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Improving the efficiency of the company based on the principles of lean manufacturing

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Abstract

The relevance of this research topic is due to the fact that in modern conditions of fierce competition, an increase in the efficiency of an enterprise is possible only with the introduction of new methods of organizing production, including lean production tools. The lean manufacturing methodology, which is primarily aimed at saving the labor of workers and the application of rational and most efficient labor methods, reduces production time by eliminating waste. At the same time, the proposed principles and methods for organizing the production of products imply a certain methodology that can be implemented not in a separate specific industry, but in any production processes, at the output of which the customer receives a product or service of a given quality. All process management activities are reduced to the formation of a continuous stream of product value creation, where value is understood as a set of consumer qualities of a product or service for which the customer is willing to pay. Due to the fact that these properties are formed only in the process of performing certain stages of processing, for example, procurement, assembly, all other activities in the value stream do not add and are considered as losses. At the beginning of the 21st century, the theory of lean manufacturing found its application in the projects of Chinese enterprises to improve performance.

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Keywords

Production process, lean manufacturing, workflow, enterprise management, China.

Introduction

Lean production is a management system for an economic entity based on a constant desire to complete the production cycle and eliminate all types of losses. This system involves participation in the process of optimizing the production of each employee, with its final focus on the consumer. The concept under consideration appeared as an interpretation of the ideas of the production system of the Japanese company Toyota by American scientists [Levinson, 2021].

In the second half of the 20th century, Toyota used the principle of in-line production, first proposed by the famous engineer Henry Ford, and implemented it in Japan along with other organizational and technical measures. Thus, a production system was created at Toyota, the purpose of which was to reduce activities that consume production resources and do not add value to the end consumer of the manufactured products.

In the economic literature, there are many approaches to the definition of the concept of "lean manufacturing". Many of them are based on the results of applying this concept at Toyota. James Womack and Daniel Jones in their works consider lean manufacturing as a process that includes determining value for the consumer, highlighting a consistent stream of creating this value and ensuring its continuity, creating a "pull" production according to customer requirements, and constantly striving to improve production processes [Chris, 2020].

To organize lean manufacturing, it is necessary to establish a workflow so that the manufactured product is without failures and downtime. passed only those stages of the technical process where value is added. For this purpose, a pulling system is being created at the enterprise. We know that such a system considers the needs of a particular consumer and implies that only those materials that will be used immediately are fed to the next stage of the production process. Also, lean production requires a certain philosophy of enterprise management, including strategic management, production culture, continuous improvement of all aspects of the enterprise. By "lean manufacturing" we mean the enterprise management system shown in Figure 1.

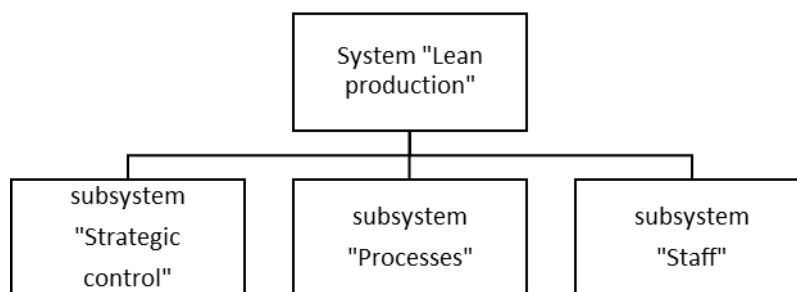


Figure 1 - Enterprise management system for the implementation of lean manufacturing

Let us consider in more detail the subsystems presented in Figure 1.

Subsystem "Strategic management": focus on customer requirements, management by key performance indicators.

Subsystem "Processes": identification and subsequent elimination of losses, organization of a continuous production process, detailed problem solving.

Subsystem "Personnel": continuous improvement of work in a team, open exchange of information between the structures of the enterprise.

System "Lean production" subsystem "Strategic management" subsystem "Processes" subsystem

"Personnel"

The above subsystems together help the enterprise to provide an innovative management basis aimed at increasing labor productivity and competitiveness of manufactured products [Maskell, 2020].

The goals of lean manufacturing are [Jones, 2019]:

- minimization of labor costs;
- reduction of terms of production of manufactured goods;
- increase in productivity at the same production capacities;
- improving the quality of products.

The main goal of this concept is maximum transparency and openness of the workflow.

