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Improvements in vertical belt elevator with the help of quality circle

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***Abstract*— In present work quality circle plays an important role in making bucket elevator a very successful machine in agriculture industries. Quality circle approach helps the agro industry in maintaining a quality of the product without increasing the cost of the product which is a major factor due to competition between various agro industries. Quality circle with its various techniques helps in identifying various problems and improvements and not only identifying but also provides the solutions to that problems and provides the means to implement that solution so that machine will improve. Quality circle is never ending process. In agro industries quality circle works on the theory of still room for improvement. All the members are committed to their work so that with the help of their ideas machine can be improved further and further. These elevators are used in mostly food industries or grain industries. These elevators are placed in front of every food grading machines so that instead of feeding material directly to grading machines which are of certain height from the floor level. This machine helps in reducing man power and their efforts to lift the material up to the height of the machine. But there were certain demerits in its working. but after applying quality circle and their tools we achieve success in making a bucket elevator a very successful machine .there were so many demerits earlier but after applying quality circle approach we find out solutions of various problems which need to be rectified so that this machine has develop in good error free machine. Quality circle approach not only helps in finding solutions to various problems but also provides the means to implement them.**

***Keywords*— Quality Circle, Vertical belt Elevator.**

I. INTRODUCTION

Quality Circles first emerged in Japan in the 1960's and were originally introduced in the journal, Gemba-to-QC, first issued in April 1962. Kaoru Ishikawa has been credited with creating Quality Circles as a method of improving quality. The movement in Japan was coordinated by the Japanese Union of Scientists and Engineers (JUSE). According to QC Headquarters, Japan, the basic principles behind Quality Circle activities, carried out as part of company-wide quality control activities, are as follows :

(i)To contribute to the improvement and development of the enterprise

(ii)To respect humanity and build a worthwhile-to-live-in, happy, positive environment

(iii)To exercise human capabilities fully and to eventually draw out infinite possibilities

Prof. Ishikawa, who believed in tapping the creative potential of workers innovated the Quality Circle movement to give Japanese industry an extra edge in creativity. Quality Circles are usually characterized as small, voluntary groups of employees set up to meet periodically for such practical purposes as:

(a) Pinpointing, examining, analyzing and solving problems in areas including knowledge management, innovation, work relations, quality, productivity, safety, cost, etc.

(b) Enhancing communication between employees and management on the above areas

This can not only improve the performance of any organisation, but also motivate and enrich the work life of employees.

The use of Quality Circles in many highly innovative companies in Scandinavian countries has been proven. The practice is recommended by many economist / business scholars and quality circles support in the collection, storage and use of both explicit and tacit knowledge. The benefits include effective team dynamics through communication, trust, shared vision, commitment, involvement, empowerment and a learning culture among the staff. Quality Circles promote individual self-development, teamwork, fellowship (each of which can in turn support knowledge sharing and distribution) and improve overall company performance and corporate

II. ORGANISATION STRUCTURE OF QUALITY CIRCLE

The organizational structure of quality circle different from industry to industry, they consist of the following elements.

1. STEERING COMMITTEE
2. CO -ORDINATORS
3. FACILITATOR
4. CIRCLE –LEADER
5. CIRCLE MEMBERS

III. LITERATURE REVIEW RELATED TO QUALITY CIRCLE

The aim of this chapter is to review the literature relevant to the research problem. It reviews the literature on quality circles practices in manufacturing enterprises, its relationship with job satisfaction, teamwork, communication, training, production, quality and cost in manufacturing enterprises. The literature on the obstacles to the implementation of quality circles in manufacturing enterprises is also reviewed. The objectives of review are:

(A) To identify various problems and their most desirable solution in vertical belt elevator

(B) To identify the effect of quality circle on vertical belt elevator

(C) To study literature related to quality circle on vertical belt elevator

FOREIGN STUDIES

In this section review of literature relevant to quality circles, their influential factors and the critical success factors are presented.

