Innovations in Production Planning: Digitalization as a Catalyst for Efficiency

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Abstract—Digitalization of a particular industry has enabled the improvement in operational planning of production through integrating technology, which facilitates the improvement of various processes. This paper studies how Coca-Cola employs digital technologies within the enterprise, focusing on the Digital Twin, and the trex DCAS. A cross-sectional study has indicated reasonable percentage increases in operating efficiencies measured as the use of production assets, hence demonstrating the reasonably established consequences of progress in digital technology on production systems. Other identified benefits include the reduction of the lead times by 20% and higher Overall Equipment Effectiveness (OEE) by 15% illustrate the importance of digitalization in modern manufacturing processes. This article also addresses the changes in system designs that are bad and the development of increased tack in the wider context.

Keywords—digitalization, production planning, efficiency innovation, OEE, manufacturing optimization, digital twin, smart manufacturing, industry 4.0, IoT.

I. INTRODUCTION

Technology advanced has greatly changes the production planning process in organizations. Words and techniques have changed and such wonderful tools as Artificial Intelligence (AI), Internet of Things (IoT) and good data analysis have emerged. It has led to a change of operational flexibility, efficiency and effectiveness in utilization of resources as well as a capacity to meet changing market conditions. Coca-Cola is a world's most recognized beverage company that has adopted modern systems like Trex DCAS and CCI Digital Twin. These technologies have helped to transform the way the company has been dealing with the challenges to optimise on productiveness. This paper looks at

- The effectiveness of these systems in increasing efficiency in production
- Operational effectiveness

II. DIGITALIZATION IN PRODUCTION PLANNING

A. The Role of Digitalization in Modern Production

Digitalization has become the unified direction for planning in contemporary production systems.[1] Changes in demand for effectiveness together with complex planning needs and flexibility definitions drive this result. Modern industrial transformation occurs through major digital influences including. [12]:

Artificial Intelligence (AI): These are systems which make use of algorithms to improve the efficiency of production planning by scheduling, forecasting inadequate resources, and predicting failures to facilitate automation. [3]

Internet of Things (IoT): Devices equipped with IoT technology can harvest real-time data from machinery for enhanced maintenance and operations. [11]

Better and reliable forecasting and demand planning result from greater computing power and increased storage available for data operations. Cloud Computing provides businesses with unlimited access to storage systems while permitting enterprises in various locations to conduct essential business operations. [2]:

B. The Emergence of Industry 4.0 amd Smart Manufacturing

The modern industrial strategy known as Industry 4.0 features intelligent and automated systems as its primary characteristics. Other distinct features include. [3]:

- Two key features of Industry 4.0 include Cyber physical systems (CPS) that oversee production operations to facilitate autonomous optimization.[5]
- Smart robotics which eliminates human input as a source of error and increases productivity. [3]
- Blockchain Technology as a source of transparency and security in supply chain management. [9]
- The term Digital Twins defines computer-based process models that serve to optimize simulations through modeling software. [6]

C. Digital Tools For Optimizing Production Workflows

The present-day manufacturing industry operates with diverse digital instruments that accomplish. [4]:

- The Enterprise Resource Planning (ERP) system provides information about production requirements to all departments and their schedule. [8]
- The use of automated scheduling systems eliminates human interaction because production optimization occurs through AI-based system controls. [7]
- Machine Learning Algorithms: Continuously and independently improve their reasoning and workflow automation. [10]

III. Case Study: Digital Transformation in Coca-Cola Production Planning

A. The Role of Trex DCAS in Coca-Cola's Production

Coca-Cola initiated their first application of Trex DCAS for production monitoring purposes. The production monitoring feature enabled companies to check key elements through its functions that included observing the following:

- Processes of production
- Performance analysis
- Data collection for operations insight.

Mirroring its advantages, the software demonstrated certain limitations. The system had incorrect failure tracking abilities and few automation functionalities that limited operational effectiveness.

