ADVANCED MANUFACTURING TECHNOLOGIES USED IN MANUFACTURING INDUSTRIES

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ABSTRACT

With the emphasis on reducing costs and increasing efficiency, a record number of companies are embarking on different forms of advance manufacturing technologies (AMT). AMT are broadly defined by many authors (small and chen, Sheppard and stock) as “an automated production system of people, machines and tools for the planning and control of the production process, including the procurement of raw materials, parts and components and the shipment and service of finished products” In particular, AMT is defined as any new manufacturing technique, the adoption of which is likely to lead to changes in a firm’s manufacturing practice, management systems and approaches to design and production engineering of the product. Advanced Manufacturing Technologies are split into:

(a) Pure Technical tools(hardware) and
(b) Management tools(manufacturing practices software)

Keywords: Component; Formatting; Style; Styling; insert (keywords)

INTRODUCTION:

Under the heading of Advanced Technical tools(hardware) the following can be included:

(i) Computer Aided Design –CAD
(ii) Computer Aided Manufacturing –CAM-NC-CNC
(iii) Computer Aided Design/ Computer Aided Manufacturing –CAD/CAM
(iv) Robotics
(v) Flexible Manufacturing Systems FMS’s and
(vi) Automated Guided Vehicles—AGV’s

Under the heading of Production Management tools the following can be included:

(i) Just in Time-JIT
(ii) Total Quality Management-TQM
(iii) Group Technology-GT
(iv) Material Requirements Planning-MRP
(v) Manufacturing Resource Planning—MRPII

Successful firms have recognized the fact that technology has become a key competitive tool for success and are trying to leverage it for competitive advantage. Although there is no path towards gaining a competitive advantage it is of general agreement that the implementation of Advance Manufacturing Technology is a critical component for success. According to Denis “the difference between a loser and a winner is the ability to apply new technologies and to build the company’s future on the creativity and imagination of its brain resources through an adequate management”. The most important competitive weapons, however, are not the technologies themselves, but their effective deployment, implementation and ultimately their management. Many organizational and managerial procedures and policies have been developed to decrease uncertainty in traditional manufacturing systems. These constraints are reduced or possibly eliminated with the use of advance technology. The use of computer networks and automated machines provides efficient information feedback mechanism for even the physically longest manufacturing system. Automated processing times are extremely reliable and data reports from machines are very accurate, unbiased and timely.” Thus most of our traditional manufacturing management, industrial engineering and operations research techniques for increasing the efficiency and effectiveness of manufacturing systems are irrelevant in the factory of the future.”

The implementation of AMT affects not only the manufacturing division of plant, but also the marketing, human resource, research and development, and engineering design divisions. This technology alters the design of a plant as well as the relationship between the various units. The relationship between the firm and its customers also changes; for example, firm can adjust to
changes in demand more quickly and are able to offer better quality, shorter lead times, and improved reliability.

For organizations that have successfully implemented AMT, the benefits have been outstanding. General Electric modernized its locomotive plant with flexible manufacturing system and reduced machining time for multi-ton engine frame parts from 16 days to 16 hours.

**LITERATURE REVIEW:**

AMT represent a wide variety of modern manufacturing systems, mainly computer based that are devoted to the improvement of manufacturing operations. There is a continuum of possible AMT that can be implemented by a firm. This ranges from stand-alone units such as a robot, to more integrated systems such as flexible manufacturing systems and ultimately to fully integrated systems called Computer integrated Manufacturing (CIM). The amount of integration of AMT is one of the key determinants for organizational changes that are complementary to the implementation process. The implementation of AMT changes the characteristics of any manufacturing plant. The degree to which a plant will change is dependent on the number of AMT implemented as well as the level of integration. Goldhar and Jelinek (1985) summarize the operating capabilities of the advanced factory as follows:

1. The economic order quantity approaches one.
2. Variety has no-cost penalty on the factory floor.
3. Revenue per unit is highly sensitive to total production volume (not volume for this design only) because fixed conversion costs approach 100% of all conversion costs.
4. Joint-cost economics obtain: the value of system (its potential returns on investment) is a function of the bundle of products it produces, the range of processes it can perform.
5. Rapid response to changes in product design, market demand, and production mix are possible.
6. Unmanned and continuous operation is standard.
7. Closely-coupled and highly integrated production systems and close supplier-user links will result in minimal inventory levels- and greater vulnerability to error:
8. Consistently high levels of quality, accuracy and repeatability will be demanded, as well as permitted by the technology.

It has been shown that flexibility often reduces the engineering cost of design changes and the attendant system modifications. However, these savings are normally offset by increased cost for programming the equipment. The labour changes are also normally offset, as there will be a decrease in unskilled labour requirements but an increase in those for skilled labour (Sanchez, 1996). An implementation of AMT normally results in a decrease in total human resource costs, because AMT reduce turnover rates by increasing employee satisfaction (thus decreasing recruiting and training costs). AMT have also been shown to reduce the amount of rework and scrap, which translates into improved quality and reliability for the customer. This decrease has been attributed to the elimination of the operator (the process is automated with AMT), as well as the elimination of operator fatigue and boredom (Troxler, 1990).

In order to demonstrate the importance of AMT to firms, the current literature focusing on the organizational factors critical for the successful implementation of AMT as well as their impact on the market structure and competitive advantage of the firms. This section will set the foundation for the complimentary analysis to be performed by introducing some of the components already known to aid in the successful implementation of AMT. It will also demonstrate the impact that AMT can have in a plant, firm and even industry in order to aid in the justification of the importance of the results from this study.

**Organizational Factors Critical for Success**

Certain organizational factors are necessary conditions for the implementation of AMT. The first of these factors is a team based project management approach (Small and Yasin, 1997). This approach is necessary because of the complementary nature of AMT with so many different departments in the organization. The more integrated the system, the more critical the need for input from multiple departments during the planning stages.

A second factor for determining the successful of an implementation of AMT is commitment from both a project champion and from the organization as a whole. It has been
found that without solid commitment from the management and workers the full potential of AMT cannot be achieved. The faith of the organization in AMT affects many types of benefits derived from the implementation such as return on quality, level of enhanced competitiveness, amount of cost reductions, and improvement in control (Udo and Ehie, 1996).

The employees are the third focus of organizational factors. Employee empowerment defined as giving workers more responsibility and control over the manufacturing process, was shown to be positively correlated to increased AMT performance (Boyer et al, 1997). Worker empowerment also requires training so that workers are able to take on added responsibility and become comfortable with the new technology. Furthermore, it is important that training occur before, during and after the implementation of AMT (Frohlich, 1998). The increase in employee empowerment requires a complementary change in hiring and training policies as well as a change in the incentive structure of the firm. With increased responsibility, workers will expect and demand, increased salaries and other benefits. All of the human resource policies must be set to agree with the changes to the new expectations placed on the workers (Chung, 1996; Sun and Gertsen, 1995).

