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Order Management in the Era of Customization

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ABSTRACT

The economic growth and development of the country largely depends on success in the main industries, where mechanical engineering plays a key role. The economies of different countries rely on industrial enterprises that satisfy people's needs through the production of goods and services. To ensure competitiveness in a dynamically changing market, continuous improvement and development of enterprises is required. In the current conditions, mechanical engineering enterprises increasingly need to adapt to each individual customer, which in turn forces them to rebuild enterprises to the parameters typical for single or small-scale production. The production process is the joint work of tools, equipment and personnel through which products are produced. The complexity of the process of releasing new products is due to the involvement of a large number of departments involved in this process. Order execution is based primarily on the management of production systems. One of the most important processes in enterprise management is the order management process. The purpose of this study is to determine the methods of optimizing the order management process and reducing the influence of the internal cooperation factor on the increase of the period of its implementation at machine-building enterprises. As a methodological basis such general scientific methods as analysis, synthesis, comparison and contrast were used. As the information base, the article analyzes the works of modern authors who consider the issues of order management and such an element of the organizational structure as internal cooperation between departments, their influence on the internal processes of the enterprise and the timing of order execution. The features of the planning process for a single type of production are considered. In the course of the work, the main reasons for the shift in previously determined order completion dates, the most important indicators for order fulfillment, the peculiarities of the planning process at the unit type of production were considered, as well as the most frequently encountered problems during project implementation were identified. In connection with the trend towards changes and development of enterprises, in terms of changes in order management processes for customized products, an increase in the number of created enterprises and an increase in the share of customized products, a conclusion was made about the relevance of studying the order management process in a single type of production at machine-building enterprises. Conclusions are drawn about the need for further study of the issues under consideration. The materials can be used in companies in the real sector of the economy, in administrative structures and in the educational process.

Keywords: effective management; order management; internal cooperation; machine-building enterprise; customization

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INTRODUCTION

The economic growth and development of the country largely depend on the success of the main industries, where the key role is played by mechanical engineering [1]. Enterprises that provide satisfaction of the needs of the population through the production of goods and services require constant improvement and development to maintain competitiveness in the dynamically changing market conditions.

The complexity of the process of producing new products is due to the involvement of a large number of departments, and the quality and timely execution of the order is primarily based on the management of production systems.

The article analyses the works of modern authors considering the process of order management and such an element of the organisational structure as internal cooperation between different services of the enterprise, its influence on the functioning of the business entity and the terms of order fulfilment.

CUSTOMISATION IN MECHANICAL ENGINEERING

Classification by type of production is based on data on volumes, assortment, nomenclature of manufactured products and frequency of their change, as well as the degree of employability of workplaces [2].

According to the Russian Federation Government Order No. 2436-o,¹ dated 09.09.2023, the specialised machine building industry is characterised by a high concentration of production and is represented by more than 60 enterprises in 30 constituent entities of the Russian Federation. Most of them are located in the Chelyabinsk, Bryansk, Leningrad, Tver and Yaroslavl regions.

Output indexes (excluding 2020) have been increasing in 2019–2022; the industry is currently in a state of intense growth. The production index

in 2022 was 120%, and the average for the period 2019–2022 was 109% annually. In 2022, the output of Russian specialised machinery amounted to RUB 71.1 billion.²

As the industry is oriented towards the domestic market, the share of exports in total output is less than 1%; in 2022, USD 0.01 billion worth of products were shipped abroad, which is 39% more than in 2021; the share of Russian producers in the domestic market was 24% and is continuously growing. The share of Russian producers in the domestic market was 24% and is continuously growing.

According to Rosstat data,³ industrial production volumes in December 2023 increased by 2.7% as compared to the same period of 2022 and by 9.7% as compared to November 2023. Overall, industrial production in 2023 increased by 3.5% year-on-year (*Fig. 1*).

Manufacturing industries in 2023 consistently showed high growth rates: production volumes grew monthly by more than 5.0% year-on-year. Growth was 10.5 and 10.8 per cent in Q2 and Q3, respectively, but the growth rate slowed to 7.8 per cent in Q4. In December 2023, the index increased by 5.1 per cent relative to December 2022 and by 11.0 per cent relative to November 2023. *Table 1* shows positive dynamics in such industries as manufacture of finished metal products (except machinery and equipment), manufacture of machinery and equipment (not included in other groupings).

A significant number of mechanical engineering companies have a single type of production, which in turn does not guarantee the repeatability of placing a similar order for a customer in the future. Today, manufacturers need to adapt individually to each counterparty, and this necessitates the

¹ Order of the Government of the Russian Federation No. 2436-o dated 09.09.2023. URL: <http://publication.pravo.gov.ru/document/0001202309130024> (accessed on 16.03.2024).

