufacturing industry especially for the automobile industry as explained by Evertte Adam and Ronald Ebert (1995). Surjit Angra et al. (2008) analyzed the cellular manufacturing for the layout and for work load distribution and balancing problems. Richard Schonberger (2007) analyzed the Japanese production management (JPM) elements – quick set-up, small lots, cells, kanban and its evolutions, successes with the objective of exploring the sequence of events leading to JPM. Leonardo Rivera and Frank Chen (2007) measured the impact of lean tools on the cost-time investment of a product using cost-time profiles in this paper the expected improvement through cellular manufacturing tool is given as waiting time reduction.

## 3. ANALYTICAL HIERARCHY PROCESS (AHP)

Analytical Hierarchy Process is a methodology developed by Saaty (1980) to analyze rational and irrational values comprehensively according to the level of importance to the decision – making process. AHP facilitates formulating and simulating the human decision making mechanism in multi criteria evaluation procedures. In addition, it is an effective mechanism to analyze the strategic concepts of a company by the representation of a complex problem into a disintegrated hierarchical problem. This disintegrated representation of multiple level hierarchy helps the decision-makers identify the problem and deal with it in a clear manner. The complexity of the problem determines the number of levels of hierarchy. The top level of hierarchy consists of a single element, which is the main focus of the overall objective. The remaining levels may consist of few elements. AHP compares each element in each level with each other element by a pairwise comparison process, with respect to the objective. The pairwise comparison is done through the subjective evaluation of the decision-maker depending on the nature of the importance of the attribute to the company.

A matrix is constructed by listing the attributes to be compared to the left of the row and to the top of the column. The attribute are compared along each row with the attribute on the column. When an attribute is compared with itself the value on the cell is assigned to one. When an attribute is compared with other attribute, the value is assigned depending on the importance of that attribute to the compared one to meet the objective. If that attribute is more important an integer value is assigned if the attribute is less important, the reciprocal value is assigned. The reciprocal value is entered in the transpose position of the matrix.

The AHP procedure recommends a 1 to 9 scale proposed by Saaty which is given in Table 1. Once the matrix has been completed, the priority weights for the matrix are computed. In mathematical terms it is called principle eigenvector. The estimate for that vector can be computed in the following for ways (Saaty, 1980)

a. The values in each row are summed together and that summation is normalized by dividing each sum by the total of all the sums, resulting in a summation of the vectors to unity. The first resulting vector is the priority weight of the first attribute , the second value for the second attribute and so on;
b. The reciprocal of the sum of the value in each column is computed. Then each reciprocal is divided by the summation of all reciprocal values, resulting in summation of all vectors to unity, thus obtaining normalized values. Then the priority weight is determined as in the first method;
c. Normalization of the column is carried out by dividing the values in each column by the sum of the column. Then the elements in each resulting row is added and that value is divided by the number of elements in the row, thus achieving the process of averaging over the normalized columns; and
d. The n number of elements in a row is multiplied and the nth root is calculated. Finally the resulting numbers are normalized, to get the priority weight of each attribute.

After all matrices are developed and all pairwise comparisons are obtained. Eigenvectors or relative weights and maximum eigenvalue ($\lambda_{max}$) for each matrix are then calculated. The $\lambda_{max}$ value is an important validating parameter in AHP.

The consistency ratio is calculated as per the following steps.

a. Calculate the eigenvector or the relative weights and $\lambda max$ for each matrix of order n.
b. Compute the consistency index for each matrix of order n by the formulae: $CI = (\lambda_{max} – n)/(n-1)$

c. The consistency ratio is then calculated using the formulae: CR = CI / RI.

