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Contents

INTRODUCTION

We are happy to invite you to get acquainted with the first issue of the new scientific and practical publication "Intellectualization of Logistics and Supply Chain Management".

We strongly believe that the launch of this magazine indicates the objective need to rethink a wide range of issues related to the development of theory and practice in logistics and supply chain management, awareness of the need to unite the scientific community and logistics practitioners, dissemination of modern knowledge and best practices for innovative development of the logistics services market.

The first issue of the magazine is published at a difficult time. The global coronavirus pandemic and the deep economic crisis have significantly worsened business activity in the world. Currently, global supply chains are collapsing, international trade is declining, and competition between global and regional logistics operators is intensifying. The most common thesis is that the world will never be the same again. Industry experts predict the emergence of new, more flexible and adaptive supply chain management strategies and approaches to logistics business process management. The trend towards collaborations, cooperation and unification of services is emerging, comprehensive proposals for clients are being developed. There is increasing talk about the need to build bimodal supply chains, which involves the development of different decision-making scenarios: the traditional approach - cost-effective efficiency, low risk, high predictability; a new approach "second mode" - rapid recognition of opportunities, adaptability, willingness to solve unexpected problems and look for new opportunities.

Radical transformations of the global and national markets for logistics services require appropriate scientific support. Logistics science has a special role to play in this process. Initiating the emergence of a new journal, we decided to focus on its coverage of problematic aspects of the formation and development of logistics systems at the micro, mezo and macro levels, supply chain management, digitization of logistics, methods and tools for optimizing processes in logistics and supply chains, sociopsychology relations and network interaction of enterprises using cloud technologies, artificial intelligence, e-learning, neural business process management systems, etc.

Therefore, we invite scientists, researchers and business representatives, as well as our colleagues from abroad, to cooperate and present the results of scientific research, to discus and debate on them, to work together to develop the scientific theory of logistics and promote mutual intellectual enrichment.

We hope that the new scientific publication will become a theoretical guide for young researchers and representatives of other fields.

HRYHORAK Mariia
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LOGISTICS CONTROL IN THE SYSTEM OF BUSINESS PROCESS MANAGEMENT AT ENTERPRISES IN THE TRANSPORT INDUSTRY

Perederii Nadiia, Marchuk Volodymyr, Ovdiienko Oksana. "Logistics control in the system of business process management at enterprises in the transport industry". *The article examines the peculiarities of logistics activities of transport enterprises at the macro and micro levels. A transport enterprise can be considered an intra-production logistics system in which incoming material flows are transformed into transport services. The types of logistics activities of transport enterprises are analyzed, which are divided into four groups: "Supply Logistics", "Intra-Production Logistics", "Sales Logistics" and "Resource Logistics". A comprehensive indicator for determining the level of logistics controlling is proposed, which makes it possible to assess the state of logistics management. An algorithm for assessing the level of logistics controlling at transport enterprises has been developed, which consists of three survey stages. In the first stage, a survey of the expert group is conducted regarding the importance of each type of logistics activity in four groups. The second stage of the survey is the selection of the most important logistics and control indicators for further evaluation using the Delphi method. The third stage of the survey is determining the weight, points, and relative importance of each indicator.*

A structural and logical scheme for the formation of logistics controlling indicators has been formed. On this basis, a system of basic logistics and control indicators for transport enterprises was developed. The developed model summarizes the system of logistic-controlling indicators, stages, and formulas for calculation and serves as a tool for determining the level of logistic controlling at a transport enterprise. The basis of the

model is creating an objective system of logistics and control indicators for a specific enterprise. Using the developed model for assessing the level of logistics controlling at a transport enterprise will provide the opportunity to obtain the necessary information for strategic and operational planning, as well as improve the management of logistics processes. Given the size and specificity of the enterprise's work, an essential task for managers is the formation of an information base for logistics management.

Keywords: logistics activity, logistics controlling, level of logistics controlling, supply logistics, intra-production logistics, sales logistics, resource logistics, a system of logistics and controlling indicators.

Передерій Надія, Марчук Володимир, Овдієнко Оксана «Логістичний контролінг в системі управління бізнес-процесами на підприємствах транспортної галузі». *У статті розглянуто особливості логістичної діяльності транспортних підприємств на макро- та мікрорівні. Транспортне підприємство можна розглядати як внутрішньовиробничу логістичну систему, у якій вхідні матеріальні потоки трансформуються у транспортні послуги. Проаналізовано види логістичної діяльності транспортних підприємств, які об'єднано в чотири блоки: «Логістика постачання», «Внутрішньовиробнича логістика», «Збутова логістика» та «Ресурсна логістика». Запропоновано комплексний показник визначення рівня логістичного контролінгу, який дає можливість оцінити стан логістичного управління. Розроблений алгоритм оцінки рівня логістичного контролінгу на транспортних підприємствах, який складається з трьох етапів опитування. На першому етапі проводиться опитування експертної групи щодо ваги кожного виду логістичної діяльності по чотирьох блоках. Другий етап опитування - виділення найважливіших логістично-контролінгових показників для подальшої їх оцінки за методом Дельфі. Третій етап опитування - визначення ваги, балів і відносної важливості кожного показника.*

Сформовано структурно-логічну схему формування показників логістичного контролінгу. На цій основі розроблено систему основних логістично-контролінгових показників для транспортних підприємств. Розроблена модель узагальнює систему показників логістичного-контролінгу, етапи, формули для розрахунку і служить як інструмент для визначення рівня логістичного контролінгу на транспортному підприємстві. В основі моделі є створення об'єктивної системи логістично-контролінгових показників для конкретного підприємства. Використання розробленої моделі оцінки рівня логістичного контролінгу на транспортному підприємстві дасть можливість отримати необхідну інформацію для стратегічного і оперативного планування, а також вдосконалення управління логістичними процесами. З огляду на величину і специфіку роботи підприємства для менеджерів важливим завданням є формування інформаційної бази для логістичного управління.

Ключові слова: логістична діяльність, логістичний контролінг, рівень логістичного контролінгу, логістика постачання, внутрішньовиробнича логістика, збутова логістика, ресурсна логістика, система логістично-контролінгових показників.