² Order of the Government of the Russian Federation No. 2436-o of 09.09.2023. URL: <http://publication.pravo.gov.ru/document/0001202309130024?index=70>

³ Dynamics of industrial production in 2023 Rosstat (official site). URL: <https://rosstat.gov.ru/folder/313/document/231621> (accessed on 16.03.2024).

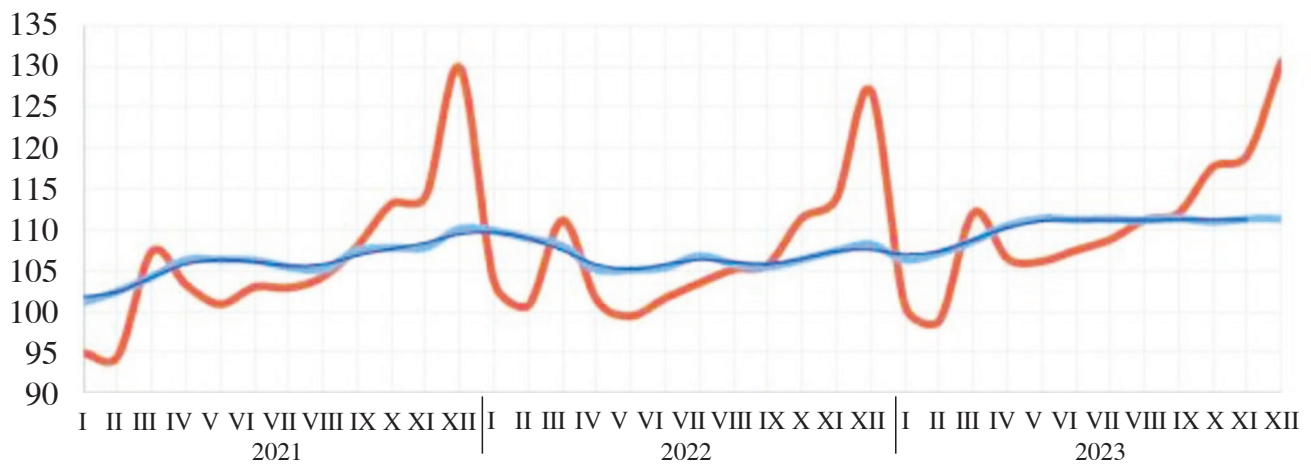


Fig. 1. Industrial production index as % of the average monthly value in 2020

Source: compiled by the author based on Rosstat data "Dynamics of industrial production in 2023". URL: <https://rosstat.gov.ru/folder/313/document/231621> (accessed on 16.03.2024).

Table 1

Production indices for certain types of main manufacturing industries^a

Type of manufacturing production	December 2023, as % of		2023, in % to 2022
	December 2022	November 2023	
Manufacture of fabricated metal products (except machinery and equipment)	113.1	119.2	127.8
Manufacture of machinery and equipment not included in other groupings	96.4	136.1	104.5

Source: compiled by the author based on Rosstat data "On industrial production in 2023". URL: https://rosstat.gov.ru/storage/mediabank/10_31-01-2024 (accessed on 16.03.2024).

Note: a – the indices are calculated in accordance with the Official Statistical Methodology for calculating the index of industrial production based on data on the dynamics of production of the most important representative goods in physical terms, assessed in prices of the base year 2018. The structure of gross value added by type of economic activity in the 2018 base year is used as weights.

need to change the order management process to take into account the parameters inherent to the single production type [3]. Industry entities that manufacture products for stock, for the most part, do not take into account the wishes of customers and create products with standard characteristics. Customised production means expanding the number of nomenclatures and variations of finished products. However, customised production is associated with individual production processes, in particular with difficulties in coordinating manufacturing and assembly procedures when

production capacity is limited. As a result of the variability of output volumes, capacity utilisation becomes inefficient [4].

Due to the increasing interest of customers in products that satisfy their individual needs, there is a trend of enterprise development, which consists in reorganising order management processes for customised (i.e., tailored to individual preferences) products. The authors of [5], who studied the impact of customisation on the performance of enterprises, argue that investment in it will increase as customised goods become the most

preferred on the market. Thus, M. Abraham, R. Archacki, J.E. González and S. Fanfarillo, who study personalisation in retail, find that the amount of investment in customisation to ensure productivity growth among the best companies is 0.9% of turnover and will increase to 30% in the future; for the others it will be 18% of turnover [6].

Due to the aspiration of existing production companies to develop in line with the above trend, as well as the increasing number of established enterprises specialising in customisation, we can conclude that it is relevant to study the process of order management at the unit type of production as applied to economic entities of the machine-building industry.

RESEARCH RESULTS

Order management as a process

Current planning and management literature associates customised manufacturing with unit production, associated with complexity and high costs. The author of the article [7] considers unit manufacturing based on modern technologies that allow the production of goods with different characteristics without high changeover costs. The emergence of new opportunities has contributed to the view that there is a need to change the attitude towards unit production, which in turn should affect the management of the latter. Batch production of goods can be favourable to companies that do not want to overstock their warehouses in a volatile market. The model, when the production of goods is planned to be customised, forces the company to actively search for prospective customers, which does not allow the allocation of fixed costs to some stable volume of finished goods [7].

