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Investigation on Various Optimizing Strategies used to Reduce Time Delay in Production Activities of Manufacturing Industries in Nigeria

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Abstract: This paper is seeks to investigated the problem of time delay in the production activities of manufacturing industries in Nigeria. This research work is focused on how to identify the root causes of time delay and its solutions in the production activities of manufacturing industries in Nigeria. This also involves identifying the research gaps that need to be pursued further to better understand time delay and the limitations associated with them. The research has identified the works of literature that discusses challenges and limitations of time delay and minimize its effect in production activities. Due to the increase in industries application, there is significant interest in an efficient simulation and optimization of strategies to reduce time delay in production activities. A manufacturing industry (Support system (SS) LTD) work process route sheet is used to demonstrate how the factors using the arena simulation model to detect the causes and effect of time delay and how it can be reduced or eliminated. The use of case studies in the report has identified real-life challenges and opportunities that help to solve the problem of time delay in production activities manufacturing industries in Nigeria using Dangote Cement and Mantrac Nig. Ltd as case studies.

Keywords: Optimization, Industries, Time Delay, Manufacturing,

I. Introduction

As a result of the present trend of changes in technology and the way of operation in the technological revolution, it has become imperative for various manufacturing industries to scale back and eliminate time delays in their various production activities. According to (Thompson et al.,2010), it is necessary to understand the history of the industrial revolution and the forces which have driven it to the stage we are presently.

From the technological revolution (mechanization through water and steam) and production lines using electricity originated within the second revolution. The fourth technological revolution started after the third with the adoption of computer, automation and enhance it with a smart, autonomous system linked via data and machine learning. This phase is known as industry 4.0 which is an industrial revolution that focuses on interconnectivity, real-time data, machine learning and automation etc. Industry 4.0 allowed various industries to optimize their operation quickly and efficiently by knowing what needs attention and solution to various production problems.

The various challenges that the Nigerian industry faced in their production activities mostly in the manufacturing sector. Time delay is one of the problems that affect the production activities in manufacturing industries. The challenges described by the National Bureau of Statistics of Nigeria are discussed in the article (Rahman et al., 2020). Another article states that Nigerian industries faced the major challenge of power supply (Raji, 2018) which is affecting the industries productivity rate.

In the world of advanced technology, implementing optimization strategies becomes easy for the

The purpose of this research is to further look at various optimizing strategies that reduce delay (downtime or wait time etc.) in manufacturing activities in some selected factories. On getting the informations on factors that causes time waste &time delay, it is imperative to also know the solution that can be proffered to solve those problems. Since growing revenues and cutting the costs of production are two important aspects of organizational growth.

Thus, optimization could play a crucial role for manufacturing companies in profit generation and operational improvement (Trojanowska et al., 2018). It is not a surprising fact that manufacturers look for new strategies in manufacturing that can reduce time delays in their production activities. The paper also identifies and suggest new optimizing strategies to overcome these time delay in production activities of the manufacturing industry in Nigeria.

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II. Materials and Methods

2.1 Data Collection

To promote further relevant input, open-ended questions was asked, to allow staff to share their thoughts on what is done well and what might be done better to enhance their production process.

The questionnaires are in terms of reflecting the objectives of this research and aid in the analysis of the data. The questionnaire were structured around key themes that are linked to the research objectives and will also discuss the main areas coming from the literature review. As an indication of the depth of focus, the Dangote cement factory staff and Mantrac Nigeria limited staff were requested to fill in some information about themselves, to answer some initial questions on their job satisfaction with the company before answering the question on time delay in their various jobs and workstations.

Table 1: Summary of Questionnaire Themes and Questions

Theme	Number of questions
Employee details	6
Purpose of the survey	1
Major time delays in your work environment affect production activities	1
Suggestions for the improvement and solutions to factors that cause time delay?	1
Main things we need to do to improve the overall performance in the factories	1
Continuous Improvement	1
records for the delay	1
Open questions	12
Total	24

The questionnaires were sent out across to different staff, from development grade engineers to senior management grades. The existing works of literature will always be considered to have in-depth knowledge of the keywords in the topics.

