

ASSESSING THE EFFECTIVENESS OF THE PRODUCTION PLANNING SYSTEM IN SPINNING MILLS: A CASE STUDY AT BAHIR DAR TEXTILE SHARE COMPANY

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ABSTRACT

Within the textile manufacturing value chain, spinning mills occupy a strategically critical position; however, persistent operational inefficiencies including output delays, excessive inventory holding, and underutilized equipment frequently hinder performance. This study evaluates the effectiveness of the production planning system at Bahir Dar Textile Share Company (BDTSC) in Ethiopia. Adopting a mixed-methods case study design, primary survey data from 67 key stakeholders were triangulated with 12 months of archival shop-floor records. The findings reveal a significant operational gap between user perceptions and system performance. While respondents acknowledged moderate capabilities in basic production scheduling, objective metrics demonstrate systemic underperformance: actual production output reached 1,400 tons against a planned 2,000 tons (70.0% achievement), average machine utilization stood at 70.0% (against an 82.0% target), unscheduled downtime reached 1,425 hours per year, and inventory turnover remained low at 2.1 turns per year. Furthermore, delivery reliability was constrained by an On-Time In-Full (OTIF) rate of 62.3%. The analysis indicates that the planning framework suffers from a lack of real-time shop-floor integration, absent predictive modeling, and limited inter-departmental visibility. Rather than isolated adjustments, BDTSC requires targeted interventions, including modernizing IT-ERP infrastructure, establishing real-time inventory and maintenance tracking, and upgrading workforce analytical skills.

KEYWORDS: Production Planning; Spinning Mill; Operational Efficiency; System Integration; Inventory Management; Machine Utilization; Forecasting Accuracy

1. INTRODUCTION

Production planning systems are pivotal for optimizing manufacturing processes, particularly in complex textile operations like spinning, where efficient resource allocation and scheduling directly impact productivity and cost-effectiveness (Ivert, 2009). The goal of these mechanisms is to exhaust the capacity that has been installed while considering production demands and the availability of energy and human resources (de Oliveira, Costa, & Ravagnani, 2017). Moreover, the unpredictability of international markets and the increasing demand call for the use of strong planning structures to be able to adjust and stay competitive in the textile industry (Topaloglu & Kabakulak, 2022). This becomes especially critical in sectors facing constricted output due to energy crises and fluctuating global demands (Alam, Islam, Hossan, & Rahman, 2023). An automated production planning and control device, for instance, can predict future productivity based on current capacity, plan materials, and schedule production, thereby addressing these challenges (Nwamekwe, Mgbemena, Okpala, & Igbokwe). These types of systems typically have advanced prediction models to handle changes in demand and limited capacity, which are very important for reducing bottlenecks and maximizing throughput in spinning mills.

The textile industry has a complex production planning problem, especially the spinning department, where the production process is multi-phased, planning horizons are different, and production requirements are diverse (Karacapilidis & Pappis, 1996). Despite being foundational to early manufacturing systems like the Toyota Production System, many textile companies still contend with inefficiencies stemming from fluctuating market demands and an inherent lack of leanness in their operational frameworks (Mahmood, 2020). The common inefficiencies in the spinning sector are poor resource utilization, increased waste generation, and extended lead times that lower the productivity and competitiveness of the spinning sector (de Carvalho, Lopes, & Raimundo, 2025). For the productivity and competitiveness in the market to remain high within that field, it is a must to have in place robust and efficient production planning systems capable of resource coordination, operation scheduling, and balancing supply and demand in a volatile market environment (Safra, Jebali, Jemai, Bouchriha, & Ghaffari, 2019). Efficient production planning is essential to operational success as it determines the flow of materials, the use of machinery, inventory management, and the delivery of the finished products to customers (Ivert, 2009). To address these challenges, advanced production planning systems are crucial for optimizing resource allocation, minimizing raw material, lowering the amount of operational waste, cutting down lead times and finished product inventories, and reducing processing times (Gomes, Pinheiro, & Saraiva, 2021). Such systems enable manufacturers to operate closer to their optimal operating points, a necessity for high-wage countries aiming to offset elevated production costs (Kins, Möbitz, & Gries, 2025) (Karabuk, 2008; Mwasubila, Taifa, & Kundi, 2022). Because of



this, the implementation of sophisticated computational methods like machine learning and data analytics has been progressively indispensable to companies to increase their responsiveness and to keep their daily operations efficient. Such technologies have the power to facilitate resource management in a more efficient manner and to reduce lead times, whereby manufacturers can be very flexible in the rapidly changing conditions of the market (Mustajab, 2023). These systems enable a proactive response to market changes and demand fluctuations, thus minimizing disruptions and optimizing throughput across the spinning value chain (Fries, Nießner, Ludwig, & Kotthaus, 2025). The continuous drive to reduce costs, enhance operational efficiency, and mitigate environmental impacts further underscores the necessity for robust supply chain management, often leveraging data analytics, AI, ML, and IoT for optimization (Rahaman, 2024). The operational intricacies of the textile supply chain, encompassing aspects from fiber production to garment manufacturing, necessitate sophisticated decision-making processes, often informed by operational research techniques and statistical learning models (Ghasemy Yaghin & Goh, 2023). Specifically, within the operational realm, studies often concentrate on optimizing production resources, scheduling machinery and workshop flows, and sequencing various jobs in the spinning process to enhance efficiency (Lorente-Leyva, Alemany, & Peluffo-Ordóñez, 2024).

The trajectory of production planning in textiles has shifted from traditional, reactive methods to proactive, data-driven approaches, embracing advanced analytical tools to improve adaptability and responsiveness (Ghasemy Yaghin & Goh, 2023) (Lorente-Leyva et al., 2024). This change is majorly influenced by the utilization of Industry 4.0 technologies that provide improved monitoring, real-time insights, and quick reactions to the unplanned disruptions that necessitate re-planning. This paradigm shift facilitates the development of intelligent operations planning that can significantly reduce operational inefficiencies and ensure the timely delivery of finished products, thereby boosting the textile industry's overall efficiency and resilience (Lorente-Leyva et al., 2024). Using AI in production planning is changing the face of lean manufacturing dramatically; it is moving the factory from a mode of just reacting to problems to one of proactively optimizing processes (de Carvalho et al., 2025). Specifically, AI technologies, including machine learning and deep learning, are revolutionizing conventional textile production by enhancing productivity, optimizing processes, and enabling advanced quality control, thereby making human intervention almost redundant in certain aspects (de Carvalho et al., 2025).

State-of-the-art planning systems are distinguished by their capacity to process and interpret large datasets, automate key decisions, and continually improve through AI 2.0 (Lorente-Leyva et al., 2024). Such integration supports dynamic, event-driven re-planning instead of relying solely on fixed, periodic schedules (Lorente-Leyva et al., 2024). On top of that, these smart instruments use complex algorithms to make dyeing processes more efficient, lower the use of chemicals, and decrease the amount of water used; thus, they are in line with sustainability goals. AI-powered solutions also inject a great deal of accuracy and efficiency in recipe development, color matching, and pattern recognition, which, in turn, directly leads to higher product quality and less waste (de Carvalho et al., 2025). The deep integration of these technologies opens the way for the industry to facilitate predictive maintenance and allocate resources most efficiently throughout the production chain, thus lowering the time of work stoppages and increasing the production output. Moreover, the deliberate utilization of production planning and scheduling supported by machine learning and Industry 4.0 considerably increases the operational tempo and flexibility (Mustajab, 2023). This includes the capacity for systems to adapt to changing environments, moving from static, single-solution models to dynamic, multi-iteration approaches that can re-plan in response to disruptive events or at predetermined intervals (de Carvalho et al., 2025). The disparity in performance is particularly pronounced within the spinning division of Ethiopia. For instance, Bahir Dar Textile Share Company encounters spiraling challenges that significantly impede the daily operations of the company; these inefficiencies consequently engender unstable production outputs, protracted lead times, periods of machine inactivity, and a divergence between the established planning objectives and the observed performance on the shop floor (Dedimas & Gebeyehu, 2019). Based on this, the current research is eager to know about the production planning practices at Bahir Dar Textile Share Company through assessing the performance, pinpointing the major challenges, and suggesting feasible changes. The ultimate goal of the research is to bridge the gap between theoretical planning constructs and their practical implementation, thus promoting both academic scholarship and industrial practices in textile production planning.