Within the framework of analysing scientific works, different interpretations of the concept of “order management” should be highlighted. Modern authors define it as a process, a logistics function, a cycle in the order structure. This allows us to conclude that there is no unified approach to the problem of order management.

In [8] the researchers consider the issues of the order flow process — those that are newly accepted must be accompanied by the creation of a new technological process, despite the existence of developments on similar products. Since efficiency is not characteristic of all departments, data on similar decisions previously made in different industries are not made public and, consequently, are not analysed by the enterprise as a whole [8].

In order to successfully position itself on the market, a modern industrial company must monitor and respond to changes in customer preferences in a timely manner. The emphasis should be shifted towards the most promising and profitable orders. D.V. Vyshegorodsky and M.V. Shishkin speak about the need to form a database of incoming orders to determine the possibility of their realisation at the price offered by the customer, within the agreed time frame with maximum profit for the company [9].

Order fulfilment is based primarily on the management of production systems, which largely depends on the planning of the machine-building enterprise (strategic, tactical, and operational).

The leading role from the point of view of science and practice today is played by operational processes, in particular, attention is paid to the operational capabilities and structures of the organisation [10]. In [11], the order management process is presented as a change in the state of the product from the moment when it was accepted to the actual transfer of the finished product to the customer. Let us use some definitions applied by the author [11]:

- process is a successive change of states of an object, event or phenomenon;
- a sub-process is any part of the process, allocated in a certain way and having the right to exist;
- a functional management task (FMT) is a set of actions to fulfil one management function within a given subprocess.

G.G. Levkin considers order management as a logistic function, and an order as a formalised

unit of information flow.⁴ According to the author, the main tasks in the order management are as follows:

- fulfilment of obligations to the customer in a qualitative and timely manner;
- increasing the efficiency of work with counterparties;
- reducing the timeframe for fulfilment of obligations.

G.G. Levkin singles out the coordination of logistics processes at different stages of material flows as the most important direction for improving the efficiency of order fulfilment, as well as the need for timely provision of information to the buyer.

Yu.S. Ronzhina uses such a tool as dynamic modelling in her research [12]. The principle of model building is based on the formation of a functional logistics cycle consisting of “Order Management” and “Order Fulfilment”. The input to the cycle is the customer’s order with its requirements and wishes for products. The output is the expected results of logistics operations. Order management, according to this paradigm, begins after its receipt and formation and represents the function of expert assessment of the possibility of manufacturing this product. Effective management implies accepting orders based on production potential and in agreement with the customer: it is necessary to refuse or accept orders that are known to be impossible to fulfil, subject to approval of probable deadlines. The application of this kind of dynamic model should ensure the sustainable development of the industrial enterprise.

In organisations with a single type of production, the order management process is the optimal management of each of a set of consecutive sub-processes (concluded in the interval between order acceptance and its shipment from the warehouse), taking into account the complex

interrelationships between them. Their duration in the course of development and execution of each individual order determines how flexible the company is and how ready it is for organisational and production changes (*Fig. 2*).

The success of most of the organisation’s business processes and, as a consequence, the time frame for task execution, counterparty satisfaction and loyalty, and ultimately the company’s profitability, will depend to a large extent on how well the customer order management process is established.

This study considers lead time as a key criterion for optimising the order management process, which in turn is the basis for shaping the workload of the company (*Fig. 3*).

Planning of order fulfilment, according to the authors of the article [13], is carried out in accordance with the regulations of production of a separate product by drawing up a shift assignment, through which the control of production units is carried out. The order is considered as a subject of financial and economic relations, an object of investment of owners’ funds; its effective management is the key to achieving the stated goals and indicators by the enterprise. Fulfilment of orders with the required quality and on time will provide the organisation with a leading position in the market. Y.S. Rezanova and E.V. Belyakova, considering the tools of order management, conclude that there are no such tools to satisfy the interests of market agents (both manufacturer and customer) [14]. Defining the order as a number of related processes, starting from the moment of its acceptance and up to the shipment of products, these authors emphasise that often industrial enterprises with the order-based type of production violate the terms of its execution, do not provide the required quality, ignore customer requests. They also note that effective order management should start with the creation of a system of indicators and understanding of the logical relationship between them [14].

⁴ Levkin G.G. Logistics of distribution. Study guide. Moscow: Direct-Media; 2024. 253 p.

