ISSN 2249-5908
Issue 7, Vol. 1 (January 2017)

APPLICATION OF QUALITY FUNCTION DEPLOYMENT (QFD) AND LEAN TO MINIMISE INDUSTRIAL WASTES

Harshita Dubey[1], Ashish Kumar Paharia[2], Chandresh Joshi[3]

[1]PG scholar (Industrial Engg. & Management) Takshshila Institute of Engineering & Technology Jabalpur (M.P.)

[2]Assistant Professor, Takshshila Institute of Engineering & Technology Jabalpur (M.P.)

[3] Assistant Professor, PSIT College of Engineering Kanpur, (UP)

ABSTRACT

Lean manufacturing is a culture in which all employees continuously work for improving processes. Lean manufacturing describe seven crucial sectors in manufacturing system where the situation of waste (Functions which is not considered for any value in terms of customers) arises. In this research work it is tried to identify the most common types of manufacturing waste and tried them to reduce through the application of quality tool called Quality Function Deployment. Quality Function Deployment (QFD) is a method for converting the voice of the customer into engineering parameter and type for developing the goods or providing best services. This work employs QFD in manufacturing sector for utilizing their faculty in minimization of seven deadly wastes namely MUDA within manufacturing system. This work is proceeds by obtaining the high prioritized areas of waste are taken as inputs through the data collected in the derivation of House of Quality (HOQ). The well developed QFD-waste removal model proved to be a dominant tool for prioritizing, identifying and taking decision, by the most realistic methods for getting free of major wastes in a shop floor atmosphere ultimately the courses function of this process in improving lead times, fewer delays, quicker set ups, Business able to respond quicker. Less work in progress and inventory, so less capital tied up in the end reaches to profitable approach.

KEYWORDS: Quality Function Deployment (QFD); MUDA (Wastes); House of Quality (HOQ); Voice of Customer (VOC), Lean Manufacturing.

1. INTRODUCTION

Quality Function Deployment (QFD) is an exclusive and powerful quality tool for development of methodology that focuses on customer expectations in planning, design and manufacture products within industries. QFD is “an appropriate function that provides a technique of translating customer requirements into the relevant technical requirements for each stage of product design, product development and its production (i.e., product design, planning, marketing strategies, engineering,

production process, prototype evaluation production, development, sales etc)''.In today's scenario Quality improvement for product or service has become one of the critical competitive strategies in today's global market[18]. To make sure the development of quality and productivity of any organisation, and evaluate how the organization is meeting those needs, QFD is an appropriate tool. Any organization that correctly implements Quality Function Deployment is encouraged to focus on its customers and their requirements. For focusing in a system, required for translating the customer requirements and needs to improve through engineering knowledge, quality, productivity (product development time), new technology, and by reducing costs, QFD is the best quality tool. Quality function deployment is a team-based management tool for manufacturability, and statistical process control in which the customer expectations are used to push the product improvement process. The basic concept of QFD is the use of customer's requirements, specified for product specification and design, through improving engineering characteristics and subsequently into parts characteristics. This is achieved through sound production planning, and understanding production requirements to obtain a higher quality product in a shorter time. Quality Function Deployment (QFD) is to be considered as a necessary part of concurrent engineering. It is a procedure for capturing and translating the requirement of customers and represents it by a series of interconnecting matrices that establish the WHAT, the HOW's and the interrelationship of all parameters involved in the product improvement and development process. The requirement of customers is tabulated and voice of the customer (VOC) is prepared, then this VOC is converted into engineering characteristics of products or services. Basically QFD belongs to the categories of quality assurance tools. To understand the basics of QFD, first we have to approach towards the quality assurance Perspective [17].

1.1 HOUSE OF QUALITY OF QUALITY FUNCTION DEPLOYMENT

In Quality Function Deployment (QFD) systematic approach of quality involvement is taken, in this arrangement house of Quality (HOQ) is prepared. As Quality Function Deployment is a planning process for products and services that starts with the customer's requirement, CRs (voice of the customer) and organize a quality matrix known as House of quality. In this quality matrix 'Wi' denotes the relative weightage given by customer of the ith term of CR (CRi; i = 1,2,3 . . ,m), AIj is the absolute importance rating of the jth DR (DRj; j = 1,2,3 . . ,n), and Rij is the relationship coefficient between CRi and DRj. The relative effect of Cri on CV is quantified via Wi. AIj is computed using Wi and Rij (Dae-Kee Min et al. 2008). The absolute important of the system is computed with the relation as shown$(\mathrm{AIj})^n = \sum_{j=1}^{m} \mathrm{WiRij}, \mathrm{J} = 1,2,3 \ldots\ldots \mathrm{n}$.

1.2 INTRODUCTION TO LEAN MANUFACTURING

The efficient cost control of manufacturing by lean philosophy is basically based on unvalued work elimination and source of these unvalued works is identified as 3M's known to Muda (literally means waste in Japanese terminology), Mura (literally means inconsistency, unevenness and irregularity in Japanese terminology) and Muri (literally means unreasonableness, overloading and overburdening in Japanese terminology).

All these things wastes cause the highest amount of unvalued work. Hence this unvalued work is further categorized into seven types as **Transportation:** Muda in transportation is movement of material that is not directly associated with a value adding process, **Inventory:** Muda of unnecessary stocks due to buffer stock of raw materials, **Motion:** Muda of motion, is related to unnecessary transportation of work material which add no value to the products. **Wait:** Muda due to inactive time, usually due to waiting for machines to complete the sequence, or working material not delivered on time etc. **Over-processing:** Muda due to over- processing ahead of required due to unplanned activity, this is very chart when inventory support up long before it needed for next process. **Over-production:** Muda due to over- producing is the manufacturing of product in a greater quantity. **Defect:** Muda due to producing defect due to substandard planning, scheduling and routing within the organization.

2. LITERATURE REVIEW

Dae-Kee Min et al. 2008 :-In this work author elucidate a comprehensive QFD planning model for selecting design requirements (DRs) with longitudinal effect taken into consideration. Quality function deployment (QFD) is a method for translating the customer requirements; CRs (called ‘‘voice of the customer’’) into the design requirements; DRs (called language of the engineers). DRs are further translated into process plans, parts characteristics, and detailed production requirements. Author explains QFD with essential models required for preparation of house of quality. Different models are applied for different purposes such as C-Model 1 attempts to maximize the CV under budget constraints. This model intended to maximize the customer satisfaction by formative an optimal set of DRs under organizational resource constraints. Then another model of QFD is C-Model 2 which is essentially required to minimize the total cost of the process. C-Model 2 intended to achieve the specified target of CV with the minimization of total cost.