2. RESEARCH METHODOLOGY

2.1. RESEARCH DESIGN

This study utilizes a mixed-methods case study research design combining quantitative operational metrics and qualitative stakeholder insights to evaluate the production planning system at Bahir Dar Textile Share Company (BDTSC).

2.2. TARGET POPULATION AND SAMPLING TECHNIQUE

The research was carried out in a local textile spinning mill (e.g., Bahir Dar textile spinning mill). The staff who were included during the study were production managers, planners, quality inspectors, and machine operators, as well as the other employees who are directly or indirectly engaged in production planning and implementation as shown in Table 1. The target population comprised $N = 90$ personnel directly involved in production planning, inventory management, machine operation, quality control, and maintenance within the spinning department. The required sample size n was calculated using Yamane's formula at a 95% confidence level ($\alpha = 0.05$);

$$n = \frac{N}{1 + N(e)^2} = \frac{90}{1 + 90(0.05)^2} = \frac{90}{1.225} \approx 73.47 \dots \dots \dots (1)$$

Thus, a target sample size of $n = 74$ respondents was established. A stratified random sampling strategy was implemented across four operational strata to ensure balanced representation. A total of 74 questionnaires were distributed, and 67 fully completed responses were recovered (representing an efficient response rate of 90.5%).

Table 1: Demographic Breakdown of Respondents ($n = 67$)

Category	Strata / Characteristic	Count (n)	Percentage (%)
Job Role	Production Planning & Management	8	11.9%
	Machine Operators & Line Supervisors	34	50.7%
	Maintenance Personnel	13	19.4%
	Quality Control Staff	12	17.9%
Education Level	TVET / Diploma	38	56.7%
	Bachelor's Degree	25	37.3%
	Master's Degree or higher	4	6.0%
Work Experience	Less than 2 years	8	11.9%
	2–5 years	22	32.8%
	6–10 years	24	35.8%
	More than 10 years	13	19.4%

2.3. QUESTIONNAIRE VALIDATION AND RELIABILITY

Content and face validity of the structured questionnaire were established through evaluation by three university academic experts in textile engineering and two senior operations managers at bdtsc. Internal consistency reliability was tested via cronbach's alpha (α) on a pilot sample of 10 respondents (representing ~11% of the target population). The overall instrument achieved a cronbach's alpha of 0.835, with individual subscale values comfortably exceeding the standard minimum threshold of 0.70; production efficiency with α of 0.805, material & inventory visibility with ,2.3. 0.778, machine utilization & scheduling with α of 0.824 and delivery & lead time at α of 0.791.

2.4 DATA COLLECTION METHODS

To confirm the effectiveness of the production planning system, this research utilized a wide range of data from both primary and secondary sources. Primary data, which included the results of the surveys, interviews, and direct observations, were collected with great care by the research team. Quantitative data about the current planning methods, the problems, and the performance of the system were obtained through the distribution of structured questionnaires addressed to production planners and managerial staff. Moreover, qualitative information on operational and managerial issues, which influence the performance of production planning, was collected through semi-structured interviews with key staff members. Besides that, the production processes and planning were directly checked to find the most important bottlenecks, inefficiencies in the workflow, and the actual use of the planning system on the shop floor. Along with the above-mentioned data, secondary information was obtained from numerous internal company documents, such as production reports, planning documentation, machine utilization records, and inventory statistics for a certain period. These data were crucial in analyzing operational trends, measuring efficiency metrics, and locating the differences between planned and actual performance. The investigation was mainly driven by quantitative methods, and descriptive statistics were used to summarize the main performance indicators (KPIs) that showed how the production planning system had been effective. Answers from the questionnaires were assessed with a five-point Likert scale, thus allowing participants to express their level of agreement with the given statements, from (1) strongly disagree to (5) strongly agree. Such a mixed methodological approach served to raise the inquiry by delivering both numerical and contextual insights, so it was possible to make a full assessment of the system's strengths and identify the areas that required further enhancement.

2.5 DATA ANALYSIS & ANALYTICAL FRAMEWORK

Descriptive statistics (Percentages, Means, Standard Deviations, and Relative Importance Index [RII]) were computed for Likert scale items (1 = Strongly Disagree to 5 = Strongly Agree). Objective production records (12-month archival data) were analyzed to calculate Key Performance Indicators (KPIs) including Overall Equipment Effectiveness (OEE), Inventory Turnover Rate, and On-Time In-Full (OTIF) delivery rates. x

To evaluate overall effectiveness, a composite effectiveness score (CES) was aggregated using weighted dimensions:

$$CES = \sum_{i=1}^k w_i^k \cdot X_i \dots\dots\dots(2)$$

where w_i represents the assigned dimension weight based on RII, and X_i is the normalized mean score of dimension i .

3. RESULTS AND DISCUSSION

3.1 OBJECTIVE OPERATIONAL PERFORMANCE INDICATORS

To complement the perception data obtained from questionnaire respondents, historical operational logs from the BDTSC spinning department covering a 12-month period were analyzed.

Table 2: Objective 12-Month production KPI summary at BDTSC

Performance Indicator	Target Benchmark	Actual Observed Mean	Performance Gap	Primary Operational Cause
Machine Utilization Rate (%)	82.0%	70.0%	-12.0%	Unscheduled maintenance, yarn breakages, material delay
Annual Production Output (Tons)	2,000 Tons	1,400 Tons	-600 Tons (70.0% target)	Machine downtime, speed losses, raw material supply gaps
Unscheduled Downtime (Total Hours)	< 500 hrs/yr	1,425 hrs/yr	+925 hrs	Spare part shortages, delayed maintenance response
Inventory Turnover Ratio (turns/yr)	6.0 turns	2.1 turns	-3.9 turns	Excess buffer stock, slow-moving inventory accumulation
On-Time In-Full (OTIF) Delivery Rate	90.0%	62.3%	-27.7%	Inaccurate production scheduling, lead time volatility
Finished Goods Lead Time (Days)	14 Days	24.5 Days	+10.5 Days	Bottlenecks in spinning stages, lack of real-time scheduling

Table 3: Quarterly machine utilization & downtime breakdown

Quarter	Planned Production (Tons)	Actual Output (Tons)	Target Utilization (%)	Actual Utilization (%)	Unscheduled Downtime (Hours)
Q1	500	350	82%	70.0%	312 hrs
Q2	500	390	82%	78.0%	365 hrs
Q3	500	300	82%	60.0%	410 hrs
Q4	500	360	82%	72.0%	338 hrs
Annual Total / Avg	2,000	1,400	82%	70%	1,425 hrs

3.2 ANALYSIS OF PRODUCTION EFFICIENCY

The survey results depicted in Figure 4.1 demonstrate the degree of agreement of the respondents about the effectiveness of the production planning system in terms of the three performance dimensions:

- Series 1: Increasing production quantity (Q1)
- Series 2: Reducing production cycle time (Q2)
- Series3: Improving resource utilization (Q3)

Indeed, people were asked to respond on a 5-point Likert scale from strongly disagree (1) to strongly agree (5).

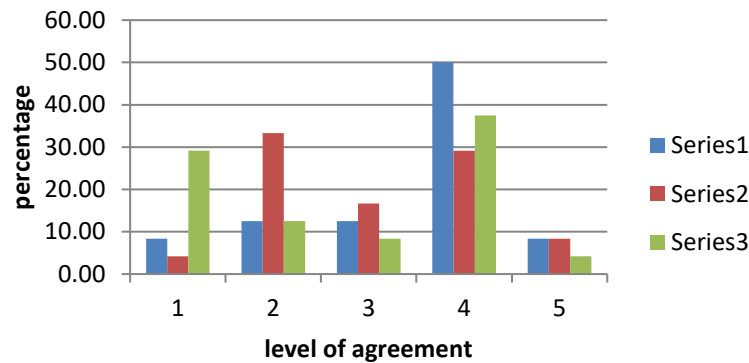


Figure 4.1: Production efficiency

First, Q1 shows the system's contribution to increased production with the same resource input. Nearly 50% of the people surveyed said yes. The latter is a clear indicator that a very positive perception of the system's contribution to the increase of production efficiency prevailed among most respondents. Just a few individuals, 8.6% of them strongly disapproved of the idea, pointing out that the system's contribution to the improvement of productivity was acknowledged by most participants.