Передерий Надежда, Марчук Владимир, Овдиенко Оксана «Логистический контролинг в системе управления бизнес-процессами на предприятиях транспортной отрасли». *В статье рассмотрены особенности логистической деятельности транспортных предприятий на макро- и микроуровне. Транспортное предприятие можно рассматривать как внутрипроизводственную логистическую систему, в которой входные материальные потоки трансформируются в транспортные услуги. Проанализированы виды логистической деятельности транспортных предприятий, которые объединены в четыре блока: «Логистика снабжения», «Внутрипроизводственная логистика», «Сбытовая логистика» и «Ресурсная логистика». Предложен комплексный показатель определения уровня логистического контроллинга, который дает возможность оценить состояние логистического управления. Разработанный алгоритм оценки*

уровня логистического контроллинга на транспортных предприятиях, который состоит из трех этапов опроса. На первом этапе проводится опрос экспертной группы относительно веса каждого вида логистической деятельности по четырем блокам. Второй этап опроса - выделение важнейших логистически-контроллинговых показателей для последующей их оценки по методу Дельфи. Третий этап опроса - определение веса, баллов и относительной важности каждого показателя. Сформирована структурно-логическая схема формирования показателей логистического контроллинга. На этой основе разработана система основных логистически-контроллинговых показателей для транспортных предприятий. Разработанная модель обобщает систему показателей логистического-контроллинга, этапы, формулы для расчета и служит в качестве инструмента для определения уровня логистического контроллинга на транспортном предприятии. В основе разработанной модели лежит создание объективной системы логистически-контроллинговых показателей для конкретного предприятия. Использование разработанной модели оценки уровня логистического контроллинга на транспортном предприятии даст возможность получить необходимую информацию для стратегического и оперативного планирования, а также совершенствования управления логистическими процессами. Учитывая величину и специфику работы предприятия для менеджеров важной задачей является формирование информационной базы для логистического управления.

Ключевые слова: логистическая деятельность, логистический контроллинг, уровень логистического контроллинга, логистика снабжения, внутрипроизводственная логистика, сбытовая логистика, ресурсная логистика, система логистически-контроллинговых показателей.

Introduction. The logistics activity of the transport industry enterprises has many particularities and differs from enterprises in other sectors of the economy. Properly organized logistical support contains significant reserves for increasing the efficiency of management decision-making. The main emphasis of the logistics activities of transport enterprises is the synchronization of deliveries in time, selection of modes of transport, route optimization, information provision of the system regarding transportation needs and implementation possibilities, quality of service and packaging, etc. Taking into account the size and specificity of the work of transport enterprises, an important task is the formation of an effective management system for logistics business processes based on controlling, an innovative management tool in modern economic conditions. Controlling will allow not only to form an objective assessment of the state of the company's management system of logistics business process but also to ensure their proper information support, which is relevant for enterprises in the transport industry.

Recent research and publications analysis. The logistics and controlling integration form the concept of logistics controlling, which helps to determine directions for improving the management of material, financial and information flows in order to ensure the maximum efficiency of the enterprise as a whole. Logistics is aimed to optimize costs, associated with the organization of material flows. Controlling, as an integrated management function, uses these costs in the profit management system.

The use of logistics controlling for the management of logistics business processes emphasizes the importance of modeling and thorough research of indicators to improve the management system of the business process.

Evaluation of the effectiveness of the implementation of the enterprise's management system of the business process based on controlling ensures the integration of strategic and tactical management systems. In work [1], the effectiveness of the

controlling implementation into the practice of business process management is proposed to be measured using a two-component integral indicator of the effectiveness of organizational design, which is based on diagnostics: the degree of the internal environment capabilities usage and the degree of the business model rationality.

The application of logistics controlling increases the efficiency of the logistics system and makes it possible to identify and eliminate its "bottlenecks". This is achieved by the use of modern innovative logistics controlling solutions and provides an opportunity to provide the enterprise's top management with the necessary practical means to increase the managing logistics business processes efficiency.

Therefore, logistics controlling provides an opportunity to ensure an orderly and, if possible, continuous process of handling logistics data to identify deviations between the planned and actual values of logistics indicators, as well as to analyze these deviations to identify the causes of discrepancies.

The aim of the article. The research and formation of an indicators system of logistics controlling and, on their basis, to ensure the improvement of the logistics business processes management of enterprises in the transport industry.

The main material. Enterprises of the transport industry differ from industrial enterprises, firstly by their dual role in the functioning of logistics systems, which determines the specificity and peculiarities of the methodological tools of logistics controlling. For transport companies, the main logistics chain "supply - production - sales" is transformed into a chain "loading - transportation - delivery" [2, p. 55].

On the one hand, the transport enterprise is an element of macro-logistics systems that provide communication between stages of the logistics chain (advancement of material flow). On the other hand, it is a consumer of individual material flows, the final stage of the corresponding logistics chain. The transport enterprise acts as an intra-production logistics system in which incoming material flows (fuel, spare parts, aggregates, tires, etc.) are transformed into material services - transport. Transport enterprise as an element of macro- and micro logistics systems is presented in fig. 1.

At the macro level, transport enterprises act as elements of macro logistics systems. They ensure the rhythm of these systems and are sources of transport services. At the micro level, transport enterprises act as an intra-production logistics system and represent a number of interconnected subsystems that form certain integrity, and unity. These subsystems ensure the material flow entering the system, passing through it, and leaving the system in the form of transport services. According to the concept of logistics management, the construction of intra-production logistics systems should ensure constant coordination and mutual correction of plans and actions of supply, production, and sales stages within enterprises.

All elements of the micro logistics system closely interact with each other and have a single goal, which is subordinate to the functioning of the logistics system.