Frohlich (1995) also found that increased coordination of worker’s efforts through non-technical means (e.g., facilitating communication) was positively correlated to increased performance and growth with AMT. This increase in communication facilitates the required interaction between the various groups of the organization to help solve problems more efficiently. It is also critical to the integration of the systems so that the entire organization is able to achieve the maximum benefit from AMT.

A specifically designed comprehensive questionnaire was used as a basis of extracting information from the companies. The questionnaire was based on recent developments in the subject and was designed after a thorough study of international literature. A set of management activities performed during the process of Implementation of AMTs in the Manufacturing Industry were examined followed by an investigation and qualification of the impact of AMT on a comprehensive set of company performance indicator grouped as competitive priorities and manufacturing parameters.

Competitive priorities are the features and characteristics of the products that are visible to the customer and attract him to buy it. These include price quality consistency, product performance, delivery lead time, delivery performance, product design flexibility, and volume flexibility.

Manufacturing parameter is that parameter in the production environments that affect directly the competitive priorities and are expected to be influenced by the introduction of AMT in the manufacturing environment. These includes the quotation and design the lead times, the design to manufacture the lead times, the ability to design and manufacture the products, the manufacturing through put time, the changeover time, the manufacturing lead times, the batch size, the direct labor cost, WIP (work in progress), the average level of product quality etc.

Based on impact of AMT on the above indicators which was measured on a 10 point scale, the level of success of each technology was established the success was identified using a purpose development formula which takes into consideration the impact of the technology on the specific indicator, the degree of influence this indicator had on the introduction of the technology as well as the importance level of the indicator on the company performance. Based on the level of success and the management activities identified in the process of Implementation, a regression analysis was carried out to determine the factors contributing to the success or failure of the implementation of AMT. After a critical examination of the success and failure factors and the influence level of AMTs on the above mentioned indicators, an integrated planning model was devised to provide the frame work and all the necessary information for the manufacturers to identify their needs, justify and select the most appropriate AMT to satisfy their strategic plans and competitive priorities.

**Questionnaire Administration**

As stated before the questionnaire was based on the recent developments in the subject and was designed after a thorough study of international literature. It’s a structure includes four sections. Each one addressing separate issues. Section A and B deal with the general characteristic of the companies and the application of advanced manufacturing technologies. Section C determines the impact of AMT on the company products, competitive priorities and manufacturing parameters. While section D and E examine
the management process followed during the introduction and the operation of AMT in the manufacturing environment.

Section A: General Characteristic of the Companies:

This section includes questions which aimed to extract information of a general nature, and related to the introduction and implementation of advanced manufacturing technologies. In detail it yields information on:

1. The employment characteristic of the companies.
2. The manufacturing characteristics
3. The operational characteristics
4. The production plant characteristics

Section B: Advanced manufacturing technologies: Present and Future Applications

This section examines the level of application of AMT in the surveyed companies. In particular it investigates the present and future applications of CAD systems, NC and CNC machines, CAD/CAM systems, robotics, flexible manufacturing systems (FMS), Automatic Guided Vehicles (AGVs), Manufacturing resource planning systems (MRP) etc…

Section C: Impact of AMT on Company Competitiveness – Success and Failures of AMT

This section examine the impact of AMT on company competitiveness. In detail, it extracts information on:

1. The impact of AMT on product – Market characteristics
2. The impact of AMT on the company’s competitive priorities
3. The impact of AMT on the manufacturing parameters and
4. The estimated and the real situations as to the level of competitive priorities a company should possess.

Section D: AMT Planning Factors.

This section examines the level of planning for the implementation of AMT. In detail the following are addressed:

1. The factor influencing the decision to introduce AMT
2. Problems in financial justification of AMT
3. The planning level of the AMT transfer process
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Section E: AMT operational factors

This section examines the management process followed during the transfer and implementation of AMT in the manufacturing environment. Specifically, it address the following:

1. Technology selection and transfer issues
2. Infrastructure preparation issues

Data Collection

- Our data collection is identifying comparable theories through various books and journals. Moreover, annual reports from the various cases are reviewed in order to have a more detailed understanding of the case study companies. There is no single source of information that can provide a comprehensive and complete perspective on the study. It is therefore important for case study research to use multiple sources of data to get as broad a view as possible about each specific case.

Data Analysis

In our attempt to collect and organise data in such a way that we later will be able to conduct an analysis, we structure our analysis according to the steps presented by Merriam. The first step is to organise the data in topical or chronological order so it can be presented in a descriptive manner. The next step is to classify the data into categories, themes, or types. The final step involves making conclusions, developing models, or generating a theory. All empirical data was organised in topical order according to the design of the interviews and presented case by case. The classification of the empirical findings constituted the next step, which we also based on the questions found in the interviews conducted. In the final step, our aim was to enlighten factors that are general across the research study. However, individual findings that we felt were of interest and of importance to our study.

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Keywords: AMT, WIP, CNC, CAD/CAM/ ROBOTICS.

I. Introduction

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III. Research Methodology

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B. Research Design

A research design is a type of blueprint prepared on various types of blueprints available for the collection, measurement and analysis of data. A research design calls for developing the most efficient plan of gathering the needed information. The design of a research study is based on the purpose of the study. A research design is the specification of methods and procedures for acquiring the information needed. It is the overall pattern or framework of the project that stipulates what information is to be collected from which source and by what procedures.

C. Research Strategy

The strategies that are of interest to our study are surveys and a multiple case study. We feel that individually using surveys or case study (by interview) will not reveal a clear and honest enough picture. So I will use both parameter of study: first one use for upper or mid management employees and second one use for lower Management and labour class employees.

D. Research Method:

Case studies are suitable for practical problems and they are often thought of as being problem-centered, small-scaled, and entrepreneurial. Moreover, one of the strengths of a case study is its unique ability to use a lot of different empirical evidence. The research strategy that is best suitable to our thesis is therefore a multiple-case study. We designed our study in such a way that the research findings will represent comparative cases. They are comparative in the sense that the interviews are semi-structured, thus inviting the interviewees to enlighten additional areas of importance.
Survey studies are suitable for inherent problems which are not shown in the interview and lower management employees do not understand typical type interview question. So by the structured questionnaire method we collect real information of current circumstances about our research. These structured questionnaires must be designed to relate to objectives in the evaluation process; they must cover the issues, and the data must be able to be collected and analyzed.

E. Data Collection

- Our data collection is identifying comparable theories through various books and journals. Moreover, annual reports from the various cases are reviewed in order to have a more detailed understanding of the case study companies. There is no single source of information that can provide a comprehensive and complete perspective on the study. It is therefore important for case study research to use multiple sources of data to get as broad a view as possible about each specific case.

F. Data Analysis

In our attempt to collect and organize data in such a way that we later will be able to conduct an analysis, we structure our analysis according to the steps presented by Merriam. The first step is to organize the data in topical or chronological order so it can be presented in a descriptive manner. The next step is to classify the data into categories, themes, or types. The final step involves making conclusions, developing models, or generating a theory. All empirical data was organized in topical order according to the design of the interviews and presented case by case. The classification of the empirical findings constituted the next step, which we also based on the questions found in the interviews conducted. In the final step, our aim was to enlighten factors that are general across the research study. However, individual findings that we felt were of interest and of importance to our study.