As a matter of fact, persons' options to Q2: the apparatus for saving the time of the production cycle were more diverse. About 33.3% of people surveyed disagreed with the statement, whereas 29% agreed with it and 9.5% strongly agreed. Thus, we can assume that the size of the impact on cycle time reduction that has resulted from the process being streamlined is uneven and limited across different operational areas because of the response distribution to this question. Next, Q3 is about the system's performance in facilitating labor and equipping with the resources utilization, the answers were as diverse as for Q2. Around 37.1% of the respondents claimed that the system helped in resource use, while 28.6% were in strong opposition. The differences in this argument suggest that, though some production units have become more efficient through the better scheduling and utilization of capacity, others probably have not received the benefits of the same developments. The underlying rationale for these discrepancies may be attributed to varying levels of system implementation, the presence of technological obstacles, or an insufficiency in user education and training.

By and large, the data reveal that the production planning system has had the most significant positive impact on increasing production quantity (Q1), a moderate positive impact on reducing production cycle time (Q2), and a positive impact on resource utilization (Q3), although effectiveness varies. Though productivity has been improved in several ways by the system, the potential that it has is still left aside. To make the performance level stable, it will be helpful to the textile industries if they take on a more integrated and standardized implementation plan that focuses on synchronization of processes, capacity building, and a user-friendly data collection method. While survey results in Table 3 indicates that nearly 50% of respondents agreed the planning framework supports output goals, objective shop-floor records paint a more complex picture. Total annual actual production reached 1,400 tons against a planned target of 2,000 tons, representing an output fulfillment rate of 70.0%. This discrepancy highlights that while the existing framework provides a basic operational structure, it lacks the dynamic scheduling mechanisms required to maintain target throughput volume under real-world factory constraints.

3.3 ANALYSIS OF RAW MATERIAL MANAGEMENT AND INVENTORY VISIBILITY

Figure 4.2 presents an overview of how much the respondents agreed with each statement, indicating that the production system was effective in enabling the timely availability of raw materials (Series 1 (Q1)), in cutting waste and spoilage (Series 2 (Q2)), and in giving a clear view of raw material inventory levels (Series 3 (Q3)).

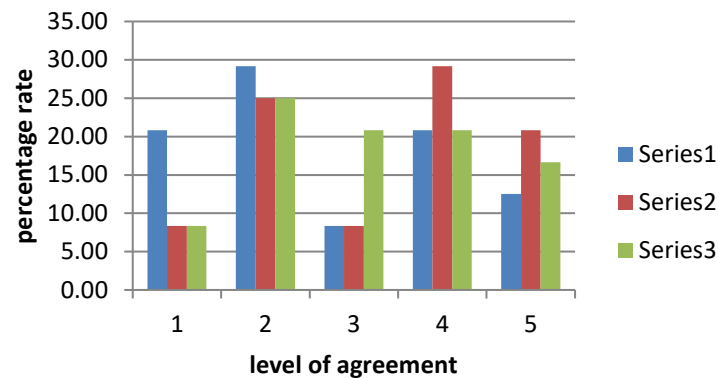


Figure 4.2: Material management

The responses to Q1, which gauges whether the system ensures the timely availability of materials and components, were quite diverse. Most of the respondents (29%) indicated level 2 (disagree), while 21% chose strongly disagree, which in turn shows that a substantial number of participants view the coordination of raw materials and supply of basics as unreliable. Even so, 20% of the respondents believed, and 20% of them were definitely of the opinion, that some respondents have witnessed material availability to be at a certain level in those operational parts where it has been improved. The distribution of answers to Q2, which is about a system designed to reduce waste and spoilage of materials, is mixed, too. The largest number of agreements was (29%) at level 4; thus, several respondents found positive results in waste minimization. However, at level 1 (8.6%) and at level 2 (25%), the disagreement is still quite significant, and this, together with the indication that the waste reduction implementation may not be fully optimized or uniformly executed.

In Q3, the system transparency to provide visibility into raw material inventory levels was examined, and participants' views were more or less evenly split. Roughly a quarter of the respondents (25%) were not in favor of the statement, whereas 21% agreed and 17% strongly agreed. These findings show that there is a moderate level of trust in the system to facilitate inventory transparency, and at the same time, users demand further development of the monitoring and real-time tracking functions to increase their satisfaction.

The production system, according to the findings, is clearly at the first level able to manage materials and inventory. The waste reduction and inventory show that there has been some progress in terms of visibility. However, the disagreement on the timely availability of raw materials is still quite strong, mainly due to problems that have been associated with logistics and coordination challenges, and it appears that these have been ongoing. To enhance their performances, industries are required to implement measures that will enable them to interlink their supply chains, data-driven material plan requirements, and production monitoring through digital technologies so that the flow of raw materials is not interrupted and transparency is kept intact across the entire process. The observed Inventory Turnover Ratio of 2.1 turns per year falls far short of the standard industry benchmark of 6.0 turns. Raw materials and semi-finished buffer stocks remain tied up in storage due to decoupled material requirement planning (MRP). Furthermore, objective tracking shows an average finished goods lead time of 24.5 days (against a target of 14 days) and an On-Time In-Full (OTIF) delivery rate of only 62.3% as revealed in table 2.

3.4 ANALYSIS OF DELIVERY PERFORMANCE AND LEAD TIME MANAGEMENT

Figure 4.3 shows the staff members' opinions about the impact of the operating system on delivery performance, which was evaluated through three main indicators:

- Series 1: Reduction of customer order lead time (Q1)
- Series 2: Consistency in meeting committed delivery dates (Q2)
- Series 3: Improvement in delivery time prediction accuracy (Q3).

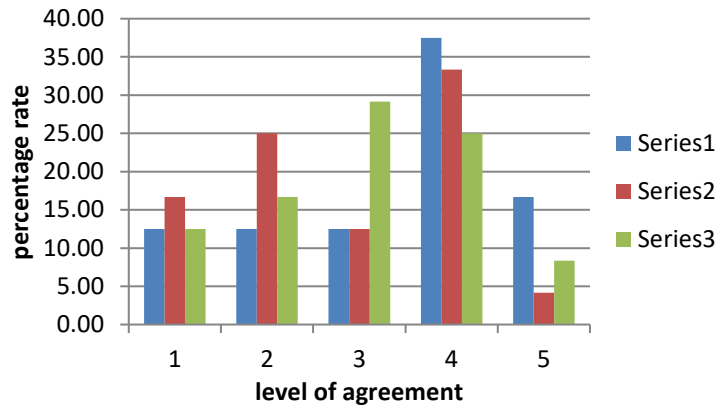


Figure 4.3: Lead Time and Delivery Performance

Q1 is an evaluation concerning whether or not the system was helpful in lead time reduction of customer orders; the survey results reveal a favorable perception. Most of the respondents (37%) marked level 4 (agree), and 21% of them picked level 5 (strongly agree). The number of people who strongly disagreed is very small (11%); thus, it may be assumed that the majority of the participants have recognized that the scheduling and planning mechanisms have resulted in significant reductions of lead time. The question in Q2 is about system support in delivery date assurance, which is committed to being met consistently. The response pattern is similar in that 34% of respondents agreed, and 25% of them strongly agreed. However, about 12% of the respondents disagreed with the view, which thus implies that although delivery reliability has generally been enhanced, there may still be occasional deviations and bottlenecks in certain operational areas.