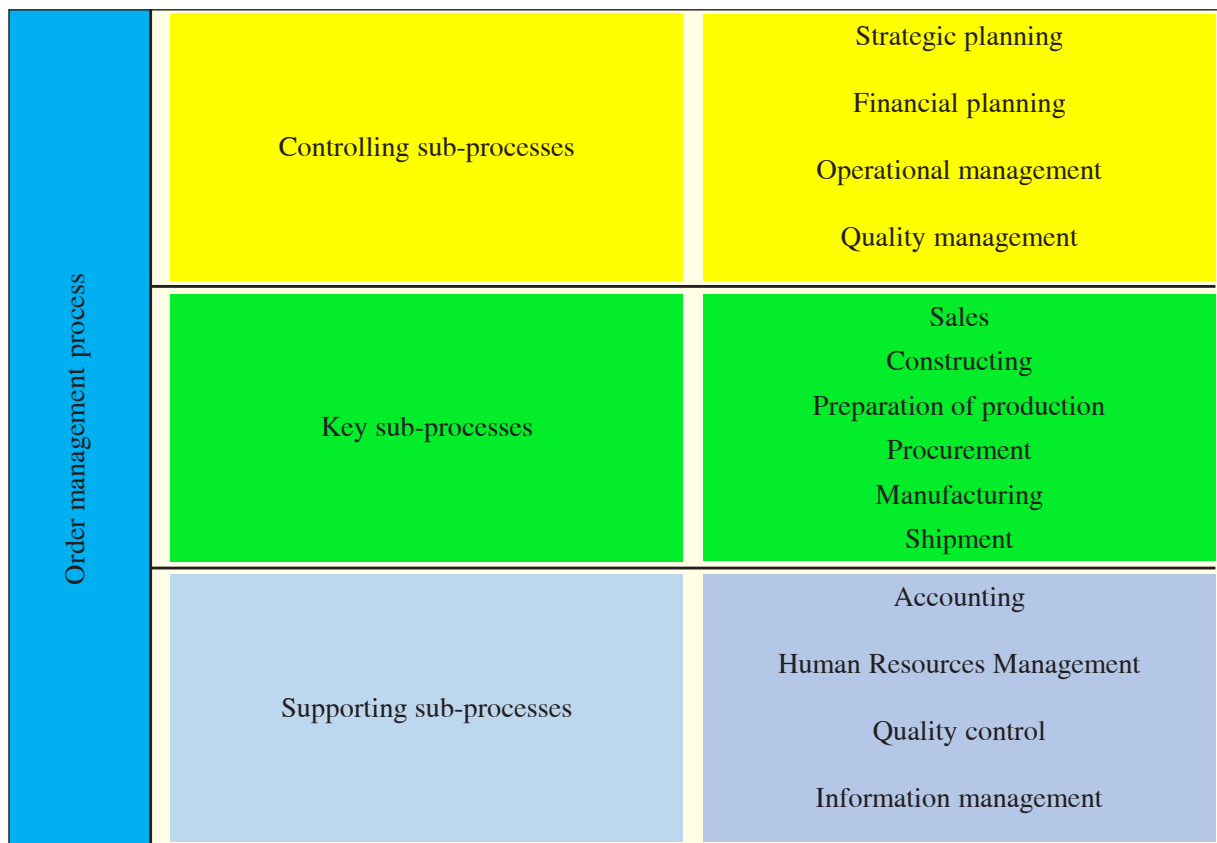


Fig. 2. Order management process structure

Source: developed by the author.

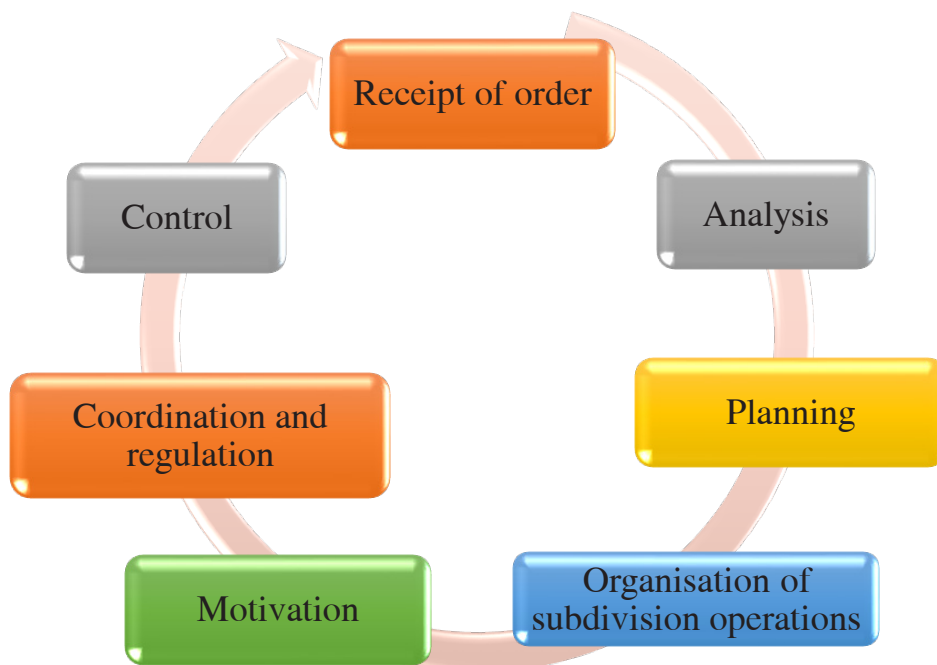


Fig. 3. Order management process

Source: developed by the author.