The basis of lean manufacturing, as mentioned earlier, is the methods and tools for improving business processes that were used in the Toyota production system. The essence of these activities is that the processes in production are built in such a way as to create a continuous flow of single products. At the same time, all operations that do not create value for the final consumer of the product, such as unnecessary transportation or excessive processing, are excluded from the flow. Within the framework of the concept of lean production, there is a set of tools designed to achieve this goal [Chris, 2020].

The most popular tools and methods of lean manufacturing implemented in the practice of Chinese enterprises are [Maskell, 2020]:

- streamlining the employee's workplace (5S);
- quick changeover of equipment (SMED);
- Total Productive Maintenance system;
- pull system and custom work (Kanban);
- deliveries just-in-time (Just-In-Time);
- visualization;
- standard operations cards (FOS);
- continuous improvement (Kaizen);
- value stream mapping (Value Stream Mapping).

Chinese companies occupy leading positions in the world, competing with European companies and the United States not only in terms of prices and quality characteristics of their products. The Kaizen system (continuous improvement) has been widely used in China.

The standardization of processes, automation of production, the continuity of the assembly line makes it possible to ensure high productivity of companies. At the enterprises of Lenovo, Jeely, Metso, they systematically approach the issues of cost reduction, while using the Kanban system, SMED (Single-Minute Exchange of) equipment changeover tools, etc. [Womek, Jones, 2021]

As a result of the introduction of lean manufacturing, it is possible to obtain the following benefits [Chris, 2020]:

- improving the quality of manufactured products with a high level of control;
- increase in operational readiness and productivity of the equipment;
- reduction of stocks of raw materials and finished products;
- increase in working capital;
- reduction of production costs;
- release of personnel to solve new problems;
- reduction of the production cycle.

An enterprise can obtain these advantages without attracting significant investments in the reorganization of production. The system of lean production consists of 80% organizational and

technical measures and only 20% are investments in technology [Luyster, 2021].

The advantage of the lean production system is the high organization of processes, which allows you to eliminate unnecessary costs and successfully compete in today's market.

In general, you need to understand that the economic impact of Lean manufacturing is not always easy to calculate, and this is what manufacturers often care about in the first place. The real economic effect is a consequence of the involvement of employees. When people begin to take part in the management of the company, improve their workplace, when they begin to understand that their ideas affect not only the development of the enterprise, but also their wages and working conditions, then the economic effect will be noticeable. Only in this case, everyone benefits from the system.

Methods

In the study, the authors used some methods such as analysis and synthesis, induction and deduction, historical and logical, abstraction and concretization.

Results

Zhuhai Gree Electric Appliance Co., Ltd. from Zhuhai was founded in 1991 and was listed on the Shenzhen Stock Exchange in November 1996. In the beginning, Gree was just a company that assembled home air conditioners. Now it has grown into a diversified technology global industrial group that has expanded its business into air conditioners, household appliances, high-tech equipment and communication equipment.

According to statistics released by the China National Standards Institute, Gree, Inc. over the past 8 years has been No. 1 in the air conditioning industry since 2011. In 2018 Gree, Inc. won the China Quality Award.

The company is following the supply-side structural reform, adjusting and optimizing the industrial layout, and actively promoting the upgrading of smart manufacturing to ensure high-quality development. Since 2013 Gree, Inc. began to explore the fields of intelligent equipment, communication equipment and molds, expanding its business into a diversified high-tech industry from the production of professional air conditioners. At present, Gree, Inc. intelligent hardware. not only provides state-of-the-art equipment for its own transformation of automation, but also provides services and solutions for household appliances, automobiles, food, 3C digital products, building materials and sanitary ware industries. The cost of production per person was increased to 1.496 million yuan in 2018 from 0.912 million yuan in 2012.

In 2018, the company achieved sales revenue of 200.24 billion yuan with a net profit of 26.20 billion yuan, contributing 16.02 billion yuan in total taxes, and ranked first in tax in the home appliance industry for 12 years in a row.

The company has established the principle of R&D spending: "input according to demand and no upper limit"; In 2018, the annual R&D contribution reached 7.268 billion yuan. Through many years of research and development, the company has applied for 61,052 national patents, including 29,755 invention patents and 1,970 international patents. In the list of Chinese invention patents published by the National Intellectual Property Administration of China, Gree, Inc. ranked 6th in China and 1st in the home appliance industry in terms of the number of patents granted. Currently Gree, Inc. has developed 24 "world-leading" technologies, won two national science and technology achievement awards, one national technology invention award, and four Chinese patent gold awards. According to

the Nikkei newspaper, the company's share of the global home air conditioner market reached 20.6% in 2018, ranking first in the world for many years. The company's central air conditioner market share has ranked first in the domestic market for 7 years in a row.