Regarding Q3, which is intended to measure the degree of accuracy of delivery time predictions, the respondents' opinions were somewhat different. The most significant portion, 28%, is at the 'agree' level, followed by 25% at the 'neutral' level and 17% at the 'strongly agree' level. The results indicate that the respondents are somewhat satisfied with the accuracy of their predictions since some of them acknowledge that there have been improvements in predictive accuracy, while others remain undecided, most probably because of fluctuations in data integration and real-time monitoring systems.

When looking at the findings from a general perspective, they show that the production system has been a major factor in bringing about positive changes in delivery performance, especially in terms of lead time reduction (Q1) and reliability of delivery (Q2). Nonetheless, delivery time prediction accuracy (Q3) remains a problem; therefore, there is a need for improved coordination between production data, order tracking, and customer communication systems. By developing these areas further through the application of advanced analytics, predictive scheduling tools, and integrated supply chain visibility, not only on-time performance but also customer satisfaction can be elevated to a higher level.

3.5 ANALYSIS OF MACHINE UTILIZATION AND SCHEDULING EFFICIENCY

The effectiveness of manufacturing equipment in the production processes was assessed through machine utilization.

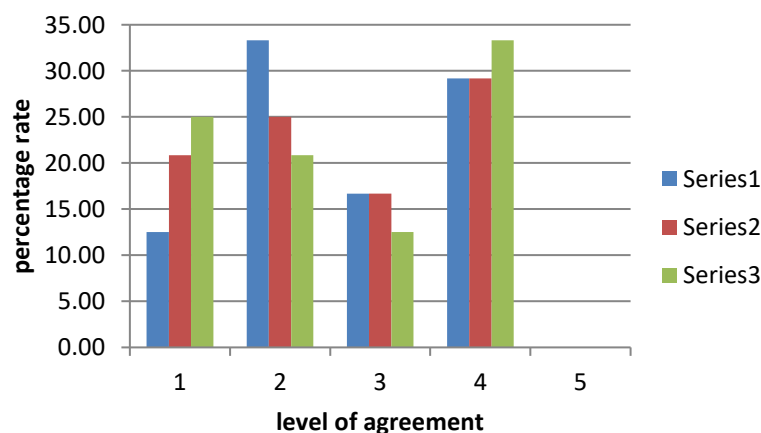


Figure 4.4: Machine utilization rates and scheduling

Figure 4.4 depicts the perceptions of the respondents concerning the impact of the production system on the utilization of machinery and operational scheduling. The evaluation was of three different aspects:

- Series 1: the improvement of machinery utilization rates (Q1),
- Series 2: the reduction of unscheduled machine downtime (Q2), and
- Series 3: effectiveness of machine scheduling to avoid bottlenecks or idle time (Q3).

Q1 is a question that refers to whether the production system has led to improved utilization rates of production machinery and equipment. Mixed perceptions have been collected, which leads to the conclusion that the results are ambiguous. The most significant number of people (33%) showed the tendency to disagree (level 2), while 29% were in favor of (Q4). Only 12% of people strongly disagreed, which gives an idea that quite a few improvements are visible; however, a significant number of people still argue that the use of production machinery has not been maximized, probably due to inefficiencies and maintenance issues that have existed for a long time. The analysis of Q2, determining whether the machine downtime that was not scheduled was reduced by the implementation of the system, reveals a pattern similar to that of Q1. The majority of the percentage (29%) refers to the “agree” position (level 4), and “disagree” (level 2), with 25% follows. This situation indicates the system's partial effectiveness in reducing machine downtime. While some respondents testify to the progress made, others claim that they still experience disruptions, which in turn indicate that the areas of maintenance planning and real-time monitoring could still have more room for growth.

Regarding Q3, which is aimed at determining how well the solution could ensure regular scheduling of machinery and, at the same time, enable it to avoid bottlenecks or idle time, 32% of respondents agreeing, staggeringly account for the highest percentage across all three indicators. Nearly 21% of the respondents disagreed, and 13% strongly disagreed, which implies that despite the scheduling system being generally efficient, some operational gaps may still be present, which could result from limited coordination between production planning and equipment availability.

In general, the findings of the research indicate that the production system has achieved a moderate level of success in terms of the performance of machinery and scheduling efficiency. The greatest improvements can be seen in the effectiveness of scheduling (Q3), while still, machinery utilization (Q1) and downtime reduction (Q2) are at levels that require further enhancements. Consequently, apart from optimizing the system's working capacity, industries can also benefit from predictive maintenance tools, integrated scheduling software, and data-driven performance tracking mechanisms that will not only maximize equipment availability but also reduce downtime and ensure a continuous production flow. A major structural bottleneck identified in the objective data is the low machine utilization rate, which averaged 70.0% across the four quarters (Q1: 70.0%, Q2: 78.0%, Q3: 60.0%, Q4: 72.0%) against the company target of 82.0%. Correspondingly, total production output suffered due to severe unscheduled downtime totaling 1,425 hours across the year (peaking at 410 hours in Q3) (Table 3). These numerical findings directly explain why 33% of survey respondents disagreed that equipment performance is optimized. The primary causes are spare part shortages, reactive maintenance scheduling, and yarn breakages confirm that the current planning tools act reactively rather than incorporating preventive maintenance schedule constraints.

3.6 ANALYSIS OF PRODUCT QUALITY IMPROVEMENT AND QUALITY MANAGEMENT EFFICIENCY

Quality control (QC) is a systematic process aimed at ensuring that products or services meet defined quality standards, thereby enhancing customer satisfaction and operational efficiency.

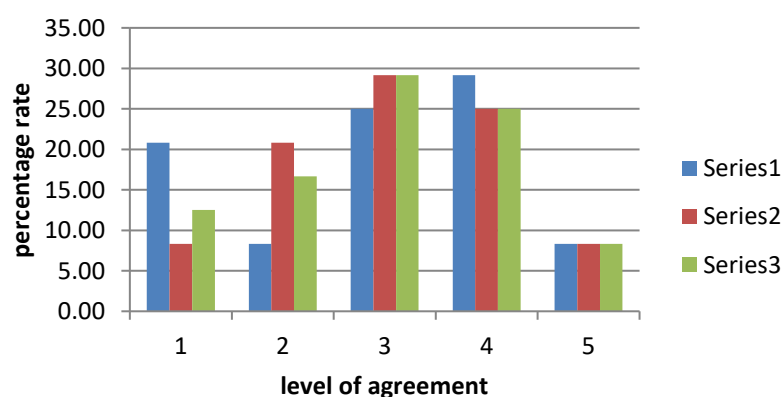


Figure 4.5: Quality Control

Figure 4.5 shows the thoughts of respondents on how the production planning system has helped product quality development and the solving of quality-related problems. The evaluation, in this case, is grounded on three major aspects:

- Series 1: improving the quality of the final product (Q1),
- Series 2: decreasing the number of defective or reworked products (Q2)
- Series 3: making the quality issue tracking and root cause identification easier (Q3).

Q1 refers to a problem that evaluates the extent to which the system has helped in producing a high-quality final product. The responses indicate a wide range of distributions. The majority of respondents gave their assessment as 3 (25%) and 4 (29%) respectively, thus reflecting that a significant number of respondents consider the system as moderately effective in producing quality results. On the contrary, 20% of the participants disagreed with the statement strongly, which may be suggestive that in certain sectors at the stage of production, before quality, there was only slight progress or had not changed at all, and this could be due to process monitoring or execution irregularities.

Regarding Q2, which is about whether the system led to the reduction of defective or rework-demanding products, 29% of respondents considered their answer as neutral (level 3), 25% agreed (level 4), and 21% disagreed (level 2). Such a way of distributing holder opinions discloses that they had mixed perceptions, thus implying that while the system has helped in some cases to reduce defect rates, it has not been able to be used fully for the purpose of minimizing rework and quality deviations.

Q3, which investigates whether a system can help track quality-related issues as well as identify their root causes, had the biggest share (29%) of neutral (level 3) answers, and then 25% at level 4 (agree). Nearly 17% of those questioned disagree (level 2), thus reflecting the belief that the system is only an average tool for quality control, which can provide some insight into the quality of the product but lacks comprehensive analytical or feedback capabilities needed for sound root-cause analysis.

