ENHANCEMENT ON MATERIAL HANDLING TECHNIQUE BY FORECASTING TO REDUCE TIME WITH REGRESSION ANALYSIS

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Abstract

Material handling has a major significance in industries for enhancement in their productivity, production timing and inventory control, respective industries have different departments such as quality control, forging, heat treatment process, inspection, store; material is transferred from department to department by means of manual material handling these types of material handling are used in industries for transfer of components for different processes.

In our analysis material handling time is reduced by considering material handling vehicle in respective department i.e. store room to room quality control and from room quality control to the machining line, the conveyor transmission is used from machining line to line quality control which also cover heat treatment process to the final quality control, time evaluation is analyzed by considering two variables i.e. dependent variable which means the material is handled manually another is independent variable in which material handling vehicle and conveyor transmission is used in respective departments, regression analysis and analysis of variance methodology is used to analyzed enhancement in optimized parameters for conversed and enhanced forecasting and is found that by applying these technique 95% of improvement with an overall error of 10.91% with a significance of a 0.1094 in regression analysis was observed thus by implementation of these parameters enhances the productivity of Volvo Eicher commercial vehicle industry as well as production time is reduced

Keywords— *Material handling, fore casting, regression analysis, analysis of variance (ANOVA).*

I INTRODUCTION

Material handling involves short-distance movement within the confines of a building or between a building and a transportation vehicle. It uses a wide range of manual, semi-automated, and automated equipment and includes consideration of the protection, storage, and control of materials throughout their manufacturing, warehousing, distribution, consumption, and disposal. Material handling can be used to create time and place utility through the handling, storage, and control of material, as distinct from manufacturing, which creates form utility by changing the shape, form, and makeup of material. Material handling plays an important role in manufacturing and logistics, which together represent over 20% of the U.S. economy. Almost every item of physical commerce was transported on a conveyor or lift truck or other type of material handling equipment in manufacturing plants, warehouses, and retail stores. While material handling is usually required as part of every production worker's job, over 650,000 people in the U.S. work as dedicated "material moving machine operators" and have a median annual wage of $31,530 (May 2012). These operators use material handling equipment to transport various goods in a variety of industrial settings including moving construction materials around building sites or moving goods onto ships. Efficient materials handling is the organised movement of materials in the correct quantities, to or from the correct place, accomplished with a minimum of time, labour, wastage and expenditure, and with maximum safety. Important techniques identified in Table 26.1 are the use of a systems approach to planning a handling scheme, the use of continuous methods of handling, unit loads and bulk handling, and automation. A systems approach applied to raw materials, ingredients, in-process stock and finished products creates optimum flows of materials, in the correct sequence throughout the production process, and avoids bottlenecks or shortages.

II TYPES OF MATERIAL HANDLING

1.3.1 Manual handling

Manual handling refers to the use of a worker’s hands to move individual containers by lifting, lowering, filling, emptying, or carrying them. It can expose workers to physical conditions that can lead to injuries that represent a large percentage of the over half a million cases of musculoskeletal disorders reported in the U.S. each year, and often involve strains and sprains to the lower back, shoulders, and upper limbs.[12] Ergonomic improvements can be used to modify manual handling tasks to reduce injury.

These improvements can include reconfiguring the task and using positioning equipment like lift/tilt/turn tables, hoists, balancers, and manipulators to reduce reaching and bending. The NIOSH (National Institute for Occupational Safety and Health) 1991 Revised Lifting Equation[13] can be used to evaluate manual lifting tasks. Under ideal circumstances, the maximum recommended weight for manual lifting to avoid back injuries is 51 lb (23.13 kg). Using the exact conditions of the lift (height, distance lifted, weight, position of weight relative to body, asymmetrical lifts, and objects that are difficult to grasp), six multipliers are used to reduce the maximum recommended weight for less than ideal lifting tasks.

1.3.2 Automated handling

Whenever technically and economically feasible, equipment can be used to reduce and sometimes replace the need to manually handle material. Most existing material handling equipment is only semi-automated because a human operator is needed for tasks like loading/unloading and driving that are difficult and/or too costly to fully automate. However, ongoing advances in sensing, machine intelligence, and robotics have made it possible to fully automate an increasing number of handling tasks.