IV. References

Experimental study of Heat Transfer Enhancement due to Artificial Roughness in Annular Flow (Advanced manufacturing technology)

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Abstract: This paper presents results of an experimental investigation of heat transfer enhancement due to artificial roughness in annular flow. In this experiment we have taken two relative roughness pitch set up (p/e=10 and p/e=5) observations with helical springs wrapped on copper tube (Annular duct). The objective of the present experiment is basically to study the effect of use of perforated roughness elements on the heat transfer for the flow of air through an asymmetrically heated annular duct with helical coil spring wrapped in the form of helix on the copper tube. This study can be used as guidelines for better work on the annular heat exchanger with using helical springs wrapped over the duct.

Keywords: Heat transfer, annular duct flow, Roughness, Friction factor, Reynolds number

I. Introduction

Heat transfer to a fluid flowing in a circular tube annulus is a particularly interesting problem and one of considerable technical importance because of the surface can be heated independently. The duct wall roughness has a little effect on laminar flow however; it exerts a string influence on the turbulent flow. The ratio of the surface roughness height to the laminar sub-layer thickness must be determining factor for the effect of roughness. For commercial pipes, the surface roughness height is very small as compared to the laminar sub-layer thickness and hence the roughness does not affect heat transfer.

Artificial roughness on the heat-transferring surface in the form of wires, integral ribs, or twisted tap inserts of different shapes and in various arrangements have been used in tubes and annular ducts. The main thermal resistance to the convective heat transfer is due to the formation of a laminar sub-layer on the heat transferring surface. Efforts for enhancing heat transfer have been directed towards artificially destroying or disturbing this layer. This can be achieved by mechanical active, passive and combination of active and passive methods.

Active methods are:

- Mixing or scrubbing of fluid from the heat transferring surface by mechanical means
- Vibrating or rotating the heat transferring surface
- Suction of heated fluid through a porous surface

Passive methods are:

- Use of Fins
- Use of swirl flow devices
- Artificial roughness to create near wall turbulence to break the laminar sub-layer or to reduce its thickness.

Artificial roughness on the heat transferring surface in the form of wires, helical springs or rib of different shapes and in various arrangements have been used in tubes and ducts.

For any basic type of roughness the key roughness parameters are

- Relative Roughness Height = \( \frac{\text{Roughness Height (e)}}{\text{Hydraulic diameter of flow passage (D_h)}} \)
- Relative Roughness Pitch = \( \frac{\text{Distance between two adjacent element’s pitch (p)}}{\text{Roughness height (e)}} \)
- Shape and type of roughness elements
d. Angle of attack (a):
It is the angle of roughness element orientation with respect to the direction of flow. Gee and Webb investigated friction and heat transfer characteristics of rib roughened tubes having helix angle of 30°, 49°, 70°. The friction factor for a tube with ribs at 70° helix angle was found to be 60% higher than that with the smooth tube and friction factor decreased with the decrease in helix angle from 70° to 30°. The Stanton number was also found to be decrease as helix angle decreases. Various researchers have reported optimum p/e ratio of 8 to 12 (Preferred value of 10). For p/e > 8 the flow reattaches after jumping the rib at a distance of 5 to 6 roughness height. It further develops before reaching next rib. The angle of inclination of helical coil spring with respect to flow direction is 66° (Approx)

II. Experimental setup

Figure-1 Experimental setup
Figure-2 Test section assembly

The setup is shown in figure-1. The annular test section has been fabricated to determine the convective heat transfer coefficient for flow of air in annuli. The value of heat transfer coefficient ‘h’, Nusselt number ‘Nu’, has been found out at different flow rates for two configuration namely helical spring wrapped tube with p/e=5 and p/e=10.

The setup consists of a centrifugal blower connected with a flow regulating valve and an annular test section through an orifice plate along with an inclined ‘U’ tube manometer. The test section is an annular duct, consisting of a heater placed inside the inner copper tube through its length. The specifications of the equipments used are given. Some modifications have been made in heater, entrance length, and pressure tap locations.

List of Equipments and Specifications:

(1) Blower- Motor: Power-2KW, RPM-2880, Voltage- 415V, 3Ø
(2) Air Heater: Nichrome wire of 450 O wounded on ceramic tube insulators with Bakelite discs at ends, which Resists the heat loss from the ends of copper tube and they keep the heater concentrically in the Copper tube.
(3) Test Section: L=2200 mm (4), Control valve (5), Orifice plate: Dia. 30 mm (6) Ammeter: 0-10 amps.
(7) Voltmeter: 0-300 volts (8) Multimeter (9) Wattmeter (10) Electronic micro manometer L.C. =0.01 and U-tube manometer (1:4.82)

III. Heater Assembly and heater circuit

The heater assembly consists of hollow ceramic rods. Nichrome resistance wire is wound around the ceramic rods. These ceramic rods are then slipped on mild steel rod, ceramic rods being separated with Bakelite washers’ in between them, as shown in figure attached. The resistance placed in series is capable of generating 117.6 Watt heat at full voltage supply. Teflon tape has been wound around the mild steel rod to avoid any short circuit or electric shock possibility. The mild steel rod has been threaded at its end to hold the ceramics rods firmly in position with the help of nuts. A variance has been used to control the supply of electric energy to the heater. The copper tube (1365mm long) which works as heat transferring surface is slightly longer than the length of heater assembly (1250 mm) the assembly is placed centrally inside the Cu tube. Two Bakelite sheet washers of diameter equal to inner diameter of the copper tube are screwed on the threads at the end of the MS rod. These washers are insulators, which resist the heat loss from the ends of the copper tube and also, they keep the heater concentrically in the copper tube.
Figure-3 Heater Assembly

Figure-4 Heater Circuit

Calibrated copper-constantan thermocouples have been used to measure various temperatures. A thermocouple located mid way in the pipe before the inlet to the test section measure the inlet air temperature. The outlet air temperature has been measured by transverse a thermocouple in the annular space as shown in figure. The inner tube surface (Heat transferring surface) temperature has been measured by fixing 11 thermocouples along the length as depicted in the figure attached. The electric energy supply to heaters has been measured with the help of an ammeter, a voltmeter and a Wattmeter.

Test Section Assembly:

The heater assembly along with the copper tube is placed inside a steel pipe (81.83 mm inside diameter). Three locating pins, provided on the periphery of the GI pipe at each end, located the assembly concentrically within the GI pipe. The heat generated in the heater is transferred to the flowing air by convection.

Orifice Plate Assembly:

The orifice plate assembly for the measurement of air flow rate through the test section is shown in the figure attached. A vertical/Inclined water manometer has been used. The coefficient of discharge $C_d$ for $d/D=0.6$, has been taken to be 0.65 specified in Kent’s hand book.

Roughened tubes:

The roughened tubes for the present investigation have been prepared by wrapping a helical springs of 4.65mm diameter in the form of helix with pitch of 43mm and 21.5mm. The helical spring has coils at pitch of 1.67mm and wire diameter of 0.5mm.