Table 1 Relative Importance Saaty's 1-9 Scale

| Intensity | Definition | Explanation |
|---|---|---|
| 1 | A and B are equally important | A and B contribute equally to the objective |
| 3 | Weak importance of A over B | Experience and judgment slightly favours attribute A over B |
| 5 | Essential or strong importance of A over B | Experience and judgment strongly favour attribute A over B |
| 7 | Very strong or demonstrated importance of A over B | Attribute A is strongly favoured over B , and the dominance of A has been demonstrated in practice |
| 9 | Absolute importance of A over B | The evidence of favouring A over B has the highest possible order of affirmation |
| 2,4,6,8 | Intermediate values | When compromise is needed |

Where RI is known as random consistency index obtained from the Table 2 .The acceptable CR range is 0.1. If the value of CR is equal to or less than 0.1 implies that the evaluation within the matrix is acceptable or indicates a good level of consistency in the comparative judgments represented in that matrix. In contrast if CR is more than the acceptable value, inconsistency of judgments within that matrix has occurred and the evaluation process should therefore be reviewed, reconsidered and improved. An acceptable consistency property helps to ensure decision-makers reliability in determining the priorities of a set of criteria. As the matrix is consistent, the weight of each element is calculated as explained above. Finally, the weighted evaluation for each alternative is obtained by multiplying the matrix of evaluation ratings (criteria relative weights) with the matrix of priority weights of the alternatives (relative weights of alternative) the multiplied value is known to be global weights of the alternatives, moving upwards through the hierarchy and summing overall the vector values for the alternative will give overall priority of the alternatives. The alternative with the highest global weigh evaluation is considered to be fulfilling the objective of the problem with maximum satisfaction and chosen for further consideration.

Table 2 Random Consistency Index

| N | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| R.I | 0 | 0 | 0.58 | 0.9 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 |

## 4. MODEL DEVELOPMENT - DETERMINATION

The analytical hierarchy process has been a widely used method to solve multi-criteria decision making problem. Application of this method is widely used in many fields. The main advantage of AHP is it decomposes the problem and to make pairwise comparisons of all elements in the level just above. The schematic of the manufacturing system selection model is given in Fig 2 which is mainly focused on manufacturing system selection for a Brake lining manufacturing company in Chennai to find out the suitable manufacturing system.

### 4.1. Goal

Develop the focus or overall goal of the analysis in this case selecting / determining the best manufacturing system. It is given in Level 1 of Fig 2.

### 4.2. Criteria

Develop factors or criteria which contribute to the focus or goal in the Level 1. The criteria are the main components defined by a company when it has to take decision on which manufacturing system to use. The selection of criteria is through literature survey, discussion and consultation with the industry personnel. The criteria details are given in Level 2. The definitions of criteria are given in Table 3.

Table 3 Criteria definition

| S.No | Criteria | Definition |
|---|---|---|
| 1 | Flexibility [F] | It covers the design, volume, routing, machine, process & operation. Can the system handle variations in part size & geometry, batch size and product types. |
| 2 | Inventory [IO] | Inventory of raw materials, WIP, FG. To what extent does the system help in reducing inventory cost? |
| 3 | Throughput [T] | Indicator of the lead-time, cycle time & delivery time of the system. |
| 4 | Investment [IM] | Is the company in a position to make the required investment? Does this investment fit in with the company's overall corporate strategy? |
| 5 | Operating Cost [OP] | In includes the tooling and scrap and running cost. |
| 6 | Employee Relation [E] | In terms of safety, communication, ergonomics in terms of efficiency and convenience. |

### 4.3. Alternatives

The alternatives are the manufacturing system chosen to be compared and evaluated from the given set of alternatives, i.e. the options which are to be evaluated in terms of the criteria are given in Level 3. The model evaluates the best manufacturing system for the application. The alternative manufacturing systems are listed out with the definition on Table 4.

1. Transfer Line [T.L]
2. Job shop [J.S]
3. Cellular / Lean Manufacturing [CM]
4. Flexible Manufacturing System [FMS]

Table 4 Alternative definition

| S.No | Alternatives | Definition |
|---|---|---|
| 1 | Transfer Line | Machines dedicated to manufacture of one or two product types, system permits limited flexibility. |
| 2 | Job Shop | Machines are grouped together based on the operation (function); there is no control on the sequence of production. |
| 3 | Cellular Manufacturing | A cell thus consists of a group of machines and a family of related components being produced on these machines. Since the manufacturing plant would now consist of several cells, manufacturing using such group technology is also called cellular manufacturing. Group technology exploits the similarities and relationships between large populations of components. |
| 4 | Flexible Manufacturing | NC machines, material handling equipments are linked, controlled and monitored by a central computer. |