1.4 Material-handling equipment

Material handling equipment is mechanical equipment used for the movement, storage, control and protection of materials, goods and products throughout the process of manufacturing, distribution, consumption and disposal.[1] The different types of handling equipment can be classified into four major categories:[2] transport equipment, positioning equipment, unit load formation equipment, and storage equipment.

1.4.1 Transport equipment

Transport equipment is used to move material from one location to another (e.g., between workplaces, between a loading dock and a storage area, etc.), while positioning equipment is used to manipulate material at a single location.[3] The major subcategories of transport equipment are conveyors, cranes, and industrial trucks. Material can also be transported manually using no equipment.

- **Conveyors-** Conveyors are used when material is to be moved frequently between specific points over a fixed path and when there is a sufficient flow volume to justify the fixed conveyor investment.[4] Different types of conveyors can be characterized by the type of product being handled: unit load or bulk load; the conveyor's location: in-floor, on-floor, or overhead, and whether or not loads can accumulate on the conveyor. Accumulation allows intermittent movement of each unit of material transported along the conveyor, while all units move simultaneously on conveyors without accumulation capability.[5] For example, while both the roller and flat-belt are unit-load on-floor conveyors, the roller provides accumulation capability while the flat-belt does not; similarly, both the power-and-free and trolley are unit-load overhead conveyors, with the power-and-free designed to include an extra track in order to provide the accumulation capability lacking in the trolley conveyor. Examples of bulk-handling conveyors include the magnetic-belt, troughed-belt, bucket, and screw conveyors. A sortation conveyor system is used for merging, identifying, inducting, and separating products to be conveyed to specific destinations, and typically consists of flat-belt, roller, and chute conveyor segments together with various moveable arms and/or pop-up wheels and chains that deflect, push, or pull products to different destinations.

Industrial trucks- Industrial trucks are trucks that are not licensed to travel on public roads (commercial trucks are licensed to travel on public roads[7]). Industrial trucks are used to move materials over variable paths and when there is insufficient (or intermittent) flow volume such that the use of a conveyor cannot be justified. They provide more flexibility in movement than conveyors and cranes because there are no restrictions on the area covered, and they provide vertical movement if the truck has lifting capabilities. Different types of industrial trucks can be characterized by whether or not they have forks for handling pallets, provide powered or require manual lifting and travel capabilities, allow the operator to ride on the truck or require that the operator walk with the truck during travel, provide load stacking capability, and whether or not they can operate in narrow aisles.

III LITERATURE REVIEW

Rajesh R [1] Ergonomic evaluation of Manual Material Handling (MMH) has largely been based on task analysis approach where the job are broken down into simpler tasks and studied. But there is lack of clarity in the use of terms defining various MMH activities. The challenge in classifying MMH arises because of the dependence of man-machine interaction on multiple work system characteristics. This paper presents a classification scheme for MMH tasks. Towards making a classification scheme the work system characteristics are examined and the important dimensions from those are identified that are able to differentiate the nature of MMH exposure. Suitable examples for each class are presented. The methods for collecting biomechanical and Physiological responses, and nature of ergonomic analysis required are discussed. A qualitative judgment on exposure magnitude and measurement cost is made. Finally, critical issues and scope for research is presented.

Ivana Sulírova et al. [2] Providing a desired level of customer service in the business is an important part of logistics management. The role of logistics is to provide transport right material in the right quantities and the right quality to the right place. The problem arises when harmonization logistics requirements. This article focuses on solving the problem of increasing the level of customer service through effective material transport, handling and storage. The first part focuses and compares different types of warehouses and the order picker´s inventory management technologies. The second part is devoted to logistics and supply. Warehouse management and transport of the material is connected with tractive control system that reacts flexibly to changes in customer requirements. Authors in solving based on the results of realized survey of the current situation in enterprises in the described areas.

