PRODUCTIVITY IMPROVEMENT OF A FORGING INDUSTRY USING TIME STUDY TECHNIQUE –A CASE STUDY

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ABSTRACT

An attempt is made to improve the productivity of forging process of the cranes hooks of an industry, located in the northern part of the India. This paper deals with the application of time and motion study in the industry manufacturing the crane hooks of a forging industry. Increased productivity makes it possible to pay good wages to employees, provide satisfactory dividends to stockholders and to sell products and services at low prices. Many industries compute their labor productivity index annually and keep a continuous record, making comparisons with other companies in their industry and with the national index. It is found that percentage improvement in productivity of crane hooks may be increased by 107 % after proper implementation of motion and time study.

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1. Introduction

The objective of implementing work and time study are to find the optimum and most efficient way of using the available resources which include material, machinery, men and money. A work measurement technique consisting of careful time measurement of the task with a time measuring instrument, adjusted for any observed variance from normal effort or pace and to allow adequate time for such items as foreign elements, unavoidable or machine delays, rest to overcome fatigue, and personal needs. A time and motion study (or time-motion study) is a business efficiency technique combining the Time Study work of F. W. Taylor with the Motion Study work of Frank and Lillian Gilbreth. It is a major part of scientific management (Taylorism). After its first introduction, time study developed in the direction of establishing standard times, while motion study evolved into a technique for improving work methods. Motion and time study principles are applied in the forging industry producing flanges, agricultural forming machinery, crank hooks, etc.

The work done in the area of motion and time study is discussed in the next section.

2. Literature Review

Some useful work in the area of work study is summarized in this section.

Choi et al. (1999) analyzed that high labour costs and the inconsistency of manual assembly have led to the wider acceptance of the robotic assembly in products manufacturing. Planning robot assembly tasks requires a method of estimating robotic cycle time. They identify some of the relationship between robot assembly time and manual assembly time, in order to develop a method of robot assembly time estimation based on manually assembly times. Grunberg (2004) stated that many methodologies and techniques for improving operational performance have been developed over the years – which provide structured ways of improving company performance, but they do not explicitly tell us where to start. He presented a definition of performance, productivity and profitability and two main views of the relationships between the terms – a hierarchical view and a subset view. Each has its merits. He offered brief descriptions of some improvement techniques to show where the ideas for the suggested improvement method are taken from, i.e. a part of the analysis and synthesis process. He finally, proposed a methodology for improvement work – this is to be evaluated in later research.

Ravi et al (2005) presented an interpretive structural modelling (ISM) based approach; employed to model the reverse logistics variables typically found in computer hardware supply chains. These variables have been categorized under “enablers” and “results”. The enablers are the variables that help boost the reverse logistics variables, while results variables are the outcome of good reverse logistics practices. The finding of this modelling is that environmental concern is the primary cause of the initiation of reverse logistics practices in computer hardware supply chains. For better results, top management should focus on improving the high driving power enabler variables such as regulations, environmental concerns, top management commitment, recapturing value from used products, resource reduction, etc.

Watkins (2007) used an approach informed by Lefebvre's theory of space, and presented a Lefebvrian analysis of organisational performance. He identified a number of problematic issues within current considerations of organisational performance. This paper makes transparent the domination of the abstract representations of performance, while facilitating an engagement with the aspects of performance this domination neglects. It suggests that through neglecting the everyday lived aspects of performance, in their obsession with abstract "representations of performance", managers make decisions without a sufficiently clear concept of the effect of those decisions on the organization. In light of this suggestion, a number of potential areas where Lefebvre's theory may be beneficial in the study and management of organizations are identified. Stefansson and Lumsden (2009) proposed the conceptual model of the Smart Transportation Management (STM) system and analyze how the included factors change the performance of distribution activities and what management issues are at stake. The main finding of their study is a model that includes three major components of smart transportation management, namely, smart goods, smart vehicles and smart infrastructure. These components embrace some factors that have effects on supply chain performance; however, to different extents. Chu et al. (2011) investigated the performance effects of an incentive plan that links buyers' compensation to financial measures, namely sales and gross margin, in the retail industry. It seeks to examine the issue using field data obtained from the 3C (computers, communications, and consumer electronics) company, the largest electronics chain store business in Taiwan. In addition to t-tests, the authors use a multiple regression model to examine the impact of the buyer incentive plan on purchasing performance. It was found that the gross margin return on inventory investment (GMROI), the most critical purchasing performance measure in retailing, deteriorated after implementing the incentive plan. Further analysis showed that although sales and gross margins increased as a result of the plan, the benefits were completely offset by a significant decrease in inventory turnover.