Fig. 1. trex DCAS

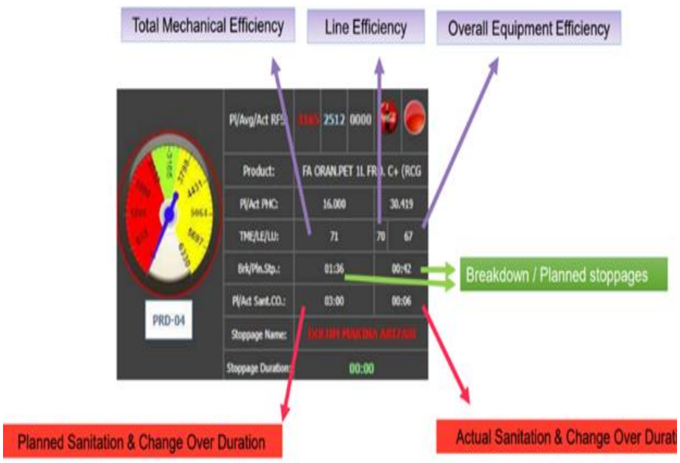
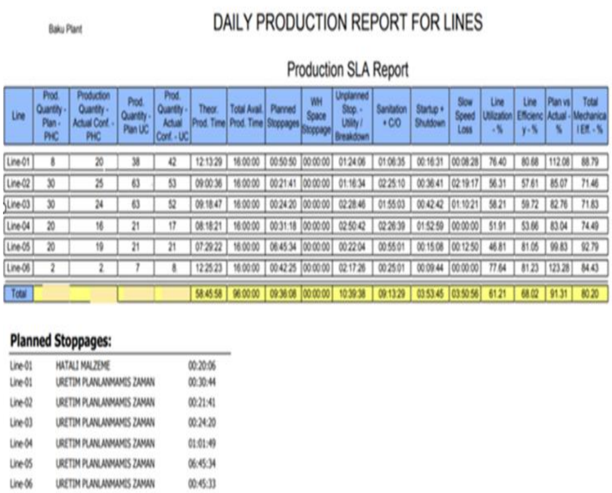


Fig. 2. Daily Production Report for Lines



Baku Plant

DAILY PRODUCTION REPORT FOR LINES

Production SLA Report

Line	Prod. Quantity - Plan - PHC	Production Quantity - Actual Conf. - PHC	Prod. Quantity - Plan UC	Prod. Quantity - Actual Conf. - UC	Theor. Prod. Time	Total Avail. Prod. Time	Planned Stoppages	WH Space Stoppage	Unplanned Stop. - Utility / Breakdown	Sanitation + C/O	Startup + Shutdown	Slow Speed Loss	Line Utilization - %	Line Efficiency - %	Plan vs Actual - %	Total Mechanical Eff. - %
Line-01	8	20	38	42	12:13:29	16:00:00	00:50:50	00:00:00	01:24:06	01:06:35	00:16:31	00:08:28	76.40	80.68	112.08	88.79
Line-02	30	25	63	53	09:00:36	16:00:00	00:21:41	00:00:00	01:16:34	02:25:10	00:36:41	02:19:17	56.31	57.61	85.07	71.46
Line-03	30	24	63	52	09:18:47	16:00:00	00:24:20	00:00:00	02:28:46	01:55:03	00:42:42	01:10:21	58.21	59.72	82.76	71.83
Line-04	20	16	21	17	08:18:21	16:00:00	00:31:18	00:00:00	02:50:42	02:26:39	01:52:59	00:00:00	51.91	53.66	83.04	74.49
Line-05	20	19	21	21	07:29:22	16:00:00	06:45:34	00:00:00	00:22:04	00:55:01	00:15:08	00:12:50	46.81	81.05	99.83	92.79
Line-06	2	2	7	8	12:25:23	16:00:00	00:42:25	00:00:00	02:17:26	00:25:01	00:09:44	00:00:00	77.64	81.23	123.28	84.43
Total					58:45:58	96:00:00	09:36:08	00:00:00	10:39:38	09:13:29	03:53:45	03:50:56	61.21	68.02	91.31	80.20

Planned Stoppages:

Line-01	HATALI MALZEME	00:20:06
Line-01	URETIM PLANLANMAMIS ZAMAN	00:30:44
Line-02	URETIM PLANLANMAMIS ZAMAN	00:21:41
Line-03	URETIM PLANLANMAMIS ZAMAN	00:24:20
Line-04	URETIM PLANLANMAMIS ZAMAN	01:01:49
Line-05	URETIM PLANLANMAMIS ZAMAN	06:45:34
Line-06	URETIM PLANLANMAMIS ZAMAN	00:45:33

Fig. 3. Online Plant Monitor

B. The Shift to CCI DIGITAL TWIN

With all the inefficiencies of Trex DCAS, CCI DIGITAL TWIN was brought into use by Coca-Cola. With this system, a number of challenges are solved: Collection of data in real time without human intervention, enhancing production analytics, and predictive maintenance to avoid random turns off of the device.