Besides becoming a means of product quality improvement and defect reduction, the production planning system is the cause of these results, showing that quality tracking and issue resolution have space for improvement. Quite a few respondents gave a neutral answer, which indicates that the system's potential has not been fully exploited yet. To increase the system's effectiveness, the implementation of quality management modules, real-time defect monitoring, and data-driven analytics tools would be beneficial. Apart from making quality tracking more efficient, these changes would also enable the quicker identification of recurring issues and the continuous improvement of production performance.

3.7 ANALYSIS OF FINISHED GOODS INVENTORY MANAGEMENT EFFICIENCY

The inventory turnover ratio quantitatively assesses the frequency at which an enterprise sells and subsequently replenishes its inventory within a designated timeframe. The precision of the inventory and the turnover metrics of the organization are illustrated in Figure 4.6.

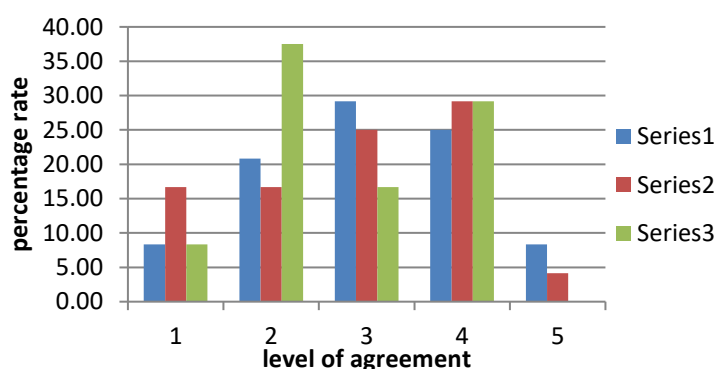


Figure 4.6: Inventory accuracy and turnover

Figure 4.6 shows the levels at which the respondents agreed with the statement that the production planning system has had a significant impact on the finished goods inventory management.

This analysis involves three aspects:

- Series 1: correctness of inventory data (Q1),
- Series 2: improvement in inventory turnover rate (Q2), and
- Series 3: alleviation of excess inventory holding costs (Q3).

When it comes to Q1, the data exhibits significantly different views on the matter of whether the system furnishes accurate information about the finished goods inventory levels. Of particular interest is the fact that 29% of the respondents indicated their agreement (level 4), whilst 30% of participants picked a neutral position (level 3). However, 21% of the participants disapproved of the statement (level 2), and 9% strongly disagreed (level 1), thus suggesting that while a substantial number of respondents view the system as a reliable source for achieving inventory accuracy, it seems that some inconsistencies in data reliability or reporting still exist. Regarding the question to which the system has resulted in the enhancement of the inventory turnover rate (Q2), the participants' replies varied. The biggest percentage of participants (36%) disagreed with the statement (level 2), and the next largest group equally agreed (level 4) and remaining neutral (level 3), with 25% each. This pattern points out that the turnover rate has only gotten slightly better; thus, only a few have

noticed the changes, while a significant number of respondents do not recognize any changes, leading to potential inefficiencies in inventory flow or demand forecasting.

Q3 estimates, which reflect the extent to which the system has reduced the additional costs of holding excess inventory, are somewhat balanced. A significant proportion of respondents, about 29%, agreed (level 4), while 17% strongly disagreed (level 1), and 18% of respondents disagreed (level 2). Such a situation indicates that the system has brought about some cost-saving benefits, but these impacts are far from being consistent throughout the organization.

Overall, the evidence shows that the production planning system has been of moderate benefit to the management of finished goods inventory, especially in providing more accurate stock information (Q1) and by partially reducing holding costs (Q3). Its impact on inventory turnover (Q2) is, however, still very limited, thus reflecting the possibility of challenges in the integration of demand forecasting and production scheduling. Based on such a diagnosis, it is recommended that steps be taken to enhance system performance in order to achieve leaner and cost-efficient inventory management, some of which are real-time inventory tracking, predictive analytics for demand forecasting, and dynamic inventory optimization models.

3.8 ANALYSIS OF PRODUCTION DELAY MANAGEMENT (FREQUENCY AND CAUSES OF PRODUCTION DELAYS)

Production delays may arise from excessive periods of inactivity following equipment malfunctions or an insufficiency of requisite materials, resulting in significant inefficiencies. The frequency and underlying causes of production delays within the organization are illustrated in Figure 4.7.

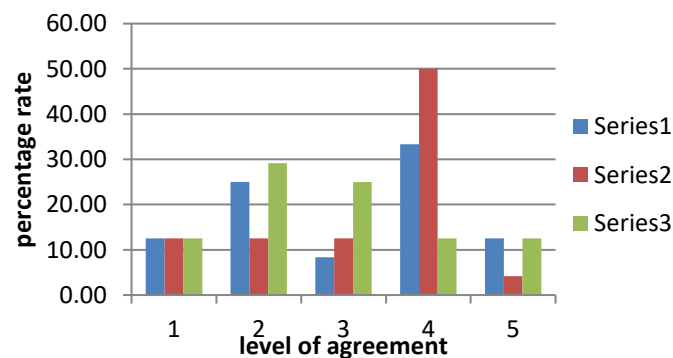


Figure 4.7: Frequency and causes of production delays

Figure 4.7 shows data representing answers to questions that measure the performance of the production planning system in minimizing and predicting production delays. These three questions about production delays were:

- Series 1: Whether the number of unjustified production delays has decreased after implementation (Q1)
- Series 2: Whether the system helps in finding the main causes of production delays(Q2),
- Series 3: Whether the system provides tools that are anticipatory or predictive for potential delay problems, Q3.

Information obtained from the questionnaires tends to be positive overall, and in most cases, the subject revolves around the system's contribution towards lowering delays in production. Given to Q1, slightly over one-third of the respondents agreed at level 4 that 'unjustified production delays' had been reduced, and a quarter of them agreed at level 2; on the other hand, only about 12% strongly disagreed. That's to say, the system certainly improved the process of scheduling and coordinating; however, situations of inconsistency are still present.

For Q2, half of the respondents (50%) agreed at level 4 that the system helps in identifying the main causes of the delays. Hence, this question has the highest agreement level compared to all three items. The evidence here is that the system is very effective in giving more visibility with regard to the operational bottlenecks, mainly when they occur either in digital tracking or in the use of real-time reporting tools.

As for Q3, answers had a larger dispersion of distribution - 26% agreed, level 3; 27% moderately agreed, level 2; and 14% strongly disagreed, level 1. This would mean that the system is good at situations that have already happened, but not as good at its predictive or preventive functions. The general findings of the questionnaires indicate that the production planning system has significantly facilitated the detection and reduction of delays, although the predictive analytics and the early warnings still need to be further enhanced in order to enable a proactive approach to management.

3.9 ANALYSIS OF EMPLOYEE SATISFACTION WITH THE PRODUCTION PLANNING SYSTEM

High levels of employee satisfaction have a significant positive impact on the workplace. Additionally, satisfied employees often foster better customer experiences, contributing to overall organizational success.

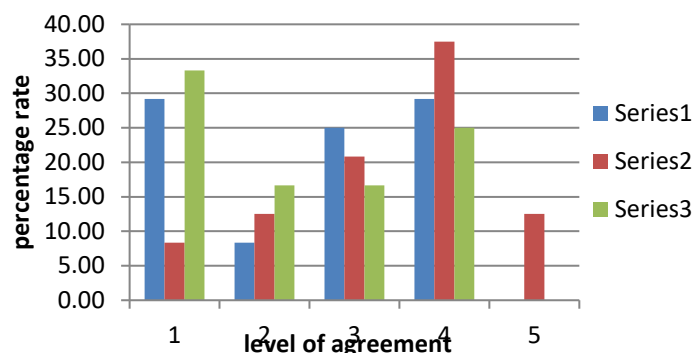


Figure 4.8: Employee satisfaction with planning processes

The analysis was conducted by considering these three main issues;

- Series 1: Employee satisfaction with system ease of use (Q1)
- Series 2: Informed performance of the task by the information provided (Q2) and
- Series 3: System is hassle-free and does not create any confusion regarding planning activities (Q3)

As shown in Figure 4.8 results show diverse but on the whole-average employee satisfaction. For Q1 (ease of use), a large number of respondents (30%) strongly disagreed (level 1), and 33% of Series3 respondents also disagreed, indicating that the usability issue is still the most significant one. Roughly 25–30% of the respondents moderately agreed (level 4), thus reflecting some progress but not generalized satisfaction. The situation is such that some employees may have successfully navigated the system, while a large number of them may be struggling with the navigation or training gap.