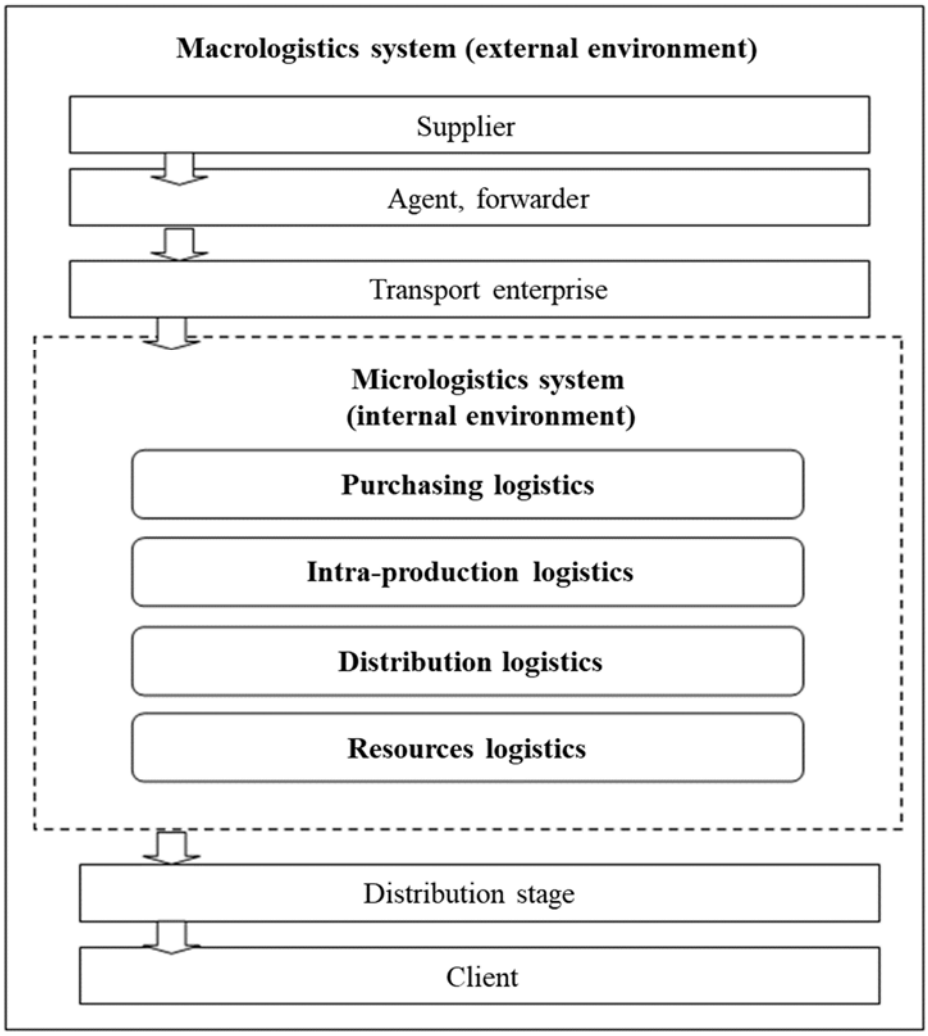

Figure 1 – Macro- and micro logistic systems of the transport enterprise

The purpose of the micro logistics system of transport enterprises is to satisfy the need for transport services of the required quality, in the required place, in the required quantity, at the required time, and with minimal costs. The micro logistics system of transport enterprises is a complete set of elements that interact with each other (fig.2).

Therefore, the micro logistics system of transport enterprises includes the following subsystems [3]:

– Procurement (material and technical support) - ensures the supply of material resources to the transport enterprise;

– Warehouses (buildings, constructions, devices, etc., where material stocks are temporarily placed and stored, and where material flows will be transformed);

– Inventory (materials that allow to respond quickly to changes in demand, and ensure the reliability of transport vehicles);

– Transport fleet (the rolling stock of the enterprise providing transport services);

– Production maintenance (maintenance and repairmen of rolling stock);

– Sales (the implementation of transport services);

– Information (communication between the elements of the micro logistics system, controlling the execution of logistics operations);

– Personnel (organization personnel engaged in logistics operations);

– Finances (circulation of funds necessary for managing the material flows of the micro logistics system of the enterprise).

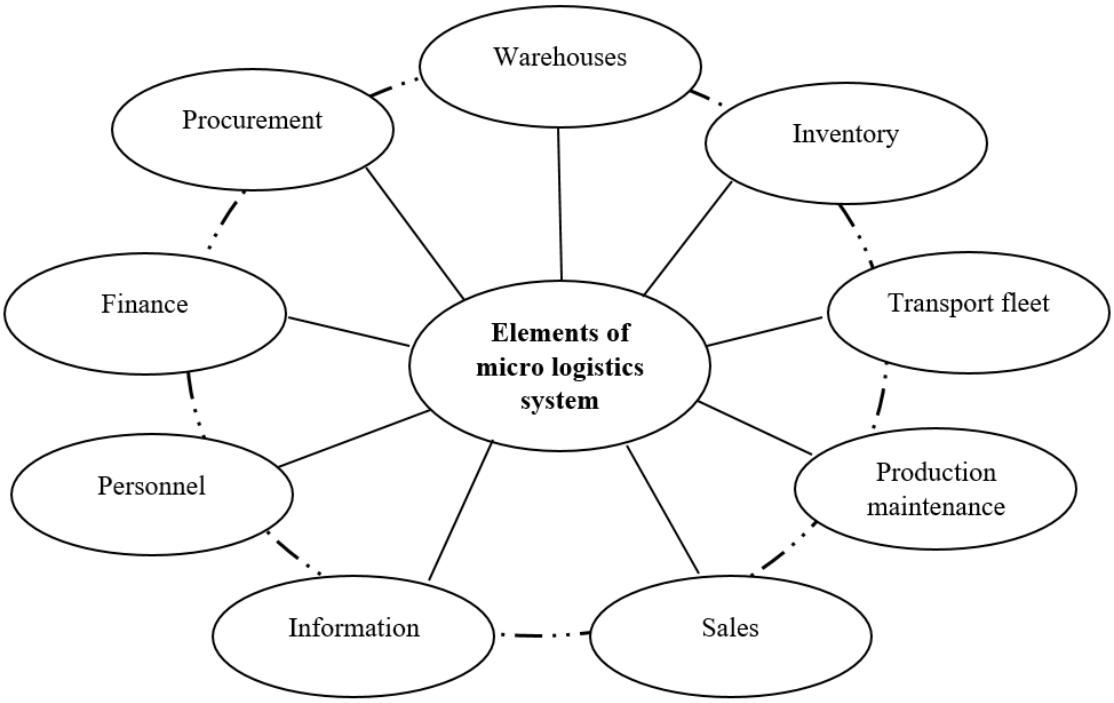

Figure 2 – The micro logistics system of transport enterprises

"Procurement", "Warehouses" and "Inventory" are subsystems in which the tasks of supply logistics for a transport company are solved. These tasks are formulated as the following statements:

– Material resources planning and forecasting;

– Nomenclature of consumed material resources optimization;

– Inventory management of the transport enterprises;

– Materials purchases and delivery organization;

– Material storage at the warehouse organization;

– Programs to save material resources development and control over their implementation;

– Control over the implementation of the cost estimate for supplies, etc.

"Transport fleet" and "Production maintenance" are subsystems in which tasks of intra-production logistics of transport are solved. These main tasks include:

– Transport services (main production) forecasting and planning;

– Maintenance and repairmen of rolling stock (auxiliary production management);

– Economic assessment of transport products;

– Main and auxiliary production operative management;

– Control over the quantity and quality of transport services, etc.

The main tasks of "Sales" at the transport enterprise contain:

– Transport type and mode choosing;

– Common planning of transport processes on different modes of transport;

– Rational routes development;

– Common planning of transport, warehouse and production processes, etc.

Subsystems "Information", "Personnel" and "Finance" solve the tasks of resource logistics. The content of resource logistics is largely determined by the list of problems solved by functional logistics, so it is appropriate to consider the problems solved by individual types of functional logistics [4].