Secondarily, data in the form of the 'written down process' and formal learning materials were collected from the company's intranet pages and reviewed to support the overall analysis of the process. Analysis of the primary and secondary data, and the information gathered allowed the researcher to achieve a greater understanding of the issues surrounding time delay and optimizing strategies in production activities.

2.2 Factors that cause time delay in production activities of manufacturing industries in Nigeria.

After reviewing several pieces of literatures, some of the common causes were identified which could cause time delays in production activities of manufacturing industries in Nigeria. Some of the causes are discussed below:

(i) Availability of material: According to Ammar et al., (2013), only a few raw materials can be sourced locally by the cement industry of Nigeria, which implies some raw materials are being imported to complete the production supply chain. Even the materials that are locally available are not enough to fulfil the manufacturing process of products according to the demand of the customers. Therefore, according to the views of Ammar et al., (2013), the company like Dangote cement must import from countries to fulfil the demand for raw materials. They mainly import materials from Indonesia, Malaysia, and China. The process of sourcing, procurement as well as transportation of the materials requirement of manufacturing experiences delay. Furthermore, after the raw material reaches the country, most companies use the land as a means of transport for raw material. Mostly the lack of effective rail system in Nigeria makes material transportation to depend on road.

According to Ammar et al., (2013), this further increases the time required for sourcing the raw material for the further manufacturing process.

(ii) The wrong estimation of material that is required for production: According to Gao et al., (2014), When sourcing material for the manufacturing process, the project management team atimes make wrong estimation in costing and quantity of

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material they will require for production activities. Hence if that estimation is not accurate, there can either be a shortage of raw material or an excess of raw materials. Whenever there is a shortage of material, the operations for manufacturing cement will be disrupted and management will be forced to reorder the material which will take lots of time before it gets to the mills. This, therefore, led to time delays which affect production activities in the industries.

This also makes companies incur an excess cost, which can disturb the budget for the whole project and thereby further impacting the lead time.

This view was supported by Ahiaga-Dagbui & Smith (2014), as they added that there is a possibility of reordering of materials that might not likely be the ones that were previously ordered which can also delay the process.

(iii) Poor workmanship: While manufacturing cement, several processes need to be undertaken in the mills. According to the views of Hwang &Yang (2014), bad workmanship or poor performance of employees also delays the manufacturing process. The machines and human inefficiency and operational abilities hinder the manufacturing process of cement in the company thereby causing a delay in the production activities. Hwang & Yang (2014), also emphasis on wrong operation and installation if done by the employees and attitude of "quickly finish the work", could also cause delays in lead time. When such discrepancy of work is noticed, often an investigation takes place and due to this, the manufacturing process in the cement industry is often delayed. They may also disrupt the operation efficiency in the plant, and more raw materials will need to be reordered which will take lots of time to arrive in the plant and hence the process is further delayed.

(iv) Quality of raw material: According to the views of Russell et al., (2015), sometimes time delays can occur due to the quality of raw materials. Sometimes, improper handling of raw material during the shipment can cause some major defects in the product. Sometimes the defect is repairable and sometimes it is not. Whenever the raw material cannot be managed, repaired, or utilized, the company will have to replace it with a new product. In the cause of sourcing, the production process and other activities might experience a delay in the cause of procurement and logistics until when available before the plant will be able to start the manufacturing process (Russell et al., 2015). Therefore, the bad quality of raw materials can impact the manufacturing process and hence, increasing the lead time.

(v)**Inconsistent customer demand:** Sometimes it is difficult to analyse the volume of products that can effectively fulfil the requirement of the market Dolgui et al., (2013). For instance, there might be a certain type of cement that is required by the customers and will not be available in the stock of the company (Dolgui et al., 2013). There is also a possibility that local supplier does not have enough raw material through which they can manufacture the required type of cement. In such a scenario, the company will have to source raw materials from an overseas supplier, which as mentioned earlier, will halt the operations of the company and hence delaying the production activities.