Lian-Yin Zhai et al. 2009 :- To design a product well, sophisticated customer requirement have resulted in the development of progress complex products with a shorter lead time, a design teams needs to know what it is they are designing, and what the end-users will expect from it. Quality Function Deployment is a systematic approach to design based on a secure attentiveness of customer desires, attached with the integration of corporate functional assemblage. It consists in translating customer desires in product development concerns the understanding and management for each stage of the product improvement of complex relationships between customers’ needs and technical requirements. Quality function deployment (QFD) is a tool that is referred to as the “voice of the customer,” or as the “house of quality” is utilized employed to manage design information and assist decision-making in human cantered product development. Quality function deployment has been described as a process to make certain that the customers’ wants and, requirement are attend to and translated into technical characteristics.

Rallabandi Srinivasu et al. 2011 :-In this literature author prescribed the statistical quality process for quality control technically known as statistical process control (SPC). Author signifies Statistical Quality Control (SQC) as a scientific method to analyze manufacturing data for the effective approaches of process monitoring and diagnosis through the statistical principals and process of quality control. The techniques for the quality control is

characterised on the basis of products, methods, machine, equipments based on this analysis, measures are taken to maintain the quality of the manufactured product both for the company and operators.

Yonatan Mengesha Awaj et al. 2013:-In this study of statistical process control (SPC) author defines production processing and quality control through examination of production process lines, control charts, direct and indirect observations. Author signifies SPC implementation as significant process of improvement in performance by reducing product variability and develops production efficiency by decreasing scarp and rework. The process of statistical process control is progressed through data collection and taking samples of process at different points and analysing the probability of passing requirement to the customers.

Yanbin Du et al. 2013:-In this presentation author explain the utilization QFD in the manufacturing sector. He explains that remanufacturing is not immediately the process of performance recovery or utility addition, at the same time as remanufactured product should be designed as the procedure of new product design. Redesign, as the foundation and basis of remanufacturing, is an innovative design procedure in which the functions and organizations of remanufactured products are designed. QFD definite as a method for developing a design quality intending at fulfilling the consumer requirement and then translating the consumer's demand into creating targets and major quality reassurance points to be used throughout the production stage. In addition, the procedure of conceptual remodel is analysed in feature, such as the process of function characteristic planning based on QFD, construction redesign, and so on. Finally, in enjoin to authenticate its probability and authority, the anticipated method is applied to machine tool remanufacturing and it is established that redesigned products can obtain the similar performance with new designed products.

N.Toliušienė et al. 2013: In this present work author focuses on an internally purposeful drive to eliminate waste, a process in the main of cost reduction and labour elimination to increase profits and reduce costs, the essential terms which has to be recognise is the first and most important part of lean that is what is value (requirement) to the customer? The self-interested drive to diminish costs wrongly assumes value on the part of the customer and the organisation tends to become not lean but they remove the ability to be able to react to customer changes, to become accustomed when there are supplier and internal problems. Because of this organisation that "have done lean" quickly relapse to the way they were before the improvements, bringing back old inefficient processes to cover over other substances and rehiring the labour that they removed, lean being put on the dispose of quantity of management fads.

3. METHODOLOGY

This work, used 5 point scale, which are assigned to degree of satisfaction level of the respondent with regard to the requirement of the project.

1	2	3	4	5
Very least Important	Least Important	Important	Very Important	Most Important (On Priority)

3.1 Customer Requirements (WHATs) in manufacturing system:

This list is normally referred as the 'what' that customer requests or expects in a particular product. In this work the customer is supposed to the internal customer within the manufacturing units. The desires of customers must be clearly represent with minute details. To calculate the degree of importance for every WHAT, each decision-maker are requested to use the linguistic variables given in order to assess the degree of importance for each WHAT.

In this work the first stage in the execution of the Quality Function Deployment practice involves putting together a "House of Quality".

3.2 What table for evaluating the internal customer voice: This table functions on the basis of the data processed through the questionnaire and secondary data available and prepared the 'whats' table of house of quality in which the value of customer of the cause in five pointer scale is given and on the basis of these the lean parameters of waste is prepared and the table is formed. Lean system identifies the seven types of waste for which no value is aided for the product.

Table 3.1: Internal Customer functions for the waste analysis in lean manufacturing system.

Internal Customers' factors for wastes (What`s`)		
Waste Type	**Problems**	**Weight age**
Over Production Waste	Producing more then what is required	4
	Unbalanced line of manufacturing.	4
	Be short of proper Scheduling	3
	Be deficient in proper Production Planning	4
	Lack of proper Customers Specifications	5
Re-Processing Waste	Frequent Engineering Changes in products	4
	Working Standards are Out of Date	4
	Understanding the Process is not proper for work	3
	Lack of Improvement & Innovation in design	4
Waiting for the process	Improper coordination in Processes	5
	untrustworthy supply chain &Shortages of material	4

	Lack of Proper multi-skilling/flexibility workforce	4
	Ineffective production planning , scheduling and control	3
	Unscheduled Machine Downtime due to improper coordination	3
	Manpower Shortage for manufacturing	4
Transportation	Inappropriate Designed Process and plant Layout	3
	Flows of Material in plant is Complex	4
	Improper Route Planning and sequencing	5
	Work Place not in proper order and Disorganized	4
Unnecessary motion or Excess Motion	Inappropriate standards and operating procedure	4
	Housekeeping not up to the mark	3
	Inadequate Training of personnel	3
	Improper coordination between inter departments	4
Unnecessary Inventory	Inaccurate forecasting and ordering of raw materials	2
	Production schedule is not up to the mark.	3
	Push system of manufacturing instead of pull system.	2
	Large batches Processing	2
	Improper recording of inventory items	3
Scrap, Rework and Defects (Non-Right First Time)	Incapable and Out of control processes leads to defects	4
	Lack of training & skill on the job support to the rework or defect	2
	Engineering and Technical design is Inaccurate	4
	Machine inaccuracy or faulty tools	3

3.3 List of Technical Descriptions (HOWs)

The essential function or goal of House of Quality is to design or change the design of a process in a way that get together or exceeds the customer satisfaction. Implementation of the customer requirements are treated into technical language, this provision similar to refining marketing specification into system-level engineering specification.