Internal cooperation in the order management process

In the course of order management, the head of the enterprise and heads of departments perform the function of organisation and control. The classical scheme, in which the control of work performance is carried out through operational and planning meetings, has proved to be ineffective due to the large number of controlled items. Accordingly, the quality of reporting information is reduced, which, in turn, affects the effectiveness of decisions made.

Order fulfilment time is one of the key parameters, and one of the reasons for its increase is poor cooperation between the company's divisions, called "internal". When striving to perform local tasks by individual employees, the whole algorithm of the order management process is not taken into account, which can negatively affect the work of related structures of the organisation. However, when several of them are involved in the fulfilment of one task, there is a blurring of obligations for its fulfilment and the interest of each individual unit in its completion is lost — the responsibility is shifted to other services of the enterprise.

In case of duplication of task fulfilment by employees of different departments, similar documents accompanying its fulfilment appear, which further increases inconsistency of actions and leads to internal conflicts.

The order flow sequence can be represented in the form of the following scheme (*Fig. 4*).

According to *Fig. 4*, the algorithm of order implementation looks quite simple, but in reality, there is a sufficient number of difficulties and problems in this chain.

For example, the chief designer's department has included in the product specification such a purchased component (or material) that the purchasing department will not be able to supply in the required time; or the technological equipment is designed with excessive require-

ments to the accuracy of its manufacture, which increases the duration and cost of its production. It happens that the departments determining the causes of defects in a particular product shift the responsibility for determining the causes to each other, which again increases the time of order implementation.

In order to eliminate this misalignment of actions, it is necessary to consider the services involved in the process from the perspective of a supplier and a customer. In the context of this concept, the customer is an official who requests the required information (product or service) from a supplier within the company in order to fulfil his/her functions. The functioning of this kind of co-operation requires a detailed description of both roles (*Table 2*).

If we characterise order management as a process that ensures the activity of the enterprise through the performance of certain algorithms by employees, then cooperation between employees is its essence. Thus, the author of [15] states that the structure of production in workshops is characterised by a variety of technological links and specialisations, which generates interaction between functional links, and the unit can act simultaneously as a consumer and supplier of products (services, raw materials). Production structures of this type are called business units.

Modern researchers mostly consider the issues of cooperation between departments and communication of employees without taking into account their influence on the enterprise processes. However, there are works in which internal co-operation is considered as a factor influencing the construction of business processes. For example, the authors of the publication [16] define cooperation as coordinated activity of participants to achieve joint goals and objectives and argue that within the enterprise it directly affects the creation of business processes, the results of the organisation's work and the achievement of its goals. In the absence of coordination of actions, internal processes