IV. Experimental Procedure

- Connections for the heater circuit are made (As in figure)
- The main supply is switched ‘ON’ and variance is adjusted, keeping the voltmeter and the ammeter reading constant, heater is allowed to work for some time.
- The blower is switched ‘ON’ and the control valve is adjusted to give desired flow rate. Orifice manometer and micro manometer readings are recorded.
- The manometer is recorded when steady state is reached. The steady state condition has been assumed to reach when the temperature does not deviate for 20 minutes period. The steady state condition was achieved in 1.5 to 3.0 hrs.

Throughout the time of taking observations, manometer, ammeter and voltmeter readings are maintained constants. A number of observations have been taken for different heat input and flow rates. The observations recorded are given in the tables (Observation tables). However, the micro monometer went out of order and pressure drop data for friction factor calculation could not be recorded.

V. Data Reduction and Observations

A. Data Reduction:

1. Mean tube surface temperature:
   \[
   T_S = T_1 + T_2 + T_3 + T_4 + T_5 + T_6 + T_7 + T_8 + T_9 + T_{10} + T_{11}
   \]
Where $T_1$, $T_2$, $T_3$, $T_4$, $T_5$, $T_6$, $T_7$, $T_8$, $T_9$, and $T_{10}$ are temperature measured from the thermo couples placed on the heat transfer surface.

2. Mean outlet temperature: Mean of the readings taken by traversing thermocouple radially at outlet of pipe.

3. Mass flow rate:

\[ m = \rho (\Pi/4 d^2) C_p \sqrt{2gh_a} \]

where $h_a = (\rho_a h_w)/\rho_a$

4. Heat gained by the air:

\[ Q = mC_p(T_i - T_o) \]

5. Heat Transfer coefficient:

\[ h = Q/A_s(T_i - T_m) \quad \text{where } T_m = (T_i + T_o)/2 \]

6. Hydraulic Diameter:

\[ D_h = 4 x \text{Flow Area}/(wetted perimeter) \]

7. Nusselt number: \[ Nu = (D_h h)/k, \] Where $k = \text{thermal conductivity of fluid}$

The properties of air $\mu_w$, $\rho_w$ etc. have been taken at mean air temperature $T_m$.

9. Coefficient of friction:

\[ f = 2gD_h(\Delta p)/4pV^2 \]

Where $\Delta p$ is pressure drop in the test section.

B. Formule used in calculations:

Heat transfer coefficient:

\[ h = Q_A/(A(T_i - T_m)) \quad \text{where } A = \text{Total Area}, D = 0.0319, L = 1.364 \text{m} \]

$T_m = (T_i + T_o)/2$

$T_i$, $T_o$ - mean of all temperatures corresponding thermocouple readings at surface of copper tube.

Nusselt No.: $Nu = hD_h/k$, Where $D_h = 4A/P = D_p D_l$

$K = 0.0274$ at $T_m$ temperature, So $N_u = 1.8285h$

| Table-I | Shows the Nusselt Number corresponding to P/e=5 and P/e=10 |

<table>
<thead>
<tr>
<th>S.No.</th>
<th>P/e=10</th>
<th>P/e=5</th>
<th>(Nu)/ (Nu)10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>45.876</td>
<td>49.219</td>
<td>1.073</td>
</tr>
<tr>
<td>2.</td>
<td>57.992</td>
<td>69.022</td>
<td>1.190</td>
</tr>
<tr>
<td>3.</td>
<td>68.309</td>
<td>869.893</td>
<td>1.272</td>
</tr>
</tbody>
</table>

| Table-II | OBSERVATION TABLE (For P/e=5) |

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Flow (m)</th>
<th>Applied Voltage (V)</th>
<th>Air inlet temperature T (mv)</th>
<th>Tube surface temperature (mv)</th>
<th>Air outlet temperature T_o (mv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>70.0</td>
<td>44x4</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>2.</td>
<td>70.0</td>
<td>44x4</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>3.</td>
<td>70.0</td>
<td>44x4</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>4.</td>
<td>200.0</td>
<td>50x4</td>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>5.</td>
<td>200.0</td>
<td>50x4</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>6.</td>
<td>380.0</td>
<td>56x4</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
</tr>
</tbody>
</table>

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Table-III  Shows the observation of temperature for particular flow rate (For P/e=10)

<table>
<thead>
<tr>
<th>S. No</th>
<th>Flow (p)/mm</th>
<th>Applied Voltage (V)</th>
<th>Air inlet temp T1(°C)</th>
<th>Tube surface temperature (°C)</th>
<th>Air outlet temp T4(°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>70.0</td>
<td>44x4</td>
<td>1.80</td>
<td>2.5</td>
<td>0.00708</td>
</tr>
<tr>
<td>2.</td>
<td>70.0</td>
<td>44x4</td>
<td>2.5</td>
<td>2.8</td>
<td>0.00708</td>
</tr>
<tr>
<td>Avg</td>
<td>70.0</td>
<td>44x4</td>
<td>2.3</td>
<td>2.7</td>
<td>0.00708</td>
</tr>
<tr>
<td>3.</td>
<td>200.0</td>
<td>50x4</td>
<td>1.80</td>
<td>2.4</td>
<td>0.00708</td>
</tr>
<tr>
<td>4.</td>
<td>200.0</td>
<td>50x4</td>
<td>1.80</td>
<td>2.4</td>
<td>0.00708</td>
</tr>
<tr>
<td>Avg</td>
<td>380.0</td>
<td>56x4</td>
<td>1.80</td>
<td>2.4</td>
<td>0.00708</td>
</tr>
</tbody>
</table>

Table-IV  Shows the observation of Average value of data  (For P/e=10)

<table>
<thead>
<tr>
<th>S. No</th>
<th>Flow (p)/mm</th>
<th>Applied Voltage (V)</th>
<th>Air inlet temp T1(°C)</th>
<th>Tube surface temperature (°C)</th>
<th>Air outlet temp T4(°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>70.0</td>
<td>44x4</td>
<td>44.80</td>
<td>61.2</td>
<td>70.3</td>
</tr>
<tr>
<td>2.</td>
<td>200.0</td>
<td>50x4</td>
<td>43.45</td>
<td>27.7</td>
<td>64.65</td>
</tr>
<tr>
<td>Avg</td>
<td>380.0</td>
<td>56x4</td>
<td>44.80</td>
<td>56.5</td>
<td>70.3</td>
</tr>
</tbody>
</table>

Table-V  Shows the observation of Average value of data  (For P/e=5)

<table>
<thead>
<tr>
<th>S. No</th>
<th>Flow (p)/mm</th>
<th>Applied Voltage (V)</th>
<th>Air inlet temp T1(°C)</th>
<th>Tube surface temperature (°C)</th>
<th>Air outlet temp T4(°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>70.0</td>
<td>44x4</td>
<td>40.00</td>
<td>55.35</td>
<td>62.35</td>
</tr>
<tr>
<td>2.</td>
<td>200.0</td>
<td>50x4</td>
<td>44.00</td>
<td>57.22</td>
<td>66.5</td>
</tr>
<tr>
<td>Avg</td>
<td>380.0</td>
<td>56x4</td>
<td>44.80</td>
<td>58.9</td>
<td>70.3</td>
</tr>
</tbody>
</table>