GRYA (1981), based on the study of eleven companies which have adopted quality circles has reported that a number of attitudinal changes are being observed in management and workers. Workers believed that participation in quality circles has resulted in improving their personal capabilities and self respect. It also helped in improving their communication with supervisors and management. Supervisors also reported that image of workers improved in their eyes due to workers abilities to solve problems. However, this study is limited to a small sample and more descriptive in nature.

SRINIVASAN (1982), had studied quality circles in a large computer peripheral manufacturing company in U.S.A .He used experimental design to measure both pre-test and post-test measures to examine the impact of quality circles on productivity, group behaviour , and interpersonal behavior . He found no significant difference between quality circle and non quality circle groups after a period of two months. Though this study was based on experimental design, the weakness of the study was that two months may be too short a period to measure the impact of quality circles.

ZAHARA (1982), conducted a study of quality circles in two U.S. organizations. Using ANOVA and the 't' test ,did not find any support for an association between quality circle membership and job satisfaction. However, Strong association was found between quality circle membership and perceived changes in quality of work life.11Rieker & Sullivan (1982), have found that, in USA , quality circles were started as a part of a programme for improving quality of work life. International Association of Quality Circles and American Society of Training and Development were two prominent agencies, actively prorogating quality circles in USA. Both of them have been focusing on motivational aspects of quality circles.

ROSOW & ZAGER (1983), has stated that participation in quality circles may promote the objectives of unions such as democratization of the work place and strengthening of union membership. Therefore, in the U.S.A., some of the large unions, namely, United AutoWorkers, Communication Workers of America, International Brotherhood of Electrical Workers and United Steel Workers, together representing almost three million workers have been supporting quality circle interventions.

TAKEZAWA (1982), stated that the unions in Japan have played a major role in the acceptance of quality circles and improvement in productivity. A large percentage of unions are enterprise based and include all the workers , regardless of type of work. These unions identify theirinterest with the interest of the organization and cooperate with the company to better the company's12competitive position vis-à-vis other companies. Therefore, they support quality circle activities. The above discussion suggests that organization having healthy management-union relations is likely to receive union support for quality circle activities. Also, an educational strategy explaining to the unions how quality circles can help to improve quality of work lifefor workers and a guarantee that problems under the purview of collective bargaining will not be discussed in quality circles, can facilitate acceptance of quality circles by unions.

DALE (1984), studied the quality circle programmes in five manufacturing companies in U.K. He found that quality circle leaders believed that employees who participated in quality circle activities were more quality conscious. In all five companies it was recognized that relationship between circle members had improved, leading to increased cooperation in their work environment. Some cost savings were also achieved. However, this study is limited to five manufacturing companies only.

COLE (1984), had reported that the success of quality circles in an organization depends upon the support of the management. Top management can support a13quality circle intervention by forming a steering committee and ensuring that it meets regularly to guide and monitor quality circle activities, providing budget for quality circle members to attend activities, attending quality circle presentations, and encouraging quality circle members to attend the quality circle conventions seminars etc. This study is more descriptive in nature.

SMITH (1984), based on a study of quality circles if our organizations found that the employee's alienation decreased. Also, the employee's ability to manage job dissatisfaction increased as a result of membership in quality circle. This is because of an exigencies related to work and superiority complexities.

with vocational training. Eight programmes from six countries describing the establishment and the targeting of quality circles work are presented as case reports. However in the last 10 years, substantial development of quality circles has taken place in Netherlands, UK, Denmark, Belgium, Ireland, Sweden, Norway, Germany, Switzerland and Austria, further evaluation is needed to clarify the impact on quality of care.

ALHOL & HAM (2005), have made a study on the Effectiveness of Quality Circle Participation in Industrial and Service Organizations in Malaysia. This study reported that quality circle proponents suggest a wide array of positive results when this participation technique is used either in manufacturing or in service21sector. This study is to determine whether quality circles one sector are performing more effectively than the other. This assessment includes technical aspects, length of participation, training, members' feelings about quality circles, job satisfaction and job commitment. The study also illustrated the impacts of participation on 109quality circles members from five Malaysian companies. Results showed that Industrial QCs members were more enthusiastic than service QCs members in terms of involvement in QCs activities and showed higher job satisfaction and job commitment compared to members in service organizations.

