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Simulation of Automatic Container Handlings System and Production Productivity Forecast of Camera Module of LG Innotek Company

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A B S T R A C T

In recent years, the camera module manufacturing industry is developing extremely strongly in most countries in the world such as the US, South Korea, China and even Vietnam. In this study, the Grey Forecast Model (G (1,1)) [1] [2] are used to predict and analyze the needs and growth potential of LG Innotek. In addition, the team uses Plant Simulation software to simulate the production process of camera modules. From there, you can understand the production process and operation methods of a production line. The market results have also shown the solid foundation of LG Innotek in business and brought positive expectations. On the other hand, from the analysis results, it can be known that the ability of production activities, especially the camera module production process, needs to have improvements, effective solutions for business activities as well as the development potential of the camera module industry in the coming years. The development of the module camera manufacturing industry contributes to improving the quality of equipment such as camcorders, phones, televisions, electronic devices, etc. thereby bringing better experiences to people. In addition, this manufacturing industry also creates jobs for people, contributing a large amount of resources to the development and growth of the country as well as the global economy.

Keywords: Greys, Plant Simulation, module camera, LG Innotek company,

1. Introduction

The component manufacturing industry in Vietnam in recent years has developed rapidly, providing a variety of packaging products for companies and industries such as automotive, mobile, IoT, displays, semiconductors, LEDs, etc. In addition, the component industry also contributes significantly to the state budget, creating jobs for employees, contributing to ensuring people's lives and stabilizing the social situation. More importantly, the component industry has become an important link of Vietnam's industry. Helping our country reach out to the international market in the field of modern components industry.

According to statistics, the use of components in Vietnam in recent years is gradually increasing and has developed strongly. The automotive technology components industry has an average localization rate of about 10-20% (some trucks and buses can be up to 40-50%). The electronics industry ranges from 5-10%. For Vietnamese companies, VinFast is currently promoting the localization of auto components, but still relies heavily on imported components. According to the Ministry of Industry and Trade, there are currently about 5,000 enterprises participating in the supporting industry, but only about 30% meet global supply chain standards. [14]

Because it belongs to the essential production group, in recent years, the development of the component industry is still quite slow, but component businesses still maintain steady growth. In the coming years, the increase in population, income and demand of people will also increase, leading to more targets. This is an opportunity to promote strong development in the field of components in Vietnam. However, the development of the component industry is still not commensurate with the potential of the domestic developed market because currently the consumer demand for the component industry is still very large.

The automated container handling system at LG Innotek Hai Phong Co., Ltd. is a modern solution to optimize the logistics process in the factory. This system includes key components such as automatic cranes, intelligent conveyors, central control systems, and logistics management software. Automatic container handling system is a The high-tech system uses automatic control software to arrange and transport without requiring direct human intervention. Using an automated loading and unloading system helps manufacturers optimize the transportation and loading and unloading process, the automated system and line will control the operation, production and packaging operations... ensure the implementation process efficiently and properly and meet quality standards. Control cabinets are used to set the parameters of the packaging process and monitor the operation of the packaging system.

When researching this topic, we aim to research and forecast the production productivity of camera modules of LG Innotek Co., Ltd. Thereby helping to solve the problems of energy saving and environmental protection. Through the scientific research project, students will help promote the student

scientific research movement of the University of Industry in general and the Faculty of Industrial Systems in particular. From there, it will form a habit of researching with students, regularly learning about the requirements of progress and developing new things to meet the requirements of life as well as the requirements set by society. From the beginning, my team identified two main objectives of this study. The first is to use the Grey forecast models to predict the data of LG Innotek Co., Ltd., and then find the best prediction model. The second is to use the Plant simulation model to simulate the automatic container handling system and production line of the camera module. The combined results of these three goals help the group come up with more practical and valuable ideas and suggestions.