From Q2, about clarity and sufficiency of information, some 22–25% agreed, level 3–4, whereas nearly 10% strongly disagreed, level 1. From this, we can infer that the quality of information and accessibility are areas that do need attention. Probably better interface design or more user-friendly reporting features matching users' workflow may facilitate this.

For Q3, which is on stress and confusion reduction, the responses were divergent: about 35–38% of Series2 respondents strongly agreed to level 4, which means significant improvement was experienced by some, while 25–30% were neutral or disagreed. Such a mixed opinion points out that the benefits of the system are mostly conditional upon the user's familiarity with the system and the kind of work.

In short, this means that the findings show the production planning system is able to assist employees only partially in reaching their goals, while the factors of usability, clarity, and training need to be improved with a view to increasing workers' satisfaction and reducing stress linked with planning.

3.10 ANALYSIS OF SYSTEM FLEXIBILITY, RESPONSIVENESS, AND ADAPTABILITY

Flexibility and responsiveness reflect a teacher's capacity to modify instruction in response to shifting conditions. Flexibility generally relates to the inherent characteristic of a system that permits it to make adjustments or changes within defined limits.

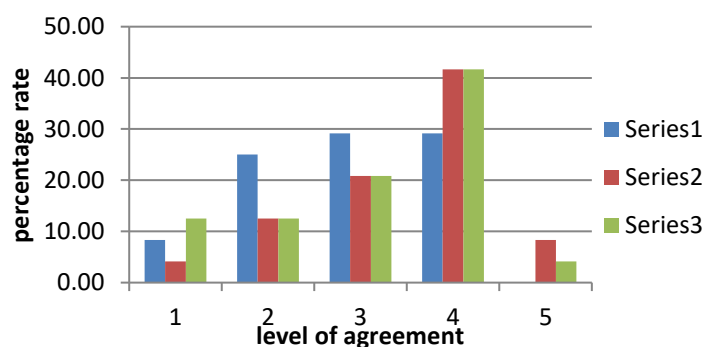


Figure 4.9: Flexibility and Responsiveness

Figure 4.9 illustrates respondents' perceptions regarding the flexibility and adaptability of the production planning system to changing operational conditions. The questions assessed included:

- Series 1: Does the system provide rapid responses to unexpected changes in demand and supply chains? (Q1)
- Series 2: Can production plans be easily and efficiently modified through the system? (Q2)
- Series 3: Does the system enable different planning scenarios in order to cope with modifications in the environment? (Q3)

The data insights provided show that users generally seem to have a positive attitude towards the flexibility of the system. As far as Q1 is concerned, the majority of the people who answered the questions in all three series were found to be in agreement at level 4, 40–42%, indicating that the system is quite responsive to changes in demand and supply chains. On the other hand, 10–15% of the people were found to disagree with the statement, possibly indicating situations such as operational bottlenecks or communication delays in system updates, which have not been changed in isolation.

In Q2, approximately 35–40% of the EMA participants also agreed to the fact that production adjustments can be done easily with the use of the system by stating agreement at level 4. Between 20 and 25% of the people took a moderate agreement position at level 3, and the rest of the people, that is, less than 15% disagreed, implying them as minor usability challenges that can be resolved by means of training or obtaining system upgrades.

In the case of Q3, the same pattern is mirrored, where more than 40% of the participants strongly agreed that the system facilitates scenario-based planning. It gives an indication that the features of the system for scenario simulation and contingency planning are smoothly incorporated. However, a small number (less than 10%) remained doubtful, which may indicate the possible existence of gaps in awareness or access to advanced functionalities.

In general, the results indicate that the production planning system is highly flexible, adaptive, and responsive to changes in operations. The directions of the positive response trends reveal that the system is an effective tool for dynamic decision-making, which in turn leads to the organization's enhanced capability to adjust to unstable market or supply conditions. The slight limitations that come to light seem to be related to differences in user skills and the uneven use of advanced planning tools.

3.11 ANALYSIS OF PRODUCTION FORECASTING AND SCHEDULING ACCURACY

Planning involves setting goals, deciding what needs to be done, and figuring out how to do it. Scheduling is about putting those plans into a timeline, showing when tasks should start and finish. Together, these skills ensure that projects are completed on time and within budget.

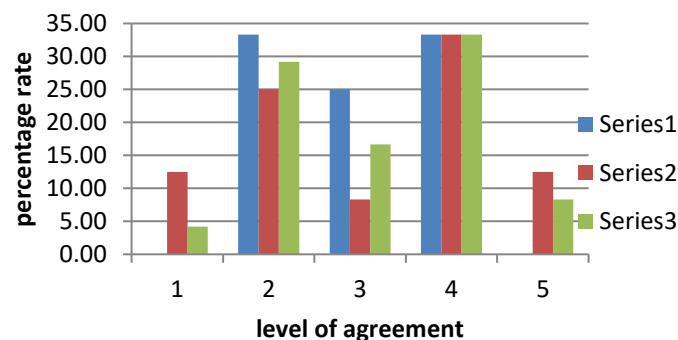


Figure 4.10: Planning and Scheduling Accuracy

Figure 4.10 presents the level of agreement among respondents with respect to the accuracy and reliability of production forecasting and scheduling after the implementation of the production planning system. The specific items analyzed comprise:

- Series 1: Demonstration of precise and accurate production forecasts and plans (Q1).
- Series 2: Degree of production schedule compliance resulting from the system (Q2).
- Series 3: Occurrence of less rescheduling due to unexpected changes (Q3).

The findings reveal a positive trend of moderate to considerable strength in the viewpoints of respondents on the system's performance in these areas.

Concerning Q1, approximately 30–33% of the respondents indicated level 4 (agree), and about 30% of them marked level 2, implying that while many acknowledge the improvements in forecasting accuracy, some individuals still maintain a skeptical view of the system's predictive precision. Such a mixed distribution means that the system has enhanced forecast reliability, but there might be some aspects of predictive algorithms or data inputs that still need to be refined.

In Q2, responses mirror those of Q1, with nearly 32% at level 4 and 25–30% at level 2. This means that most respondents agree that the system facilitates adherence to planned schedules, but factors affecting operations might still lead to deviations, e.g., delays in the supply of materials or breakdown of machinery. Also, the relatively low number of respondents at levels 1 and 5 suggests that the majority have a balanced view, with few people strongly disagreeing or totally satisfied.

For Q3, around 30% of respondents also agreed at level 4, confirming that they had noticed a decrease in the need for rescheduling due to unforeseen changes since the system was put in place. Nevertheless, about 15–20% of people indicated moderate or low levels of agreement (levels 2–3), thus giving reasons why it is possible that the system can only provide stability in planning, and that rescheduling due to fluctuations in orders or resource constraints may still be occurring.

Summing up, the evidence from these questions shows that the production planning system has led to more reliable scheduling and accurate forecasting of work, which, in turn, has allowed for more predictable production flows. However, continuous efforts toward better data integration and predictive analytics will not only make the system more efficient but will also open new avenues for tackling the variability problem and ensuring production consistency in the long run.

3.12 ANALYSIS OF OPERATIONAL COST EFFICIENCY AND RESOURCE UTILIZATION

Cost efficiency refers to the practice of reducing production costs while maintaining the quality of products or services, ultimately enhancing profitability and resource utilization.