PERIERA & OSBORN (2007), conducted a study on "Effects of Participation in Decision Making on Performance and Employee Attitudes: A Quality Circles Meta-analysis". This study explores the effects of a participative technique, quality circles, on several employee attitudes and performance. The sample included 36studies with 42 independent samples. Mean effect sizes were small for

employee attitudes and moderate for job performance suggesting quality circles affected job performance to a greater degree than employee attitudes. For organizations involved in quality management these results seem to suggest that quality interventions have a stronger impact on job performance than on employee attitudes. The study conclusions provide a positive outlook on the effects of quality circle interventions on productivity. A single intervention in quality circles of group participations integrated in the group's normal working procedure did not have a significant effect on the quality of antibiotic prescribing. More attention to the context and structure of primary care practice, and insight into the process of self reflective learning may provide clues to optimise the effectiveness of quality circles.

INDIAN STUDIES

In India only a few research studies were conducted.This has been described in this section.

KAMAT (1983), based on his experiences as a blue collar worker in a Toyota assembly line, observed that Japanese employees participated in quality circle activities due to pressure from their peers and superiors. Further, he commented that the shop foreman often sets the targets about number of suggestions a quality circle group should forward, and that becomes a goal to be met by everybody in the group.

JOSEPH (1984), conducted a study of quality circles at Bharath Heavy Electronics Limited, Hyderabad found23that members of those quality circles which met regularly perceived that their quality of work life to be better as compared to that of non quality circle members. But non quality circle members were found to be superior on quality of work life parameters as compared to the quality circle members whose circles were not functioning properly. However this study is limited to only one variable and one industry.

AMSA (1990), in her study has observed that with regard to quality circles in India was not one of culture or group orientation, but of preparedness on the part of the top management of Indian organistions to introspect and examine their own beliefs and values about workers and to reorient themselves suitably. Some management in India was responding remarkably well to that challenge and if that trend continues quality circles would find a place in Indian organizations. After all, the idea or the philosophy of quality circles, viz., respecting human dignity and potentials of the workers, and involving the min organistional affairs is neither new nor can be confined to any nation, but what was new about quality circle was that it provides a structure and methodology for translating that philosophy into practice in today'sorganizations.24

SRINIVASAN (1991), through an empirical survey had reported that the organizations which are practiced quality circles were at a better level in operating income and gross profit compared to others. And quality circle has helped to impart creativity among workers and a sense of belonging to the organization.

KRISHNAMURTHY (1992), reviewed the functioning of quality circles in Bharath Electronics Limited Bangalore. The experience at the Bharath Electronics Limited in implementation of quality circles found that the implementation of quality circle has enabled the company to reduce the time required for development and implementation of a company specific model for total quality management. However this study is very much limited to only one organization. A study conducted by Agarwal (1994), has focused on the impact of quality circle as an intervention, on improving the quality of work life and productivity. This has provided only partial answer to the research question on how to evaluate the performance of a quality circle.

RAJKUMAR & GARG (2002), has conducted a case study in Dye House of a Shipping mill of West Bengal and in that a quality circle, through the use of statistical tools had25solved the problems one by one and moved the industry towards increasing profits and improves productivity. The study found that among the various quality control techniques, quality circles was simple, with economic and best techniques for brining incremental improvement in the organization. The review of research described so far appears to show mixed evidence for the success of quality circles. In some instances, or with respect to some effectiveness variables, quality circles appear to be effective. In other cases, they appear ineffective. This suggests a need for a more systematic examination of the effectiveness of quality circles. It is this mixed scenario of the high potential of quality circles with many ifs and buts attached to them which makes it a subject rich and relevant for the research. Accordingly, it was planned to study quality circle movement and its effectiveness in Indian organizations. Accordingly, the present study was planned to investigate the effectiveness of quality circles in Indian enterprises. Research questions identified to fillMany researchers have carried out significant work in the area of Bucket Elevator Literature related to the present work will be reviewed. Bucket Elevator is used to handling various commodities. In the literature, Vertical Bucket Elevator has continuously drawn attention from researchers and Users. This is reflected in a number of survey articles, reviews, and case studies. Relevant articles are reviewed as under.