(vi) Special requirements by customers: When the customers need cement for special purposes may be to build special infrastructures like prisons, hospitals, or certain types of offices, then the cement which is required has differential requirements. According to the views of (Jarkas & Haupt, 2015), some types of buildings require cement of high quality and properties.

However, this view was opposed by Dolgui et al., (2013), Since the technology used in making such materials changes several times, therefore manufacturing large stocks of such cement can lead to heavy losses once a newer type of cement is needed which is produced using better technology. In such cases, there are changes in the market and demand which may also bring a kind of change in the mode of operation. Therefore, the company will have to manufacture such type of cement base on customer's demand. Most time sudden changes in market and customer demand may cause a kind of delay in production activities.

(vii) Productivity of the workers: According to the views of Shanmugapriya & Subramanian (2013), the manufacturing industry needs greatly trained skilled workers on their various operations. Especially in the manufacturing of types of cement, workers play a significant role in various operations, transportation of material from one place to another. Shanmugapriya and Subramanian (2013), emphasis on the mistakes some industries make by employing unskilled labour in the critical section of the industries. In the cause of maximising profit, companies make mistakes of hiring unskilled labour, especially in manufacturing sectors where lots of physical work is required. The inefficiency of workers affects production activities mostly when incompetent workers oversee production activities. The incompetency of workers tends to affect work and operation which further delaying the manufacturing process.

(viii) Poor management: Ruqaishi & Bashir (2015), says one of the most significant factors which can cause the increase in lead time is the poor production management of the production activities. Inefficient planning and organising are some of the primary causes of time delay in production activities. There is a need for proper production scheduling and planning for effective production. Scheduling of employees and their working hours in such a way that they will be able to complete the manufacturing

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work in time without compromising the quality of the work (Aziz et al.,2013). According to Alinaitwe et al.,(2013), communication gaps among management and the stakeholders can inevitably lead to delay in the production and projects execution. The management of the company must communicate with all the relevant suppliers and schedule the deliveries of raw materials to avoid delays in production activities.

(ix) Slow decision making: According to Ansar et al., (2014), slow decision making is a critical factor that has consequences like cost overruns and delays of the commodity delivery. Sometimes, workers require confirmation before moving to the next process of an operation. The workers must be proactive to ensure a prompt and smooth manufacturing process which an efficient production system.

III. Discussions

3.1 Strategies for reducing time delay

After close evaluation of various factors affecting the manufacturing activities of the companies (CASE STUDY), some optimizing strategies were identified after analysing some relevant literature which give insight on how to effectively minimise or reduce time delay in production activities of manufacturing industries in Nigeria.

3.1.1 Lean six sigma approach

According to the views of Shamsuzzaman et al., (2018), lean six sigma is a procedure through which an organisation minimises the cost and time of manufacturing processes by eliminating the waste and unnecessary steps which lengthens the whole manufacturing procedure (Carretero et al.,2010). According to the views of Singh et al., (2019), this technique essentially focuses on identifying aspects of the manufacturing process which causes unnecessary costs and wait time within the procedure of manufacturing. This unnecessary cost and wait time are often developed due to overproduction, defects identified during the manufacturing process and various other factors (Singh et al.,2019). As mentioned earlier, that lean six sigma is associated with eliminating waste, this waste is often recognised as an unused talent, excess stocks, errors, overproduction etc.

The lean aspect of the lean six sigma approach is associated with speed, while the technique aim is to increase the speed of the process by eliminating unnecessary steps and wastage so that there will no impact on production completion.

One of the major aspects of this strategy is to solve the time delay problem which will inevitably lead to a quick manufacturing process. These processes do not focus on solving the problems of the manufacturing process, but rather focus on the problems due to which the probability of delay in the manufacturing process will be able to reduce the lead time (Salah et al., 2010).