### 4.4. Relative Weights [RW] calculation

***Criteria***

The criteria are compared with each other on a pairwise comparison. Table 5 gives the pairwise comparison and relative weights for level 2 criteria. The weights or priorities are obtained. A questionnaire was developed with respect to the case situation used as an input to the AHP model. From the pairwise comparison matrix [PCM] the respective weights are calculated. The distributions of the relative weights [RW] are given in Fig 3 & 4.

***Alternatives***

With respect to each criteria the alternative performance are evaluated using saaty's 9 point scale to construct a pairwise comparison matrix [PCM]. From the PCM the relative importance of alternatives are calculated. The PCM and relative weights for throughput and flexibility criteria are given in Table 6 & 7.

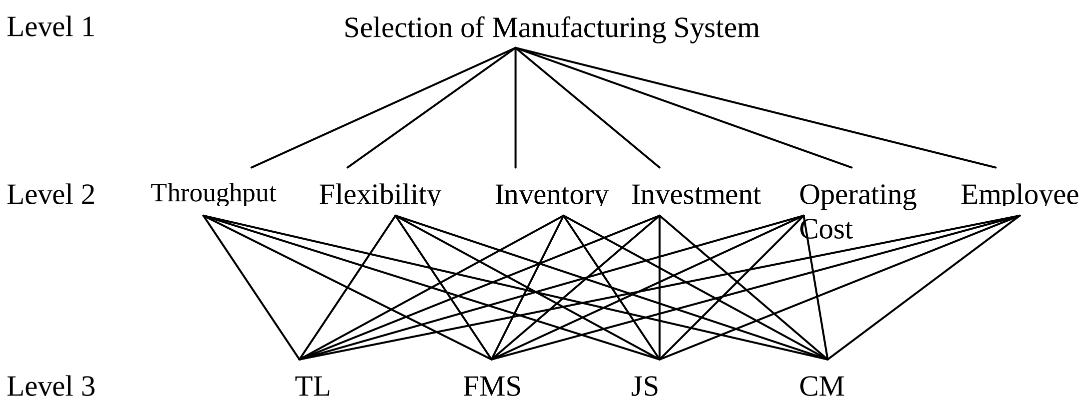


Figure 2 Manufacturing system selection hierarchy

Table 5 Criteria PCM & RW

| CRITERIA | T | F | IO | IM | O | E | RW |
|---|---|---|---|---|---|---|---|
| **T** | 1.00 | 3.00 | 3.00 | 3.00 | 4.00 | 6.00 | 0.3733 |
| **F** | 0.33 | 1.00 | 2.00 | 3.00 | 4.00 | 5.00 | 0.2331 |
| **IO** | 0.33 | 0.50 | 1.00 | 2.00 | 4.00 | 5.00 | 0.1764 |
| **IM** | 0.33 | 0.33 | 0.50 | 1.00 | 2.00 | 3.00 | 0.1059 |
| **O** | 0.25 | 0.25 | 0.25 | 0.50 | 1.00 | 3.00 | 0.0722 |
| **E** | 0.17 | 0.20 | 0.20 | 0.33 | 0.33 | 1.00 | 0.0391 |
| **λmax** | 6.3 | R.I | 1.24 | | | | |
| **C.I** | 0.11 | C.R | 0.05 < 0.1 (Accepted) | | | | |

