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Checking the activities and Performance Management in the Automotive Industry

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Abstract - *The subsequent paper details the preliminary findings of a case study being undertaken in the auto industry. Through more effective production sequence planning and its control, the project aims to improve operations management. The report analyses the problems with production plan execution monitoring. The theoretical underpinnings of the study and examine the key issues raised by performance analyses of manufacturing systems.*

Key Words: **production planning, production control, MPS, performance measures, production sequence.**

1.INTRODUCTION

The manufacturing system is viewed as a complex system made up of several economic, social, and technological subsystems that are influenced by the external business environment. Production planning must be able to deal with uncertainty and support the capacity to meet customer expectations for quicker delivery times, higher quality, and cost effectiveness in a dynamic, ever-changing business environment. The proper procedures for process flow monitoring and normalisation in case of fluctuations, whose scope is greater than the manufacturing system's buffering capabilities, are necessary for the effective control of production processes. The usual approaches to production planning and control are sometimes insufficient in unexpected situations. A crisis that results from insufficient planning and control of the manufacturing process could adversely endanger the ongoing operations of the production system. The car manufacturer in the scenario that served as the inspiration for the project has trouble completing the due-to-order deliveries of the completed product within the time frame demanded by the clients. The goal of the study was to enhance production planning and control procedures in order to boost the planned production sequence's reliability. The preliminary analysis revealed a research gap regarding the methods for assessing operations management performance in uncertain circumstances. The authors of the study that follows claim that the effectiveness of operations management is measured in relation to the final goods that are produced within a certain production cycle. The presentation of several unique metrics that might be used to track manufacturing systems in the automotive industry is the paper's main contribution. The study is structured as follows: in Section 2, where the topic of production planning and control under uncertain conditions is covered, the theoretical underpinning of the research is offered. The case study description and the authors' suggested remedies are included in Section 3. In Section 4, final conclusions are presented as well as the steps for further research. The main shifts in industrial strategies can be attributed to the development of the market and vehicle usage conditions on the one hand, and to the availability of new technology as well as safety and environmental regulations on the other. Competition among rivals causes differing rates of development at various epochs. Due to pre-existing industrial systems and labour agreements, production systems advance gradually; however, business strategies must continually be centred on product/market aims, with regular evaluations of one's closest rivals.

2. Industry Operations Management System

In order to create an alluring product mix for assembly plant balancing, the European automotive industry forecasts consumer demand for volume and item specifications many months in advance. Actual client orders are either accommodated into the production schedule that has been programmed months in advance or, to the extent that production flexibility permits, the forecasted orders in the system are modified to meet the needs of the customer. When real production sequence is disrupted and deviates from imagined plans, the line balancing strategy creates a need for accurate sequencing management and prompt response. The management of business procedures to achieve the best level of productivity within an organization is known as operations management (OM). In order to increase an organization's profit, it is concerned with transforming resources like labor and materials into products and services as effectively as feasible. Operations management solutions are designed to enhance team performance and motivate them to concentrate on tasks that are essential to the expansion of their organization. An organization has various departments, and each of them is responsible for achieving its own objectives. Typically, an OMS acts as a guide to make sure that these diverse departments collaborate to meet shared business objectives.

2.1 Sequencing in Automotive Industry

The manufacturing method under consideration is typical of the modern European automobile industry and combines classic mass production elements in the department in charge of pre-treatment with the lean production idea in the area of final assembly [1].

High stability characterizes the industrial system.

- stable production strategies
- Many weeks in advance, the Master Production Schedule (MPS) is created.
- extremely similar production processes.
- Despite having a very similar product structure (BOM), they may differ in a few small details like color.

The following two production planning policies are combined by manufacturers to safeguard the integrity of the production system and realize scale-based cost savings:

- build-to-order
- build-to-forecast

Figure 1: Build to order requirement model

The ability to predict the future is a problem that is present in many disciplines, from engineering to physics and economics. The grey forecasting model has become popular in many different study domains in recent years due to its ability to provide accurate predictions with little data.

The car sector is typical for the production sequencing procedure [2]:

- **Order entry** is the process of determining whether an order can be built and, if it can, transferring it into the order bank.
- All unsold orders are kept in the **order bank** until the production schedule is set.
- **Order scheduling** is the process of selecting orders from the order bank and allocating them to build intervals (often weeks) at various factories. Daily, biweekly, or weekly delivery are frequent requirements for automakers' stamping vendors. Stamping factories can significantly lower schedule variances when they run production on a weekly timetable to satisfy this demand pattern. The levels of incoming raw materials can be evened out by stampers, encouraging more dependable, repeatable performance from their own material suppliers. Sequence scheduling becomes useful in this situation. The sequence scheduling approach is helpful for balancing production with a little finished goods buffer to account for variations in demand, notably increases. The stamper can select between two corrective actions if inventory monitoring reveals an increase in finished goods: either skipping a week of production of a part when the buffer reaches the level needed to meet the next weekly demand, or reducing the weekly production amount until the buffer is depleted.
- **Order sequencing** is the process of rearranging the planned orders for a construction week into a sequence of build orders for the assembly facilities. Build limits must be taken into consideration by the sequencing tool. In any event, suppliers do not actually receive their final call-off of what is necessary until after the orders are sequenced because only then is it determined which items will be required.
- **Manufacturing,** the orders are forwarded to the body shop after being sequenced, where the order is often identified with the actual floorpan, which is subsequently transformed into a complete body. After the body shop, bodies are gathered to be painted the same colour in order to maximise efficiency in the paint shop. The disadvantage of batching is that it distorts the initial production sequence, making it unpredictable for all future operations to know what automobiles are progressing through the process. Before being placed on the assembly line, the cars are typically rearranged once more after painting to make sure the mix of cars adheres to the restrictions imposed by the line balance operations.

Techniques	Focus
✓ Make-to-stock (MTO)	✓ Scheduling of finished goods
✓ Make-to-order (MTO)	✓ Scheduling of raw materials
✓ Assemble-to-order(ATO)	✓ Scheduling of module production

Figure 2: Production Sequencing techniques and focus

Any changes in order sequence result in issues with on-time component deliveries because all raw material and component deliveries are just-in-time deliveries, which substantially impairs the performance of operations management as a whole.

2.2 Literature review on production planning and management

The analysis of the literature revealed that numerous studies have looked into various buffering or dampening approaches to reduce the impact of uncertainty in production planning and control. The majority of them take into account production systems where planning is based on the MRP concept and Planned Order Release schedule. Guide and Shiverasta [3] provide a thorough overview of the literature. Koh and Saad [4,5] examined a model for the diagnostic of manufacturing planning activities in order to determine the root causes of problems with late deliveries of finished goods and documented the effects uncertainty has on the manufacturing planning system using MRP. When a new production system has been introduced, schedule. The anxiousness in the system is brought on by the high replanning frequency used to overcome uncertainty. Changes in MPS have an impact on the amount, timing, and due date for open orders as well as planned orders of finished goods. The aforementioned adjustments are being converted into overall changes in component requirements and delivery schedules. In addition, there may be differences between the planned and actual release schedules. Unexpected changes in MPS can result in a situation where the materials required for a certain order may not be accessible, especially if the quantity ordered is increased and the delivery date is pushed back. Changes in MPS that affect customer satisfaction on time in the automotive industry, where Just-in-Time deliveries are a typical business practice, are problematic. Numerous studies that have been done in the automotive industry to improve performance primarily focus on integrating planning activities and managing material flow within the supply chain[6,7,8,9]. Customer projections, pertinent production costs, and cost characteristics related to production planning are assessed in connection to one another. By using the planning tool, the production planning process might be automated, saving time for the scheduler.

There is a study gap in determining the impact that MPS execution interruptions may have on operations management performance.

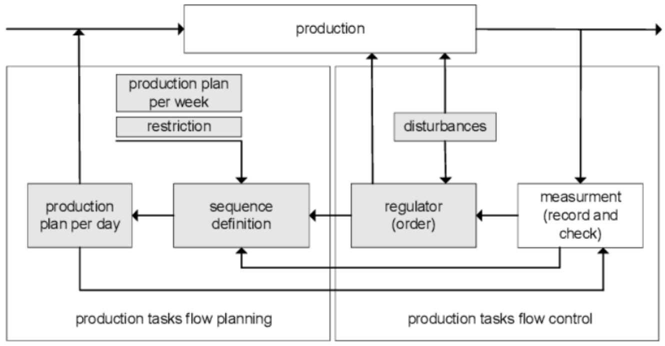

Figure 3: Production Management sequencing

2.3 Performance Measures

The performance indicators used in the automobile sector fall into two categories:

- Financial
- Non- Financial

Financial metrics including market share, sales volume, and sales likelihood primarily reflect sales performance. Most non-financial indicators employed by automakers focus on logistical performance, such as lead time, fill rate, on-time performance, damage, or response, and primarily improve the capacity of First tier suppliers to meet OEM needs. Since there are many non-financial measures that are worrisomely ambiguous and therefore easier to manipulate than financials, it is difficult to demonstrate benefits from measuring non-financial performance. This is because links between non-financial measures and the anticipated results are not self-evident and require careful verification. In order to prevent missing anything crucial, businesses frequently overburden themselves with an increasing number of signs. The research project that follows has shown that in order to quickly assess the success of sequencing activities in the automobile industry, a set of clearly defined indicators for operations management performance measurement is required. The indicators should demonstrate the effectiveness of the overall planning initiatives and point out areas with potential for rising competitiveness. The assumptions behind the methodology guidelines for indicators definition (discussed in section 3) are that the best measurements, from a managerial perspective, achieve the following four goals:

- Validity
- Usefulness
- Robustness

- Integration

The ability of an indicator to characterize performance in three dimensions—what, where, and how—can be thought of as the indicator's validity. The simplicity of the definition and calculation method, as well as the lack of additional operational expense, have been used to define the usefulness of the indicators. In the subsequent research, robustness is defined as the metrics' application to various manufacturing system components (nodes and links). Unfortunately, these requirements cannot be met at the same time. Integration of measures is understood as the capacity to improve performance at the entire manufacturing system and permit conducting extensive field research for primary. Validity and usefulness are particularly applicable at the operational level, where measurements may both capture characteristics of the activity and offer practical assistance. Measures lose value as they are incorporated into higher, more strategic levels of reporting. The robustness and integration criteria, whose value is highest at the consolidated or strategic level and lowest at the operational level, operate in the opposite way [11]. Manufacturers who are able to control availability in this way are able to give customers a larger selection of products while still maintaining the highest standards for quality. Manufacturers can enhance the efficiency of their assembly lines and satisfy demand by flexible and effective part sequencing. Manufacturers should be cognizant of fresh approaches to satisfy demanding consumer demands as productivity rises.

3. Monitoring and improvement for the operations management

3.1 Problem domain

Several differences are seen in the analysed manufacturing system when the complex Master Production Schedule is implemented, both in terms of the order in which the orders are completed and their completion times. On the basis of predetermined criteria that are well-known, the MPS is developed. The assembly plant's various Production Control Points (PCP) are where the monitoring system for operations management now records the production sequence (fig. The manufacturing sequence between the PCP cannot be maintained due to system complexity.

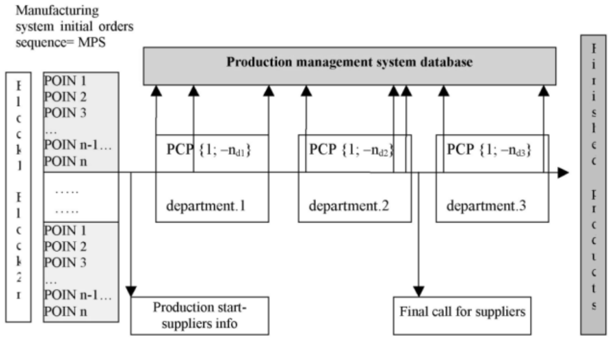

Figure 4: Monitoring of operation management in manufacturing system

Due to a number of unsettling occurrences that happened between the time the observation was made and the MPS was prepared, issues with the production system surface. Events that occurred between the development of MPS and its execution have histories that are known. All raw material and component deliveries follow the just-in-time principle. Suppliers are given prior notice of production schedules (production plans) by a few days. Three time points are used to tell first-tier suppliers about the requirements for both the qualitative and quantitative orders. When the Master Production Schedule is established a few weeks before production begins, suppliers receive the initial preliminary information on the components and materials needed. When the production orders sequence is planned and the first PCP order point (a few days prior to production starts) is reached, the more specific orders are defined. When pre-treated goods depart Department 2, the final call for component supplies is made. Final assembly is the phase that generates the most value (Dep. 3). Since there are no buffers, all supplies of components should arrive at the final assembly department in the proper order. Any major deviations from the anticipated order of events during the production process are caused by issues with timely component suppliers during final assembly. The proper sequencing of manufacturing orders is essential for business performance because of the logic of the production process (Fig. 2).

3.2 Problem Solution

The production order sequence at the beginning of the manufacturing system should match the one shown at the control point at the end of production in an ideal system. The changes in the actual manufacturing system are substantial. The order of the defined block of orders at the conclusion of the production system is inconsistent and jumbled when compared to the entry in the manufacturing system. The perception of the inconsistency is that the original block of objects was broken up into smaller blocks and mixed with additional blocks. As a result, it is impossible to predict with accuracy either the moment at which a defined block of orders will be produced or the moment at which the order following a POIN inside that block will appear. The capacity to deliver clients' requested goods on time is severely impacted by this circumstance, which also affects the timely supply of components for final assembly. The following two indicators have been suggested for gauging the discrepancy between the ideal and actual system states:

- A block of POIN's sequence dispersion range (SDR) is calculated as the difference between the block's maximum and minimum order identification numbers as detected at a selected production control point.
- The number of pairs of order identification numbers that occur at the end production control point in the same order as they did at the initial production control point is known as the sequence order displacement (SOD) for a block of POIN. However, is it also possible to measure the partial SOD within the manufacturing system's defined PCP scope, for instance at the entry and exit of the production department 1.

3. CONCLUSIONS

The report describes the initial findings of a case study done in the auto industry. Through the optimization of production planning and control activities, the studies seek to enhance operations management performance.

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