Table-VI  Shows the Final value after calculations  (For P/e=10)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>flow</th>
<th>Qm</th>
<th>m</th>
<th>R1</th>
<th>f</th>
<th>h</th>
<th>Nu</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>44.8</td>
<td>54.2</td>
<td>69.0</td>
<td>49.5</td>
<td>70</td>
<td>66.985</td>
<td>0.00708</td>
<td>4040</td>
<td>-</td>
<td>25.0903</td>
<td>45.878</td>
</tr>
<tr>
<td>2.</td>
<td>43.45</td>
<td>50.7</td>
<td>66.91</td>
<td>47.075</td>
<td>200</td>
<td>85.98</td>
<td>0.0118</td>
<td>6790</td>
<td>-</td>
<td>31.71</td>
<td>57.992</td>
</tr>
<tr>
<td>3.</td>
<td>44.8</td>
<td>50.7</td>
<td>67.22</td>
<td>47.75</td>
<td>380</td>
<td>99.43</td>
<td>0.0166</td>
<td>9710</td>
<td>-</td>
<td>37.358</td>
<td>68.309</td>
</tr>
</tbody>
</table>

Table-VII  Shows the Final value after calculations  (For P/e=5)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>flow</th>
<th>Qm</th>
<th>m</th>
<th>R1</th>
<th>f</th>
<th>h</th>
<th>Nu</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>40</td>
<td>48.9</td>
<td>61.66</td>
<td>44.45</td>
<td>70</td>
<td>63.327</td>
<td>0.00708</td>
<td>4040</td>
<td>-</td>
<td>26.918</td>
<td>49.219</td>
</tr>
<tr>
<td>2.</td>
<td>44</td>
<td>51.5</td>
<td>65.18</td>
<td>47.75</td>
<td>200</td>
<td>89.942</td>
<td>0.0118</td>
<td>6790</td>
<td>-</td>
<td>37.748</td>
<td>69.022</td>
</tr>
<tr>
<td>3.</td>
<td>44.8</td>
<td>51.9</td>
<td>66.74</td>
<td>48.35</td>
<td>380</td>
<td>119.45</td>
<td>0.0116</td>
<td>9710</td>
<td>-</td>
<td>47.516</td>
<td>86.893</td>
</tr>
</tbody>
</table>
VI. Result and Discussion

The experimental analysis always shows that Nusselt no. increases by 7% to 27% when the pitch is changed to half, i.e. from p/e=10 to p/e=5. The enhancement increase with Re. It is to note that p/e=10, Nusselt no. values obtained here are reasonable agreement with the earlier studies. Despite the fact that there was some error in correct measurement of surface temperature. This enhancement shows that in case of perforated roughness a lower pitch is preferable as against p/e=10 has been reported to be nearly optimum for solid rib roughness.

![Image of graph showing Nusselt number vs. Reynolds number]

The result can be increased turbulence due to closure arrangement of spring coils. However due to known measurement of pressure loss data, it is not possible to predict the correct effect on the friction factor. Basically any enhancement scheme success depends on heat transfer enhancement greater then friction factor enhancement. The work can be extended/repeated in future with better instrumentation and pressure loss data recording, for friction factor calculation.

VII. Conclusion

In this paper, an experimental investigation has been carried out for heat transfer and friction factor in annular duct with helical spring wrapped on the inner heated tube of annulus flow. Reynolds no. extends from 4040 to 9710 i.e. in the transition region. Two p/e values have been selected for the study. The heat transfer enhancement is 7% to 27% increasing with Reynolds no. which can be termed as quite significant. This enhancement can be attributed to the increased turbulence level at the heated surface. The real advantage of the enhancement scheme can be ascertained by taking friction factor data.

VIII. References

Advanced Manufacturing Technology: A Case study in small scale organizations
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1Assistant professor, 2Pro. V.C. Jagannath university, JAIPUR
1mahendra.singh@jagannathuniversity.org)

Abstract: This paper entitled “Kaizen: The process of continuous improvement (Applied in small scale organizations)” concerns with the cost reduction by some modification in processes of small scale industries. The Paper is also focuses on the improvements that can give the minimum rejection level the products. In this paper some data’s are collected by experimenting specially in the wire harness manufacturing companies for automotive vehicles. Here are some modifications by implementing these in the same industries the quality of the products can be improved. By adapting these Kaizen techniques the processes can be made more efficient and effective.

Key words: Kaizen, cost reduction, Minimum rejection, continuous improvements

I. Introduction

Kaizen is a Japanese word for the philosophy that defines management’s role in continuously encouraging and implementing small improvements involving everyone. It is the process of continuous improvements in small increments that make the process more efficient, effective, under control and adaptable. Improvements are usually accomplished at little or no expenses, without sophisticated techniques or expensive equipments. It focuses on the simplification by breaking down complex processes into their sub-processes and then improving them.

For the paper some experiments have been completed before and after the improvements and modifications in process, data are collected before and after modifications and on the basis of these information’s the cost and rejection levels of the products are identified. Then calculations have been done on standards cost basis. After calculations some conclusions are find out that are represented with the help of tables. Some examples of kaizen improvements in wire harness manufacturing companies and their effect on cost and rejections levels are shown with the tables. To find out the results the certain procedure is followed.

Procedure applied for Cost reduction:
1.Identification of problems 7.Data analysis
2.Selection of the problem 8. Action
3.Objective 9.Developing solutions
4.Defining the problem 10. Achievements
5.Data collection: Before and after 11.Effectiveness
6.Root cause analysis 12.Tangible benefits
1.1 PROBLEM: Lock reverse bend in 6.4F terminal

Terminal lock in correct condition          Terminal Lock Bend condition

This is the general problem that occurs on wire and terminal crimping machine while feeding the terminal chain from feeder. The causes of this type of problems may be:

- Terminal lock stuck in terminal chain
- Terminal lock striking in cutter guide
- Loose binding of terminal roll

1.1.1 Defining the problem:

Terminal feed in machine(Problem)

1.1.2 Impact of the problem:

a. Insertion problem of coupler assembly  b. Productivity loss
b. Operator fatigue                          c. Increase line rejection
d. Tool breakdown                           e. Wastage of raw material

1.1.3 Data collection:

<table>
<thead>
<tr>
<th>PRODUCTION AREA</th>
<th>PROBLEM STAGE</th>
<th>AUTOMATIC WIRE PROCESSING LOCK BEND (in pcs) IN ONE MONTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>I week</td>
</tr>
<tr>
<td>AWP AREA</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>WIP AREA</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>WIRE INSPECTION</td>
<td>AREA</td>
<td>155</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>WIRE ASSEMBLY AREA</th>
<th>6</th>
<th>8</th>
<th>4</th>
<th>10</th>
<th>28</th>
</tr>
</thead>
<tbody>
<tr>
<td>COUPLER ASSEMBLY AREA</td>
<td>6</td>
<td>5</td>
<td>7</td>
<td>5</td>
<td>23</td>
</tr>
<tr>
<td>TOTAL</td>
<td>377</td>
<td>400</td>
<td>560</td>
<td>393</td>
<td>1730</td>
</tr>
</tbody>
</table>