Table 3.2 Matrix of Technical Requirements (How`s`) of QFD

S.No	Technical Requirement (How`s`)
1	Adequate production planning for the raw material ordering.
2	Production according to customer agenda or customer requirement.
3	Proper maintenance policy and procedures should be applied.
4	Continuous improvement of the working standards.
5	Inventory Policy or inventory control through just in time should be applied
6	Proper training of personnel of specific tasks or jobs.
7	Method time study and motion economy principle should be applied.
8	Proper coordination between different departments should be maintained.
9	Logistics system of the organisation should be improved for proper control.
10	Productive Management system (PMS) should be developed.
11	Balancing of manufacturing lines or process for continuous and smooth function.
12	Proper Human Resources management through motivation and innovative approach.
13	Maintenance of Machines, machine tools and Equipments.
14	Fool proof and organised workplace for effective working (Pokayoke system).
15	Valuable supervision and control over the processes.
16	Maintenance of proper records of the material flow within the department
17	Dispose-off superseded material to save space and to avoid confusion.
18	Job Simplification through proper design and technology.

19	Communication System between various departments.
20	Maintain Relation with Supplier.

3.4 Mathematical model for result Analysis: In quality function deployment function the relationship matrix is where the personnel determines the relationship between customer needs and the company's ability to meet those needs or requirements. An house of quality (HOQ) significantly contains information on Customer requirements (CRs), relative importance of the CRs (Liang-Hsuan Chen et al. 2003), Design Requirements (DRs) essential for satisfying the CRs, relationships between CRs and DRs, and correlations between DRs (Dae-Kee Min et al, 2008) . In conventional methods of QFD applications, a cell (i, j) in the relationship matrix of HOQ (i-th row and j-th column of HOQ) is assigned values as per priority of 1, 3, 9 to represent a weak, medium, or strong relationship between i-th CR (called CR_i) and j-th DR (called DR_j), respectively. The absolute and relative importance's of DRs are calculated and computed by using the relative importance of CRs and the relationship ratings (i.e., 1-3-9) (Dae-Kee Min et al,.2008)

For each DR, the absolute importance rating is computed as:

$$AI_j = \sum_{i=1}^{m} W_i \; R_{ij}, \qquad (1)$$

where AI_j = absolute (technical) importance rating of DR_j, j = 1, ..., n,

W_i = degree of importance (i.e., importance weight.) of CR_i, i.e. i = 1, ..., m,

R_{ij} = relationship rating representing the strength of the relationship between CR_i and DR_j.

The absolute importance rating can then be transformed into the relative importance rating, RI_j, as

$$RI_j = \frac{AI_j}{\sum_{k=1}^{n} AI_k}.$$

In QFD system the larger the RI_j is, the more important DR_j is. Thus, devoid of consideration of any other constraints (e.g., cost and time), DRs should be included into the product of interest in enjoin of their relative significance rating to attain more customer satisfaction.

3.5 House of Quality Matrix of QFD: aims to achieve the given target of Customer Value (denoted as V) with the minimal total cost. This model is expressed through the matrix as

ISSN 2249-5908
Issue 7, Vol. 1 (January 2017)

Table 3.3: Matrix of quality function deployment in preparation of house of quality

		DR_1	----------	DR_j	----------	DR_n
CR_1	w_1					
....	....					
CR_i	w_i					
....	....			R_{ij}		
CR_m	w_m					
		AI_1	.....	AI_j		
		.....	AI_n			

Where: CR – Customers requirements in specific manner

W -- Weight given by customer in five point scale.

DR – Design Requirement of the system.

AI -- Absolute weight comes out by the calculation of the matrix.

4. RESULTS AND OUTCOME

This work of analysing through lean manufacturing system the different types of wastes and tried to eliminate or reduce these wastes through the application of quality function deployment. The following outcome of this endeavour is revealed in the following constraints as shown in the following tables.

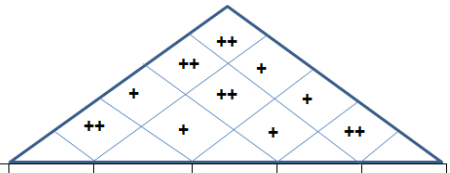
ISSN 2249-5908
Issue 7, Vol. 1 (January 2017)

4.1 CONCLUSION ON OVER PRODUCTION WASTES:

Table.4.1: Table showing the house of quality for over production waste, and reducing it at priority.

Strong positive = ++
Strong Negative= --
Week positive = +
Week negative = -

SR- Strong Relation = 9 point
MR-Medium Relation =3 point
WR- Week Relation= 1 point



	Hows (ways to reduce these wastes) / Whats(in terms of Over production wastes in manufacturing system)	Value scale of severity	Production according to customer agenda or customer requirement.	Continuous improvement of the working standards.	Inventory Policy or inventory control through just in time should be applied	Proper coordination between different departments should be maintained.	Proper training of personnel of specific tasks or jobs.
1	Producing more then what is required	4	9	3	9	9	1
2	Unbalanced line of manufacturing.	4	1	3	1	3	9
3	Be short of proper Scheduling	3	9	3	3	1	3
4	Be deficient in proper Production Planning	4	9	3	9	3	3
5	Lack of proper Customers Specifications	5	9	3	1	1	1
	Absolute Weight		148	60	90	68	66
	Relative Weight		0.343	0.139	0.208	0.157	0.153

DISCUSSION AND OUTCOME ON OVER PRODUCTION WASTES:

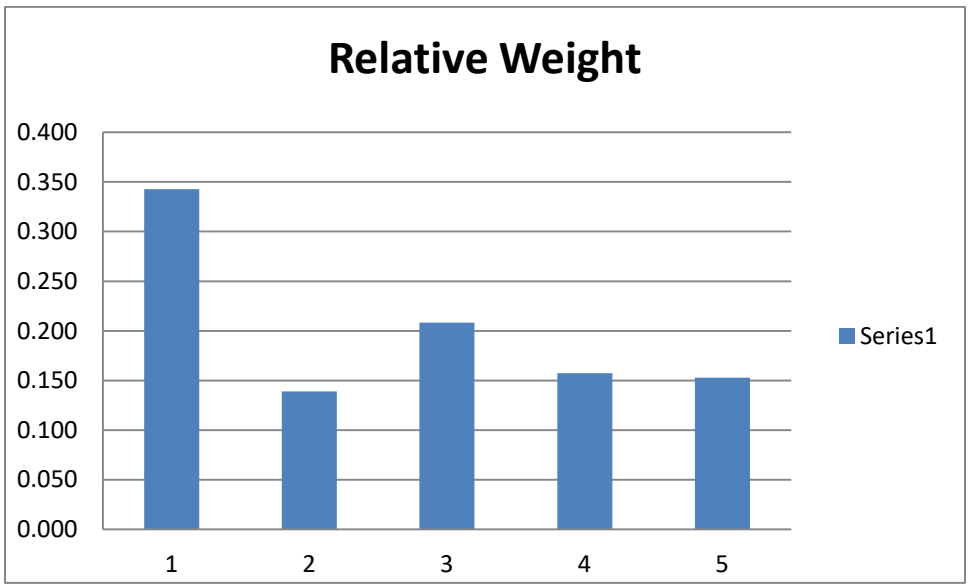


Figure. 4.1: Graph showing the priority of effective measures to be taken for the reduction of the wastes.