Managers need to monitor the state of each type of logistics activity of a transport enterprise. A comprehensive indicator that

shows the state of the management system of the logistics business process is the level of logistics controlling. In order to assess the level of logistics controlling, it is necessary to create a group of experts to conduct a survey, which will allow managers to obtain information necessary for strategic and operational planning to assess the state of management of logistics business processes. The algorithm for evaluating the level of logistic controlling consists of three stages of surveying an expert gr; as a rule, it consists of 6-10 people with the necessary competencies.

The first step consists in surveying the expert group regarding the weight of each type of indicator in four groups in the enterprise's logistics activities: I "Supply logistics", II "Intra-production logistics", III "Sales logistics" and IV "Resource logistics" (table 1).

Table 1 – The system of main indicators for transport enterprises

Group name	Group description
I "Supply logistics"	- procurement logistics controlling (volume of supply, reliability of supply, the average cost of supply, costs of supply, total volume of transport costs for supply, number of suppliers, number of submitted orders, etc.); - stock logistics controlling (stock utilization level, stock holding costs, stock storage period, stock turnover, etc.); - warehouse logistics controlling (warehouse utilization rate, the average cost of warehouse space, warehouse freight turnover, storage costs, etc.).
II "Intra-production logistics"	- production logistics controlling (the number of vehicles, the technical readiness ratio of the transport fleet, the degree of transport usage, the utilization ratio of carrying capacity, transportation costs, transportation time, a total distance of transportation, average distance of transportation, costs of overloading, etc.); - internal transport controlling (operating costs for vehicles, labor-intensive maintenance, labor-intensive current repairs, vehicle utilization ratio, etc.).
III "Sales logistics"	- orders controlling (the number of transport services consumers, the total number of orders received, the volume of unfulfilled deliveries (transportations), the volume of transport operations, the reliability of deliveries, the quality of deliveries, the rhythm of deliveries, the uniformity of transportation of goods, sales costs, etc.).
IV "Resource logistics"	- information resources controlling (level of information support, speed of document circulation, etc.); - personnel resources controlling (personnel quantity, labor productivity, coefficient of total turnover of personnel, coefficient of stability of personnel, etc.); - financial resources controlling (revenue from logistics services, net profit (loss), the profitability of transportation, the share of logistics costs in revenues, the share of transportation costs in logistics costs, the share of logistics costs in the structure of total costs, etc.).

The result of the first step of this methodology is the formed equation for determining the level of logistics controlling (LLC) at the transport enterprise (1):

$$LLC = \alpha\ Su + \beta\ IP + \gamma\ Sa + \delta\ Re \quad (1)$$

where α –weight determined by experts for group I "Supply logistics" (Su);
β – weight determined by experts for group II "Intra-production logistics" (IP);
γ – weight determined by experts for group III "Sales logistics" (Sa);
δ – weight determined by experts for group IV "Resource logistics" (Re).

The sums of the relative values of the indicators within each of the groups Su, IP, Sa, and Re will be calculated in the third step of this methodology.

The basis of the model for determining the level of logistics controlling is the creation of an objective system of indicators for a specific enterprise. That is why the preparation of materials for conducting the second step of the survey is the formulation of the base of the indicator on the enterprise's activity. Built on these analyses and systematization of the indicator base, a system of indicators is formed to assess the level of logistics controlling at the transport enterprise.

The second step of the survey is the selection of indicators for their evaluation according to the Delphi method. At this phase, experts are invited to make a detailed analysis of the micro logistics system of the transport enterprise. Experts use the system of indicators to separate those that best reflect the implementation of tasks set before each type of logistics activity of the enterprise. Secondary indicators will be "screened out" each time. The survey is conducted until the experts reach a final agreement. The optimal quantity of indicators for each of the four groups is considered at the level of ten.

The second step of the survey is completed when the experts reach an agreement and allocate approximately ten indicators in each group. The analysis outcome is a compiled resulting table of indicators of logistics controlling with the most significant evaluation indicators.

The third step of the survey consists in determining the weight, points, and relative importance of each indicator. At this phase of the survey, each expert is offered a resulting table with the results of the second step. Their task is to evaluate each indicator relative to the strength of its influence within each group by type of logistics activity on a point scale from one to ten and determine its weight in percentages (1-100%). Each indicator is subjected to fundamental analysis.

The next step is to find the sum, and average values by weight and points, and calculate the relative importance of the indicators. Next, the sum of the relative values of the indicators within each type of logistics activity of transport enterprises is determined and the level of logistics controlling is calculated according to formula (1). The developed model summarizes the system of logistics controlling indicators, and stages, and serves as a tool for determining the level of logistics controlling at a transport enterprise (fig. 3).

LLC presented the level of logistics controlling management at the transport enterprise. Its result provides the management staff of the companies with important information for decision-making. Hence, it is considered if values are equal to:

0 – 2,0 – LLC is absent – the indicator value is too low. This specifies the crisis state of the company's logistics system and the practical absence of management of logistics business processes at this particular transport entity.

2,1 – 4,0 – LLC is low – logistics management does not solve the tasks given to it; a detailed analysis of indicators and the preparation of appropriate measures for each logistics activity are needed, in particular.

4,1 – 6,0 – LLC is average – the enterprise manages logistics business processes, but it does not allow to ensure the fulfillment of all the tasks given to it, namely, it does not allow to ensure a quick reaction to changes in the system, which in turn affects the quality of logistics service.