1.1.4 Data Analysis:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>CAUSE</th>
<th>OBSERVATION</th>
<th>NO. OF FAILURES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>NOS.</td>
<td>IN%</td>
</tr>
<tr>
<td>1.</td>
<td>Terminal lock get stuck in terminal chain</td>
<td>15 times</td>
<td>8</td>
</tr>
<tr>
<td>2.</td>
<td>Terminal lock striking in cutter guide</td>
<td>15 times</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>Loose binding of terminal roll</td>
<td>15 times</td>
<td>3</td>
</tr>
</tbody>
</table>

1.1.5 Action:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Problem</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Terminal lock stuck in terminal chain</td>
<td>Modified the hanger guide</td>
</tr>
</tbody>
</table>

Fig: Before improvement

Fig: After improvement

1.1.6 Action:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Problem</th>
<th>Reason</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Terminal lock striking in the cutter guide</td>
<td>Terminal lock height variation</td>
<td>Lock height controlled at vendor end</td>
</tr>
</tbody>
</table>
1.1.7 Action:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Problem</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>Loose binding of terminal roll</td>
<td>Training provide to the operator at vendor end</td>
</tr>
</tbody>
</table>

Fig: After Improvement

1.1.8 Tangible benefits:

a. Material cost:

Monthly rejection of terminal=1730 Pecs
Cost of rejection of terminal=1730*0.36=Rs. 623

b. Manpower cost:

Operator cost for processing: 2*1730=58 hrs.*22=Rs 1276
One piece rework time: 2Min.

c. Machine cost:

Rs 0.75 per terminal
Total machine cost: 1730*0.75= Rs 1298/month
Tool broken (punch + cutter guide)= 48 Nos.
Cost of punch or cutter guide =Rs 250
Total cost per month = Rs. 12000
Total cost saving = 623+1276+1298+12000=Rs15197/month
Total cost saving per year =15197*12=Rs 182364
References

[8] Masaaki Imai, A book on commonsense approach to a continuous improvement stra
Study the Effect of Advanced Manufacturing Technologies on Manufacturing Industries

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²Pro Vice Chancellor, Jagannath University, Jaipur, Rajasthan, INDIA

ABSTRACT

This paper revolves around the impact of Advanced Manufacturing Technologies in Indian Manufacturing industries. Statistics inculcates that a number of industries subsists, which are using different forms of Advanced Manufacturing Technologies (AMT). “Advanced Manufacturing Technologies (AMT)” is a generic term, depicting an assembly of manufacturing technologies, which combines both scope and scale capabilities in a manufacturing environment.

Keywords: Advanced Manufacturing Technologies (AMT), CAD, CAM, CNC, JIT, etc.

I. INTRODUCTION

Advanced manufacturing technology (AMT) is broadly defined by distinguished authors in their terminologies; Small and Chen, (1995) say, it is “An automated production system of people, machines and tools for the planning and control of the production process, including the procurement of raw materials, parts and components and the shipment and service of finished products”. In particular, the AMT can be defined as any new manufacturing technique, which is likely to cause constructive changes in a firm’s manufacturing practices, management systems and its approach for the designing and production of various engineering products. Advanced Manufacturing Technologies are classified into two classes: hardware and software by Small and Yasin (1997).

(I) Pure Technical tools (hardware)
(II) Management tools (manufacturing practice software)

Pure Technical tools or Advanced Technical tools (hardware) can be further classified into the following range of technologies:

(A) Computer aided design (CAD)
(B) Computer numerical control machines (CNC)
(C) Direct numerical control machines (DNC)
(D) Robotics (RO)
(E) Flexible manufacturing system (FMS)
(F) Automated material handling systems (AMHS)
(G) Automated guided vehicles (AGV)
(H) Automated storage and retrieval system (AS/RS)
(I) Rapid prototyping (RP)

The implementation of AMT affects not only the manufacturing division of a plant, but also the Marketing, Human Resource, Research and Development, and Engineering Design divisions. These technologies transform the design of a plant as well as the relationship between these various interconnected units. The relationship between the firm and its customers also changes; for example, firms can adjust to frequent changes with respect to the demand, more quickly and would be able to offer better quality, shorter lead times, and improved reliability. For organizations that have successfully implemented AMT, the benefits have been outstanding. The liberalization of the economy has opened new windows of opportunities for the Manufacturing sector. Overall the growth of manufacturing industry is sustained on Innovations, Research and Development.

II. LITERATURE REVIEW

Advanced Manufacturing Technology (AMT) express a wide diversity of modern manufacturing systems, mainly computer based which are devoted to the improvement of manufacturing operations. There is a
continuum of possible advanced manufacturing system that can be implemented by an industry. This confine from stand-alone units such as a robot, to more integrated systems such as flexible manufacturing systems and ultimately to fully integrated systems called Computer Integrated Manufacturing (CIM). The implementation of advanced manufacturing technology develops the aspects of any manufacturing plant. The extent to which a plant will modify is reliant on the number of advanced manufacturing technology implemented as well as the level of investment. It has been shown that flexibility often reduces the engineering cost of designs development and the ancillary system conversion. An implementation of advanced manufacturing technology consequence in a decrease in total human resource costs, because advanced manufacturing technology reduces the turnover rates by increasing employee satisfaction (thus decreasing recruiting and training costs). Advanced manufacturing technologies have also been shown to minimize the amount of rework and scrap, which explicate into improved quality and reliability for the customer. In order to express the importance of advanced manufacturing technology for industries, the current literature focuses on the organizational factors, critical for the successful implementation of AMT as well as their impact on the market structure and competitive advantage of the industries. It will also express the impact that advanced manufacturing technology can be in a plant, firm and even industry in order to advancement in the account of the importance of the completion from this study. A careful examination of these conceptualizations reveals it is possible to split AMT investigated into six clear AMT provinces:

1. A design and planning province, i.e. advanced design and Engineering Technologies (ADET); concerned largely with design and engineering technologies, such as CAD, CAE, GT and CAM;
2. A production planning and logistics-related province i.e. Advanced Planning Technologies (APT); concerned with production and logistic planning, such as MRP, MRP II and ERP;
3. A materials handling province i.e. Advanced Material Handling Technologies (AMHT): which materials handling and transporting of materials, such as ASRS and AGVs;
4. A manufacturing province i.e. Advanced Machining Technologies (AMT) – concerned with repetitive production technologies such as robotics and numerical control machine (NC/CNC/DNC);
5. A manufacturing province i.e. advanced management systems: comprises of as production management tools and can be classified as TQM, BPR, SPC, and JIT.
6. A manufacturing province, i.e. advanced improvement process systems: comprises some advanced process improvement technologies are: bench marking, recycling, kaizen and management training.