Graph interpretation: Following interpretation is taken through the graph to reducing the overproduction waste on the basis of priority given by the house of quality.

1. Through producing according to the customer requirement as the priority to reduce the over production of wastes.
2. Next to it is to have an effective inventory policy such as Just in time approach.
3. Proper coordination between various departments is also essential.

ISSN 2249-5908
Issue 7, Vol. 1 (January 2017)

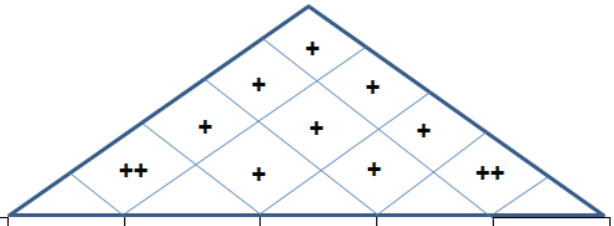
4. Proper training is also required to reduce the wastes.
5. Continuous improvement is required.

4.2 CONCLUSION ON RE-PROCESSING WASTES:

Table.4.2: Table showing the house of quality for over production waste reducing priority.

Strong positive = ++
Strong Negative= --
Week positive = +
Week negative = -

SR- Strong Relation = 9 point
MR-Medium Relation =3 point
WR- Week Relation= 1 point



	Hows (ways to reduce these wastes) / Whats(in terms of Re-Processing wastes in manufacturing system)	Value scale of severity	Proper maintenance policy and procedures should be applied.	Balancing of manufacturing lines or process for continuous and smooth function.	Maintenance of Machines, machine tools and Equipments.	Fool proof and organised workplace for effective working (Pokayoke system).	Adequate production planning for the raw material ordering.
1	Frequent Engineering Changes in products	4	1	3	3	9	9
2	Working Standards are Out of Date	4	1	1	1	9	9
3	Understanding the Process is not proper for work	3	3	3	3	9	3
4	Lack of Improvement & Innovation in design	4	1	3	9	3	9
Absolute Weight			21	37	61	111	117
Relative Weight			0.061	0.107	0.176	0.320	0.337

DISCUSSION AND OUTCOME ON RE-PROCESSING WASTES:

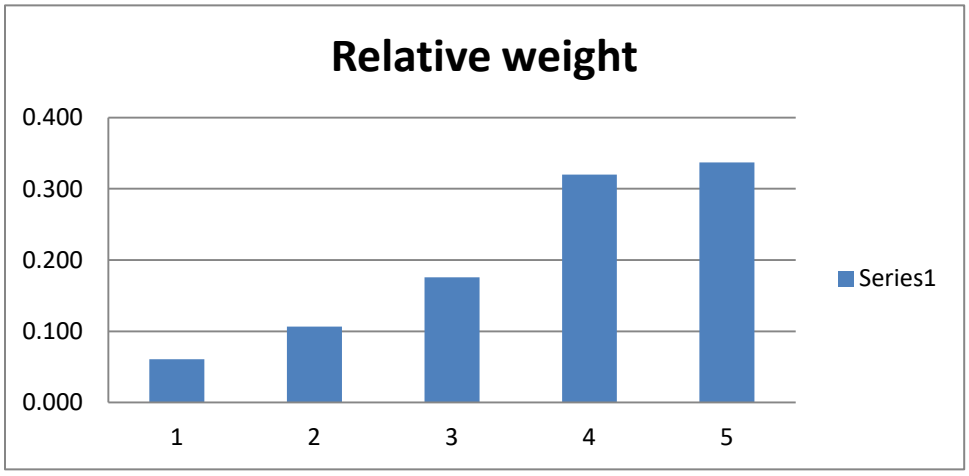


Figure 4.2: Graph showing the priority of effective measures to be taken for the reduction of Re-Processing wastes.

ISSN 2249-5908
Issue 7, Vol. 1 (January 2017)

Graph interpretation: Following interpretation is taken through the graph to reducing the Re- Producing waste on the basis of priority given by the house of quality.

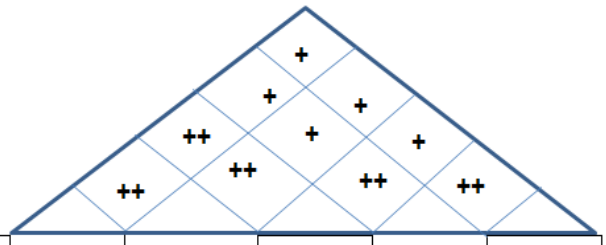
1. Through adequate production planning for the raw material ordering
2. Next to it is to have an effective fool proof and organised workplace for effective working such as pokayoke system.
3. Proper maintenance of machines, machine tools and equipments is also essential.
4. Balancing of manufacturing lines or process for continuous and smooth function.
5. Proper maintenance policy and procedures should be applied.

4.3. CONCLUSION ON WAITING FOR THE PROCESS WASTES:

Table.4.3: Table showing the house of quality for waiting for the process and its effects, to reduce it on priority.