Quintana and Leung (2012) performed the study to illustrate a practical approach for industrial work process design in an integrative manner, captured essential concerns from different parties associated with manufacturing. The aim of their study was to incorporate utility expectation from the perspectives of operational managers, floor workers, and financial planners into the decision making process. Their results suggest that the proposed BBN framework is effective in modelling and solving the work design problem. Their findings may be useful in the adoption and capacity of BBN in the fields of ergonomics, worker health management, and performance improvement. Ahmed et al. (2013) developed a model for any kind of organization where performance evaluation is significantly important for staff motivation, attitude and behavior development, communicating and aligning individual and organizational aims, and fostering positive relationships between management and staff. Fuzzy control is used to determine the overall performance index by combining results of the performance in selected criteria and provided it in numerical values which will undoubtedly ensure convenience of the concerned human resource personnel during performance rating calculation. It is found that managers encounter many decisions that require the simultaneous use of different types of data

in their decision-making process. A critical decision area for managers is the performance evaluation of personnel, whether individually or as a member of a team. Performance evaluation is critically essential for the effective management of the human resource of an organization and evaluation of staff that help develop individuals, improve organizational performance, and feed into business planning.

Sharma and Dalip (2014) measured the performance of the Indian banking sector in terms of efficiency and productivity levels and their determinants during the post-reform period. They used pooled data for duration of 15 years (i.e. 1997/1998-2010/2011) from 59 selected banks for estimating the Hicks-Moorsteen (HM) total factor productivity (TFP) index. They found that poor technical efficiency has experienced with scale efficiency change exerting dominant factors; whereas relatively better productivity growth has been experienced by the banks with major contributions from technical change components. The study found relatively underestimated efficiency and productivity levels by traditional data envelopment analysis-based Malmquist index. Additionally, the study brings into account the results for external and environmental determining factors contributing to the TFP growth.

3. Introduction of the Industry

It is a group of companies is a global provider of forged, cast, machined, sheet metal, Fabrication products for automobile, agriculture and construction industry has excelled itself in the field of manufacturing and exporting since 1992. It is also accredited by ISO 9001:2000 certification and follows the latest international standards and continuously upgrade R&D activities and Infrastructure to comply with the latest standards.

They have a state to art technology; three production plants, 15000 sq. yards covered area, 800 strong workforce and are well equipped with latest production machinery, Modern Testing facilities (UTM, Chem. Lab) and backed by well strengthened Tool room (VMCs) and Development section with CAD/CAM stations.

Annual turnover of the company of the plant is about 250 crores and it is located in the northern part of the India.

The main components manufactured by this firm are:

(i) Forming products (ii) Walk boards (iii) Flanges (iv) Couplers fitting (v) Post shore & accessories (vi) Spigot castings (vi) Truck and trailer parts (vii) Clamp & collars etc.

3.1 Customers of the company

1. Mahindra & Mahindra 2. New Holland 3. Bharat gear group 4. Gajra group etc.

Export to the following countries:

(i) Germany (ii) UK (iii) China (iv) Japan

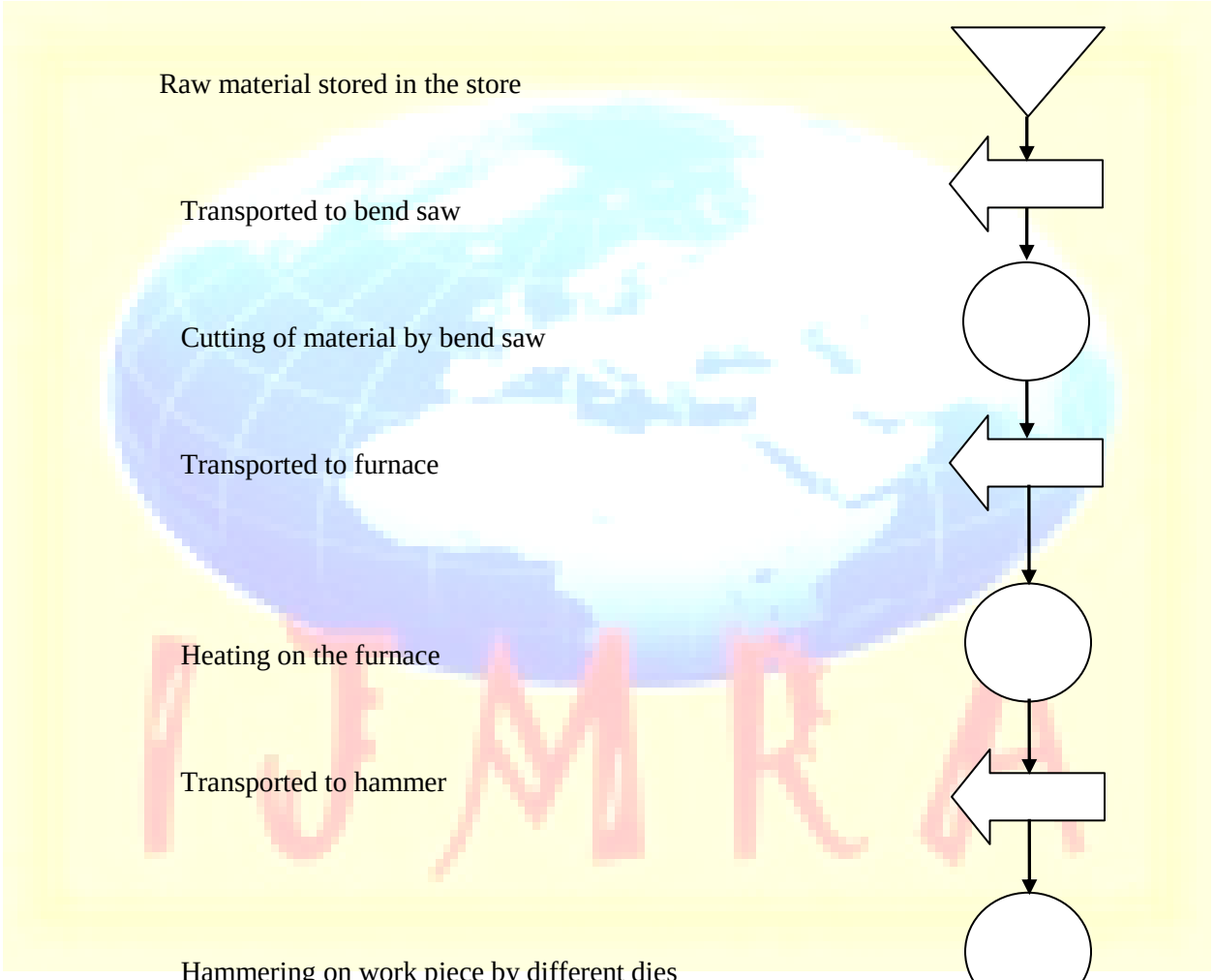
3.2 Manufacturing processes

Various processes in auto forging in this industry are:

1. Bend saw operation
2. Billet heater operation
3. Hammering operation

4. Mechanical Press operation
5. Heat treatment
6. Shot blasting furnace
7. Visual inspection
8. Mega flux inspection for detection
9. Dispatch

The complete process of manufacturing of crane hooks is presented in the form of flow process chart as shown in Figure 1.