Karel Kruger and Anton Basson [3] Holonic systems have been a popular approach to face the challenges of the modern manufacturing environment and should continue to play a vital role in the fourth industrial revolution. Holonic control implementations have often made use of multi-agent systems – this paper presents, as a potential alternative, a case study implementation based on Erlang. Erlang is a functional programming language with strong scalability, concurrency and fault-tolerance characteristics, which prove to be beneficial when applied to the manufacturing control context. The case study used in this paper is the holonic control of a palletized conveyor material handling system – this implementation was chosen to demonstrate the advantages that Erlang can offer as implementation language for holonic systems..

Andreas Bjornsson et al. [4] increasing use of fiber reinforced polymer composites follows a natural pursuit for more rational and effec- tive manufacturing. Robotic pick-and-place systems can be used to automate handling of a multitude of materials used in the manufacturing of composite parts. There are systems developed for automated layup of prepreg, dry fibers and thermoplastic blanks as well as to handle auxiliary materials used in manufacturing. The aim of this paper is to highlight the challenges associated with automated handling of these materials and to analyze the main design principles that have been employed for pick-and-place systems in terms of handling strategy, recon- figurability, gripping technology and distribution of gripping points etc. The review shows that it is hard to find generic solutions for automated material handling due to the great variety in material properties. Few cases of industrial applications in full-scale manufacturing could be identified

Chris Siu Kei Leung and Henry Ying Kei [5] found it optimization of complex real-world problems often involves multiple objectives to be considered simultaneously. These objectives are often non-commensurable and competing. For example, material handling is a vital element of industrial processes, which involves a variety of operations including the movement, storage and control of materials throughout the processes of manufacturing, distribution, and disposal while having to satisfy multiple objectives. Having an efficient and effective material handling system (MHS) is of great importance to various industries, such as manufacturing and logistics industries, for maintaining and facilitating a continuous flow of materials through the workplace and guaranteeing that required materials are available when needed. In this paper, a hybrid multi-objective optimization algorithm largely based on Artificial Immune Systems (AIS) is applied to simulation-based optimization of material handling system. This proposed algorithm hybridizes the AIS with the Genetic Algorithm (GA) by incorporating the crossover operator derived from the biological evolution..

V METHODOLOGY

4.1 Analysis of variance (ANOVA)

Analysis of variance model is an estimation of staticals models to analyze the dirrerance between two models or samples in case of time or in case of physical and fundamental respects the particular variable is partition in two variables and these variables are supposed as two samples and conceptually these are compared with statistical model to analysed the variance occurred in investigation of several situation i.e.:

1. Time variance
2. Situation variance
3. Fundamental variance
4. Physical variance

4.2 Regression Analysis

The statistical model is related with different variables to analyze the variation between these variables, independent and dependent variable are specified for statistical modeling the actual condition and the possible condition with probability distribution analyzed linearly with regression function to enhance the situation such as in case of prediction, forecasting, machine learning casuals relationship these functions are used to differentiate observational data so that it proves how independent variable is an optimized formulation of dependent variables.

4.3 Regression Models

1. Unknown parameters (β)
2. Independent variables (X)
3. Dependent variables (Y)

$$Y \text{ equivalent } f(X,\beta)$$

The approximation is usually formalized as

$$E(Y|X)=f(X,\beta)$$

To carry out regression analysis, the form of the function f must be specified.

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VI RESULT AND DISCUSSION

5.1 Introduction

In this chapter material handling of blanks through man power is optimized by conveyor transmission and material handling van and further time is optimized and analyzed by analysis of variance and regression analysis to forecast the layout of industry.

5.2 Time taken from store room to room in quality control

Time taken by manual material handling from store to room in quality control is illustrated below these variables are dependent variables which is on process of industry, the variable is supposed in time.

Table 5.1 Dependent variables (Store - Room in quality control)

Dependent (Store - Room in quality control)			
Part	**Dependent Time (min)**	**No. of Manpower**	**No. of Job**
2714	9	4	20
2716	6	3	20
2012	5	2	80
2020	3	2	70
3501	4	2	65
3507	5	2	50

5.3 Time taken from room in quality control to machining line

Time taken by manual material handling from room in quality control to machining line is illustrated below these variables are dependent variables which is on process of industry, the variable is supposed in time.