Strong positive = ++
Strong Negative= --
Week positive = +
Week negative = -

SR- Strong Relation = 9 point
MR-Medium Relation =3 point



	Hows (ways to reduce these wastes) / Whats(in terms of Waiting for the process in manufacturing system)	Value scale of severity	Productive Management system (PMS) should be developed.	Communication System between various departments.	Valuable supervision and control over the processes.	Method time study and motion economy principle should be applied.	Continuous improvement of the working standards.
1	Improper coordination in Processes	5	3	9	9	9	3
2	Untrustworthy supply chain &Shortages of material	4	3	3	3	1	1
3	Lack of Proper multi-skilling/flexibility workforce	4	3	1	1	9	9
4	Ineffective production planning , scheduling and control	3	9	9	1	9	3
5	Unscheduled Machine Downtime due to improper coordination	3	1	9	1	1	
	Absolute Weight		69	115	67	115	64
	Relative Weight		0.160	0.266	0.155	0.266	0.148

ISSN 2249-5908
Issue 7, Vol. 1 (January 2017)

DISCUSSION AND OUTCOME ON WAITING AS WASTES:

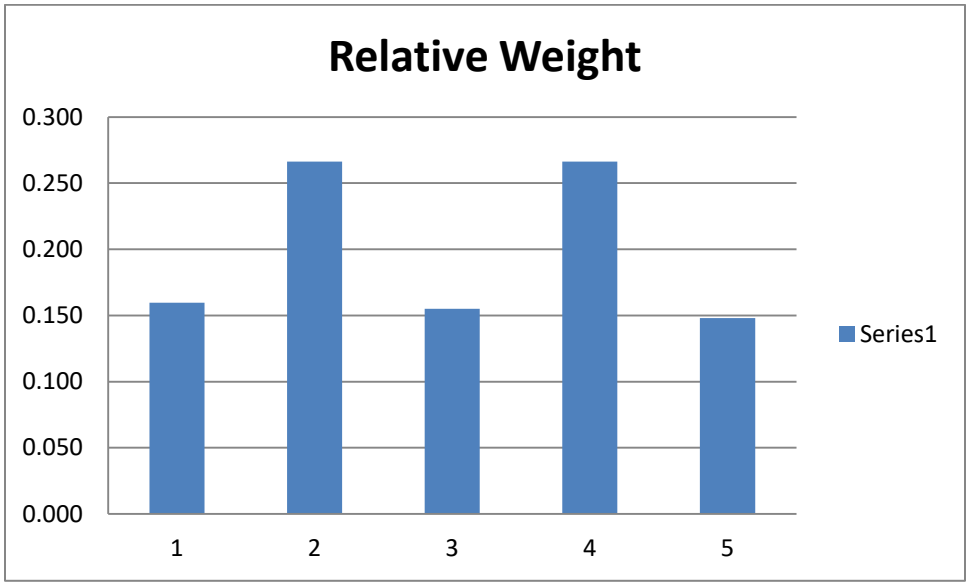


Figure 4.3: Graph showing the priority of effective measures to be taken for the waiting wastes.

Graph interpretation: Following interpretation is taken through the graph to reducing the waiting waste on the basis of priority given by the house of quality.

1. Through proper communication system between various departments should be applied.

2. Next to it is to have an effective method time study and motion economy principle for effective working on machines so that no inter department and maintenance effect the work.

3. Productive management system (PMS) should be developed so that the waiting can be reduced.

4. Valuable supervision on adequate work is essentially required to reduce waiting waste.

5. Continuous improvement of the working standards should be done on time to time.

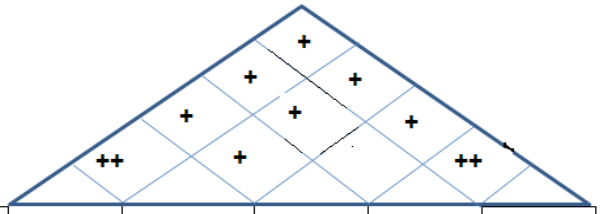
ISSN 2249-5908
Issue 7, Vol. 1 (January 2017)

4.4. CONCLUSION ON TRANSPORTATION WASTES:

Table.4.4: Table showing the house of quality for transportation and its effects, to reduce it on priority.

Strong positive = ++
Strong Negative= --
Week positive = +
Week negative = -

SR- Strong Relation = 9 point
MR-Medium Relation =3 point
WR- Week Relation= 1 point



	Hows (ways to reduce these wastes) / Whats(in terms of Transportation wastes in manufacturing system)	Value scale of severity	Continuous improvement of the working standards.	Adequate production planning for the material transpotation.	Job Simplification through proper design and technology.	Logistics system of the organisation should be improved for proper control.	Inventory Policy or inventory control through just in time should be applied
1	Inappropriate Designed Process and plant Layout	3	9	3	3	9	3
2	Flows of Material in plant is Complex	4	3	9	9	9	3
3	Improper Route Planning and sequencing	5	3	9	3	3	9
4	Work Place not in proper order and Disorganized	4	3	1	3	3	1
	Absolute Weight		66	94	72	90	70
	Relative Weight		0.153	0.218	0.167	0.208	0.162

DISCUSSION AND OUTCOME ON TRANSPORTATION WASTES:

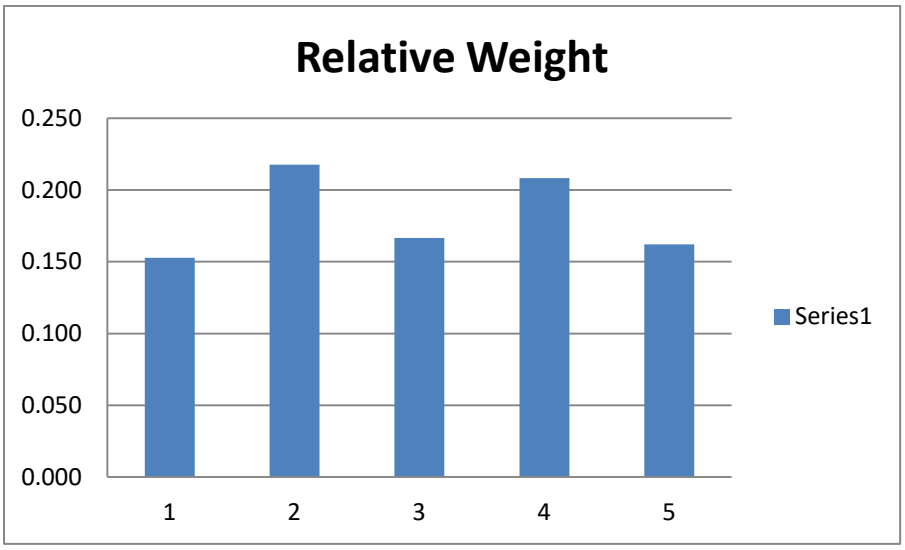


Figure 4.4: Graph showing the priority of effective measures to be taken for the Transportation wastes.

Graph interpretation: Following interpretation is taken through the graph to reducing the transportation waste on the basis of priority given by the house of quality.