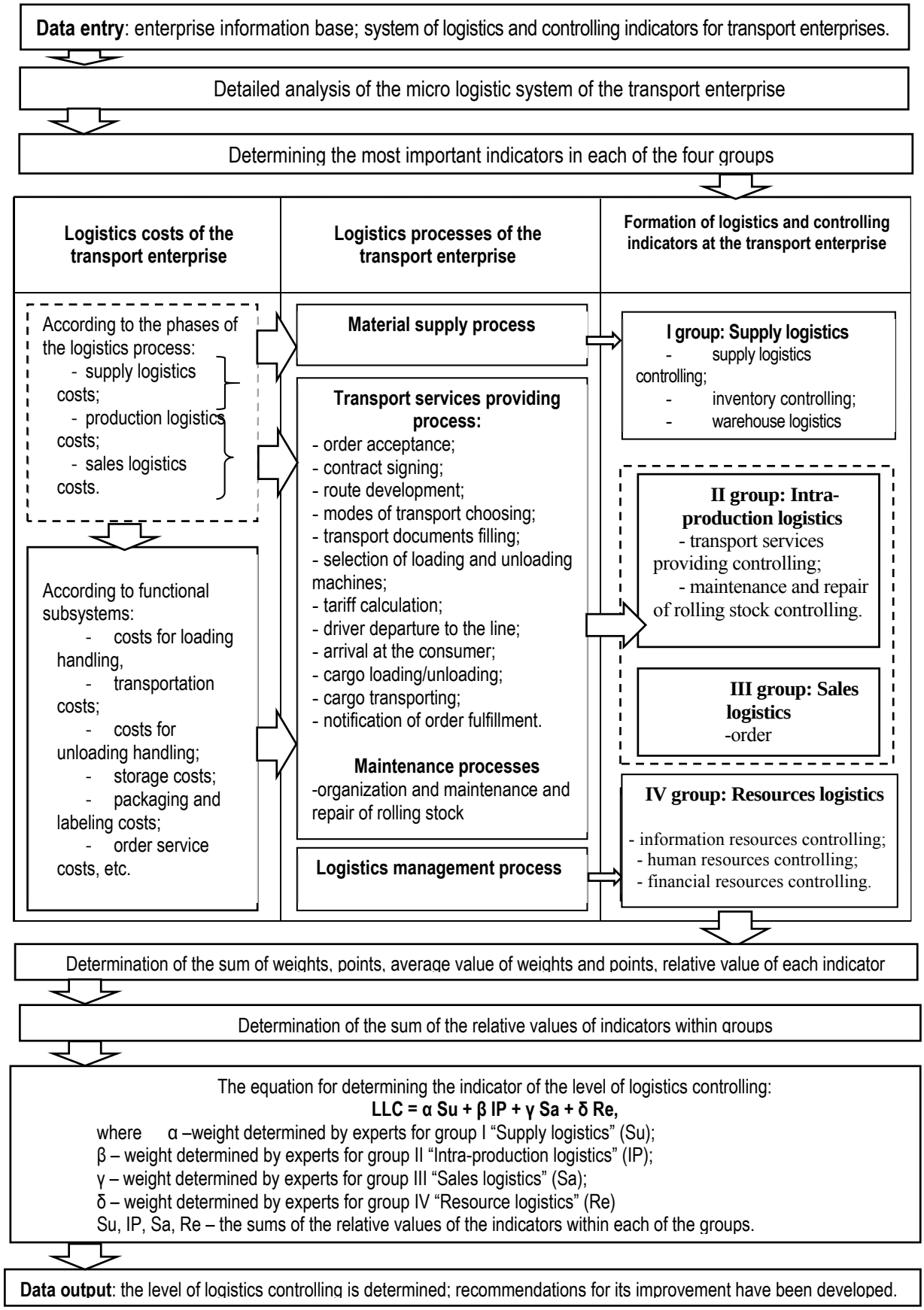

Figure 3 – Model for determining the level of logistics controlling at transport enterprise
(developed by the authors)

6,1 – 8,0 – LLC is high – management of logistics business processes ensures compliance with regulatory requirements, but its individual elements require improvement and advancement.

8,1 – 10,0 – LLC is extremely high – the management of logistics business processes functions perfectly, successfully ensuring the fulfillment of all tasks set against it with the help of individual IT solutions. Reaching such indicator values is quite difficult in modern conditions of enterprise management practice.

General recommendations for the management of the enterprise have been developed for each LLC. In the absence of LLC (0 - 2.0), the management of the enterprise should take all possible measures for the functioning of the enterprise as a logistics system and use tools of logistics controlling in the management of business processes. With a low LLC (2.1 - 4.0), the management should take the initiative to implement the concept of logistics controlling in the management activities of the transport enterprise. With an average LLC (4.1 - 6.0), the management of the enterprise should undertake steps to improve the management of logistics business processes based on logistics controlling and pay special attention to the importance of consumers, personnel, and suppliers and the introduction of modern IT technologies. With a high LLC (6.1 - 8.0), the management of the transport enterprise must maintain the current state of management and implement a wide range of logistics controlling tools. With an extremely high LLC (8.1 - 10.0), the management of the transport enterprise should pay special attention to the use of logistics controlling tools and the development and implementation of innovations in the transport services market.

Conclusions. The use of the developed model for assessing the level of logistics controlling at the transport enterprise makes it possible to obtain the necessary information for strategic and operational planning and control.

The system of indicators was formed for the purpose of detailed analysis of the state of each type of logistics activity of transport enterprises. The proposed indicator for evaluating the level of logistics controlling (LLC) enables management to periodically assess the state of logistics management. Based on the obtained results, managerial personnel can separate the logistics business processes that need to be improved. The implementation of the developed measures will make it possible to increase the efficiency of the management of logistics activities by transport enterprises, which will be seen during the next evaluation of the level of logistics controlling. Using a wide range of logistics controlling tools, managers can receive objective and reliable information for making management decisions..

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EXPLORING CURRENT PROJECT MANAGEMENT METHODOLOGIES IN THE CONTEXT OF THEIR BEST APPLICATIONS

Olena Volovyk, Oleh Harmash. "Exploring Current Project Management Methodologies in the Context of their Best Applications". *The article is devoted to the study of the main project management methodologies, their origins and authorships, advantages and disadvantages in terms of their implementation. The published scientific resources on the project management evolution are processed and analysed. The modern concepts in formulating project objectives towards "faster-efficient-effective" were traced. The three perspectives of evaluating project success which involve project stakeholders, project managers and project end users are introduced. The main categories of the project management methodologies are outlined and diagrammed; the characteristics of every category are specified; the examples of the most established methodologies recognised in the business community are given. Brief conceptual explanation of each methodology is outlined together with its pros and cons and the most suitable areas of implementation are explored. The comparison of CPM and CCM is presented in a graphical manner. The latest statistics on the current trends in the methods' usage is presented and analysed. It was revealed that there is a strong tendency in preferring and applying hybrid methodologies and a strong decline in consistent usage of traditional methodologies. Scrum as the most popular agile methodology at team level has been identified followed by Kanban and others. The extension of using agile methodologies beyond IT-related and software development applications has been detected. Basic diagrams demonstrating logical structure and principles of some methods are shown. Recommendations for considering specific project features in the context of its scope, collaborating team characteristics, level of certainty and predictability of affecting factors coming from external and internal environments, customer and stakeholder involvement, objectives and project success evaluation criteria are developed.*

Keywords*:* project management, project management methodologies, traditional project management, agile project management, hybrid project management methodologies, project management application, PMBOK®, PRINCE2, Spiral, Crystal.