Table 5.2 Dependent variables (RQC - Machining Line)

Dependent (RQC - Machining Line)			
Part	**Dependent Time (min)**	**No. of Manpower**	**No. of Job**
2714	8	4	20
2716	5	3	20
2012	4	2	80
2020	2	2	70
3501	3	2	65
3507	4	2	50

5.4 Time taken from machining line to line quality control

Time taken by manual material handling from machining line to line quality control is illustrated below these variables are dependent variables which is on process of industry, the variable is considered in time.

Table 5.3 Dependent variables (Machining Line- LQC)

Dependent (Machining Line - LQC)			
Part	**Dependent Time (min)**	**No. of Manpower**	**No. of Job**
2714	5.5	4	22
2716	4.5	3	20
2012	3	2	80
2020	1.5	2	70
3501	2.5	2	55
3507	3	2	70

5.5Time taken from line quality control Final Quality Control

Time taken by manual material handling from line quality control to Final quality control is elaborated below these variables are dependent variables which is on process of industry, the variable is considered in time.

Table 5.4 Dependent variables (LQC-FQC)

Dependent (LQC - FQC)			
Part	**Dependent Time (min)**	**No. of Manpower**	**No. of Job**
2714	5	4	20
2716	4	3	80
2012	2.8	2	70
2020	1.3	2	55
3501	2.2	2	70
3507	2.7	2	22

5.6 Independent variable

To enhance the time taken in dependent variables that is in actual practice is optimized in independent variables by decreasing man power from the use of material handling van between store room and room in quality control with application of conveyor transmission from machining line to dispatch, the optimized time is illustrated below in detailed.

5.7 Time taken from store to room in quality control

Time taken by material handling van from machining line to line quality control is illustrated below these variables are independent variables which is on process of industry, the variable is considered in time.

Table 5.5 Independent variable (Store - room in quality control)

Independent (Store - room in quality control)			
Part	**Independent Time (min)**	**No. of Manpower**	**No. of Job**
2714	7.1	1	20
2716	4	1	20
2012	4.5	1	80
2020	2	1	70
3501	3	1	65
3507	3.5	1	50

5.8 Time taken from room in quality control to machining line

Time taken by material handling van from machining line to line quality control is illustrated below these variables are independent variables which is on process of industry, the variable is considered in time

Table 5.6 Independent variable (RQC - Machining Line)

Independent (RQC - Machining Line)			
Part	**Independent Time (min)**	**No. of Manpower**	**No. of Job**
2714	6.1	1	20
2716	3.5	1	20
2012	3	1	80
2020	1.5	1	70
3501	2.2	1	65
3507	2.5	1	50

5.2 Time taken from machining line to line quality control

Time taken by conveyor transmission from machining line to line quality control is illustrated below these variables are independent variables which is on process of industry, the variable is considered in time

Table 5.7 Independent variable (Machining Line - LQC)

Independent (Machining Line - LQC)			
Part	**Independent Time (min)**	**No. of Manpower**	**No. of Job**
2714	1.5	Nil	20
2716	1.2	Nil	80
2012	1	Nil	70
2020	1	Nil	55
3501	1	Nil	70
3507	1	Nil	22

5.2 Time taken from line quality control to final quality control

Time taken by conveyor transmission from machining line to line quality control is illustrated below these variables are independent variables which is on process of industry, the variable is considered in time

Table 5.8 Independent variable (LQC - FQC)

Independent (LQC - FQC)			
Part	**Independent Time (min)**	**No. of Manpower**	**No. of Job**
2714	1.5	Nil	20
2716	1.2	Nil	80
2012	1	Nil	70
2020	1	Nil	55
3501	1	Nil	70
3507	1	Nil	22

