

Optimization and Balancing of Torque Hub Assembly Sequences

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Abstract: The main objective was to look for the most efficient and economical line design. Line balancing is about arranging a production line so that there is an even flow of production from one station to another. All the data required for line balancing was collected and the line balancing model with calculation was done. The data gathered was optimised at Dana Plant. Among the improvement activities conducted in order to balance the line was combining a few processes into one, creating more sub-assembly stations, automation of a few manual processes, and removing waste from the line.

Keywords: Theoretical Framework, Data Analyses, Present state Analyses, Future State Analyses

1. INTRODUCTION

Torque hub is designed and is utilized in gearboxes that power everything from fundamental plant hardware to front line electric vehicles. The basic arrangement of a focal drive and circling gears was created a great many years prior to display the developments of the wheel hub. Today, engineers utilize this apparatus in the places that request high force thickness, operational effectiveness and toughness.

The planetary gear assembly is commonly made up of three main components:

1. The sun gear fits in the centre (central gear).
2. Numerous planet gears.
3. The ring gear (outer gear).

The following components are incorporated inside a planetary gearbox. For higher proportions, we can offer twofold or triple stages. Gearboxes can be powered by electric motors, pressure-driven motors or oil or diesel-consuming engines. The heap

from the sun gear is dispersed to a couple of planetary apparatuses which can either be used to drive an outside ring or a post or pivot.

2. Problem Statement

After visiting and investigating at the organization there are a couple of issues that are distinguished and can be improved. Initially, is the helpless work station format. The work station design is dispersed and confounded. The get together segment is very long way from the mechanical production system. Be that as it may, the process duration taken just beginnings at the stripping station so this doesn't influence the entire process duration of the cycle. Also, a portion of the cycle in the sequential construction system makes some cycle memories a lot higher than the Takt time dispensed by the promoting, when this happen it may be difficult for the line to accomplish the everyday target. Next issue is with respect to the quantity of non-esteem

including exercises that have been discovered which bring lopsided line. This non esteem adding exercises should be recognized and improved so as to decrease the work cost and to advance the line. At last, the cycle which takes the longest process duration adds to bottleneck issue. The Spindle get together is the bottleneck of the cycle as this cycle has the longest process duration. Nonstop improvement exercises should be done to diminish the bottleneck of the line. The tended to issue here is to limit the Idle Time of workstations in the creation line of the assembling unit under examination. Here our goal is to diminish the inactive time, distinguishing the process duration and ideal technique for creation. Line adjusting and its suggestion must be investigated to improve the efficiency of the machine just as association overall.

3. Object of study

To setup up another amassing way for Torque Hubs in the comparing workstations at Dana

Graziano, Ahmedabad, the targets of this investigation are,,

- To improve the productivity of the process.
- To enhance Line Efficiency.
- To recommend Product line and process design
- Operation time investigation on the pre arrangement measure
- Using mistake sealing strategies on the product offering utilizing poka-burden (fool sealing) standards Balance the line utilizing

the process duration breaking down techniques

- Develop the assembly cycle with respect to effectiveness and quality necessities requirements
- Develop ease in work for manpower.
- Eliminate the bottlenecks in assembly process.

3 Literature survey

Assembly optimization is a one of important concerns for production industries in order to improve efficiency by limiting the process duration or the quantity of workstations. The adjusting issues deal with the task of undertakings to workstations to accomplish the reason targets. The overall practice in the sequential construction system adjusting is to appoint errands to workstations so that each all-out season of allotted undertakings to every workstation has equivalent line process duration. Sequential construction system optimizing the assembly line is characterized as to be various workstations can be arranged in designed layout that makes it to move the items between the stations. Information crude materials or semi completed item enter the activity line through the workstations to the yield store. Process duration is resolved for every workstation relies upon the objective item request. It's figured as the hourly accessible season of work per request during that specific period. The two objectives for the Simple Assembly Line Balancing (SALB) are to limit both the process duration and workstation quantity so as to reach at the objective interest.

Puneet (1) proposed a whole number programming detailing to choose which preparing elective from the current station to

use so as to abbreviate the errand term for a given all out expense. Because of the sort of cycle is a manual operation and each non valued can be done at any station, this proposition has been made to accomplish the objective destinations of limiting the process duration or the cost or either limit or augment the work stations.