Materials handling makes production flow possible, as it gives dynamism to static elements such as materials, products, equipments, layout and human resources (Stock & Lambert, 2011; Chopra & Meindl, 2011). Groover (2012) highlights that despite its importance, materials handling is a topic that frequently is treated superficially by the companies. However, other authors have perceived its relevance. During the period in which Shingo (2001) contributed to the development of the Toyota Production System, he developed the Production Function Mechanism that proposes to explain how the production phenomenon happens.

SHINGO (2001) indicated that, in the West, production was treated as a process of a sequence of operations. In the Production Function Mechanism, the concepts are directly related to a production analysis focus. A process analysis consists of an observation of the production flows that turn raw materials into final products. From this concept, the author highlights that the main analysis is the one associated with the process, because it follows the production object.

The analysis of the operations comes later because it focuses on production subjects (operators and machines). When making this distinction, it is possible to perceive the relevance of materials handling.

BOWERSOX & CLOSS (2005) state that a critical factor in positioning stocks in process is a balance between convenience and consolidation to create efficiencies when the stock flows along the value chain.

According to **GURGEL** (2007), the equipment should be selected based on some preliminary considerations: take into account the utilization of the factory floor and its load capacity; examine the dimensions of doors and corridors; pay close attention to ceiling height, identify the environmental conditions and their nature, avoid the use of combustion engines traction.

IV. PROBLEMS IDENTIFICATIONS BY QUALITY CIRCLE

1. Problem: Grain damage in boot section.
2.Problem: Off tracking of belt after continuous running of elevator for 1 week.
3.Problem: Overload on machine and burning of motor
4.Problem: Less output & poor functioning of V.B.E due to slippage of belt.
5.Problem: Reverse movement of belt due to power failure

V. SOLUTIONS PROVIDED BY QUALITY CIRCLE

1.Solution: Use of conical shaped pulley instead of circular pulley.

BEFORE CHANGE: A circular pulley was used in boot section. When we feed material in boot section via feed hopper some of the material get crushed between round pulley and belt and due to this safe material handling capacity of the elevator get reduced to 65-70%.

AFTER CHANGE:

We control grain damage in boot by using conical shaped wing pulley in boot instead of round pulley. Due to the use of conical shaped wing pulley material instead of getting crushed between pulley and belt falls safely in boot tray which will again feed to feed hopper.This helps in increasing safe material handling capacity of elevator from 65% to 85%

2.Solution: We can prevent off tracking of belt by using grooved rubberized pulley instead of Simple pulley

BEFORE CHANGE: Most of the times it was found that the belt of the V.B.E get off tracked after continous running for 1 week. This will have an adverse effect on the working life of the elevator.

AFTER CHANGE:

We minimizes the chances of belt off tracking by using grooved rubberised pulley in head section instead of simple pulley. This grooved pulley helps the belt to move on pulley continously without getting off tracked.

EFFECT: Use of rubberized grooved pulley helps in maintaining alignment of belt with pulley. This will further increases the working life of the elevator.

3.Solution: We can easily identify slippage of belt by using zero speed sensor.

BEFORE CHANGE: We were facing a very serious problem of less output due to slippage of belt. it was very difficult identify the slippage of belt while elevator is in its working mode and due to this it becomes very difficult to maintain the proper output throughout the working life cycle of elevator

AFTER CHANGE: Zero speed sensors detect the speed changes in rotating devices such as screw conveyors, bucket elevators or belt conveyors. Zero speed switches are very similar to speed sensors but detect the lack of speed or zero speed in rotating equipment.Speed sensors and zero speed switches are used to protect equipment and processes. When the sensor or switch detects a change in speed or zero speed, a signal is sent to a control panel or an alarm to alert the operator of a malfunction. The process may be halted to prevent damage to other conveying or processing equipment. Speed switches are typically mechanical type and directly connected to the shaft of the rotating equipment.

EFFECT: Due to the use of zero speed sensor we are able to identify the slippage of belt very easily and accordingly maintain elevators output capacity throughout its working life.