1. Adequate production planning for the material transportation is required on priority.

ISSN 2249-5908
Issue 7, Vol. 1 (January 2017)

2. Next to it is to have an effective logistic system of the organisation for proper transportation function.

3. Job simplification through proper design and technology.

4. Inventory policy or inventory control through just in time should be applied.

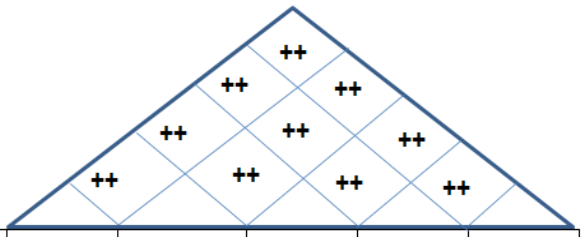
5. Continuous improvement of working standards should be done.

6.5. CONCLUSION ON UNNECESSARY INVENTORY WASTES:

Table.4.5: Table showing the house of quality for unnecessary Inventory and its effects, to reduce it on priority.

Strong positive = ++
Strong Negative= --
Week positive = +
Week negative = -

SR- Strong Relation = 9 point
MR-Medium Relation =3 point
WR- Week Relation= 1 point



	Hows (ways to reduce these wastes) / Whats(in terms of Unnecessary Inventory in manufacturing system)	Value scale of severity	Production according to customer agenda or customer requirement.	Continuous improvement of the working standards.	Inventory Policy or inventory control through just in time should be applied	Proper coordination between different departments should be maintained.	Proper training of personnel of specific tasks or jobs.
1	Inaccurate forecasting and ordering of raw materials	2	9	3	9	9	1
2	Production schedule is not up to the mark.	3	9	3	9	9	3
3	Push system of manufacturing instead of pull system.	3	1	3	1	3	3
4	Large batches Processing	2	3	3	1	1	9
5	Improper recording of inventory items	3	3	3	9	3	1
Absolute Weight			63	39	77	65	41
Relative Weight			0.146	0.090	0.178	0.150	0.095

DISCUSSION AND OUTCOME ON UNNECESSARY INVENTORY WASTES:

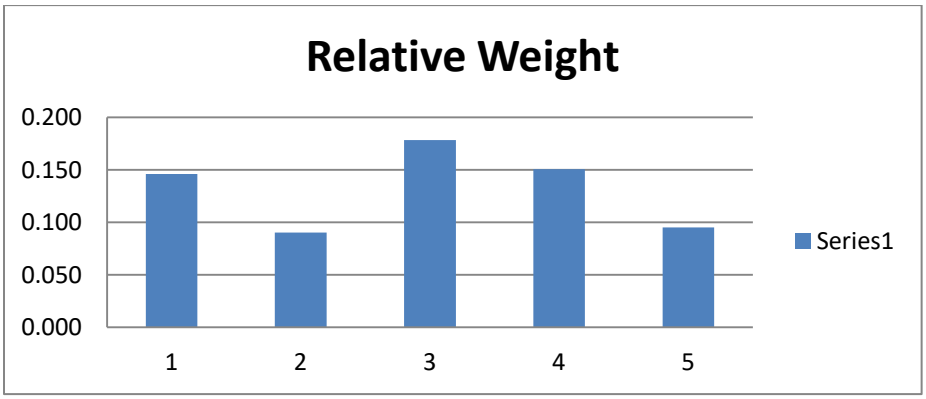


Figure 4.5: Graph showing the priority of effective measures to be taken for the unnecessary inventory wastes.

ISSN 2249-5908
Issue 7, Vol. 1 (January 2017)

Graph interpretation: Following interpretation is taken through the graph to reducing the unnecessary inventory waste on the basis of priority given by the house of quality.

1. The priority of improving is the Inventory policy or inventory control through proper inventory managing technique such as Just in time.

2. The effective coordination between various departments should be required so that the use of inventory item has to be perfectly recorded.

3. Then the inventory system if followed according to the customer specification then the inventory wastage can be minimized.

4. Proper training of the organisation personnel should be done on the inventory usage and its recordings.

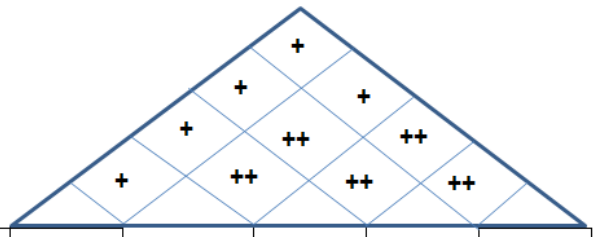
5. Continuous improvement of working standards should be done.

4.6 CONCLUSION ON UNNECESSARY MOTION OR EXCESS MOTION WASTES:

Table.4.6: Table showing the house of quality for unnecessary motion or excess motion and its effects, to reduce it on priority.

Strong positive = ++
Strong Negative= --
Week positive = +
Week negative = -

SR- Strong Relation = 9 point
MR-Medium Relation =3 point
WR- Week Relation= 1 point



	Hows (ways to reduce these wastes) / Whats(in terms of Unnecessary motion or Excess Motion in manufacturing system)	Value scale of severity	Continuous improvement of the working standards.	Maintenance of proper records of the material flow within the department	Job Simplification through proper design and technology.	Balancing of manufacturing lines or process for continuous and smooth function.	Proper training of personnel of specific tasks or jobs.
1	Inappropriate standards and operating procedure	4	3	9	9	3	3
2	Housekeeping not up to the mark	2	3	3	9	3	3
3	Inadequate Training of personnel	3	3	3	3	9	9
4	Improper coordination between inter departments	4	3	3	3	9	3
Absolute Weight			39	63	75	81	57
Relative Weight			0.090	0.146	0.174	0.188	0.132

DISCUSSION AND OUTCOME ON UNNECESSARY MOTION OR EXCESS MOTION WASTES:

ISSN 2249-5908
Issue 7, Vol. 1 (January 2017)