5.22 Comparison of dependent and independent variables

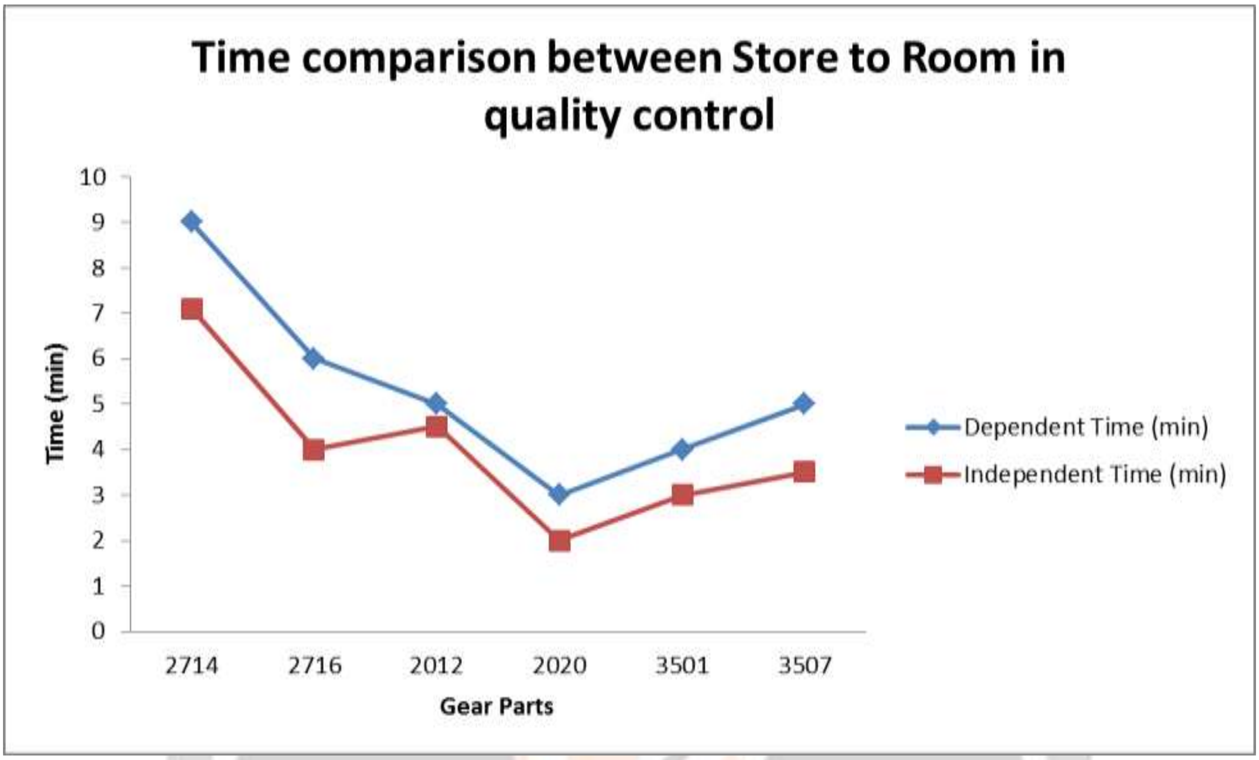

Fig. 5.1 Time comparison between store to RQC.