Fig. 4. CCI DIGITAL TWIN

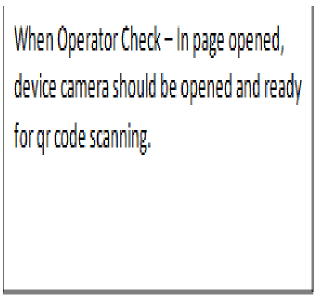


Fig. 5. Production Status

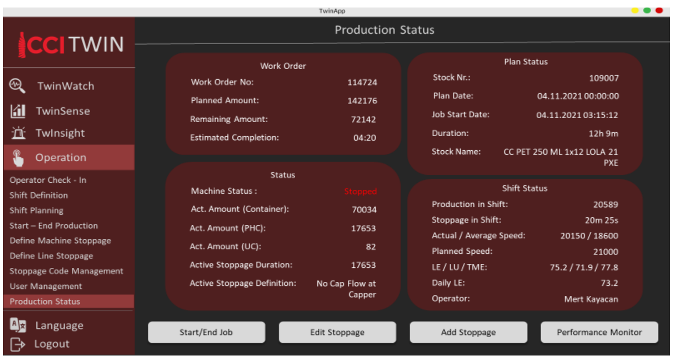
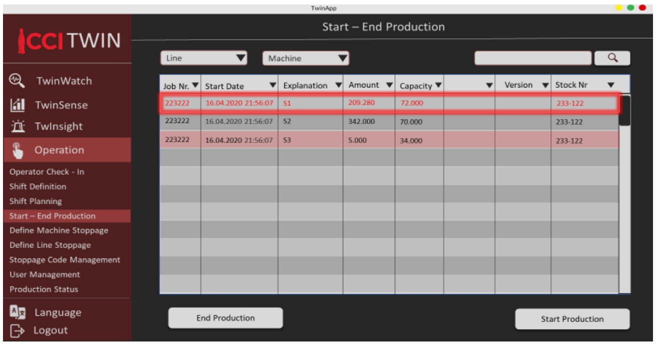