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Олена Воловик, Олег Гармаш. «Дослідження сучасних методологій управління проектами в контексті їх найкращих застосувань». *Стаття присвячена дослідженню основних методологій управління проектами, їх виникненню та авторству, перевагам і недолікам у частині їх реалізації. Опрацьовано та проаналізовано наукові публікації з еволюції управління проектами. Простежено сучасні концепції у формулюванні цілей проекту в напрямку «швидше-рентабельно-ефективно». Представлені три точки зору оцінки успіху проекту, які включають зацікавлені сторони проекту, менеджерів проекту та кінцевих користувачів проекту. Окреслено та наведено схеми основних категорій методологій управління проектами; вказуються характеристики кожної категорії; наведено приклади найбільш усталених підходів, визнаних бізнес-спільнотою. Стисле концептуальне пояснення кожної методології викладено разом із її перевагами та недоліками, а також досліджено найбільш прийнятні сфери впровадження. Порівняння CPM і CCM представлено в графічному вигляді. Наведено та проаналізовано останні статистичні дані про сучасні тенденції використання методів. Було виявлено, що існує сильна тенденція віддавати перевагу та застосовувати гібридні методології та значне зниження використання обмеженного тількі традиційними методологіями. Scrum як найпопулярніша гнучка методологія для командної роботи була визначена. Друге місце по популярності віддається методолгії Kanban. Було виявлено розширення використання гнучких методологій за межі проектів, пов'язаних з інформаційними технологіями та розробкою програмного забезпечення. Наведено основні схеми, що демонструють логічну структуру та принципи деяких методів. Розроблено рекомендації щодо розгляду конкретних особливостей проекту в контексті його обсягу, характеристик команди, що співпрацює, рівня визначеності та передбачуваності впливаючих факторів зовнішнього та внутрішнього середовища, залученості замовника та зацікавлених сторін, цілей та критеріїв оцінки успіху проекту.*

Ключові слова: управління проектами, методології управління проектами, традиційне управління проектами, гнучке управління проектами, методології гібридного управління проектами, застосування управління проектами, PMBOK, PRINCE2, Spiral, Crystal.

Елена Воловик, Олег Гармаш. «Исследование современных методологий управления проектами в контексте их наиболее эффективных применений». *Статья посвящена изучению основных методологий управления проектами, их происхождению и авторству, преимуществам и недостаткам с точки зрения их внедрения и применения. Научные публикации по развитию управления проектами обработаны и проанализированы. Прослежены современные концепции в формулировании целей проекта по направлению к «быстрее-рентабельнее-эффективнее». Представлены три точки зрения на оценку успеха проекта, в которых участвуют заинтересованные стороны проекта, менеджеры проекта и конечные пользователи проекта. Основные категории методологий управления проектами описаны и представлены в виде диаграмм; указаны характеристики каждой категории; приведены примеры наиболее устоявшихся и используемых методологий, признанных в бизнес-сообществе. Приводится краткое концептуальное объяснение каждой методологии вместе с ее преимуществами и недостатками, а также исследуются наиболее подходящие области применения. Сравнение CPM и CCM подходов представлено в графическом виде. Представлены и проанализированы последние статистические данные о текущих тенденциях использования методов. Выявлено, что наблюдается устойчивая тенденция предпочтения и применения гибридных методологий и резкое снижение использования традиционных методологий в чистом виде на постоянной основе. Scrum была определена как самая популярная методология Agile на командном уровне, за которой следуют Kanban и другие. Было обнаружено расширение использования гибких методологий за пределы проектов, связанных с*

информационными технологиями и разработкой программного обеспечения. Показаны базовые диаграммы, демонстрирующие логическую структуру и принципы некоторых методов. Разработаны рекомендации по учету особенностей проекта в контексте его масштаба, характеристик взаимодействующих команд, уровня определенности и предсказуемости влияющих факторов, исходящих из внешней и внутренней среды, вовлеченности заказчиков и заинтересованных сторон, целей и критериев оценки успешности проекта.

Ключевые слова: управление проектами, методологии управления проектами, традиционное управление проектами, гибкое управление проектами, методологии гибридного управление проектами, применение управление проектами, PMBOK, PRINCE2, Spiral, Crystal.

Introduction. The current stage of economic, social and technological development demonstrates that project management has proved to be more and more common because this approach has shown a high practical efficiency in solving complex problems in various areas of economic and business activities. Nowadays, the project management methodology has found application in many areas: construction, investment, IT-sphere, logistics, supply-chain-management and many others.

Modern concepts of project management formulate the implementation objectives towards "faster-efficient-effective", which makes it particularly challenging in the reality of a large number of restrictions and continually changing business, social and technological environment. In the process of shifting from one stage of economic and business development to the next one, the project management required new approaches in formulating project objectives, task framing and task sequence execution, time-management and activity evaluation techniques including the duration of every activity and the project as a whole, human resource management and resource management methodologies, budgeting etc.

While the first scientific approaches in project management were oriented on physical product development or construction of large-scale objects requiring long time and a great number of interrelated activities, the shift from product-oriented methodologies towards client-oriented methodologies resulted in establishing a new philosophy in management which has received the name of agile. The number of approaches continually grows resulting in a great variety of modifications of traditional (classical) methodologies, agile methodologies and hybrid ones representing a diversity of combinations of the both. Therefore, there is a strong necessity to realize the advantages and disadvantages of the suggested methods, identify the project characteristics which would justify the methodology application and choose the most suitable for it.

Analysis of the latest researches and publications. Project management has been developed, extended and modified for decades. The major distinguished contributors to this trend of scientific management are Henry Gantt, O. Taiichi, W.W.Royce, James E. Kelly, Morgan R. Walker, Eliyahu M. Goldratt, H. Takeuchi, I. Nonaka, J. Sutherland and K. Schwaber, K. Beck, L. Corey, Harry, Mikel J, B. Smith, Alistar Cockburn, B. Boehm and many others. [1-16] who introduced a variety of project management methodologies while adapting them to ever changing economic and business environment. In general, their finding were mostly industry and task oriented though further they were extended beyond the initial framework. The modern tendency in assessing critical success factors of project performance were explored by Shamim, D. M [18] , Jitpaiboon, T., Smith, S. M., & Gu.[19] and others who outlined that project success is evaluated from the perspectives of the three parts involved into the project- the project sponsor, the project manager and the project user. Taking into account the complexity of

success perception, the selected project methodology needs to meet specific evaluation criteria including technological success; efficacy of project delivery; management and organization implications; corporate efficiency and customer happiness. [18]

In 2020 Komus, A., & Kuberg, M [20] compiled an official report project management approaches applications. The results demonstrate major tendencies in preferences on different project management methodologies applications. For traditional, or classical/ sequential, approaches only 8% of the respondents stated that they use consistently traditional project management among which 23% apply PMBOK ®, 19% do no pursue standard methodologies at all and 13% apply PRINCE2. In general, there is a steady decline in consistent usage of traditional methods from 22% in 2012 to 8% in 2019. Interestingly that there is a strong tendency of preferring agile and hybrid approaches to traditional ones in project management. The same report claims that the users who prefer hybrid methods constitute 43% versus 28% of those who prefer selective agile approaches. Scrum (84%) is the most used agile approach at team level, followed by Kanban and others. Even though Agile approaches are primarily used by IT developers, there is an extensive trend of their adoption in fields without an IT connection and include physical product development, logistics, supply chain management, marketing, strategic organizational restructure, etc.