Lean six sigma is a combination of two techniques, lean manufacturing, and the six-sigma approach. Lean manufacturing eliminates the waste in the manufacturing process and on the other hand, six-sigma is aimed at "reducing variation" in the manufacturing process. This technique encourages the practice of using skilled workers along with various equipment to improve the processes of manufacturing the product (Singh et al., 2019).

3.1.2 Planning and organising

According to the views of Turner & Zolin (2012), delays in schedules can effectively be minimised if the planning and organising are efficient. Proper production scheduling and production planning is also another way to reduce time delays. A clear plan is necessary so that operations of the manufacturing process can be carried out efficiently. However, according to the views of Doloi (2013), a team should be developed which will be responsible for planning so that the probability of errors can be minimised. It was also discussed that the resources should be organised in such a way that no resources will get wasted and the manufacturing processes will be completed on time. For instance, for one process of cement manufacturing, only 10 workers are required with one piece of equipment, then at the planning stage, it should be ensured that no more than 10 employees and one piece of equipment are allocated for those processes since it will result in wastage of resources and delay of manufacturing processes (Doloi, 2013).

According to the views of Mir & Pinnington,(2014), planning and organising of usage of the resources are important for optimisation in manufacturing processes. According to them, if there is no proper planning about how the resources will be sourced and used then the time delay is not avoided. Therefore, planning and organising are essential for the reduction of time delays in production activities of manufacturing industries.

3.1.3 Effective procurement management

According to the study of AlSehaimi et al., (2013), effective procurement management of raw material that will be required in manufacturing has emerged as a central theme. This also means finding the vendors, finalising the contract, deciding the schedule

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and so on. According to the views of Lin (2016), he demonstrated that the defectiveness of the materials provided by the supplier has a direct impact on the scheduled time of customers, through his "vendor-buyer supply chain" model.

According to Rane et al., (2019), while deciding the procurement of raw materials other factors like delivery time must be considered rather than deciding solely based on the prices of raw materials. As per the opinions of Ponte et al., (2018), reduction of lead time can be done with the help of efficient supply chains. They asserted that a cause of time delay in manufacturing processes has been experienced in the cause of procurement of resources. Therefore, an effective procurement plan is suitable as an optimisation strategy.

3.1.4 Implementation of Proper Advanced Technology

According to Fan et al., (2013), manufacturing industries should avoid the time delay in manufacturing processes by avoiding obsolete equipment and technology. This is also necessary for maintaining a competitive edge since most firms use advanced technology in their manufacturing process, making them more efficient. Using efficient technology in their production activities help to make operation seamless, functional, and fast. With the use of these advanced technologies, risk and other problems are being reduced because those machines work with precision.

According to the views of Isaac et al., (2017), as an optimisation strategy that can reduce time delay, make use of advanced technology.

3.1.5 Setting a clear scope

Scope management of the project is also an important aspect that is crucial for the success of the project (Cheng, 2014). It is one of the aspects of "PMBOK (Project management Body of Knowledge)". According to Cheng (2014), after taking relevant information from the stakeholder, management will establish a clear scope for the project. This scope is further divided into "elements" for its easy control and minimising the "cost overruns" and delay of the manufacturing process. It is also important to identify and establish a general and specific scope for the project. It was also required that the "deliverables" should be mentioned for every phase of the manufacturing process to avoid any kind of errors and misunderstanding.

Since a significant risk that was identified was the rework that needs to be done, it was established that setting up a clear scope can minimise the risk for the need for the rework of the production process. It was also mentioned that "cost-analysis" is important to be conducted before establishing a scope for the project (Cheng, 2014). When the client verifies the document related to a general and specific scope, the probability of rework and changes in scope is minimised, therefore minimising the risk of the time delay of the production processes and activities. However, it was also mentioned that scope must be established by experienced professionals since poor statements along with the mistakes in the contract can lead to lots of rework which is not good for the profitability of the industries (Cheng, 2014).

As asserted by Brewer & Strahorn (2012) changes in scope can cause time delay therefore, as an optimisation strategy setting a clear scope is necessary so that last-minute changes and delays can be avoided.