4.Solution: We completely eliminate this problem by using torque limiter sprocket on the shaft of head which is driven by motor with the help of chain.

BEFORE CHANGE: Sometimes due to excessive feeding of material in boot section of v.b.e the load on the motor increases and after running for 7-8 hours the motor slowly and steadly become hot and a stage arrived at which motor burns. Sometimes it also happens due to blockage in the movement of belt due to which load on motor increases and it burns after sometime.

AFTER CHANGE:

Torque Limiter is a spring loaded friction style torque overload device. The load on the friction pads is adjusted so that the process torque is transmitted, while an overload torque in excess of the set torque causes the unit to slip. This prevents overloads from transmitting through the system. When the load falls below the set level, the torque limiter stops slipping and transmits the torque. A torque limiter does not maintain phase between input and output. The Morse torque limiter is well suited for applications that trip more frequently by design compared to the Browning® Torque limiter. It can be used in a chain drive with a specially machined sprocket inserted between the friction pads acting as the slip interface. Chain coupling packages are also available to mount between 2 shafts. Torque capacity is up to 75,600 in-lbs.

5.Solution: We can eliminate reverse movement of belt by using anti reverse mechanism.

BEFORE CHANGE: Reverse movement of belt due to power failure was a major problem in V.B.E and it happens due to the weight of material in buckets which are moving up from the boot section to the head section. In case of power failure the belt tends to move in reverse movement and all the material falls in boot section.

AFTER CHANGE: When buckets are filled with material and are moving upwards with the help of motor and suddenly power failure occurs then due to the weight of bucket belt tends to move in downwards direction and all the material fall in the boot. But by fixing one way clutch with the shaft of head pulley we can eliminate reverse movement of belt

VI. .BUCKET ELEVATOR DATA

Previous data of various parts and their effect on V.B.E

Part Used	Problem	Effect
Simple Round Pulley	Crushing of Material	Wastage of Material
Rubber Less Pulley	Off-Tracking of Belt	Cracking of Belt
Without Anti Reverse Mechanism	Reverse Movement of Belt	Fall of Material
Without Torque Limiter	Burning of Motor	Motor Burn
Without Zero Speed Sensor	Slipage of Belt	Less Output/Low Capacity

Newly formed data of various changed parts and their effect on V.B.E

Part Used	Solution	Effect
Conical Pulley With Wings	Very Rare Crushing of Material	Increases safe Handling of Material
Rubberised Grooved Pulley	Smooth Movement of Belt	Life of Belt Increases
Anti Reverse Mechanism	Reverse Movement of Belt Eliminated	No Wastage of Material
Torque Limiter	Eliminated	Motor Working Smoothly For Long Time
Zero Speed Sensor	Easily Detection of Slipage of Belt	Increase Output/High Capacity

VII. RESULTS

(a) Minimizes the grain damage in boot section

Before implementation: Grain damage in boot section is 25-30%

After implementation: grain damage reduces to 5-10%

(b) Reduces the off tracking problem of belt

Before implementation: Off tracking of belt takes place within 1-2 week of continous operation

After implementation: Off tracking of belt rarely takes place, it happens once in every six months

(c) Improved output and easily identification of slippage of belt

Before implementation: The output capacity of V.B.E was 75-80%

After implementation: The output capacity of V.B.E is 85-90%

(d) Eliminate burning of motor due to overload

Before implementation: Burning of motor due to overload takes place in 15-20% cases

After implementation: Burning of motor due to overload is eliminated completely

(e) Eliminate reverse movement of belt due to power failure

Before implementation: Reverse movement of belt takes place every time due to power failure

After implementation: Reverse movement of belt due to power failure is completely eliminated

VII. CONCLUSION

In this modern competitive industrial world one can get a step ahead of his competitor by selection of proper material handling equipment. Material handling process is overhead for the production but it is heart of any process plant. Still people prefer most advanced material handling equipment even though they are costly.

But Quality Circle approach helps in reducing the cost and enable the V.B.E to work properly throughout its working life. Bucket elevator has evolved as advanced material handling equipment in mechanized bulk material handling industry.

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