Ford (4) utilized a multi-rules decision strategy for Assembly Line Balance (ALB) issues where underscored on the quantity of stations, the process duration, the cushion size and the complete expense of the tasks. For the Simple Assembly Line Balance Problem (SALB),

General motors (6) proposed a 'kangaroo' calculation (a stochastic plummet strategy) to treat the issue of mechanical production system with a fixed number of stations. The stochastic drop strategy expects to limit the most extreme work substance of the workstations, which prompts an even work line.

Carnahan et al. (3) proposed a strategy for the Assembly Line Balance (ALB) considering both creation targets process duration and number of station just as labourer physical constraints. RS Rao (7) built up a heuristic calculation to plan adaptable sequential construction system when a few hardware choices are accessible. The goal was to limit the gear cost by controlling boundaries decides the number of hubs which could be eliminated in the project tree and lessening the size of priority chart.

Kamlekar, Gupta, and Dalpati (8) built up an improved format for an assembling organization with the goal of efficiency improvement. The strategy received for the

investigation incorporates distinguishing proof of issues in relation to the current that is format upgraded for every workstation. The need to recognize workstations by their situation along the line is delineated by the commonplace need of line directors to characterize unflinching tasks and drafting requirements. This improved sequential construction system is additionally confirmed by time study strategies. The objective is to get an ideal design as far as line effectiveness and profitability rate. Mahto, and Kumar (4) utilized two usually systems to be specific the Kilbridge-Wester Heuristic methodology and the Helgeson-Birnie Approach to plan a mechanical production system beginning with the work breakdown structure to the last gathering of errands at work stations. The particular destinations of the paper were to advance team size, framework usage, the likelihood of occupations being finished inside a specific time span and framework configuration costs. These targets were tended to all the while, and the outcomes acquired were contrasted and those of single-target draws near.

4. Methodology

4.1 Techniques Employed

The goals of this work, which are to rebuild and adjust a current mechanical production system, require a lot of necessary methodology to be continued so as to accomplish solid outcomes. Most importantly, it is pivotal to have a total rundown of tasks of the sequential construction system and their occasions, since this information is the fundamental purpose behind an assembly system, and

assessment of the optimization of a system can't be obtained without this information. In optimization stage it is basic to survey all optimization adversities of the current system for affirmation of all reasons that lead to these hardships.

Lastly resulting to abstaining from these steps, the production creation framework is composed by benefited procedures. This initial fragment in optimization presents the periods of the undertaking and highlights the methods taken at each stage. In the ensuing zone, the applied technique to do this assessment is portrayed in a point by point structure.

4.1.1 DATA COLLECTION

All the basic information related to the Torque Hub models of been done and affirmed by applying four particular data gathering strategies

- Information Collection and Analysis
- Time and Motion study
- Monitoring
- Interviews and Discussions

4.2 Information Collection and Analyses

Information collection and Analyses can be termed as gathering the information that will be utilized all through the study to be led. Nature of gathered data, which is characterized by McMilly as "how much data and information can be a confided in hotspot for any or potentially totally required utilizations", are highly significant part of information mining since it legitimately influences the result of project.

The information of activities of torque hubs assembly of Dana taken from various outlined procedures, and various information inside the manufacturing plant. Be that as it may, experienced

unconformities between various sources showed issues with refreshing of the information bases, which diminished the unwavering quality of the gathered information for a line adjusting method. Accordingly, obtaining the information from various ways, three extra information gathering procedures are followed to finish and confirm the data to be utilized all through this study.

4.3 Time and Motion studies

Glasseyy characterizes the reason for time concentrate as "to decide the duration that a labourer, or gathering of laborers, could take to make a foreordained appearing with a described execution." Glassey used the articulation "execution" as a movement of yield conveyed as a typical over the working development, and "demonstrated work" as an occupation which is created in detail that stresses high approach of quality, the mechanical assemblies and buffer materials, the working procedures under which the action must be accomplished, and the strategy to yield best quality are critical concerns defined in assembly system. Though these discussions, it might be contemplated that the sole aim of making time graphs at the preassembly station is to choose the valued events – in minimum possible duration in which an operation must be done at standard.