2. Method

2.1 Research Model

The team has built a research model as follows:

Figure 1 - Diagram of machinery at the module camera factory

The model shows the module camera production process consisting of 2 main lines: module assembly and packaging inspection. From the above simulation model, we can see that the module camera production line includes 17 working stations. More specifically, the two lines are built according to the transfer model, which are the letters L and I, respectively. The flow of moving raw materials and products in the workshop is arranged from storage ➔ production area ➔ inspection ➔ packing. The operating time of the line is 2 shifts 1 day each operating for 6 hours: shift 1 from 6 am to 12 pm and shift 2 from 12 pm to 6 pm. The break time is 30 minutes between shifts. Due to the nature of the line is automatic, a small number of workers are needed, so they will take rotational leave. [13]

2.2 Grey Computational Research Methods

In Vietnam, some fields have applied the Grey system theory to predict data in order to overcome, process and improve the efficiency of management in that field [3]. However, this method is still new and has not been widely disseminated in various fields, so lecturers and students face many difficulties in accessing research materials on this method. In order to contribute to solving the above difficulties, the author introduces an overview of the forecasting models in the Grey system theory and an assessment of the reliability when processing data related to seafarer human resources from 2019 to 2022. [4][5]

This paper uses the MAPE (Means Absolute Percentage Error) index to evaluate the accuracy of the Grey forecast model [8]. The MAPE index is calculated by the following formula [6][7] [9]:

$$MAPE = \frac{1}{n}\sum_{k=2}^{n} \frac{x^{(0)}(k) - \hat{x}^{(0)}(k)}{x^{(0)}(k)} \times 100\% \quad (1)$$

Sum formula of Grey GM model (1,1) be [10]:

$$\hat{x}^{(1)}(k+1) = \left[x(0) - \frac{b}{a}\right] * (1 - e^{(-a)}) * e^{ak} + \frac{b}{a} \quad (2)$$

In which:

- is the next forecast value in the data series.$\hat{x}^{(1)}(k+1)$

- is the initial value of the data series.$x(0)$

- (a) and (b) are the parameters of the model, calculated based on the minimum normal method.

- k is the indicator of the next forecast value in the data series.

3. Results and discussion

3.1 Research results of the Grey method

Through the research process, the team has accepted the forecast and actual list chart of LG Innotek Co., Ltd. as follows:

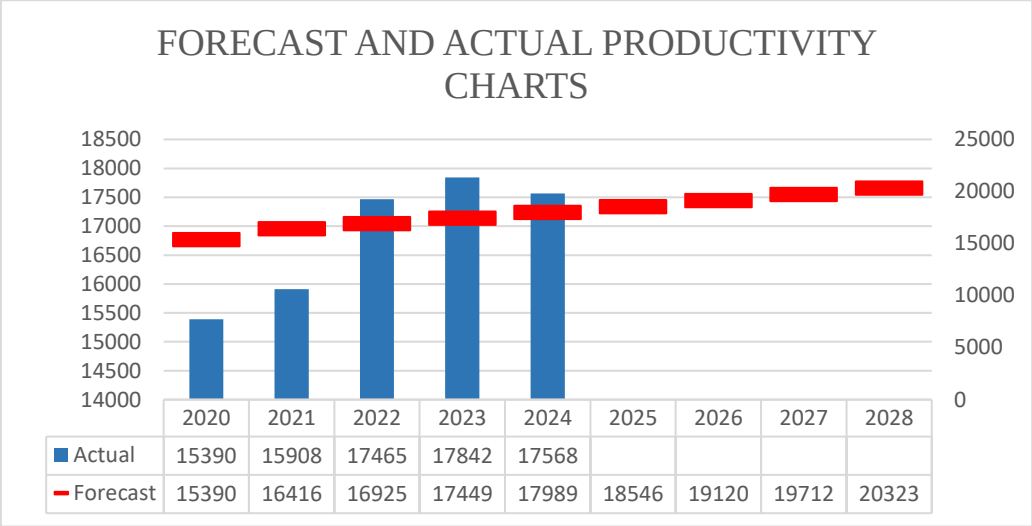

Figure 2- Forecast and actual sales of LG Innotek

Through the forecast and actual sales chart, the team commented as follows:

Trend identification:

- Revenue is forecast to increase steadily over the years from 2020-2023 with an average of 3% per year. In the period from 2021-2022, it increased sharply by 4.9% (508), in the period 2022-2023, it increased slightly by 1.5% (524).