Currently Gree, Inc. operates two major brands GREE and TOSOT, covering a wide range of products such as home air conditioners, central air conditioners, air source water heaters, household appliances, industrial products and mobile phones. Gree has a number of subsidiaries, including Landa Compressor, Gree Electrical, Kaibang Motor, Xinyuan Electronics, intelligent equipment, precision molds and renewable resources, including the entire industry chain from component production to waste recycling production.

Gree Inc. has developed products covering 20 main categories, 400 series and more than 12,700 varieties, which have been sold to more than 300 million users in more than 160 countries and regions.

Production and sales volume of Gree, Inc. household air conditioners. It ranked first. The company is always committed to using technology to improve the learning process, stimulate interest in learning, develop scientific learning skills, and facilitate high-quality educational resources for Chinese students.

Gree has 90,000 employees, including 14,000 engineers and over 30,000 technical workers. The company has 14 manufacturing bases around the world, which are located in Zhuhai, Chongqing, Hefei, Zhengzhou, Wuhan, Shijiazhuang, Wuhu, Changsha, Hangzhou, Luoyang, Nanjing and Chengdu, as well as in Brazil and Pakistan. In addition, Gree has established 5 renewable resource bases in Changsha, Zhengzhou, Shijiazhuang, Wuhu and Tianjin, covering the entire industrial chain from production to waste disposal for green, recyclable and sustainable development.

The company has 15 research institutes, namely: Institute of Refrigeration Technology, Institute of Mechanical and Electrical Technology, Institute of Home Appliance Technology, Institute of New Energy and Environment, Institute of Health Technology, Institute of Communication Technology, Institute of Intelligent Equipment Technology, Institute of Robot Research, Numerical control. Machine Tool Institute, Internet of Things Institute of Technology, Institute of Energy Technology, Motor Systems Institute of Technology, Flushing Institute of Technology, Institute of Freezing and Refrigeration Technology, and Institute of Environment and Energy Conservation. Gree has established 96 research institutes, 929 laboratories, 2 academic jobs, one national key laboratory, one national engineering research center, one national industrial design center, one nationally recognized enterprise technology center, and one robotics R&D center. Moreover, it has become the research and evaluation base for the national notification center.

The company always insists on honest work and has established a perfect quality management mode based on customer satisfaction. Through strict quality control and system building, Gree is making every effort to achieve the goal of "No defects, zero after-sales service".

Table 1 - Gree, Inc. total revenue, net income and dynamics of change to date in euros [Official website of Zhuhai Gree Electric Appliance Co, www]

Report date	Total Revenue and Dynamics (%)		Net Income and Dynamics (%)	
30.06.2021	12 834 782 720 €	-19.906 % ↓	3 871 786 240 €	+10 971.050 % ↑
31.03.2021	12 797 969 920 €	-21.163 % ↓	4 676 145 920 €	+319.92 % ↑
31.12.2020	12 586 296 320 €	-16.792 % ↓	2 754 517 760 €	+17.33 % ↑
30.09.2020	14 023 836 160 €	-3.551 % ↓	1 152 240 640 €	+27.11 % ↑
31.12.2019	15 126 379 520 €	-	2 347 736 320 €	-
30.09.2019	14 540 135 680 €	-	906 515 200 €	-
30.06.2019	16 024 611 840 €	-	34 972 160 €	-
31.03.2019	16 233 524 480 €	-	1 113 587 200 €	-