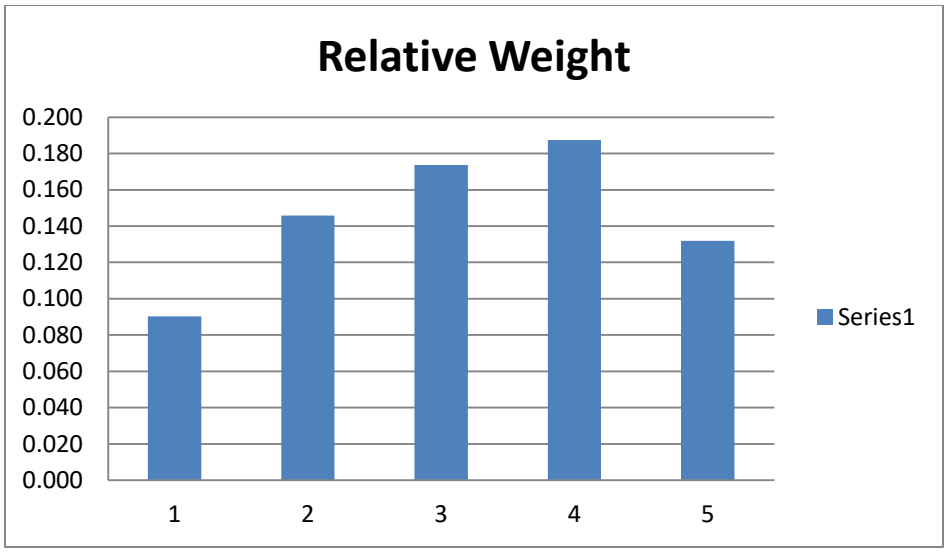


Figure 4.6: Graph showing the priority of effective measures to be taken for the unnecessary Motion or excess motion wastes.

Graph interpretation: Following interpretation is taken through the graph to reducing the unnecessary motion or excess motion waste on the basis of priority given by the house of quality.

1. The priority of improving is through balancing of manufacturing lines or process for continuous and smooth functioning.

2. By doing the job simplification is also helpful in reducing these types of wastes and also to apply proper design and technology.

3. Maintenance of proper records of the material flow within the departments and by applying the motion economic principles.

4. Proper training of the organisation personnel should be done on the inventory usage and its recordings.

5. Continuous improvement of working standards should be done.

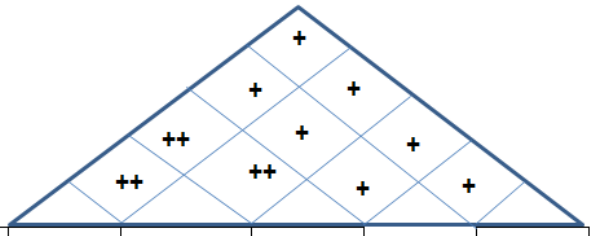
6.7 CONCLUSION ON UNNECESSARY SCRAP, REWORK AND DEFECTS (Not doing right first time) WASTES:

ISSN 2249-5908
Issue 7, Vol. 1 (January 2017)

Table 4.7: Table showing the house of quality for Scrap, Rework and Defects (Not doing right first time) and its effects, to reduce it on priority.

Strong positive = ++
Strong Negative= --
Week positive = +
Week negative = -

SR- Strong Relation = 9 point
MR-Medium Relation =3 point
WR- Week Relation= 1 point



	Hows (ways to reduce these wastes) / Whats(in terms of Scrap, Rework and Defects (Non-Right First Time) in manufacturing system)	Value scale of severity	Adequate production planning for the raw material ordering.	Continuous improvement of the working standards.	Job Simplification through proper design and technology.	Dispose off superseded material to save space and to avoid confusion.	Proper training of personnel of specific tasks or jobs.
1	Incapable and Out of control processes leads to defects	4	9	3	3	1	9
2	Lack of training & skill on the job support to the rework or defect	2	3	3	9	1	9
3	Engineering and Technical design is Inaccurate	4	3	3	9	1	3
4	Machine inaccuracy or faulty tools	3	1	3	3	1	9
	Absolute Weight		57	39	75	13	93
	Relative Weight		0.132	0.090	0.174	0.030	0.215

DISCUSSION AND OUTCOME ON SCRAP, REWORK AND DEFECTS (NOT DOING RIGHT FIRST TIME) WASTES:

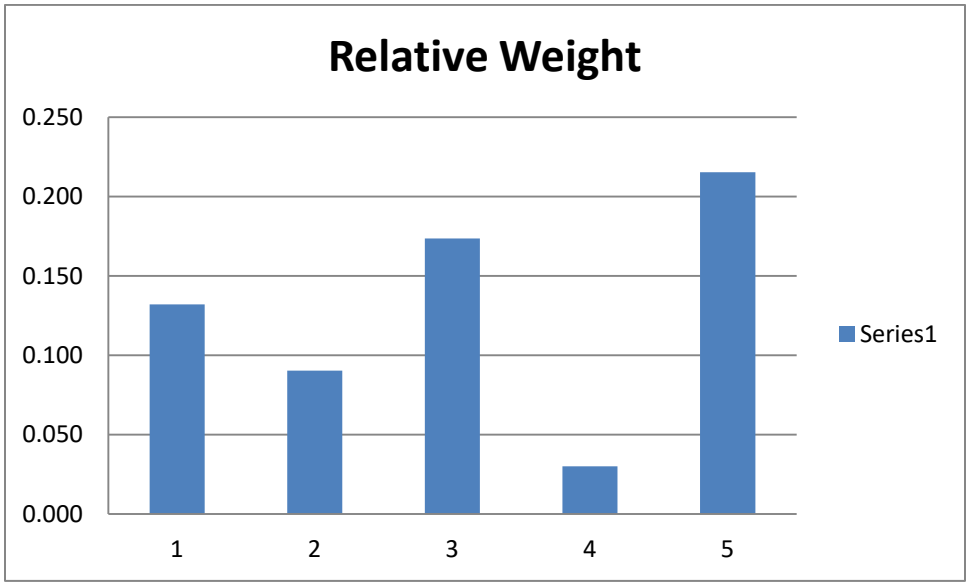


Figure 4.7: Graph showing the priority of effective measures to be taken for the scrap, rework and defects (not doing right first time)

Graph interpretation: Following interpretation is taken through the graph to reducing the scrap, rework and defects (not doing right first time) on the basis of priority given by the house of quality.

1. The essential factor to reduce scrap, rework or defects is the proper training of personnel of the specific tasks or jobs.

2. Next task is the simplification of job and the design procedures with the help of advance technology.

3. Adequate production planning is also the essential requirement of the defects reductions.

4. Continuous improvement of working standards should be done.

5. Dispose of superseded material to have the proper function, reduction of confusion within the manufacturing environment. Because old or superseded materials always create confusion in regards to standards, applications and procedures.