4.3 Monitoring

Monitoring is one of an advantageous strategy to twofold assess the records of exercises which were provided by work instruction development team, and to make duration peruses for non-valued activities which were not recorded/invigorated on the framework procedures. Exercises records

were accomplished by physically checking all stations with the outline procedures of the relating stations, and organizing all the non-valued activities with the Things recorded on the current sheets. Any differentiation among the assignments and records were observed is noted and conveyed for improvement to consulting team. Monitoring technique is applied to check the range of assignments whose duration data is missing on the once-over procedures. Glassey defines how discernment method should be applied in required movement duration assessment and rapidly isolates the cycle into three rule procedures. In the primer procedures, the spectator chooses the action to be composed and its methods, and guarantees that the executive thinks about the duration study and all crucial steps for the action to be taken. The resulting procedures, which is basically the duration information, is the spot where observer starts making assessment, the length of every movement and evaluates the introduction of the manager. At conclusion procedures, the spectator records the hour of day that the assessment completed, discovers the total period of the action and accomplishes the three rule procedure. Duration assessments at the mechanical creation framework are optimized by using the methodology defined by Glassey.

4.4 Interviews and Discussions

Interviews and Discussions were throughout the best examination device for check of the activities records and gave the basic thoughts that influenced the choices taken all through this investigation. Bunting

indicates of inquiry question types that are resolved by the data looked for during the meeting. The meetings made in this venture pointed approving information and sorting from the hypothetical suppositions. From this point of view, the inquiries which results in meetings are always assessed based on value of argument. Other type of interview where yes-no requests, were used during the fundamental gatherings at stations with the head pioneers while playing out the check of action records. The explanation behind these gatherings was to examine if there is an anomaly with the picked up action records from the organization and the social affair assignments at the stations.

In designing a developed and reliable assembly line is critical to dispose of variables that cause misfortunes; the non-valued activities. In that reason, before beginning the adjusting methodology, the creation framework is examined for deciding squanders and the components that make misfortunes.

The device that is utilized for keeping up the ideal equalization on the creation line will be Optimization of assembly line (TAKTIQ GmbH) programming. The product figures the best offset as for the info information, which would then be able to be physically controlled for additional changes. It is conceivable to adjust all info information surprisingly fast, making representation of various choices and their outcomes in a brief timeframe, and acquiring an incredible adaptability for the assessment cycle. The nature of results produced by the product is unequivocally identified with the nature of

the information; the more subtleties are given, the better arrangements are gotten.

The information contribution to TAKTIQ GmbH software for this work incorporates;

- Operation Definition,
- Operation Times,
- Preference Of Operation,
- Product requirements and model inquiries,
- Bill of materials,
- Station Counts,
- Manpower allocation,
- Buffers at specified station if any,
- Tact and Throughput time,

The basic data needed for this product to create dependable outcomes is the priority connection of activities. The product allocates activities to stations as per the priority of errands. On the off chance that this connection is characterized not completely or not accurately, infringement of errand arrangement during task of undertakings to stations is unavoidable. This issue turns out to be more genuine when managing the succession of many tasks, i.e., the quantity of Torque center point pre-gathering activities.

5. Present State Analyses

5.1 WorkStation Investigation

5.1.1 Movement of Assembly at various Workstations

There are 18 assembly stations and 25 sub-assembly stations at the Hub production line. The number of manpower – barring 8 group pioneers and 28 sub assembly station have manpower of 183. Group pioneers are not checked on the grounds that they don't work legitimately on creation line. 44 of these 183 manpower perform other assembly operations

5.1.2 Cycle Times

Takt time: 130

Time unit: minutes

6. Future Optimisation

6.1 ASSESSING THE WORK STATIONS THAT NEED MODIFICATION

Planning the developed assembly framework without examining and taking out the non-valued activities of the system. All activities must be assessed against standard procedure regarding the purpose of smoothing out the system. After every accompanying task after the quality mishaps has been assessed and the significant issues with the current exercises at workstations are noted and eliminated.

Observing the activities at each individual workstation, the main activity is to differentiate between valuable and non-valuable tasks and create arrangement recommendations to dispose of them. Planning the future condition of the assembly could be developed simply subsequent to optimizing the present line from its non valued activities and having the last rundown of tasks that ought to be adjusted in another association. End measure included eliminating activities from the production system and re-tending to them to other more suitable divisions.

Deciding idles through at a creation line is a period taking and confounded technique that requires profound examination of every activity in vast mention, that was not the aim and can't be finished inside the time furthest reaches of this task. Consequently, the spotlight has been determined to the

most critical activities of workstation the task which are not proper tasks; non-esteem included pieces of individual tasks are also examined and eliminated.