III. METHODOLOGY

A structured questionnaire was developed to qualify the presumptions; the questionnaire which is used in this study has been incorporated with inputs from various sources: most of the questions were adapted from formerly published works and henceforth, the preliminary draft of the questionnaire was discussed with the academic scholars and practitioners. The questionnaires were administered by post, accompanying a covering letter and a business reply envelope, to a total of 240 industries, out of which 68 industries reverted back with their data. After the compilation and analysis of the received data, investigation was carried out on the following key points related to the Manufacturing Industries and AMT.

1.) Manufacturing strategy of manufacturing industry
2.) Different types of advanced manufacturing technologies
3.) Level of investment on AMT
4.) Effect on manufacturing performance after accomplishment of AMT

IV. DESCRIPTIVE ANALYSIS

The basic survey data was presented for four broad manufacturing sectors on selection of firm and industry characteristics. Indian manufacturers enjoy the advantages of cheaper raw materials and accessibility of educated, qualified and skilled labor as well as engineers and designers at much lower costs. Technological advancements made by some of these domestic conglomerates have allowed them to become incorporated associates rather than outsourcing associates.

The study investigates different types of advanced manufacturing technologies (AMT), which are commonly used by manufacturing industries. These technologies can be grouped based on their functionalities, into six subgroups:

1. Advanced design and engineering technology
2. Advanced machining technology
3. Advanced planning technology
4. Advanced material handling technology
5. Advanced management system
6. Advanced process improvement system

Industries were asked to indicate the amount of investment in the individual technology, on a five point scale of 1 to 5, where 1 indicate no investment and 5 to show heavy investment. Industries were determined to be either users or non users of each technology sub-group. For example, an adopter of the design and engineering technology sub group would be using a combination of either CAD,CAM,CAE,GT or all the above. Analysis of the AMT adoption of the manufacturing industries surveyed is based on the level of investment in the technology.

4.1 ADVANCED DESIGN AND ENGINEERING TECHNOLOGIES

Manufacturing industries invested in various design and engineering technologies such as computer
aided design (CAD), computer aided manufacturing (CAM), computer aided engineering (CAE), and group technology (GT) to assist them in designing and testing a product, from a structural or engineering point, controlling of manufacturing machinery, and also for part classification and coding systems.

Figure 4.1 : Advanced design & engineering technologies in different sector

ADT1: Computer Aided Design, (CAD) ADT2: Computer Aided Manufacturing (CAM), ADT3: Computer Aided Engineering (CAE), ADT4: Group Technology (GT),

It is observed by the figure 4.1 that the most common advanced design technology among the industries surveyed is CAD, which encountered above moderate investments, i.e. means score of 3.9; followed by CAM, with mean score of 3.7. The results show that the least investment is in GT with mean score of less than 3.

4.2 ADVANCED MACHINING TECHNOLOGY

The study examines the level of investment and integration of four types of assembly and machining technologies: computer numerical control machines (CNC), numerical control/ direct numerical control machines (NC/DNC), flexible manufacturing system (FMS), and robotics (RO). These AMTs are used to perform repetitive functions and work without permanent alteration of the equipments. Computer numerical control machine operates by the computer and control all types of machining operations such as turning, boring, milling, drilling, machining centre etc. numerical control or direct numerical control machines directly control the machining operation such as turning, boring, milling, drilling, machining centre etc. Flexible manufacturing system is used to coordinate the handling and transport through centralized control. Robotics is to carry out various operations like handling, process or assembly tasks.

Fig4.2 : Advanced machining technology in different sector

AMT1: Computer numerical control (CNC), AMT2: Numerical control/Direct numerical control (NC/DNC), AMT3 Flexible manufacturing system (FMS), AMT4: Robotics (RO)

As shown in figure 4.2, regardless of the sector of the manufacturing industries, the most important investments are made in CNC technology. All the manufacturing industries are invested less in robotics technology.

4.3 ADVANCED PLANNING TECHNOLOGY

Manufacturing industries invested in various planning technologies such as material requirement planning (MRP), manufacturing resources planning (MRP II), enterprise resources planning (ERP) and activity based counting (ABC) to assist them in planning, scheduling and controlling of material and resources requirements for the production of manufacturing industries.

Figure 4.3: Advanced planning technology in different sector

APT1: Material requirement planning (MRP), APT2: Manufacturing resource planning (MRP II), APT3: Enterprise resource planning (ERP), APT4: Activity based counting (ABC).
The whole manufacturing industries seems to reach an agreement on the investment in advanced planning technologies. As shown in figure 4.3, their investments in MRP, MRPII, ERP and ABC analysis are generally moderate. The manufacturing industries invest more on MRP and MRPII and least on ABC analysis.

4.4 ADVANCED MATERIAL HANDLING

Material handling technologies are Advanced Manufacturing Technologies (AMTs) used by manufacturing industries to facilitate the handling of material in manufacturing operations. Automated storage and retrieval systems use computer to direct automatic loaders to pick and place items for production processes or storage by automatic high lift trucks. Industries employ transport automation by using automated guided vehicles (AGVs) to move materials from one place to another.

AMH1: AMHS, AMH2: AGV, AMH3: AS/RH, AMH4: RP

The study shows that industries surveyed have little investment in material handling technologies. Generally, industries invested more in automated material handling system as compared to AGV, AS/RS, RP. It is observed from the figure that the investment on material handling system is different in different sector.

4.5 ADOPTION OF ADVANCED MANUFACTURING TECHNOLOGY

The adoption of advanced manufacturing technologies (AMT) allows industries to diverge from the traditional manufacturing strategies of striving for low-cost leadership and differentiation. Effective adoption of AMT enables industries to achieve economies of scale and scope simultaneously. That is, implementing AMT reduces the cost of future product innovation, allowing the industries to increase its speed of response to market and competitive changes. Therefore, investment in AMT represents a strategic option, the value of which increases in an environment of competitive and market uncertainties. Respondents were asked to rate the industry efficiency in term of productivity, plant efficiency, product management and market performance on a 1 to 5 point level scale, where 1 indicate lower efficient, 3 indicate average and 5 indicate well above efficient.

It is observed from the figure 4.5 that owing to adoption of advanced manufacturing technology productivity, efficiency, product management, market performance are increased. As shown in figure that in different sector due to adoption of advanced manufacturing technology different factors are increased. It is concluded that efficiency enhancement of manufacturing industries through advanced manufacturing technologies.

In terms of AMTs investment, generally surveyed industries invested moderate in AMTs. The most invested technologies are in design and engineering technology, followed by machines and planning technologies. Industries invested least in material handling technologies. There is no apparent indication as to which sectors have more AMTs than other, different sectors invested different level of AMTs, automobile sector invested more in material handling as compared to other sectors.

The manufacturing industries invested more in advanced managements systems as compared to advanced improvement processes. The performance of industries is increased due to adopted or implemented by advanced manufacturing technologies. Automobile industries invested more in advanced manufacturing technologies, owing to that the productivity and performances of automobile industries are increased. It can be conclude that due the adoption of advanced manufacturing technology performance or efficiency of manufacturing industries are increased.