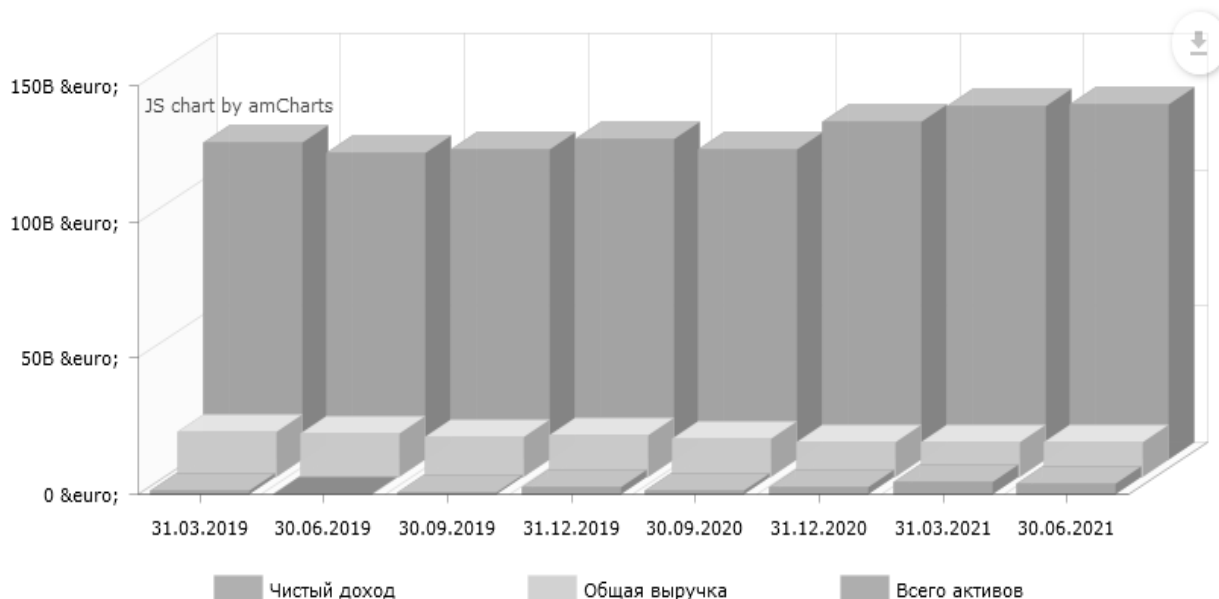


Figure 2 - Financial report of Gree, Inc., chart [ibid.]

Let's present the full financial report of Gree, Inc.

Table 2 - Financial report of Gree, Inc. [ibid.]

Indicators	30.06.2021	31.03.2021	31.12.2020	30.09.2020
Gross profit	7 436 185 600 €	7 037 687 040 €	6 622 622 720 €	7 938 680 320 €
Cost price	5 398 597 120 €	5 760 282 880 €	5 963 673 600 €	6 085 155 840 €
total revenues	12 834 782 720 €	12 797 969 920 €	12 586 296 320 €	14 023 836 160 €
Operating revenue	-	-	-	-
operating income	1 379 559 680 €	1 585 711 360 €	516 299 520 €	1 468 830 720 €
net income	3 871 786 240 €	4 676 145 920 €	2 754 517 760 €	1 152 240 640 €
R&D spending	-	-	-	-
Operating expenses	11 455 223 040 €	11 212 258 560 €	12 069 996 800 €	12 555 005 440 €
Current assets	100 377 461 760 €	98 818 439 680 €	95 700 395 520 €	87 689 930 240 €
total assets	130 123 124 480 €	129 553 446 400 €	124 142 885 120 €	113 921 811 200 €
Current cash	87 268 423 680 €	86 477 868 800 €	81 999 591 680 €	79 026 958 080 €
current debt	-	-	-	-
Total debt	-	-	-	-
Equity	110 588 412 160 €	109 151 792 640 €	104 898 073 600 €	103 386 908 160 €

Gree, Inc.'s latest financial earnings report. was 06/30/2021. According to Gree, Inc.'s latest earnings report, Gree, Inc.'s total revenue amounted to 12 834 782 720 euros and changed by -19.906% compared to the previous year. Net profit of Gree, Inc. in the last quarter amounted to 3 871 786 240 €, net profit changed by +10 971.050% compared to the previous year.

As a specialized air conditioner manufacturer, Gree introduces advanced and high quality air conditioning products to global consumers. The company currently has six production bases respectively in Zhuhai (headquarters), Chongqing, Hefei, as well as in Brazil, Pakistan and Vietnam, employing more than 40,000 employees. The company has developed both domestic air conditioners and commercial air conditioners of 20 kinds, 400 series, 7000 models, to meet the different needs of

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different consumers. The company has about 1500 technical patents.

The most important tasks for the enterprise, the implementation of which is of strategic importance, are:

- improvement of production culture;
- improving the quality of manufactured products;
- application of modern technologies and equipment in production;
- expansion of cooperation with foreign enterprises.

Throughout the existence of Gree, Inc. heads of all divisions are directly involved in the creation, implementation and continuous improvement of the processes of the product quality management system in the company. To do this, suppliers, consumers, partners are involved in order to determine their needs, expectations and proposals, to present them with information about the decisions made, while implementing the integrity and systematic improvement.