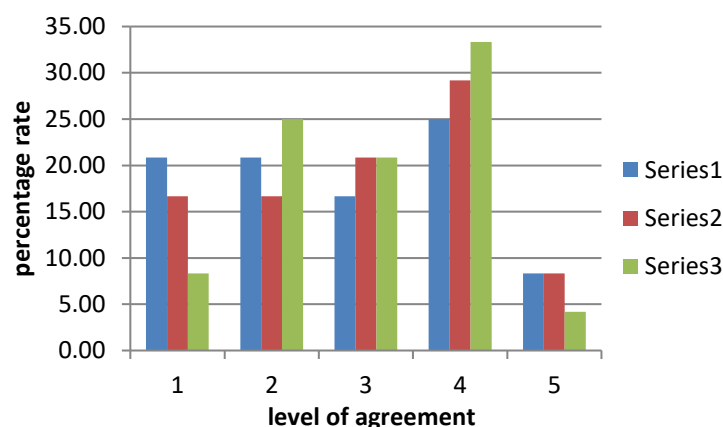


Figure 4.11: Cost Efficiency

Figure 4.11 presents the extent to which the responding facilities agreed with statements regarding the contribution of the production planning system to operational cost efficiency, resource utilization, and cost tracking capabilities. Three targeted questions were asked concerning the figure:

- Series 1: Has the system contributed to the reduction of overall operational production costs? (Q1)
- Series 2: Has the system resulted in increased efficiency in terms of energy and other resource usage? (Q2)
- Series 3: Whether by the system, production-related costs could be tracked and analyzed (Q3)

The response pattern shows a high level of agreement, and it can be inferred that the production planning system is instrumental in cost-related efficiency improvements, albeit with a remaining margin for a potential increase. In response to Q1, about 25% chose level 4, while almost 20% chose level 1. It would appear from the data that a significant number of respondents believe the operational cost reductions are fairly tangible, which could be due to better planning and less wastage of time with improved resource utilization. However, at the same time, the lower levels of agreement, as reflected in the data, could indicate that the cost-saving measures are perhaps not reaching the manufacturing sites at the grassroots level, and checkpoints to ensure consistent implementation and the accuracy of the data are needed to shed more light on that issue.

About 28–30% of the respondents, according to Q2, reported their agreement (level 4), and about 17% strongly agreed (level 5), hence showing confidence in the system that it fosters the efficient use of energy and material. This conclusion might be attributed to better harmonization of the production schedules and use of resources. Still, respondents in groups 2 and 3 could be those in organizations that suffer from inefficiencies due to aged equipment or have a poorly integrated planning and energy management system, and their opinion is reflected in this range of responses.

As regards Q3, data show a much stronger upward trend with about one-third of the responses at level 4 and less than five percent at level 5. In other words, most respondents believe that the system facilitates the tracking and analysis of

production-related costs only to a limited degree. Partial digitalization of the involved processes, limitation of real-time data access, and lack of sufficient analytics tools are probable causes that made so many respondents choose the neutral or low-agreement option.

Data from the questions show that, to a considerable extent, production planning systems have improved cost transparency and operational efficiency, enabling the organization to monitor and make more effective decisions. However, the fact that there is a disparity in the level of agreement among the respondents indicates that going forward, seamless data integration for real-time monitoring and enhanced development of cost analysis modules need to be established for complete financial optimization in all production units.

3.13 ANALYSIS OF SYSTEM INTEGRATION AND TECHNOLOGICAL SUPPORT

System integration, also known as IT or software integration, involves combining software and hardware components into a unified infrastructure. The main objective is to ensure these systems interact seamlessly, enabling more efficient information and process sharing.

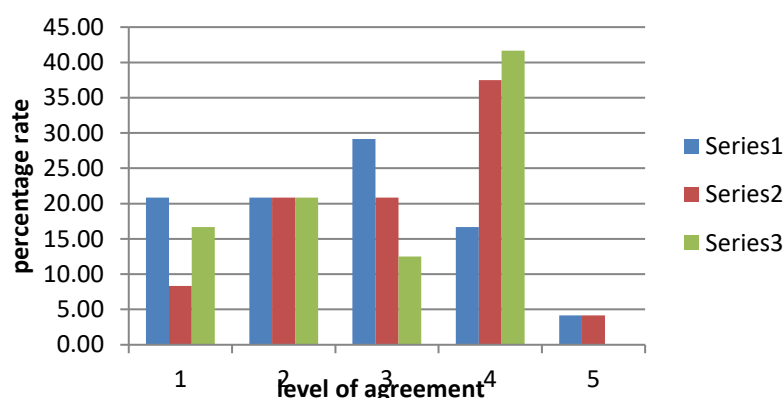


Figure 4.12: System Integration and IT Utilization

Figure 4.12 shows the level of agreement of the respondents regarding the integration, technological advancement, and user interface efficiency of the production planning system. Three questions were used to estimate:

- Series 3: How well the production planning system integrates with other operational systems, such as procurement and sales (Q1).
- Series 2: if the latest technologies & IT infrastructures are used to support the system's functionality (Q2)
- Series 3: Whether the user interface of a system guarantee ease of use and access to information? (Q3).

The overall pattern demonstrates that most respondents expressed moderate to high agreement, indicating that the production planning system is sound from both technological and functional integration perspectives, though with minor operational gaps. Of these, for Q1, about 29% chose level 3, which is neutral, and 16% chose level 4, meaning agree, while about 21% disagreed or chose level 1, indicating that the system is only partially integrated with other enterprise systems such as procurement and sales. It is likely that the degree of synchronization is different in different facilities. Such integration problems could arise from old infrastructure, inconsistent data formats, or a lack of communication between departments.

In the case of Q2, the data reveal that 37% chose level 4, saying that modern IT tools support the system; approximately 21% chose level 3, further strengthening the view that technological adoption is getting better. However, a surprising 20% were neutral or showed disagreement, which really means that while some textile industries have advanced digital systems, others still plan on obsolete software or cannot process data automatically. This technology divide shows that although technology has become part of the industry, it has not altogether changed its face.

Q3 demonstrates the strongest positive position, with more than 41% of the respondents at level 4 (agree) and less than about 5% expressing strong disagreement. Therefore, in users' opinions, the system interface is quite intuitive and accessible for them to access data in real-time and perform their tasks accordingly. Some respondents remain neutral, indicating that usability can be further improved through interface simplification or localizing languages, or even providing additional training.

These findings, in general, indicate that the production planning system is fairly well-integrated, technologically supported, and user-friendly to enable efficient operations and decision-making. However, differences in system maturity and a variation in the level of IT infrastructure across different textile facilities limit consistent performance in this sector. Inter-system connectivity with investments in digital capacity building would greatly enhance efficiency and user satisfaction from the system.

3.14 ANALYSIS OF WORKFORCE PLANNING AND LABOR UTILIZATION

Workforce management is a strategic approach to optimizing employee productivity, scheduling, and resource allocation to enhance overall organizational performance.

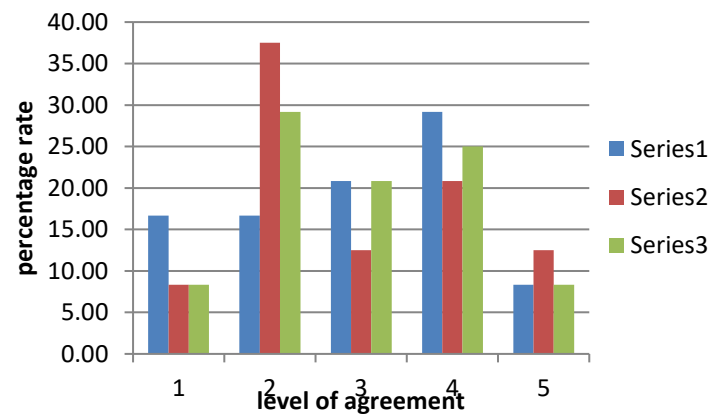


Figure 4.13: Workforce Management

Figure 4.13 presents respondents' perceptions of how well the system manages workforce-related operations with regard to planning, time use, and task distribution. These questions measured the following:

- series1: whether the system supports effective planning for the production workforce needs (Q1).
- Series 2: Whether the system contributes to enhancing labor time utilization and reducing idle time (Q2).
- Series 3: If it allows delegation of tasks and responsibilities to staff (Q3).