Cooling of work piece

Transportation of work piece to heat treatment

Starting of heat treatment on work piece

Normalizing of work piece

Transportation of work piece to shot blast furnace

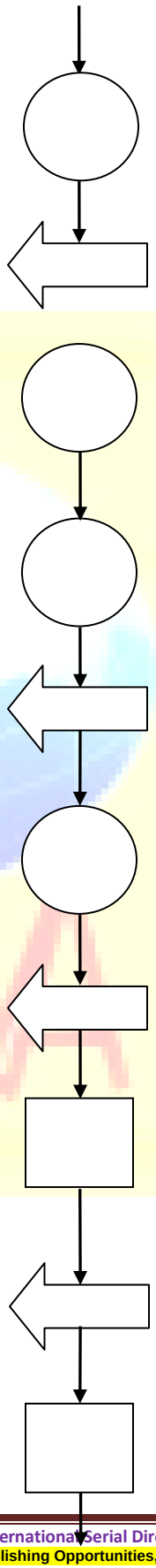
Shot blast furnace on work piece

Transportation of work piece for visual inspection

Inspection of work piece manually

Transportation of work piece to magna flux inspection

Magna flux inspection on work piece



Transported OK product to store

Stored OK product in store

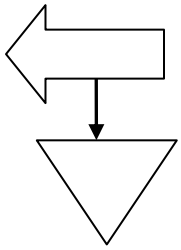


Fig.1 Process flow chart of Swati industries plant

4. Application of time study

The existing layout of manufacturing of crane hooks in the industry before time study analysis is shown in Fig. 2.