To manage and ensure product quality at Gree, Inc. a quality management system has been created, documented, implemented and maintained in working condition, and measures are being taken to constantly improve its effectiveness.

Gree Inc. applies a strategy and policy in the field of quality, when building current plans, risks are identified that may be associated with an increase in the time for the implementation of programs and plans for production and sales, the creation and implementation of projects, the achievement of intended results, etc. The possible consequences and the possibility of such risks are determined. Based on the results of the analysis, conflicts are predicted. Given the likelihood of their occurrence, activities are carried out to prevent them. In the process of direct communication, points of disagreement are identified and agreed upon. Also, interests can be coordinated during telephone conversations, business correspondence, business meetings.

Market research is carried out to identify explicit and implicit stakeholder needs using two-way communication. First of all, attention is paid to informing consumers, including high-quality advertising. An impressive amount of data about the organization's activities, mission, policy and strategy, and the results of work is regularly communicated to the public through branded publications, speeches to the media, participation in conferences, etc.

Recommendations and conclusions

Today at Gree, Inc. Since 2020, our own quality control system has been introduced. For each team of workers, a list of planned indicators was developed, which could be seen by any employee of the company. This data consisted of the percentage of rejects at each stage, the accuracy of the timing of delivery of parts to the next stage, and discipline.

At Gree, Inc. follow the recommendations of Kaizen specialists, whose main goals are to reduce inventory and organize the smooth movement of parts from processing raw materials to assembly of the finished product. But working with own productions is not for Gree, Inc. In one step, the company decided to promote lean manufacturing among its suppliers, requiring just-in-time deliveries. As a result, in two years, the factories have seriously changed their approach to work.

The implementation of kaizen is a long-term project. To stay one step ahead of the competition, Gree, Inc. must make improvements daily. It will not be possible to immediately increase profits in the next quarter. But over a longer period of improvements, labor productivity will increase by 50-100% or more. Even if you take some steps that will at least slightly increase the efficiency of work for several years, every day. In this case, the company will always be one step ahead of its competitors and is

guaranteed to receive a leadership position.

Each individual improvement may be small, but the sum of incremental improvements will lead to significant strategic gains.

In companies, often employees are forced to do their job every day, without the opportunity to make adjustments to their workflow, which can possibly improve quality and efficiency. At Gree, Inc. with the kaizen philosophy, this problem is taken into account and every employee who sees an opportunity to do their job better can and should even make these changes.

The philosophy of kaizen allows you to rally the staff, develop it and significantly strengthen the entire production system - to make it more productive, flexible and less influenced by external factors.

Including because in the course of implementation, a layer of enterprise reliability is formed in terms of managing its efficiency and a layer of employees with a high level of expert and managerial competencies who are fully involved in the processes of improving the enterprise.

Thanks to competent management and lean manufacturing, from 2020-2021 the key indicators of Gree, Inc. have undergone the following changes:

- the time from the creation of a concept to launch in a series has been reduced;
- the time from the beginning of assembly work to the release of air conditioners was reduced from 2 weeks to 9 days;
- the level of stocks decreased by 6 times;
- the level of defects in supplied parts was reduced by 100 times, on the production line - by 4 times;
- labor costs for the manufacture of products decreased by 3 times.

Gree Inc. today it has again reached profitable indicators, was able to maintain its independence and its position in the air conditioner market.

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Повышение эффективности компании на основе принципов бережливого производства

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Аннотация

Актуальность данной темы исследования обусловлена тем, что в современных условиях жесткой конкуренции повышение эффективности предприятия возможно только при внедрении новых методов организации производства, в том числе инструментов бережливого производства. Методология бережливого производства, направленная в первую очередь на экономию труда рабочих и применение рациональных и наиболее эффективных методов труда, позволяет сократить время производства за счет исключения отходов. В то же время предлагаемые принципы и методы организации производства продукции предполагают определенную методологию, которая может быть реализована не в отдельной конкретной отрасли, а в любых производственных процессах, на выходе которых заказчик получает товар или услугу данного качества. Вся деятельность по управлению процессами сводится к формированию непрерывного потока создания ценности продукта, где ценность понимается как совокупность потребительских качеств товара или услуги, за которые потребитель готов платить. В начале 21 века теория бережливого производства нашла свое применение в проектах китайских предприятий по повышению производительности.

Для цитирования в научных исследованиях

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Ключевые слова

Производственный процесс, бережливое производство, рабочий процесс, управление предприятием, Китай.

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