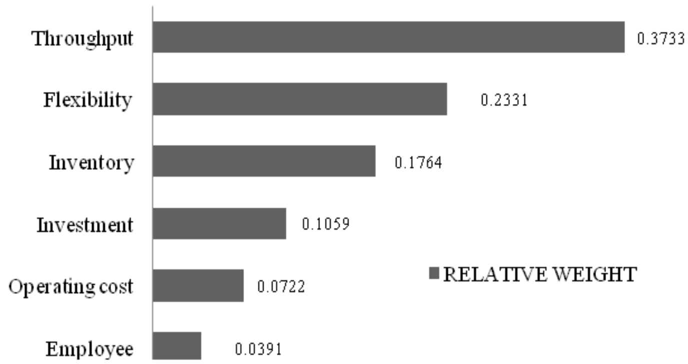


Figure 3 Criteria RW Distribution

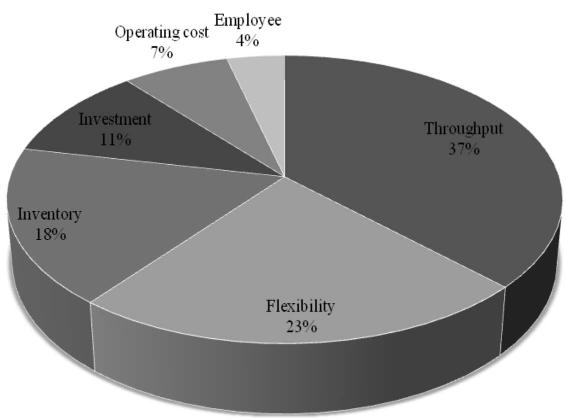


Figure 4 Criteria RW Distribution in Percentage

Table 6 Alternative PCM & RW for Throughput Criteria

| T | TL | FMS | JS | CM | RW |
|---|---|---|---|---|---|
| **TL** | 1.000 | 2.000 | 4.000 | 2.000 | 0.4079 |
| **FMS** | 0.500 | 1.000 | 6.000 | 0.500 | 0.2373 |
| **JS** | 0.250 | 0.167 | 1.000 | 0.250 | 0.0692 |
| **CM** | 0.500 | 2.000 | 4.000 | 1.000 | 0.2857 |
| **λmax** | 4.22 | R.I | 0.9 | | |
| **C.I** | 0.07 | C.R | 0.08 < 0.1 (Accepted) | | |

Table 7 Alternative PCM & RW for Flexibility Criteria

| F | TL | FMS | JS | CM | RW |
|---|---|---|---|---|---|
| **TL** | 1.00 | 0.17 | 0.25 | 0.17 | 0.0556 |
| **FMS** | 6.00 | 1.00 | 2.00 | 0.50 | 0.2787 |
| **JS** | 4.00 | 0.50 | 1.00 | 0.17 | 0.1427 |
| **CM** | 6.00 | 2.00 | 6.00 | 1.00 | 0.5231 |
| **λmax** | 4.17 | | R.I | 0.9 | |
| **C.I** | 0.06 | | C.R | 0.06 < 0.1 (Accepted) | |

The same approach of pairwise comparison matrix formation from the data collected through questioner for the remaining criteria used in decision making process level 2 (Inventory, Investment, Operating cost, Employee) are used to calculate the relative weights with respect to the alternatives. The relative weights calculated are listed in the Table 8 for global weight calculation; the global weight is obtained by multiplying the relative weights of criteria with respect to alternative performance as explained in the AHP methodology to find out the suitable manufacturing system.

Table 8 Manufacturing System Ranking

| CRITERIA | RELATIVE WEIGHT | LOCAL WEIGHTS | | | | GLOBAL WEIGHT | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | TL | FMS | JS | CM | TL | FMS | JS | CM |
| Throughput | 0.3733 | 0.4079 | 0.2373 | 0.0692 | 0.2857 | 0.1523 | 0.0886 | 0.0258 | 0.1067 |
| Flexibility | 0.2331 | 0.0556 | 0.2787 | 0.1427 | 0.5231 | 0.0129 | 0.0649 | 0.0332 | 0.1219 |
| Inventory | 0.1764 | 0.3269 | 0.1527 | 0.0629 | 0.4575 | 0.0576 | 0.0269 | 0.0111 | 0.0807 |
| Investment | 0.1059 | 0.1698 | 0.3423 | 0.0545 | 0.4335 | 0.0180 | 0.0363 | 0.0058 | 0.0459 |
| Operating Cost | 0.0722 | 0.2257 | 0.3890 | 0.1283 | 0.2570 | 0.0163 | 0.0281 | 0.0093 | 0.0186 |
| Employee | 0.0391 | 0.2356 | 0.1979 | 0.0651 | 0.5014 | 0.0092 | 0.0077 | 0.0025 | 0.0196 |
| OVERALL PRIORITY | | | | | | 0.2664 | 0.2525 | 0.0877 | 0.3933 |
| RANK | | | | | | 2 | 3 | 4 | 1 |