- Actual revenue tends to increase but not continuously over the years from 2020-2024 with an average of 3% per year. In the period from 2021-2022, it increased sharply by 4.6% (1558), in the period 2022-2023 it increased slightly by 1% (377), and in the period 2023-2024 it decreased slightly by 0.77% (274).

Error assessment: The difference between the forecast and reality is not much, the largest error is 3.19 (in 2020), the lowest is 2.34 (in 2024). The average error of 2.18% (1% < 2.18% < 5%) is at a good level.

In the period from 2020 to 2024, LG Innotek's production productivity recorded significant fluctuations, reflecting the impact of macro factors and internal strategies of the business. Compared to previous years, productivity in this period is generally considered relatively stable or slightly increased, especially from 2022 onwards. Part of the reason comes from the strong recovery of the global economy after the COVID-19 pandemic, helping businesses improve production activities and optimize factory capacity. Entering the forecast period from 2025 to 2028, LG Innotek's production productivity is expected to maintain a positive growth trend, thanks to a series of supporting factors both in technology and the market.

The forecast value is based on actual revenue, so there is an even error in the good range of 2.34-3.10 and an average error of 2.18 is also in the good range. This shows that the accuracy of the forecast of the Grey method is very good, so we can use this method to forecast revenue for the next 4 years, which is 2025-2028. [8]

3.2 Results of running the plant simulation model

After using the data collected from the factory of LG Innotek Co., Ltd., the team tested the machine at 100% capacity and found that the amount of goods produced was not as expected even though the number of melon workpieces was large and still congested in many areas[10] [11]. Most areas have a large number of waiting lines, and the number of blocked goods is quite large. And what is even more urgent is that 12 out of 20 areas have defective goods. The simulation results are shown in detail in the following chat panel:

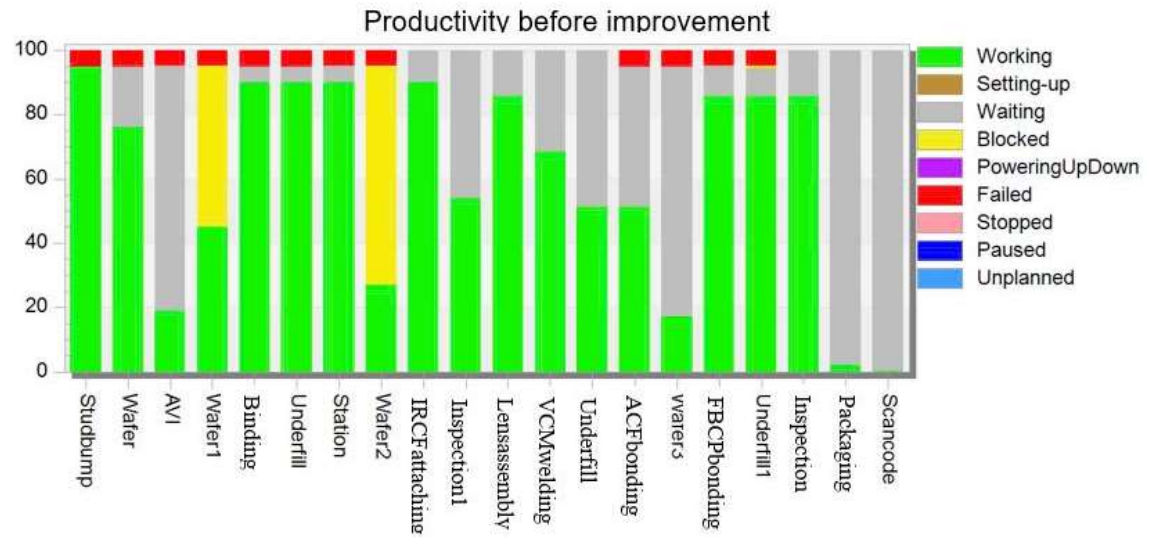

Figure 3 - 1st test chat board

Simulated chat board after running data for the first time

After analyzing the operation process of the system and determining that the blocking time at the working stations is quite large, in order to increase the productivity of the improved system, reduce the blocking time at the working stations by reducing the number of machines "Wafer1" and "Wafer2", in the system. [12] And to simplify the simulation, we will increase the time of the 2 machines, so to ensure that the waiting time of the workpiece is not too long, according to the principle of just in time. Based on the results after the improvement, we obtain a graph of the activity of the material flow through the device in the camera module production system as follows:

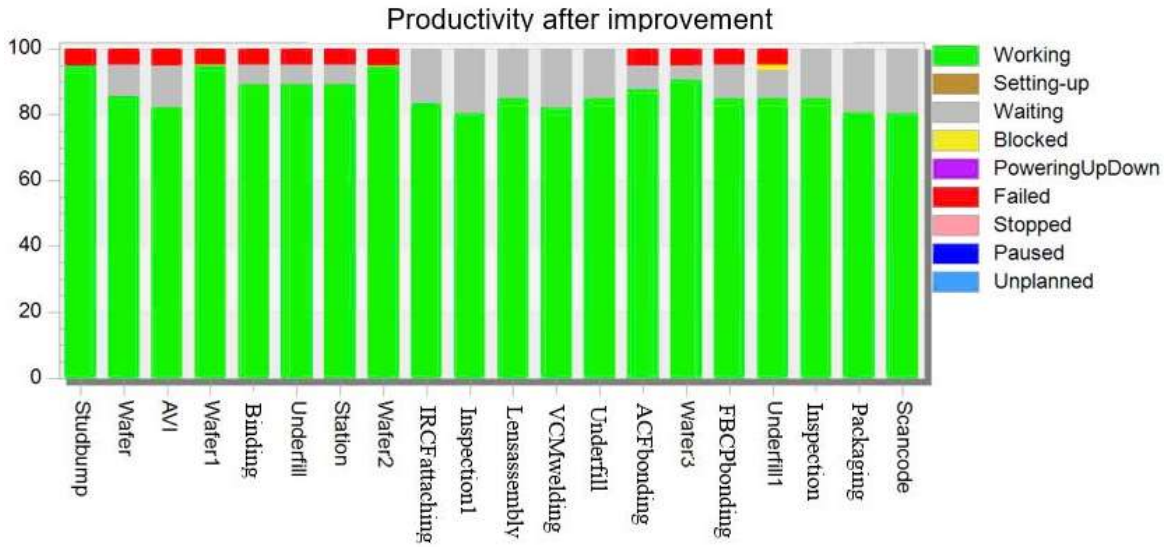

Figure 4 - Chat board after the improvement and the 2nd run

4. Conclusion

After the process of researching and perfecting the topic: "Model of automatic container handling system and forecast of camera module production productivity of LG Innotek company.". Our team has learned and accumulated a lot of experience in designing a real system model, understanding the problems that need to be included in the system design process.

The team learned more methods in the process of building the system. From there, they clearly know the advantages and disadvantages to apply to the system, helping the system to be more complete. These are methods of operating, analyzing and improving the system such as: Grey, Plant simulation**.** The team has forecasted the production capacity and revenue of LG Innotek company.

We have researched and implemented the problems posed and listed the production system scientifically, along with giving the target specifications for the system realization design.

5. Acknowledgments

After the team completed the topic: "Model of automatic container handling system and forecast of camera module production productivity of LG Innotek company." along with the main guidance of lecturer Ta Thi Tra Giang and teachers at Hanoi University of Industry. Our group would like to thank the teachers who accompanied the group throughout the process of researching and perfecting the topic. At the same time, thanks to the help of Vietnam Dairy Joint Stock Company for creating conditions for the team to survey and collect production results.

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