3.1.6 Efficient staffing and required workforce

The hiring and selection process of the workforce should be efficient and transparent. It was suggested that the firm uses a comprehensive approach while hiring employees, especially for the senior position. Rather than relying on an interview as a source of evaluation. A firm should use the approach of the three-phase section which consists of application filtering, the interview process and lastly practical test. Whenever there is a decrease in productivity of the workforce, it becomes essential for industries to evaluate the reasons which sometimes caused by lack of motivation among the workforce since an efficient workforce is crucial for successful process management. In evaluating the reason for the lack of productivity, management should ensure that a communication channel is provided to the worker. Knowing the reason for the lack of motivation, the firm should actively work on the strategies so that workers will be motivated. It is also advisable for the industries to introduce a reward management strategy for the workers. Incentive programs are also a strategy that can assist in increasing the productivity of the workers (El-Maaty et al., 2017). A firm should also provide promotions to deserving employees so that they will realise that the industries appreciate the efforts of the employees. By adopting such strategies, the industries can minimise the risk of a lack of worker's productivity and poor workmanship.

3.2 Introduction of optimization techniques from production expert

3.2.1 Taguchi optimization technique.

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Kirwin et al., (2020) gave their view on Taguchi method as a scientifically disciplined mechanism for evaluating and implementing improvements in products, processes, materials, equipment, and facilities. A production line can adopt Taguchi principle for effective operation and production efficiency. These improvements are aimed at improving the desired characteristics and simultaneously reducing the number of defects, the delay time in production, by studying the key variables controlling the process and optimizing the procedures or design to yield the best results.

As the Taguchi method is more oriented towards experimental design. The method is applicable over a wide range of engineering fields that include processes that manufacture raw materials, subsystems, products for professional and consumer markets. The method can be applied to any process be its production activities, engineering fabrication, computer-aided design, banking, and service sectors etc.

Taguchi proposed standard of 8-steps procedures by applying his method for optimizing any process. In Taguchi Method, the word "optimization" implies "determination of BEST levels of control factors. This in turn implies that the resources (materials and time) required for the experiments are also minimum. Taguchi Method is a process/product optimization method if implemented in production activities can help reduce time delay and serve as determine the best levels of control factors.

3.2.2 Optimal operation

Another technique that can be adopted as optimizing strategies used to reduce time delay is by introducing optimal operation which also is also known as process optimization. This goes along with lean logistics and supply chain, lean scheduling, lean safety etc. It is maintaining focus on the goals of the system approach by ensuring zero downtime, zero defect, minimize non-value added time etc.

3.2.3 Investing in automation

For manufacturers operating in Nigeria today's saturated markets, reducing the lead times and scaling up product deliveries is critical for sustainable business growth. To achieve efficient and timely production, they must be able to design and manufacture products faster, and ensure on-time delivery. Therefore, automation of production platforms and equipment is critical and essential for faster production and reducing time delay in production. Implementing automation leverage logically helps to increase production and avoid delays, elimination of errors and time consuming design changes. In order to optimize the production process via automation to reduce time delay in manufacturing, companies must to have the ability to identify their main bottlenecks in production process. They need to be able to set the proper goals, by grouping company's activities into modules, employing robotic activities and set the control points. Before setting up optimization strategies, the administrative personnel's should Identify bottlenecks and determine the level of resources necessary to achieve production targets. Provide accurate, objective, quantitative information to improve the process and increase productivity.

3.2.4 Employee's performance issues

According to the BS EN ISO 9004:2018-Quality management, consider continuous optimization and improvement to achieve better productivity, effective and quality product and service delivery. Improvement, learning and innovation is very key to allow employee give their best at work. Performance analysis and resource management of employee and give reward to labor. There is need to train the worker for effective service delivery at work for various responsibility. Ensuring adequate staff training and development and career advancement are also viable proposed solution to reduce delay in production.