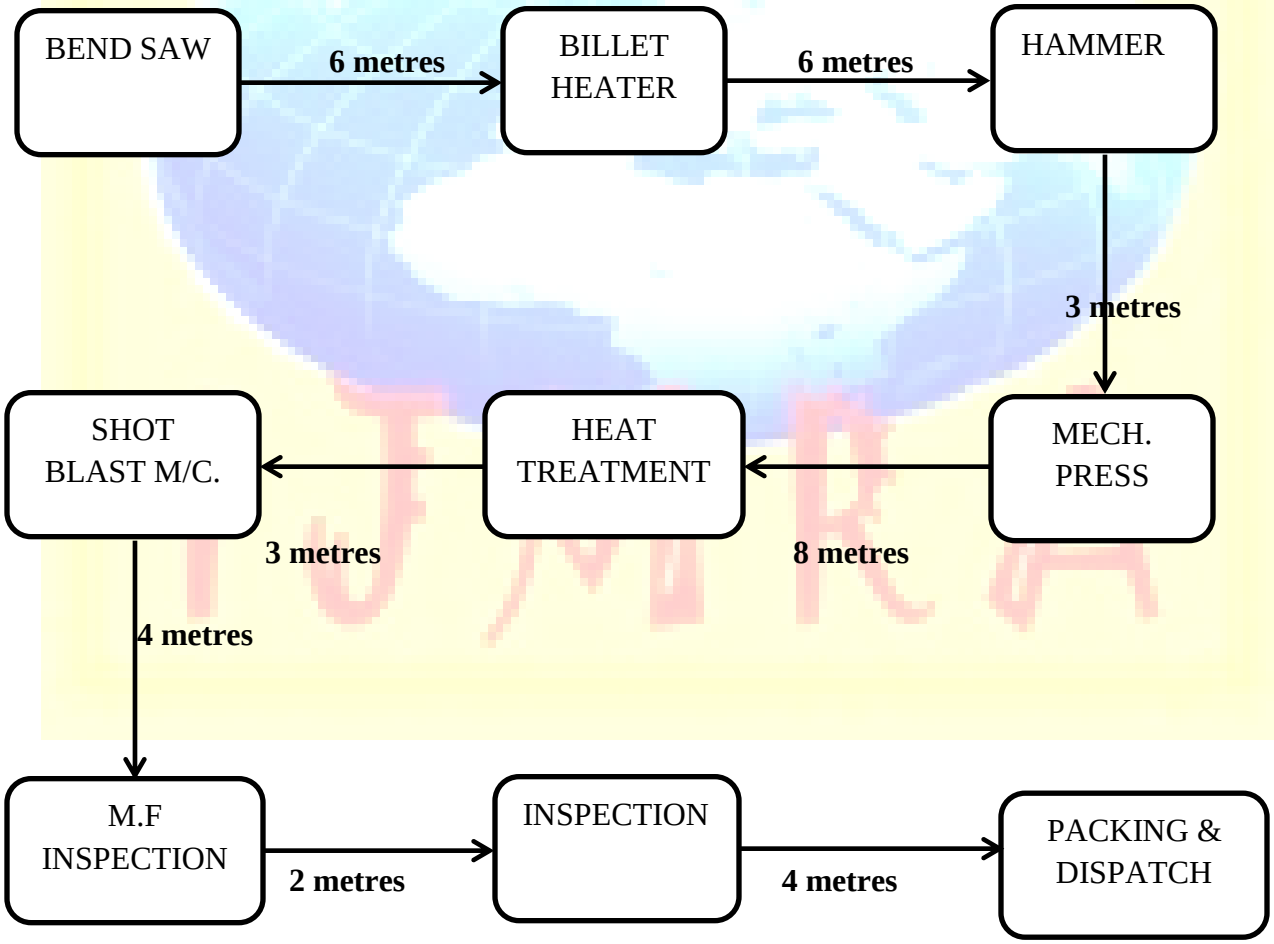


Fig. 2 Existing layout of the industry

The existing layout needs some changes to reduce the cycle time and proposed/modified layout of the industry is shown in Figure 3.

Proposed layout of Swati Industries

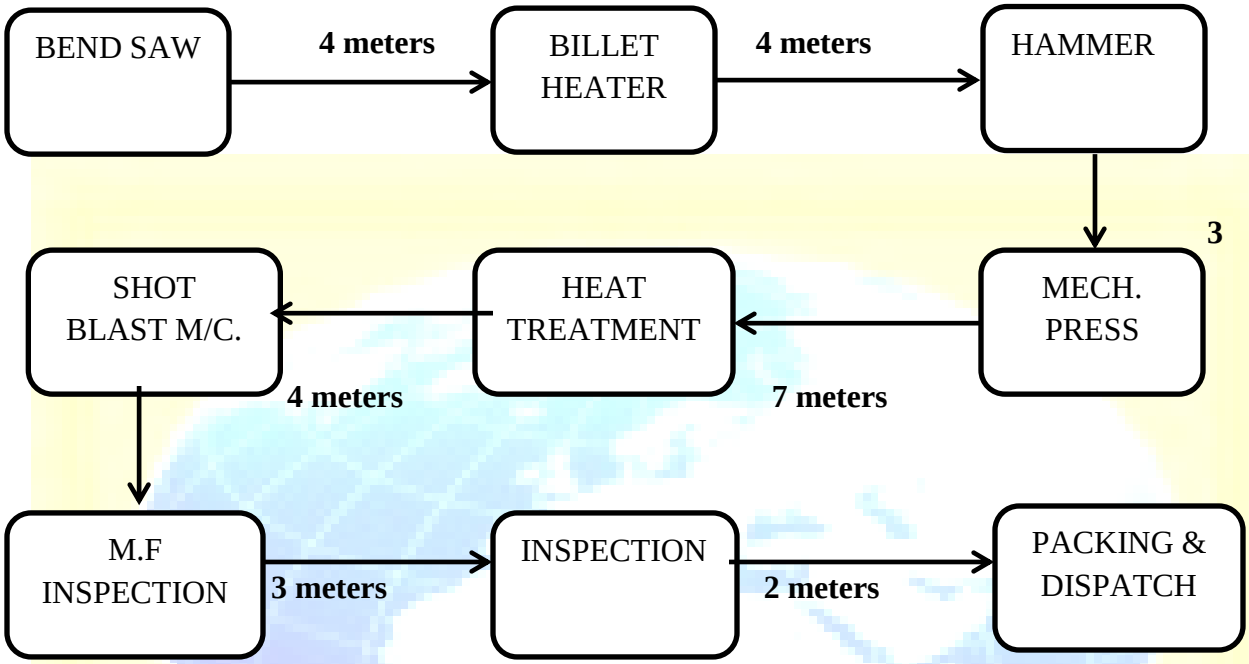


Fig. 3 Proposed layout of the industry

4.1 Travel chart for material movement

It is a tabular record of quantitative data about movement of workers/materials/equipment between any number of places over a given period of time. It is always in the form of a SQUIRE, having within it the squires. Each small squire represents a station. Along the top, squires from left to right represent the stations from where movement or travel occurs. Along those; DOWN THE LEFT HAND, the squires represent the stations **TO** which the movement is made. The numeric values between the correlation matrix represent the distance travelled. Figure 4 shows the travel chart for crane hook manufacturing area of the industry.