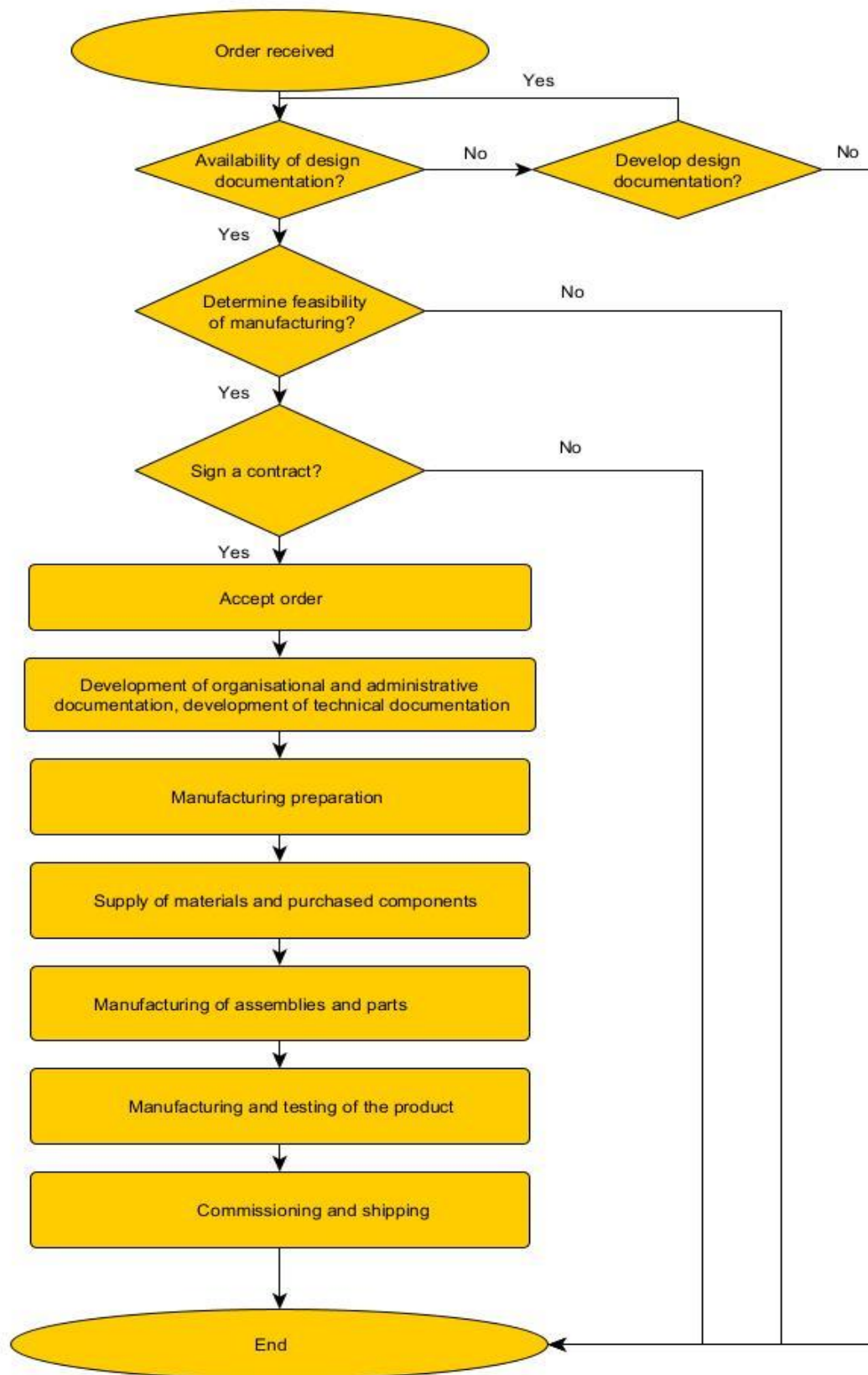


Fig. 4. Order processing algorithm

Source: developed by the author.

Table 2

Roles of client and supplier in internal cooperation

Client's responsibility	Supplier's responsibility
Informing the supplier of your needs	Keeping the client aware of their needs, providing them with services (products, raw materials) in a timely manner
Setting realistic requirements, taking into account the supplier's resources and constraints	Providing services, products, raw materials of proper quality
Providing feedback by pointing out positive and negative aspects of performance	Informing the client about the lack of sufficient data to fulfil the request
Communicating to management issues that have not been resolved in the customer-supplier relationship.	Informing the management of problematic issues that have not been resolved in the customer-supplier relationship.

Source: developed by the author.

run spontaneously, which leads to conflicts and misalignment, and also becomes the cause of inefficiency in fulfilment of planned tasks by the enterprise. Researchers in the above-mentioned work also consider interpersonal and intergroup aspects of interaction. Thus, informal relations affect the effectiveness of communication between employees. A number of organisational factors affecting effective cooperation between units are also highlighted. Management may overlook organisational difficulties because they are unaware of their existence [16]. It can be emphasised that interaction is understood as the process of development and exchange of information between units and employees, considered in the current work as internal cooperation.

At present, specialists assess the problems of communication between subdivisions and communication between employees from several points of view, and in the course of studying the works of modern authors, no unambiguous recognition of internal cooperation as a factor affecting the order management process at the enterprise as a whole was found.

Order lead times and production planning

Order fulfilment is always limited by deadlines that depend both on the productivity of the joint work of many structural units of the organisation and on the performance of each of them separately. The activity of any unit is conditioned by the presence of individual tasks and available constraints for their fulfilment, which affects the timing of the product output (Fig. 5).

Product manufacturing begins with the development and approval of organisational and technical documentation necessary for the orderly distribution of deadlines and areas of responsibility between the participants in the production process. At this stage, possible errors are identified, a list of purchased components and materials, requirements for warranty periods, etc. is drawn up. After the design documents are elaborated, technological documents are formed, on the basis of which lists of required materials and components are created, and the procedure of purchasing of all necessary materials and components is started. Identification of future suppliers is a rather labour-intensive process that requires organisation of