IV. Conclusion

Thus paper is focussed on the investigation of the various optimization strategies used to reduce time delay in production activities of manufacturing industries in Nigeria by identifying the root cause of time delay and reduce it in production activities. This was achieved by investigating properly and analysing the existing works of literature on time delay, optimization and getting primary research using questionnaires to get relevant data's &information. Most of the findings were useful and can be implemented in our various production activities in manufacturing industries in Nigeria.

The response from the questionnaire is also a true opinion of workers on the solution to time delay which is valid compares with the literature review. The research has also given new ideas concerning the effect of time delay, limitations and provided gaps in the literature that provide future research opportunities to further understand time delay in manufacturing activities.

References

1. Ahiaga-Dagbui, D.D. & Smith, S.D. (2014). Rethinking construction cost overruns: cognition, learning and estimation. Journal of financial management of property and construction, 19(1), pp. 38-54.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XII, Issue IV, April 2023

2. Alinaitwe, H., Apolot, R.,&Tindiwensi, D.(2013). Investigation into the causes of delays and cost overruns in Uganda's public sector construction projects. Journal of Construction in Developing Countries, 18(2), p.33.
3. AlSehaimi,A., Koskela, L., & Tzortzopoulos, P.(2013).Need for alternative research approaches in construction management: Case of delay studies. Journal of Management in Engineering, 29(4), pp.407-413.
4. Ammar, O.B., Dolgui, A., Hnaien, F.,& Louly, M.A.(2013). Supply planning and inventory control under lead time uncertainty: A review. IFAC Proceedings Volumes, 46(9), pp.359-370.
5. Ansar, A., Flyvbjerg, B., Budzier, A.,&Lunn, D.(2014). Should we build more large dams? The actual costs of hydropower megaproject development. Energy policy, 69, pp.43-56.
6. Adenikinju, A., & Chete, L. (2002). Productivity, market structure and trade liberalization in Nigeria. Economic development department, Nigerian institute of social and economic research (AERC). Research paper 126; African economic research consortium: Nairobi; 2002 Nov.
7. Ayanwale, A. (2007). FDI and Economic Growth. Evidence from Nigeria. African 26 Economic Research Consortium; Research Papers.p165:48.
8. Anyanwu, C . M. (2000).Productivity in the Nigerian manufacturing industry.Research department: central bank of Nigeria. p.124-129
9. Aziz, A. A., Memon, A.H., Rahman, I.A.,& Karim, A.T.(2013).Controlling cost overrun factors in construction projects in Malaysia. Research Journal of Applied Sciences, Engineering and Technology, 5(08), pp.2621-2629.
10. Brewer,G.,&Strahorn,S.(2012).Trust and the project management body of knowledge. Engineering, Construction and Architectural Management.
11. Butt, J.(2020). A strategic roadmap for the manufacturing industry to implement industry 4.0. Designs, 4(2), p.11.
12. Carpinetti, L., GeroÂlamo, M., &Dorta, M. (2000). A conceptual framework for deployment of strategyrelated continuous improvements.The TQM Maga
13. Chete, L.& Adenikinju, A. Trade policy and productivity growth: evidence from Nigeria. Final report presented at a workshop by African economic research consortium (AERC); 28 May–2 Jun.
14. Eretan, G.O.,&Adesina, B.D.(20200. Production Optimization and Corporate Productivity in the Nigerian Manufacturing Industry.
15. Cheng, Y.M.(2014).An exploration into cost-influencing factors on construction projects. International Journal of Project Management, 32(5), pp.850-860.
16. Dauda, Y.A.,& Akingbade, W.A.(2011). Technological change and employee performance in selected manufacturing industry in Lagos state of Nigeria. Australian Journal of Business and Management Research, 1(5), pp.32-43.
17. Dolgui, A.,Ammar, O.B.,Hnaien, F.&Louly, M.A.(2013). A state of the art on supply planning and inventory control under lead time uncertainty. Studies in Informatics and Control, 22(3), pp.255-268.
18. Doloi,H.(2013).Cost overruns and failure in project management: Understanding the roles of key stakeholders in construction projects. Journal of Construction Engineering and Management, 139(3), pp.267-279.