Despite a great number of researches in the field of project management, there have been insufficient efforts done towards identifying clear distinctions in methodologies' classification, determining and systemizing major advantages and disadvantages of most popular methods as well as the specific projects' features justifying application of a methodology type.

Objectives statement. The purpose of the research is to explore the development of project management methodologies, outline the categorisation in their variety applied in the contemporary business and scientific environment, give basic characteristic of different approaches in project management, analyses their advantages and disadvantages, and determine the most beneficial areas of their implementation.

Method (methodology). To achieve the goal, general scientific methods were used, in particular, literature review, methods of analysis and synthesis, system approach, tabular and graphical methods.

Basic material and results. Project management approaches can be organized into three main groups: sequential (traditional/classical), iterative (flexible/agile) and hybrid (a mixture of traditional and iterative approaches or a combination of the both) (Fig. 1).

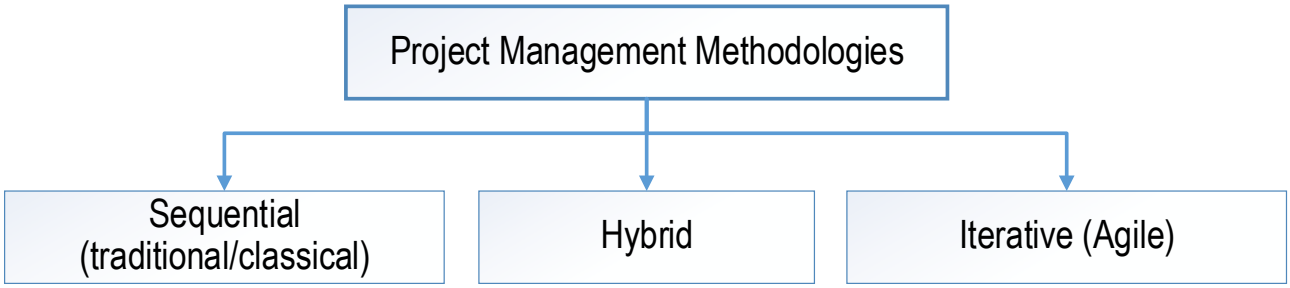

Figure 1 – Figure1 Project Management Methodologies Classification

Source: compiled by the authors

Each of the approaches has its advantages and disadvantages as well as implementation benefits. The articles gives brief conceptual explanation of each methodology together with its pros and cons and explores the areas of implementation

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which every methodology may suite the most.

Sequential, or traditional/classical, approach emphasizes linear processes where phases have precise starting and ending points and progress straight from one phase to another. Such methods have clearly defined objectives, well-controllable processes within the project, detailed documentation and high level of accountability. More advanced methodologies of the sequential approach are introduced by the Waterfall method, the Critical Path Method (CPM) with its extension PERT (Program Evaluation and Review Technique) which represents the algorithm for scheduling project activities, and The Critical Chain Method (CCM). (Fig. 2).

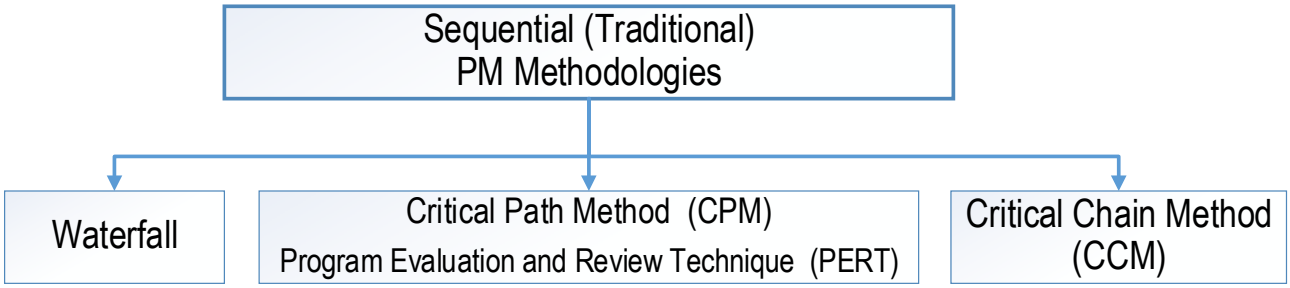


Figure 2 – Sequential Project Management Methodologies

Source: compiled by the authors

The Waterfall method was first introduced and established in 1970 by Winston W. Royce [2], a computer scientist, for manufacturing and construction businesses, though later it was successfully adopted by service-oriented industries. The main idea underlying this method is to build a system comprising static phases Requirements Determination, Design, Implementation, Verification, and Maintenance executed in a linear order. There have been several modifications to the Waterfall method, but all of them use the system approach suggested by Winston Royce. Stakeholders and customer prepare the requirements jointly and carefully document them. Interestingly that the Gantt charts which were originated in 1910 – 1915 by Henry Gantt is the most preferred tool for the Waterfall which visualizes subtasks, dependencies and project phases through the project life cycle. Gantt charts and WBS (work breakdown structure) are easy-to-use and well-visualizing tools for the sequential methodologies.