5. CONCLUSION

In Lean manufacturing system the wastes are classified in to seven types as over production, processing, inventory, waiting, delay, transportation, and unnecessary motion. These wastes effect on the lead time as well as economical functions of the organisations. Quality Function Deployment (QFD) is a constructive tool to comprehend and analyse the customer needs and expectations, presently to transfer them into product of manufacturing and process design. In this thesis work, the main focal point is to consider these lean manufacturing wastes and tried to minimise it. The significance of customer obligation is to be considering in terms of importance of the weights assigned to customer requirement in manufacturing organisation to minimise the waste of the system. Quality function deployment system to be implemented in organization or industry, for the focus on considering the minimization of rework, scrap and defects through applying effective systems. QFD system helps effectively by improving the existing system instead of replacement the existing organization design process by any means. QFD approach is tried to provide a step-By-Step function to do that and also showed how consistency in the QFD team's decision could be tested. And it also helps bring the customer's voice into the production system or manufacturing process to decrease the unnecessary wastes and cost in minimum. The finally main concern for manifestation of a fool proof system obtained by effective utilization of resources and this is applied in a QFD context and also used to determine the problem presented.

6. REFERENCES

1. Adila Md Hashim,. Siti, Zawiah, Md, Dawal. (2012) 'Kano Model and QFD Integration Approach For Ergonomic Design Improvement', Procedia- Social and Behavioural Sciences 57, 22-32.
2. Almannai, B,. Greenough, R,. And Kay, J. (2008) 'A Decision Support Tool Based On QFD and FMEA For The Selection Of Manufacturing Automation Technologies', Robotics And Computer-Integrated Manufacturing 24, 501-507.
3. Awaj, Y. M., Singh, A. P., Amedie, W.Y., 'Quality improvement using statistical process control tools in glass bottles manufacturing company', International Journal for Quality Research7(1) 107-126, 107-126.

4. Carnevalli, J.A., Paulo, Augusto, Cauchick, Migual,. and Felipe, Araujo, Calarge. (2010) 'Axiomatic Design Application For Minimizing The Difficulties Of QFD Usage', International Journal of Production Economics 125, 1-12.
5. Du, Yanbin,. Cao, Huajun,. Chan, Xiang. and Wang, Bentao. (2013) 'Reuse-Oriented Redesign Method Of Used Products Based On Axiomatic Design Theory And QFD', Journal Of Cleaner Production 39, 79-86.
6. Gautam, R,. Kumar, S,. and Dr. Singh, S.(2012) Kaizen Implementation in an Industry in India: A Case Study, IJRMET, volume 2, 26-33
7. Govers,C. P.M. (2001) 'QFD Not Just A Tool But A Way of Quality Management', International Journal of Production Economics 69,151-159.
8. Herzog, N. V., Tonchia, S. (2014) 'An Instrument for Measuring the Degree of Lean Implementation in Manufacturing', Strojniški vestnik - Journal of Mechanical Engineering 60, vol.12, 797-803.
9. Jia, G.Z,. Bai, M. (2011) 'An Approach for Manufacturing Strategy Development Based On Fuzzy-Qfd', Computers & Industrial Engineering 60, 445-454.
10. Joshi, R.R,. Patil, R,. Naik, G.R,. and Kharade,.M.V. (2009) 'Through-Put Time Reduction by Lean Manufacturing', Journal of Mechanical and Civil Engineering (IOSR-JMCE), 40-45
11. Judi, H. M., Jenal, R., and Genasan, D.(2011) 'Quality Control Implementation in Manufacturing Companies:Motivating Factors and Challenges', Applications and Experiences of Quality Control. 495-508.
12. Khalil A. El-Namrouty, Mohammed S. AbuShaaban.(2013) 'Seven Wastes Elimination Targeted by Lean Manufacturing Case Study "Gaza Strip Manufacturing Firms'', International Journal of Economics, Finance and Management Sciences. Vol. 1, No. 2, 68-80.
13. Kumar,T.V.., Dr. Babu, B.G., Dr. Saravanan, M., and Dr. Murugan, M. (2014) 'Agile Manufacturing In Small And Medium Scale Enterprises', International Journal of Innovative Research in Science, Engineering and Technology, Volume 3, Special Issue 2, 253-260.
14. Lian- Yin, Zhai., Li- Pheng, Khoo,. Zhao-Wei, Zhong,. (2009) 'A Rough Set Based QFD Approach to the Management Of Imprecise Design Information In Product Development', Advanced Engineering Informatics 23, 222-228.
15. Mehta, R. K., Dr. Mehta, D. And Dr. Mehta, N.K. (2012) 'An Exploratory Study on Implementation of Lean Manufacturing Practices (With Special Reference to Automobile Sector Industry)', Yönetim ve Ekonomi 19/2, 289-299.
16. Miller, G., Pawloski, J., and Standridge, C. (2010) 'A case study of lean, sustainable manufacturing', Journal of engineering and management, 3(1), 11-32.
17. Min, Dae-Kee,. Kim, K Wang-Jae. (2008) 'An Extended QFD Planning Modal For Selecting Design Requirements With Longitudinal Effect Consideration', Expert Systems With Applications 35, 1546-1554.
18. Munizu, M.(2013) 'The Impact of Total Quality Management Practices towards Competitive Advantage and Organizational Performance: Case of Fishery Industry in South Sulawesi Province of Indonesia', Pakistan Journal of Commerce and Social Sciences, Vol. 7 (1), 184-197.

19. Nordin, N., Deros, B. M., and Wahab, D. A.(2010) 'A Survey on Lean Manufacturing Implementation in Malaysian Automotive Industry', International Journal of Innovation, Management and Technology, Vol. 1, No. 4, 374-380.
20. Shahin A,. Janatyan N. (2010) 'Group Technology (GT) and Lean Production: A Conceptual Model for Enhancing Productivity', Vol. 3, No. 4, 105-118.
21. Srinivasu, R., Reddy, G. S., Rikkula, S. R. (2009) 'utility of quality control tools and statistical process control to improve the productivity and quality in an industry', international journal of reviews in computing, 15-20,
22. Talib, F.,Rahman, Z., Qureshi, M.N. (2010) 'Pareto Analysis Of Total Quality Management factors Critical To Success For Service Industries', International Journal for Quality research, Vol.4, No. 2, 155-168.
23. Toliusiene, N., Mankute, R. (2013) 'The study on implementation of agile manufacturing system in Lithuanian industry', MECHANIKA. VOL. 19 (6), 722-728.
24. Topolska, S.(2007) 'The Role Of Quality Control Operations In A Process Of Plastic Forming', Journal Of Achievements In Materials And Manufacturing Engineering, Volume 23, 95-98.
25. Yousefie, S., Mohammadi, M., and Monfared, J. H. (2011) 'Selection effective management tools on setting European Foundation for Quality Management (EFQM) model by a quality function deployment (QFD) approach', Expert Systems with Applications 38, PP. 9633–9647.