V. HYPOTHESES TESTING

The value cronbach’s $\alpha$ is 0.9629, it is suggested that contingency of advanced design and engineering technology is good in manufacturing industries.

Null hypothesis ($H_0$): Advanced design and engineering technology is same for different sector.
Alternative hypothesis: (H_b) Advanced design and engineering technology is different for different sector.

According to test, null hypothesis is rejected; it means advanced design and engineering technology different for different sector.

Cronbach’s α is 0.8861; which means that all technologies are correlated

Null hypothesis (H_a): All advanced machining technology are same for all sectors.

Alternative hypothesis (H_b): All advanced machining technology are different for all sectors.

According to test null hypothesis is rejected, it means all advanced machining technologies are different for different sectors.

All the advanced planning technologies are positively correlated and the value of cronbach’s α is 0.9259, which indicates strongly reliable variables.

Null hypothesis (H_a): All sectors invest same in advanced planning technologies.

Alternative hypothesis (H_b): All sectors invest different in advanced planning technologies.

According to test null hypothesis is rejected, which concluded that the level of investment are different for different sectors.

Null hypothesis (H_a): Level of investment is same by different sector.

Alternative hypothesis (H_b): Level of investment is different by different sector.

According to test null hypothesis is rejected which indicate that the level of investment by different sectors are different in advanced material handling systems.

Null hypothesis (H_a): Efficiency enhancement through advanced manufacturing technologies.

Alternative hypothesis (H_b): Efficiency decrease through advanced manufacturing technology.

According to test null hypothesis is accepted, which indicate that efficiency enhancement of manufacturing industries through advanced manufacturing technologies.

VI. CONCLUSION

1. CAD is the most popular technology and GT is the least favorable technology for manufacturing industries. Process industries invest relatively less in advanced design and engineering technologies than automobile and electronics industries. Although most industries choose to have investments in advanced design and engineering technologies. All sectors share the almost same point that investment in CAD takes the most important position followed by the CAM and CAE, while GT is worth the least to invest.

2. The most important investments are made in CNC technology. All the manufacturing industries are invested less in robotics technology. In automobile industries the most investment are made in CNC technology followed by NC/DNC and flexible manufacturing system. In electronics industries & machinery industries the most investment in CNC followed by flexible manufacturing system and NC/DNC. In process industries investment in flexible manufacturing and CNC are almost same followed by NC/DNC. Except the automobile industries all other industries invest less on robotics technology.

3. The automobile and electronics industries have moderate investment in material handling technologies. It is concluded that material handling technologies (AMHS, AS/RS, AGV ) gets the least attention in manufacturing industries.

REFERENCES

Twin Cylinder Optional Engine Mechanism 
(Advanced Technology)

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Abstract-In general, lower capacity engine gives us more mileage and a higher capacity engine gives a comparatively less mileage. Consequently, lower volume engines supply lesser power as compared to their higher volume counterparts. By designing twin cylinder optional engine mechanism , we would be able to choose between running one cylinder when at lesser loads thereby getting more mileage and at higher load conditions we can actuate the other dormant cylinder for additional power. We intend to achieve this in three phases:

1. A pedal operated model to check the feasibility at lower rpm's.
2. A running test at idling rpm of 1000 rpm using an electric motor.
3. Complete overhaul of two 50 cc engines and re-assembly with installing the mechanism (Major Project).

Index Terms—Bearing seat, crankshaft, camshaft, twin cylinder,

1 INTRODUCTION

Stage 1 and 2: The arrangement consists of the active engine mounted on a fixed pillar which is supported in position by crank shaft. The crank shaft is kept in alignment by supporting the crank shaft bearing on the fabricated bearing seat or spider. The fixed pillar is of I cross-section. This was chosen due to equal load distribution on all four sides of the bearing seat.

A slider is used to bring into contact the two crank shafts. The optional cylinder is to be moved in to position by sliding it close to the active cylinder. The slider should have only one degree of freedom so as to prevent any form of vibrations which can lead to miss alignment upon operation. We use dog clutch to engage two engines into working together because of

- Efficiency advantages
- Reduced installation space
- Low drag torques
- Low actuation forces
- Low production costs

To provide the necessary axial force so as to keep the clutch engage we have used coil springs which are placed diametrically opposite on the clutch.

So as to further eliminate any vibrations, we have used rubber seals to damp out the excessive vibrations on running of the two engines when engaged.

The slider bearing should have no tolerance and should slide smoothly over the slider shaft. And, upon engagement should not vibrate or deviate from its position. So as to ensure this the bearing should be hydrostatically lubricated and should be sealed. The dog clutch should have provision for fool-proofing. This is achieved by making three teeth square and one triangular. This is done so as to ensure engaging of the engines in the desired position i.e. both the pistons upon engagement should have the exact same positions in their respective cylinders.

Stage 3: In this stage, we mount the two cylinders in a single crank case so as to eliminate any leakage of lubrication in the crank case. After above mentioned calculations the appropriate crank diameter determined was 70 mm. This crank is a hollow cylinder in shape which has key ways on the inner side and houses in it a spring which provides an axial force of 20 N. This spring provides axial force for the male dog clutch. The male dog clutch has keys on it which limits its rotational movement and allows only linear motion. The dog clutch is made of EN8 steel.

This material was selected because of:

1. It is a mild strength steel.
2. Has high tensile strength.
3. Cost considerations.
4. Availability.
Both the cylinders are fixed in their respective positions. The hand lever controls the engaging of the dog clutch. Bearing 6214 manufactured by NBC is used since the inner race of the bearing is equal to 70 mm in mechanism 1 and bearing 6207 is used in mechanism 2 since the bearing has inner race of 35 mm. In mechanism 1, the weight of the crank was very heavy and that affected the volumetric efficiency. This was, however, rectified in mechanism 2 in which the crank size was reduced to compensate for the increased weight.

**MECHANISM 1**

Final assembly using M.S. slider:

**MECHANISM 2**

Tentative assembly of mechanism 2:

Fabricated Slider using M.S. bearing, also shown in the picture is the male dog clutch mounted on the crank shaft:

**CAD generated model for mechanism 2:**
CALCULATIONS

Design Procedure:

1. Determine the magnitudes of the various loads acting on the crank shaft.

2. Determine the distances between the supports. The distances will depend upon the lengths of the bearing. The lengths and the diameters of the bearing are determined on the basis of maximum permissible bearing pressures, \( l/d \) ratios and the acting loads.

3. For the sake of simplicity and safety, the shaft is considered to be supported at the centers of the bearings.

4. The thickness of the crank webs is assumed, about 0.5 \( d \) to 0.6 \( d \), where \( d \) is the shaft diameter, or from 0.22 \( D \) to 0.32 \( D \), where \( D \) is the cylinder bore.

5. Now calculate the distances between supports.

6. Assume allowable bending and shearing stresses.

7. Compute all the necessary dimensions of the crank shaft.

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