TO

FROM

	A	B	C	D	E	F	G	H	I
A		4	-	-	-	-	-	-	-
B	-		4	-	-	-	-	-	-
C	-	-		3	-	-	-	-	-
D	-	-	-		7	-	-	-	-
E	-	-	-	-		4	-	-	-
F	-	-	-	-	-		3	-	-
G	-	-	-	-	-	-		2	-
H	-	-	-	-	-	-	-		2
I	-	-	-	-	-	-	-	-	
Total	-	4	3	7	4	3	2	2	4 = **29**

Figure 4 Travel chart of manufacturing area of crane hooks

It is observed from Figurs 2 and 3 that the distance between bend saw and billet heater may be reduced up to 2 meters as space between two machines is used for placing material. And additional worker is transferring material so if space is reduced then the manpower used for transportation may also be eliminated. Also the distance from billet heater to hammer may also be reduced by 2 meters in same way as mentioned above. The distance i.e. 4 meter from inspection to dispatch is also too much which is wastage of time. If packing and dispatch distance is reduced then it will save lot of time. This will help in improving productivity of company and also be proved as cast saving for company.

4.2 Time study in manufacturing of crane hooks

In this industry, there are so many products which were manufactured as mentioned in company profile. They have different operating standards, different production target and different skilled workers for various operations. But time study was performed on the Crane hooks product. After performing time study, the various allowances are taken into account and processes are analysed as discussed below.

1) Variable allowance

a) Awkward bending = 2% of normal time

b) Use of force/muscular energy = 4% of normal time

2) Standing allowance = 2% of normal time

3) Contingency allowance = 2% of normal time

4) Constant allowance

a) Personal needs allowances = 5% of normal time

b) Basic fatigue allowance = 4% of normal time

Total allowances = (2+4+2+2+5+4) % of normal time

= 19% of normal time

In the process one bend saw one hammer and one mechanical press is used.

Target set by company in 8 hours /shift =95 pieces

Average normal time for one piece = 4 min

Number of machine used to produced CRANE HOOKS = 2

Standard time=NT + % allowance of NT

ST=4+4*19/100= 4.76 min

Number of pieces produced in 8 hours = 480/4.76=101

Percentage improvement in productivity=101*101/95=107%

No of pieces produced in 1 machine in one shift (8hours) = 101 pieces

No of pieces produced in 1 machine in two shift (16 hours) = 202 pieces

No of pieces produced in 1 machine in three shift (24 hours) = 303 pieces

No of pieces produced in 2 machine in 24 hours shift is = 606 pieces

While target set by company is 570 pieces per/24 hours (three shifts)

So, 36 more pieces of steering knuckle is produced in 24 hours.

There are some suggestions to achieve the improvement in the productivity as mentioned below:-

Training of workers

It is suggested that there should be proper training of workers after regular interval of time so that workers may be feel motivated and confident.

Motivation

Motivation of workers can be provided by choosing/promoting workers; who give more accuracy and efficiency using different incentive plans.

Proper supervision

It is also suggested that efficiency of each workers should be calculated by supervisor and proper record should be maintained.

4. Conclusions

As the distance is reduced, the time consumed by work piece to travel, automatically get reduced as work piece reaches another station in less time. So, the manufacturing may be started as soon as product reaches the working stations which in turn increase the productivity. The aim of doing work study is to find the optimum cycle time and most efficient way of using the available resources which include material, machinery, men and money.The limitation of the work is that the time and motion study could be applied in the other manufacturing area/sections of the industry.

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He is having the teaching and research experience of more than 18 years and published more than 90 research papers in international and national journals of repute and in the proceedings of the conferences. He is also reviewer of 6 international journals. He also guided 2 Ph.D. and more than 20 post graduate theses and guiding 4 research scholars at present. He has also chaired international and national conference in India and abroad. He also organized two short term courses and one All India Conference for the faculty of technical institutions and industries. He is also recipient of first D. N. Trikha research award for excellent research publications in international journal for the year 2009 in PEC University of Technology.