6.2 Assembly Line Obstructions

Assembly activities are continuous, amassed parts are perplexing and have numerous segments, which expand activity times. Priority connection of the get together components is severe, not permitting different undertakings to be made simultaneously. Notwithstanding the overall qualities of the pre-get together errands, high and changing item blend brings about numerous and moving bottlenecks to develop on the transport pre-sequential construction system.

6.3 Wastes

High recurrence of non-valued wastes included tasks is the fundamental issue that is seen at the transport preassembly line. Moreover, task-explicit station arrangements, for example, lodges or lifts on the pre-sequential construction system don't permit task to stations with such hardware because of ISIG, which expands balance misfortunes. So as to keep up an even mechanical production system, workstations where complex operations are to be done and tasks that require extra work and high material taking care of rates ought to be disposed of. The manpower should just perform their job efficiently and keep focus on single operation without involving in various operations.

7. Results and Discussion

7.1 Manpower productivity

The quantity of assemblies at the mechanical production system isn't liable to

change all through this examination. In this manner, because of the diminished number of manpower at the mechanical production system, the work efficiency will increment with the use of the proposed framework. The pace of increment principally relies upon which situation and an enhancement of up to 25 % in manpower profitability is conceivable later on framework.

7.2 Overall Efficiency

Th most critical concern in assembly is to reduce overabundance limit at the stations so inactive occasions and nonprofits included work at the creation framework are limited. Taking into account that a similar number of yields are delivered by fewer administrators in a similar term, and the cycle times are decreased for similar items, it tends to be said that the effectiveness of the pre-sequential construction system expanded because of this examination. Also, diminished inert occasions at stations and new methodologies created for dealing with tasks that cause takt past due – which is the best waste as far as

Effectiveness is different variable that improve the proficiency of the line. Not quite the same as the past framework, activities causing takt late won't be finished by revamp. Rather, they will be finished by joker laborers immediately at the relating station with the goal that squanders brought about by over-preparing will be disposed of. With the new line parity and administrator arranging, the greatest equalization defer time (complete inactive duration) in the line can be diminished up to 70 %. Likewise, the most extreme complete takt late can be decreased 80 % with a similar technique.

7.3 Cycle Duration

The enhancements for the ongoing creation framework zeroed in on taking out recognizable squanders in and eliminating activities which are suitable for the pre-mechanical production system. By arranging the necessary ideas for redefining those tasks and eliminating them from the pre-mechanical production system, a considerable decrease of line activity of about 30% is accomplished.

7.4 Manpower Effectiveness

Appointing unskilled Production line at any job making in assembly has tremendous effect on effectiveness of assembly. Variation misfortunes are predominantly brought about by the idea of fixing of manpower at the stations; at a sequential construction system which is adjusted at maximum unpredictable case, the manpower at workstations stay inactive owing behavioral issues, which is a limit misfortune for the workstation. The quantity of administrators needed to finish the activities at the pre-sequential construction system varies for various items, and this ought to be considered during adjusting the line for taking out limit misfortunes.

8. Conclusion

This work shows that an unoptimized assembly line system may create huge limit losses in a combined example, which requires a consistent waste disposal and adjusting approach underway. With ordinary techniques it is exceptionally hard to deal with such an undertaking at a sequential construction system with the quantity of activities arriving at a couple hundreds and much of the time changing item properties.

The created outcomes all through this examination recommends, with the ideal singular line structure of 22 workstations and 63 minutes of takt time, so as to accomplish most noteworthy expansion over the existing structure in regards to decreased operational capital and utilization of available resources, the new assembly framework must be formed with the ultimate objective that,

- *All the non-valued job that does not constitute any benefit to system must be redesigned and removed from assembly chart,*

- *The assembly must be optimized for minimal number of manpower at stations and in case where schedule if high surplus workers will be provided,*

- *Assembly stations should be re shifted in way so man and material movement will be less,*

- *The communication with logistics parties must be well so there should be no obstruction due material shortage.*

Simultaneous approach of mentioned improvements at the assembly production system will lead to,

- *A singular line of system 19 stations and 63 minutes of takt time,*

- *30% Improvement in buffer capital,*

- *19% Improvement in process duration,*

- *13% Improvement in manpower Count,*

- *60% Improvement in total inactive durations,*

- *50% reduction in total takt overdue,*

- *Nearly 20% Improvement in work supply logistics,*

- *20% improvement in Manpower utilisation,*

Also the new developed optimized system incorporates new fragments of the transport creation line will gain a justified model, which gives the preparation of a potential incorporation of these sections in future

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