The data show mixed but generally positive responses. Most of the responses have fallen between levels 3 and 4 on the Likert scale, which indicates a moderate to strong agreement with the system's positive influence on workforce management. For Q1, nearly 16% of the respondents indicated level 1 (strongly disagree), close to 17% indicated level 2, and approximately 21% indicated level 3. In the trend, while some organizations face limited support from the system regarding labor planning, a significant group of them, about 29%, chose level 4, highlighting that many textile industries make good use of the system to schedule workers. Hence, it is reasonable to say that system effectiveness may depend on the level of digital adoption and workforce data integration within each facility.

The result of Q2 shows that most answers fall within level 2, approximately 37%, followed by level 3, 29%, and then level 4, 21%. This trend suggests that the system holds promise to improve the utilization of labor time, though substantial operational inefficiencies persist, especially in areas where there is limited automation or tracking of work. Such a high-level 2 response could indicate persistent idling and underutilization of resources, perhaps due to old monitoring mechanisms or poor real-time coordination between departments.

About 25% of the respondents agreed at level 4, while 21% were neutral at level 3, meaning that this system facilitates the distribution of tasks and aligns responsibilities to a moderate degree. However, 12% of respondents expressed disagreement with the statement, showing disrupted communication flows and unclear task delegations within factories. The results also indicate that, even as the system supports administrative coordination, its effectiveness depends to a great extent on human factors like the quality of supervision and user engagement.

Generally, these findings show that the system has partially succeeded in labor resource optimization for better productivity management in Ethiopian textile industries. While its digital tools and planning modules contribute to a well-structured workforce organization, inconsistent utilization of the system, lack of real-time data feedback, and limited staff training reduce its overall efficiency. Strengthening digital labor management systems, expanding user training, and integrating performance analytics might significantly improve workforce planning and operational productivity.

3.15 ANALYSIS OF CUSTOMER SATISFACTION AND SYSTEM RESPONSIVENESS

Customer satisfaction is essentially a quantification of the pleasure customers derive from a company's goods, services, and the overall experience, and it is a main factor which determines the success of a company.

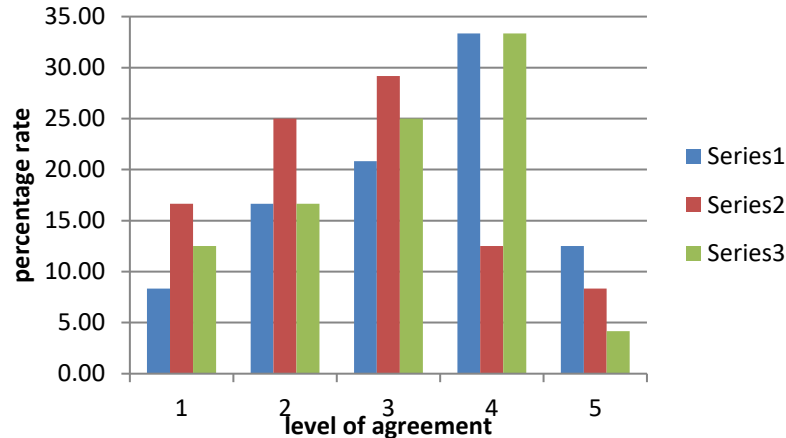


Figure 4.14: Customer Satisfaction

Figure 4.14 shows the perceptions of the respondents on how the production planning and management system has influenced the general customer satisfaction, product quality, and delivery performance. The three questions that were addressed were

- Series 1: whether the system led to higher customer satisfaction (Q1),
- Series 2: Improved feedback on punctuality and quality (Q2), and
- Series 3: has better alignment with customer expectations (Q3).

Overall, the data reveal that respondents generally perceive the system as positively influencing customer satisfaction, although with varying degrees of confidence. Most responses cluster between agreement levels 3 and 4, suggesting moderate to strong approval of the system’s role in improving customer relations and production reliability. For Q1, customer satisfaction through improved production processes, about 8–9% of the respondents strongly disagreed at level 1, while the highest share, at approximately 33%, chose level 4. That suggests that most recognize real gains in customer satisfaction coming from more efficient and reliable production processes. However, the substantial share reaching only level 3 suggests that for some enterprises, customer benefits have not been as well realized; this could be because of uneven implementation of the systems or a factor of variability in supply chain efficiency.

Regarding Q2 (positive feedback on punctuality and quality), the pattern is somewhat more balanced: approximately 17% rated level 2, 25% level 3, and nearly 29% level 4. This reflects that many textile producers experience noticeable gains in customer perception, particularly in timely delivery and consistency of fabric or garment quality. Nevertheless, the relatively high number of mid-level responses suggests that production delays and variability in product standards remain occasional challenges, possibly influenced by external supply disruptions or inconsistent raw material quality.

Q3: In the question about meeting customer expectations more effectively, responses show 25–30% at level 4, showing the system moderately enhances responsiveness to market and client requirements. A smaller group, roughly 10%, strongly agreed at level 5, while about 12–16% judged on level 1 or 2. These figures bring forth that even as digitalized planning and monitoring tools enhance predictability and coordination, high levels of customer satisfaction are achieved through integrated communication systems, real-time order tracking, and adaptable production planning. The overall evaluation dimensions of well clearly articulated in table 4 in triangular matrix.

Table 4: Triangulation matrix of subjective ratings vs. objective KPIs

Evaluation Dimension	Questionnaire Survey Perception	Objective Archival Data (12-Month Mean)	Operational Triangulation Finding
Machine Utilization	33% Disagreed that utilization is optimized	70.0% Actual Utilization (Target: 82.0%)	Perceived underutilization is verified by a -12.0% utilization gap.
Downtime Management	29% Agreed downtime was reduced	1,425 hrs total unscheduled downtime	High downtime persists due to reactive maintenance planning.
Inventory Efficiency	36% Disagreed that turnover improved	2.1 Turns/Year (Target: 6.0 Turns/Year)	Stagnant stock flow validates negative user perceptions.
Delivery Reliability	58% Agreed lead times improved	62.3% OTIF Rate; 24.5 Days Lead Time	Moderate lead time gains are undermined by low on-time delivery rates.

4. CONCLUSION

This study provided an empirical evaluation of the production planning system at Bahir Dar Textile Share Company (BDTSC) by integrating primary survey feedback from 67 operational personnel with 12 months of objective shop-floor operational data. The findings indicate that the current production planning system demonstrates partial effectiveness in maintaining routine operational stability and supporting resource allocation. However, a significant gap exists between user expectations and actual system performance, driven by structural inefficiencies in adaptability, integration, forecasting, and process tracking.

The integration of objective shop-floor performance metrics confirmed these operational challenges. BDTSC's annual actual output reached 1,400 tons against a planned target of 2,000 tons, representing a 70.0% output fulfillment rate. The machine utilization rate averaged 70.0% against an 82.0% company benchmark, severely impacted by 1,425 hours of unscheduled downtime resulting from reactive maintenance scheduling and raw material delays. Furthermore, inventory management exhibited critical stagnation, recording an inventory turnover ratio of 2.1 turns per year compared to the industry benchmark of 6.0 turns. These internal bottlenecks directly compromised delivery performance, yielding an On-Time In-Full (OTIF) delivery rate of only 62.3% and extending finished goods lead times to 24.5 days. The analysis reveals that BDTSC's planning framework remains technically outdated and operationally fragmented. The primary barriers to overall performance include a complex user interface, isolated planning tools, weak inventory control, and a lack of real-time process monitoring across departments. To modernize the system and achieve production targets with greater accuracy and flexibility, BDTSC must transition from standalone tools to a centralized Enterprise Resource Planning (ERP) network. Modernizing the network requires integrating predictive modeling tools for dynamic scheduling, streamlining system interfaces for improved usability, establishing real-time material and machine tracking, and providing continuous analytical training to staff.

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