## 5. RESULT AND JUSTIFICATION

The global weights of the alternatives are plotted in a chart Figure 5 gives the overall picture of alternative performance with respect to criteria; Figure 6 and Figure 7 gives the cellular

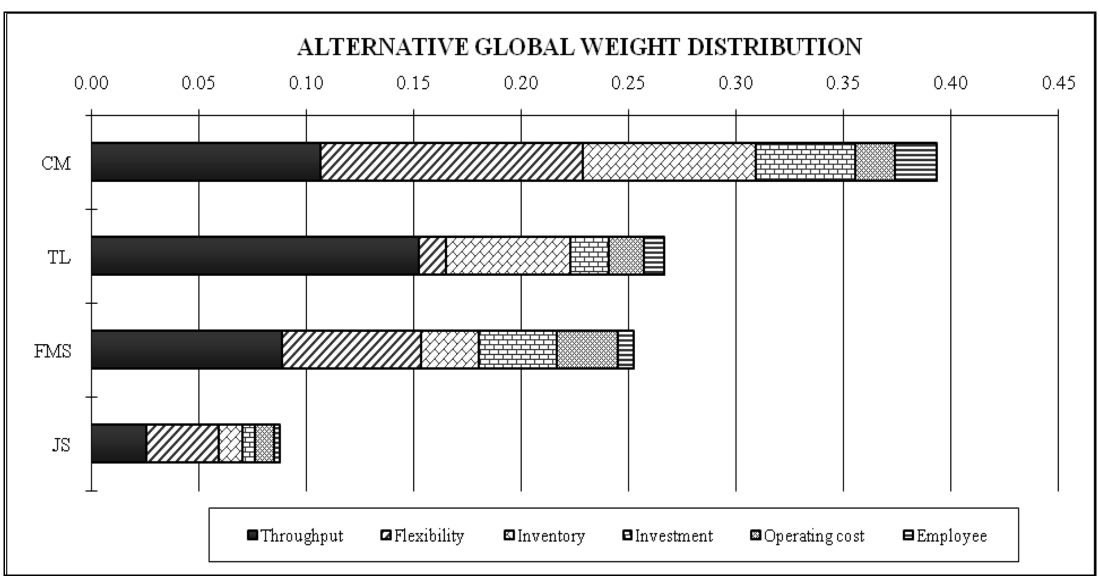


Figure 5 Alternative Performance with respect to criteria

manufacturing performance likewise all the alternative performance are plotted to compare with each other to take a strategic decision on selection of suitable manufacturing process. Manufacturing system performances are analyzed with respect to the criteria. The suitable manufacturing system for the brake lining manufacturing (auto component) company is identified as cellular manufacturing [CM] system based on the global weight score which is decided based on the data collection or quality of input through pairwise comparison. One of the advantage is the group decision making is also possible with AHP. However, improving the approach for selecting a best manufacturing system suitable for any manufacturing industry can be solved more efficiently in fuzzy environment by taking care of the uncertainties involved in the decision making process can be consider as topic for future research