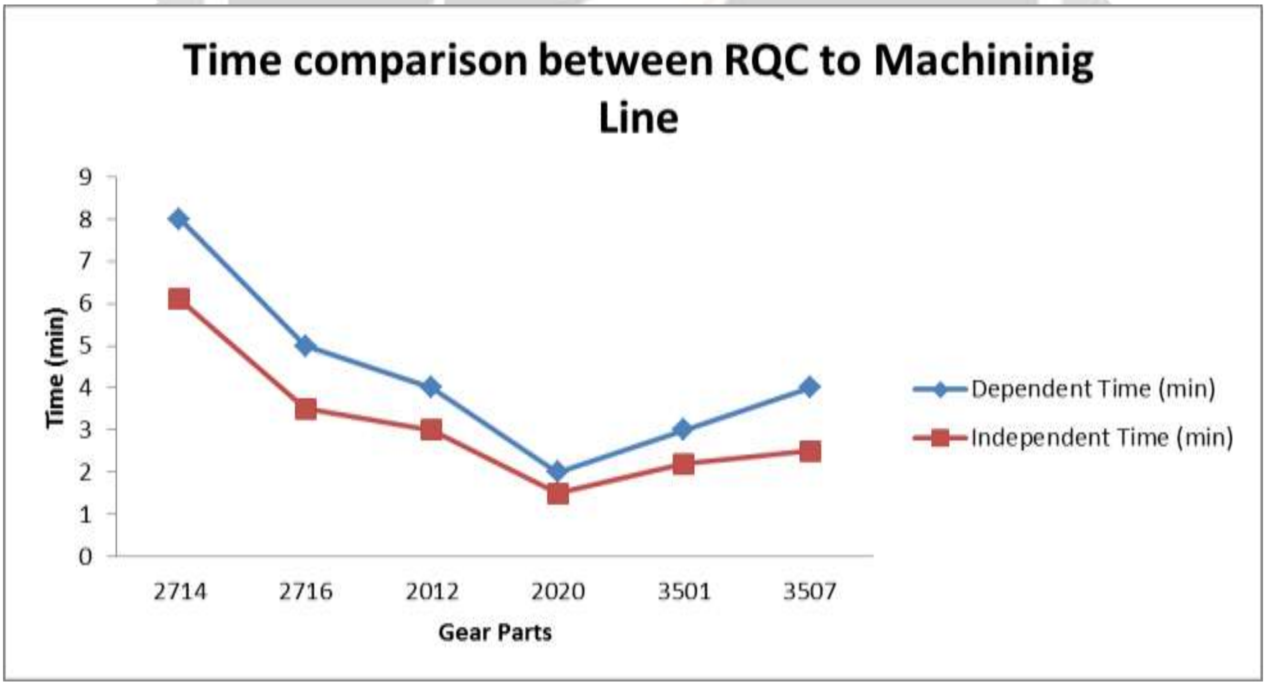

Fig. 5.2 Time comparison between RQC to Machining line.