Fig. 6. Start-End Production



C. *Comparative Evaluation of Trex DCAS and CCI DIGITAL TWIN*

Fig. 7. Stoppages

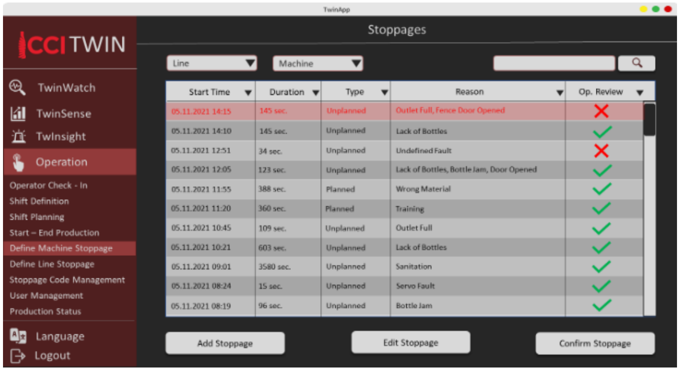


Fig. 8. Stoppages

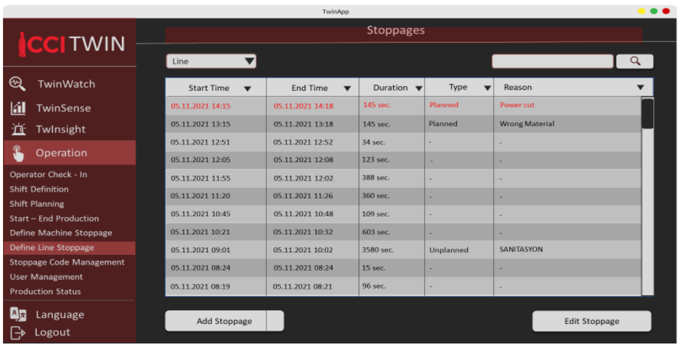


Fig. 9. Stoppages

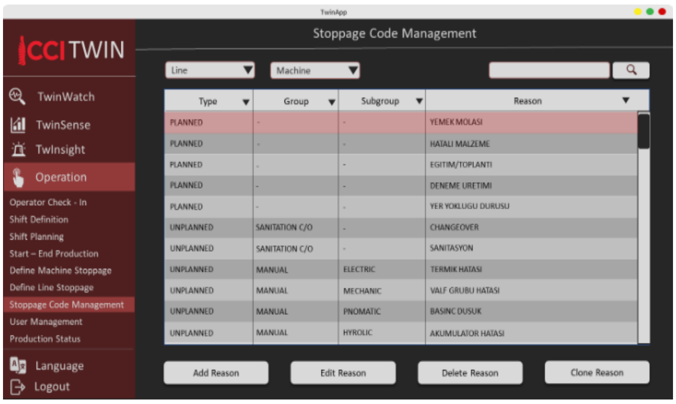


TABLE I. Comparison

Feature	***Trex DCAS***	***CCI DIGITAL TWIN***
Real-time Data Processing	*Limited*	*High-precision tracking*
Automation Level	*Low*	*Advanced AI-driven automation*
Error Handling	*Manual*	*AI-powered automatic detection*
Predictive Maintenance	*Absent*	*Integrated with real-time alerts*

D. *Performance Enhancements with CCI DIGITAL TWIN*

CCI DIGITAL TWIN created the following benefits after its installation:

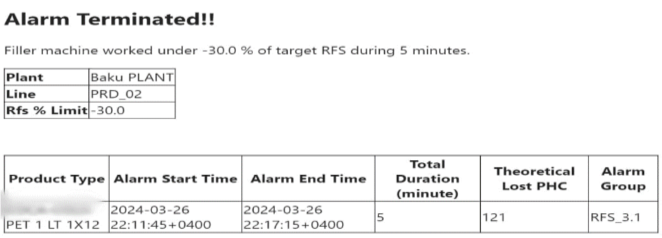
- 20% reduction in operational downtime due to proactive issue resolution.
- The organization achieved better production efficiency by 15% because of improved monitoring capabilities.
- The optimized inventory tracking reduced material waste while in operation.

Fig. 10. Shift Planning

E. *Addressing Challenges and Future Improvements*

The implementation of CCI DIGITAL TWIN has resulted in significant production growth. The system requires the implementation of real-time fault detection alerting capabilities. Our recommendation called for the development of a system to send email and mobile alerts to detect abnormal activity. Such an integrated system creates the potential for increased process resilience along with rapid response capabilities and improved operational efficiency across the entire system.

Fig. 11. Shift Planning



Alarm Terminated!!

Filler machine worked under -30.0 % of target RFS during 5 minutes.

Plant	Baku PLANT
Line	PRD_02
Rfs % Limit	-30.0

Product Type	Alarm Start Time	Alarm End Time	Total Duration (minute)	Theoretical Lost PHC	Alarm Group
PET 1 LT 1X12	2024-03-26 22:11:45+0400	2024-03-26 22:17:15+0400	5	121	RFS_3.1

IV. RESULTS AND DISCUSSION

A. *Key Insights from the Study*

- The changes made to the operations of manufacturing companies brought a 15% increase to the operational velocity and took the rate of device malfunctions down by 20%.

- The use of AI in event prediction was crucial in minimizing event magnitudes that could prove to hinder effects on manufacturing activities.

- In the existence of digital transformation tools, there was an increase in both cost effectiveness and sophisticated supply chain management.

B. *Strategic Considerations for Manufacture in the Future*

During Digital Transformation, manufacturers acquired an upgraded performance speed as well as being exposed to enhanced risk and resource management. The core development of the business branch should seek to enhance the machine learning and blockchain technologies applied where the production tracking is done.

V. CONCLUSION AND FUTURE DIRECTIONS

A. *Summary of Findings*

At Coca Cola, CCI DIGITAL TWIN demonstrates that technology capable of aiding in production planning is valuable to the business strategy. An optimized manufacturing system is established by combining AI automation platforms with IoT system monitoring and predictive analytics.

B. *Future Research Areas*

Further exploration is recommended in:

- The functionality of blockchain exists to defend manufacturing data from the modification on the part of unauthorized users.

- Extensive research indicates that the deep learning technology strengthens the pre-alteration stage.

- The integration of autonomous robotics for next-generation smart factories.

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