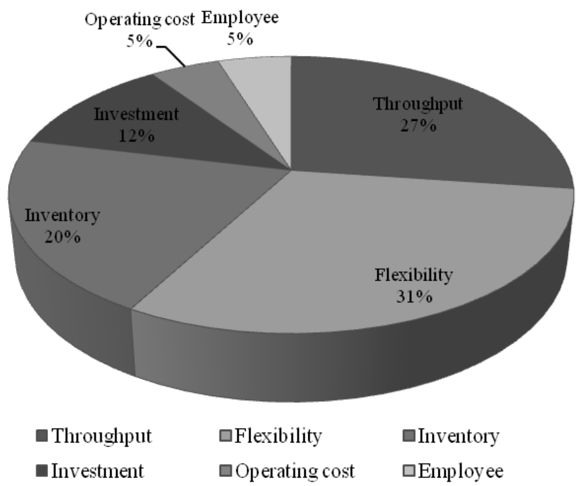


Figure 6 CM Performance in percentage

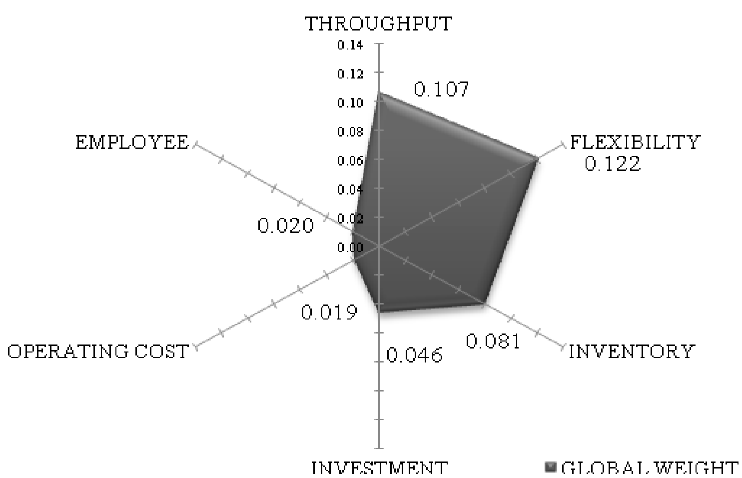


Figure 7 CM Performance in global weights

## 5.1. CM Justification

Any investments or changes require justification; unless the managers justify the CM in terms of economic the management may not be committed / interested in the change proposed. Economic

justifications require knowledge of costs and benefits attributable to the manufacturing system. Benefits and costs of many investments can be quantified in terms of tangible values, never the less, the cellular manufacturing technology provide benefits which are tangible, intangible and difficult to quantify. Following are the some of the justification methodologies, AHP comes under analytical approach, so we can use the same AHP methodology with suitable economic criteria to justify the investment with respect to the benefits with the alternatives of existing traditional manufacturing system the company has and the CM. The available justification methodologies are given in Fig 8.
New technologies are considered by decision–makers in manufacturing industry to achieve diverse goals of the organization and to satisfy various customer requirements. The customer requirements may include criteria of shorter delivery time, competitive pricing, improved product quality and reliability, diversity of products to meet the product life cycle, and improved product innovation. Hence the justification of CM has to accommodate these multi-criteria requirements for a proper evaluation.