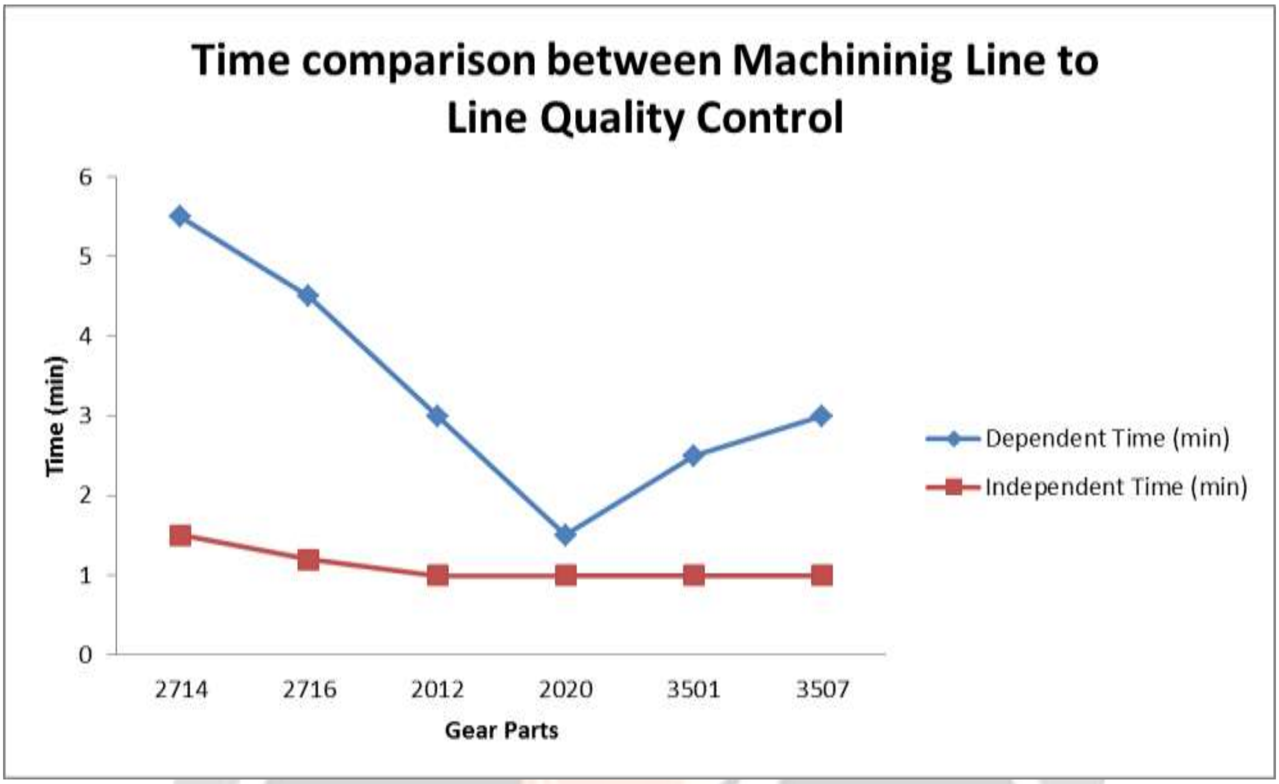

Fig. 5.3 Time comparison between Machining line to LQC.

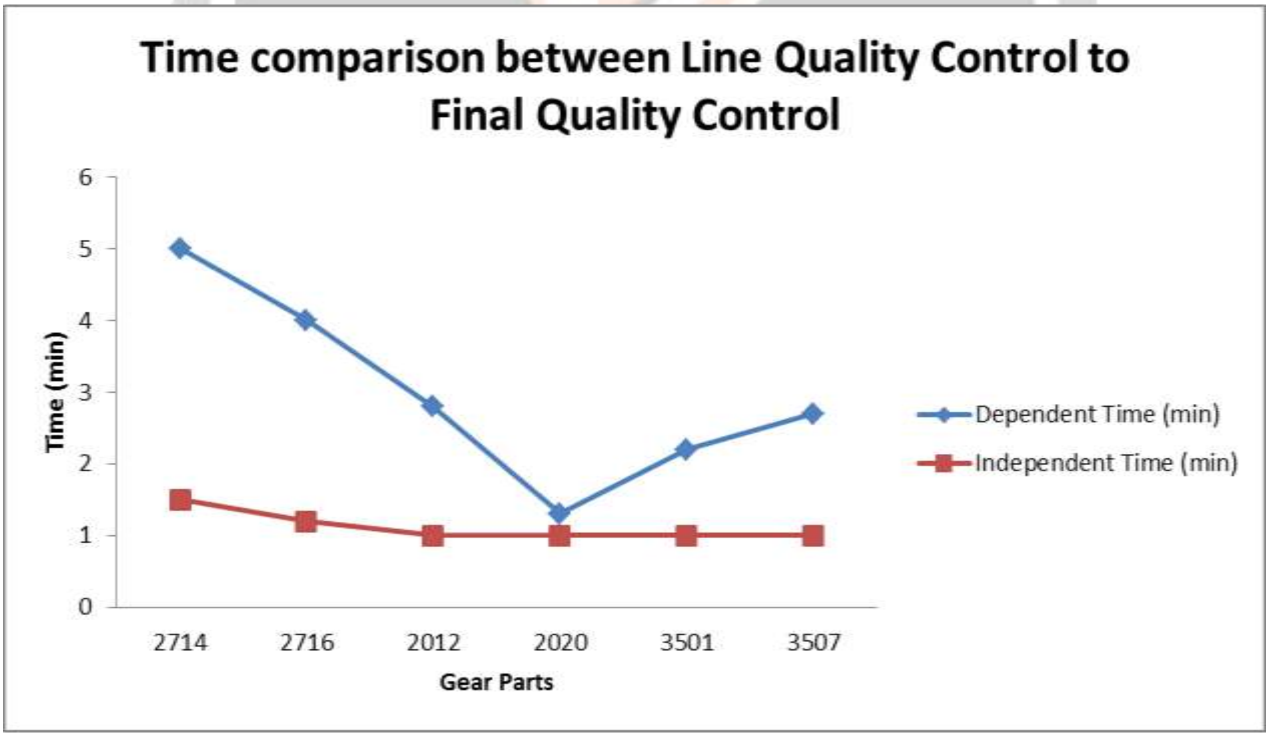

Fig. 5.4 Time comparison between LQC to FQC

5.23 Analysis of variance and regression analysis of both dependent and independent variables with respect to time for enhancement of forecasting.