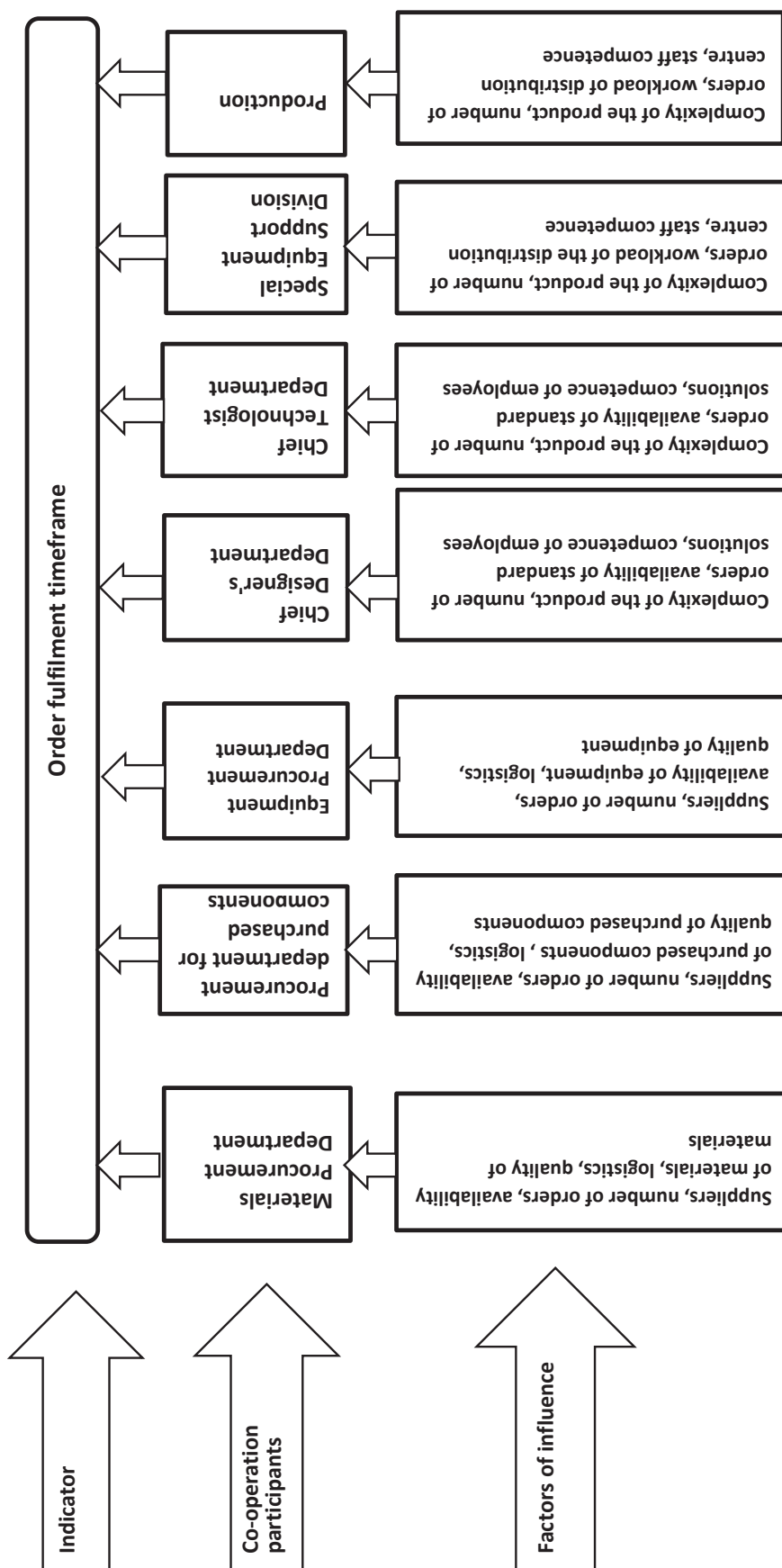


Fig. 5. Scheme of dependence of subdivisions' influence on order fulfillment terms

Source: developed by the authors.

tenders on an electronic platform, after which supply contracts are concluded.

The experience of the manager is often the only tool in determining the timeframes for work, which are very tentative and biased in this approach.

There are several main reasons for shifting the previously defined timeframes for order fulfilment:

- lack of coordinated actions between subdivisions (insufficient internal co-operation);
- high degree of bureaucratisation;
- biased methodology of forming the deadline for order fulfilment, taking into account the needs of all divisions;
- variability of processes involving people (impossibility of precise planning);
- insufficient focus on the result on the part of all participants in the processes.

Many modern specialists who have analysed the problems arising in the course of order management, called the planning stage one of the most important and considered the application of various tools to improve its effectiveness [10, 12, 17]. Researchers emphasise that the timeliness of product release increases the number of interested customers, as a consequence of which the production volume increases, which has a positive effect on economic indicators.

G.I. Galieva refers to the work of Harvard University employee R. Suri, who identified the five most important indicators in terms of order fulfilment [18]:

- external duration of order fulfilment is the time available for monitoring by external contractors of the production system;
- internal order fulfilment duration is the time required for the order to travel all the way through the enterprise;
- stated order fulfilment time — the time that sellers agree with the buyer;
- planned order fulfilment time — an indicator used in the planning systems of production enterprises (MRP, ERP);
- supplier fulfilment time — the time it takes

for your order to move from the supplier to the customer's disposal.