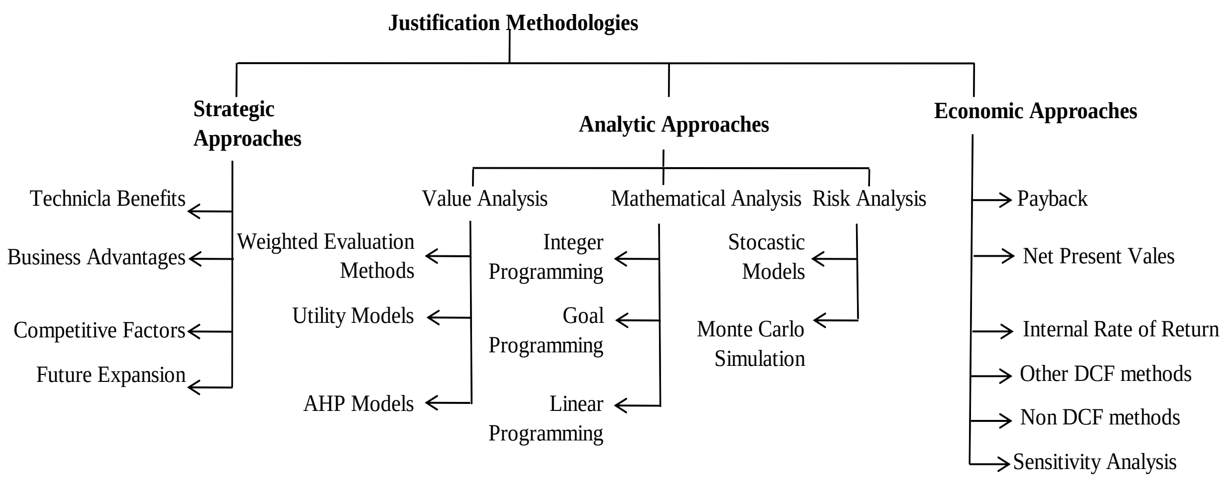


Figure 8 Justification Methodologies

## 5.2. Economic Justification approach

The economic aspects of the changes are analyzed using economic tools; it basically evaluates the cost and benefits of the proposed investment. The traditional indices such as Payback (PB), Return on Investment (ROI), Internal Rate of Return (IRR), Net Present Value (NPV) and others . These approaches cannot analyze the non-economic, strategic benefits but have the capability to analyze the issues where there is no uncertainty such as in stand-alone equipment justification or replacement justification. The advantage of these economic models lies in their simplicity and their ability to identify profitability of the investment which is the bottom line for any capital investment of an organization.

## 5.3. Analytical Justification approach

Analytic justification approaches are appropriate tools for analyzing systems which have economic and non-economic benefits. These approaches offer a realistic solution to knowledgeable decision makers, when sufficient information is available for multiple-attribute justification, while requiring more time from managers for the analysis. These analytic approaches help the decision-makers priorities the attributes which are desirable to the company. These methods can be utilized to analyze the option of linking advanced technologies with the existing ones.

### 5.4. Strategic Justification approach

Strategic approaches are less technical in nature compared with other approaches but they highlight qualitative attributes including business strategies, flexibility in meeting customer demand and competitive advantage. These approaches identify the long term goals of a company. A strategic approach is necessary for the success of adopting innovative technologies with the participation of all concerned in the implementation and usage of technology. The strategic approach will bring a better result if it is used in conjunction with the economic models as a component of a multi-criteria method.

### 5.5. Why AHP in Justification of CM

Justification of Selected manufacturing system is a multi-criteria decision making situation it arises when a situation simultaneously address multiple goals, since implementation of CM involves satisfying diverse goals, the investment for a CM should be justified on the basis of multiple objectives rather than on a single objective such as the maximization of return on investment or minimization of PB period. For solving multi-criteria situation various methods are available in literature ranking attributes, scoring models, utility models, fuzzy techniques, analytical hierarchy process and multi objective goal programming. Among all these methods the weighted scoring model and the AHP are widely used in solving multi-criteria problems. AHP is the suitable method

Table 9 Cost Elements for Economic Evaluation of a Manufacturing System

| S.No | COST ELEMENTS |
|---|---|
| 1 | System Design |
| 2 | Machine tool and material handling capital |
| 3 | Installation and training |
| 4 | Tooling |
| 5 | Fixture and jig |
| 6 | Programming |
| 7 | Maintenance |
| 8 | Computers and communication network |
| 9 | Inspection |
| 10 | Labor and supervision |
| 11 | Rework and scrap |
| 12 | Burden |
| 13 | Energy |
| 14 | Floor space |
| 15 | Raw material Inventory |
| 16 | Work – in – process Inventory |
| 17 | Finished Parts Inventory |
| 18 | Estimates of equipment working life |
| 19 | Estimates of salvage value of the equipment |
| 20 | Demand pattern of the parts over the working life of the equipment. |

for our situation where we have a criteria to justify the CM is both quantitative and qualitative and the policy of the management, etc. The main advantages of AHP is it convert the qualitative factors in to quantitative measures reliably, the criteria could be financial, non financial and it structure the problem in hierarchically that makes easy for the decision maker to take a appropriate decision, The cost elements for economic evaluation of a Manufacturing System (MS) given in the Table 9 could be taken as a criteria in AHP to evaluate the implications of alternatives and CM in implementing the CM identified as a suitable manufacturing system for the brake lining auto component manufacturing industry in Chennai.