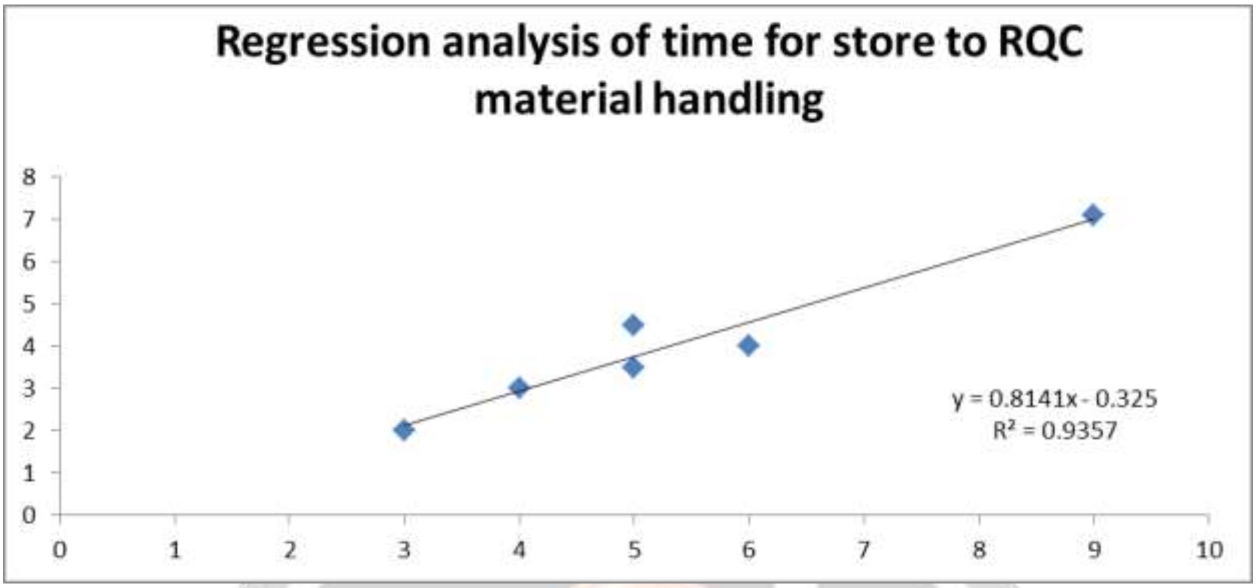

Fig. 5.5 Regression analysis of time for store to RQC material handling

.VII CONCLUSION

1. The manual material handling of gear blank from store to room in quality control time is enhanced by significance of 0.057 with an error of 0.55 in analysis of variance of independent variable, the forecasting of dependent variable is improved by 57%
2. the time taken after the quality check of gear blanks the material is shifted to machining line by manual material handling, the significance of regression analysis is found to be 0.0060 with an independent variable with an error of 0.21, thus optimized time is identified to be improved by handling the material with the help of material handling van.
3. Enhancement from conveyor transmission significance is 0.085 with an error of 0.05, thus maximum time is utilized in conveyor transmission.
4. Manual material handling from line quality check to final quality check department has an significance of regression analysis at 0.1066 with an error of 0.06, thus conveyor transmission reduces material handling time and enhances higher productivity in industrial application of components travelling time from one department to another department.
5. Overall time analysis which is perform in regression analysis with analysis of variance to forecast the material handling system the overall 10.91% of improvement is observed thus the overall significance of 0.1094 is obtained in independent time variable, thus this system could be implemented in the industries with respective manufacturing layout for optimization of overall timing for enhancement in productivity in product life cycle management

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