As can be seen, time is the main criterion for successful order management. Its production time at the acceptance stage is often overestimated, as it is determined based on the subjective opinion of the heads of departments involved in the production process. It should be noted that there are also situations when the estimated production time is insufficient. This is due to various factors. For example, in case of unsatisfactory technological development of the product, the equipment cannot provide the required accuracy of manufacturing, bottlenecks appear at individual work centres due to the absence (or impossibility to apply) to a particular product of appropriate means of technological equipment. Deviations from the established time limits also occur due to late delivery of purchased components and materials. Correction of consequences caused by errors in the design of assemblies and parts also adversely affects the product release dates.

Internal lead times directly depend on a properly designed management process, namely, minimising problems caused by cooperation between production units and the use of modern technologies (in particular, digitalisation). Some researchers consider methods of control and labour organisation that rely only on human resources to be ineffective [19]. Automatic Enterprise Management Systems (AEMS) are implemented for order management. Various models of AEMS include similar algorithms that evaluate the possibility of order fulfilment based on such parameters as cost and lead time of products, their quantity, quality, individual customer requirements, as well as simple logistics tools (in terms of purchasing of goods and materials). However, such a system is not able to take into account the change of conditions in case of abnormal situations, and therefore the accuracy of planning will be reduced.

V.M. Yachmeneva and Z.O. Osmanova consider the need to apply new methods and techniques in management to ensure the transition to a new

technological mode. In their opinion, the introduction of digital technologies is not a guarantee of success [20]. The work of A.A. Cherepashkov and P.A. Samoilov reflects the fact that reducing labour intensity does not always provide the best result. It is necessary to take into account the indicators that characterise the quality of performers' work when using automated systems and innovative interfaces. Scientists note that currently there are no such algorithms that could ensure the guaranteed integration of digitalisation elements and effective management of enterprises [21].

According to the authors of [22], the following problems often arise in the implementation of projects:

- change of objectives during the course of project implementation;
- lack of resources necessary for the successful implementation of the project;
- incorrect estimation of the duration and cost of work fulfilment;
- inaccurate preliminary assessment of possible project risks;
- inefficient organisation of project control and reporting;
- incomplete or unreliable information on the implementation of project activities.

The researchers suggest that in order to compensate for risks, when approving the consolidated plan of the enterprise, resources (namely, their volume expressed in value) should be planned and allocated to projects. Also, in order to reduce possible risks, it is necessary to create an insurance fund. The optimal allocation of resources, despite their linear dependence on the project, is a complex task. Operational management of several projects is impossible without controlling sub-processes during their execution. However, despite the use of project management tools in fulfilling the tasks of creating product samples, there is a violation of deadlines and exceeding the planned budget. Such situations are caused both by the lack of awareness when making managerial decisions

and uncertainty associated with the risks of external and internal changes. According to the results of the analysis, the authors [22] concluded that the errors of performers can cause direct losses, ranging from 10 to 20% of the adopted budget value.

CONCLUSIONS AND RECOMMENDATIONS

As a result of the analysis, the tendency of development of machine-building enterprises with a single type of production, one of the main purposes of which is to meet the needs of customers in customised products, has been revealed. An important element in the transition of an organisation to this type of activity is the order management process. The article outlines different approaches to order management, proposes the author's version of the definition of this concept as a number of interrelated sub-processes within a single entity.

When considering the structure of order management, the terms of its fulfilment are singled out as one of the main parameters. The correctness of the choice of this indicator as a key one is confirmed by the arguments of modern researchers, whose works are considered by the author of this article. The concept of internal co-operation as one of the factors causing the change of planned timeframes in the order management process was introduced; other significant reasons for shifting the previously defined timeframes of order fulfilment were studied and defined, such as:

- high degree of bureaucratisation;
- lack of an objective methodology for forming the order fulfilment period taking into account the needs of all divisions;
- human factor as an obstacle to accurate planning;
- lack of equal focus on achieving the result on the part of all participants in the process;
- changing objectives during the course of the project;

- lack of resources required for the successful implementation of the project;
- incorrect estimation of the duration and cost of the work;
- inaccurate preliminary examination of possible project risks;
- inefficient organisation of project control and reporting;
- incomplete or unreliable information on the implementation of project activities.

To optimise the order management process and reduce the impact of the above factors, it is proposed to:

- to digitalise the processes of management and information exchange;
- to apply automated control and monitoring systems adapted to a single type of production;
- optimally distribute resources, create an insurance fund;

- use methods of mathematical modelling when receiving and planning order terms;
- implement managerial innovations;
- make managerial decisions based on process-based order management.

The results of this study will allow optimising the order management process, contributing to the reduction of the impact of internal cooperation on the increase in the order lead time at machine-building enterprises. Unfortunately, there is not enough analytical information in open sources to study this factor in detail, and the available information is fragmentary. In this regard, there is a need to continue the research on the impact of individual methods and algorithms on order management, as well as the study of tools to minimise the negative effects caused by inconsistency of actions during internal co-operation.

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