The tactical benefit of the cellular manufacturing system is given in Table 10, the cost elements and the benefits are to be estimated as a procedure for justifying cellular manufacturing system. The effort put into quantifying the cost and benefits depends on the degree of accuracy required. Cell advantages are given in the Table 11; main disadvantages of cellular manufacturing is setup and one must need to know about many different process, some of the reason for why the manufacturing industries are interested in going for cellular manufacturing is given in Table 12.

Table 10 Tactical Benefits of CM

| S.No | TACTICAL BENEFITS |
|---|---|
| 1 | Reduced setup time |
| 2 | Reduced throughput time |
| 3 | Improved manufacturing control |
| 4 | Improved quality |
| 5 | Reduced scrap rate |
| 6 | Reduction of floor space used |
| 7 | Reduced labor cost |
| 8 | Reduced rework |
| 9 | Improved data management |
| 10 | Improved control of operations |
| 11 | Improved control of parts |
| 12 | Improved response time to demand variations |
| 13 | Improved working conditions |
| 14 | Lower work-in process inventories |

Table 11 Advantages of Cell

| S.No | ADVANTAGES |
|---|---|
| 1 | Control is simplified |
| 2 | Common tooling and fixtures |
| 3 | Flexible -- can produce many different part types - a part family |
| 4 | Shorter Lead Time |
| 5 | Improved Quality - Quicker problem identification |
| 6 | Improved Quality - Less potential rework or scrap |
| 7 | Less Material Handling |
| 8 | Improved Coordination |
| 9 | Reduced Inventory |
| 10 | Departmental conflicts eliminated |
| 11 | Simplified Scheduling |
| 12 | Less Space Required |

Table 12 Why companies Introduce CM

| S.No | BENEFITS |
|---|---|
| 1 | On-Time delivery |
| 2 | Improved response |
| 3 | Reduced inventory |
| 4 | Improved quality |
| 5 | Improved workflow |
| 6 | Achievement of flexibility |
| 7 | Culture change |
| 8 | Delegation of accountability |
| 9 | Better use of plant |
| 10 | Better use of skilled labor |
| 11 | Job satisfaction |
| 12 | Information Flow |
| 13 | Simplified Scheduling |
| 14 | Less Transactions |
| 15 | Less Variation, “More” Predictability |
| 16 | Forecasts Become More Accurate |
| 17 | Quicker Response To Design Changes |
| 18 | Quicker Market Response |
| 19 | Problems Are Visible |
| 20 | Product Team Organization - Eliminates Departmental Conflicts |
| 21 | Facilitates Cross Training |
| 22 | Facilitates Alternate Pay Schemes (Pay for skills) |

## 6. CONCLUSION

For a manufacturing organization to thrive in today’s business economic, prudent strategies for flexibility concerns, it must have a suitable manufacturing system. In this paper an attempt has been made to determine suitable manufacturing system for a leading brake lining manufacturer in India using Analytical hierarchy process (AHP). The methodologies used to justify the selection process were also discussed with the advantages and the tactical benefits of the cellular manufacturing. The reasons for why the companies are interested in cellular manufacturing are also given. Selecting a suitable manufacturing system from the alternatives is a multi-criteria decision making problem. In which the objectives are not equally important. AHP provides an excellent method to evaluate the many tangible and intangible benefits in multi attribute decision making model. The model developed is able to solve the problem reasonably well. By just giving the inputs to the model, it helps clarify goals of the organization as it requires deep thought and constructive decisions. AHP basically address the strategic issue of justification. In case this decision is to be evolved by a panel of experts, say consisting of the managing director, chairman, financial director, etc, then each person’s opinion can be consolidated by appropriate weights and then final decisions can be evolved. AHP’s ease of use makes it’s a viable method for everyone involved in the decision analysis. The respective nature of pairwise comparison and the structure of AHP make computerization of the technique attractive and easy. This study shows that cellular manufacturing is the suitable manufacturing system for the particular auto component manufacturing company and the process is more complex in justifying the selection process.

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