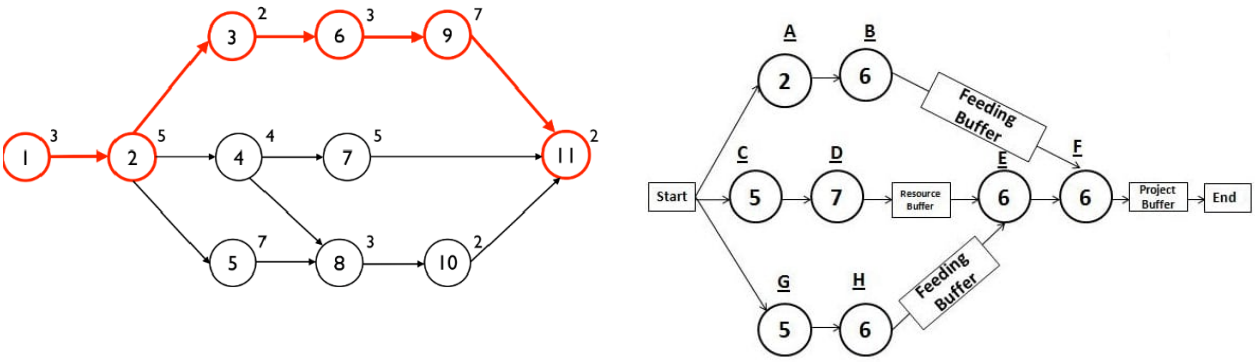
The advantages of the Waterfall methodology include clear structure of the project phases; clearly defined end goals; simplicity to use and understand; low work-in-process as the model phases are processed and completed one at a time; easiness to manage; non-overlapping project activities. Though the limitations of this methodology imply lack of flexibility and complexity to customize; the client/end user interaction is excluded during the project execution; high cost to maintain for users and extensive training for project staff. Therefore, the Waterfall methodology works poorly for long, on-going and multiple-module projects. On the other hand, it is best for the projects with well-defined end goal that have careful planning, detailed documentation, and consecutive execution.

The Critical Path Method (CPM) arises from the theory of graphs and represents an algorithm for scheduling the project activities. It is commonly used in conjunction with the Project Evaluation and Review Technique (PERT). This methodology was developed in the late 1950s by Morgan R. Walker of DuPont and and James E. Kelley Jr. of Remington Rand [3]. The critical path represents the longest (in terms of duration) sequence of essential project activities that must be completed on time. Calculating the critical path is key to determining the total duration of a project, its

milestones, deadlines and essential activities which need to be completed on time. The advantages of this methodology involve clear and logical vision of the project as a whole; quantification of timelines and tasks; flexibility in shifting resources from non-critical to critical activities and vice versa; ability to spot the details, etc. The limitations of this methodology include high complexity of the network diagram for large projects, which makes it difficult to track, and low flexibility when the information on every activity is incomplete.

The Critical Path Analysis is commonly used with all forms of projects, including construction, aerospace and defense, software development, research projects, product development, engineering, and plant maintenance, among others. Any project with interdependent activities can apply this method of mathematical analysis.

The Critical Chain Method (CCM), which was developed and introduced by the Israeli physicist Eliyahu M. Goldratt in 1997 [4], extends the theory of constraints which focuses on identifying constraints and bottlenecks in the system to improve the throughput. The CCM is defined as "the longest path in the network diagram considering activity interdependence and resource constraints." [4] It is the sequence of activities with the shortest time advance which takes into account the constraints of resources (workforce, equipment, etc.) and shifts a part of the stocks into so-called buffer activities – project feeding buffer, feeding buffer and resource buffer. Figure 3 depicts distinctive differences and similarities between the CPM and CCM.



Critical Path Methods diagram (*Source [21]*) Critical Chain Method Diagram (*Source [21]*)

Figure 3 – Comparison of Critical Path Methods and Critical Chain Method diagram

This method emphasizes prioritization, dependencies analysis, and optimization of resources and is best for complex projects with limited resources.

Table 1 summaries the project characteristics for the most suitable applications of the sequential (traditional) project management methodologies.

The given methodologies are mostly suitable for projects with clear tasks to perform and lack flexibility and adaptability to uncertain conditions in the environment.

Agile project management is an iterative approach to delivering a project throughout its life cycle. Originally, it was developed for software development projects, but now it has other applications too. Formally, Agile was launched in 2001 when 17 technologists drafted the Agile manifesto [15]. They wrote four basic principles for Agile project management, intended to guide teams on developing effective software projects. However, in practice the roots of agile philosophy dates back to the late 40s early 50s of the last century. In general, this approach is

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structured, iterative, and adaptive to business planning and managing project process which, unlike the traditional approach, suggests simultaneous execution of non-dependable activities which can be done in parallel providing flexibility to the project execution and ability to change processes while the project development is in progress.

Table 1. Summary of the suitable project characteristics for sequential methodologies

Method	Suitable project characteristics
Waterfall	Smaller projects with easy identifiable deliverables during the planning stage
Critical Path/PERT	Mainly non-research projects and some research projects with independent activities which durations easy to predict where delivery terms and deadlines are critical
Critical Chain	Complex projects with limited resources

Source: compiled by the authors

At the core, agile projects exhibit trust, flexibility, empowerment and collaboration. Major Agile project management methodologies include Kanban, Scrum, Scrumban, Lean, Six Sigma, Extreme Programming (XP), Crystal and others. (Fig. 4)

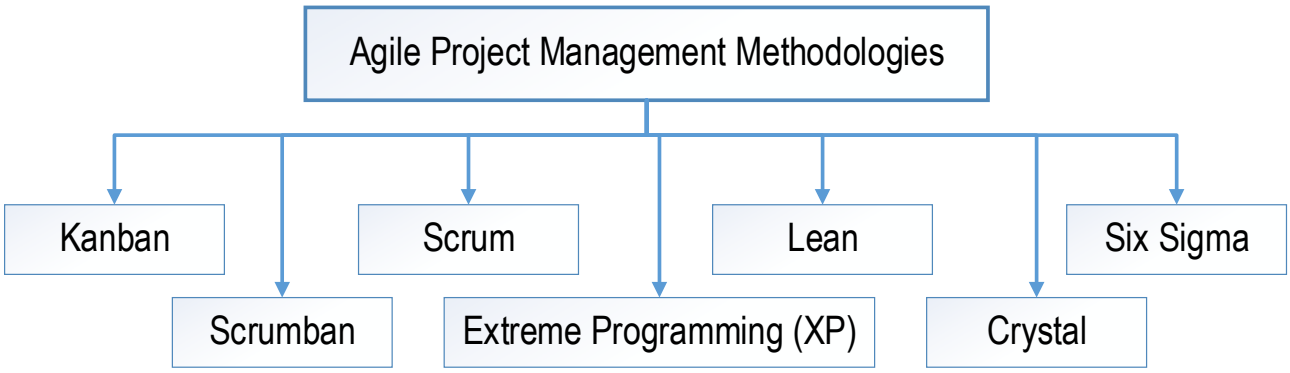

Figure 4 – Agile project management methodologies
Source: compiled by the authors

Kanban is a visual means to design, manage, and improve flow systems for knowledge work which uses Kanban boards depicting the workflow by splitting it into three stages: requested, in progress, done. It was developed by Taiichi Ohno, a Japanese industrial engineer, in 1953 for effective inventory management and later extended on other industries including IT-development [1]. This method does not have a strictly designed process rather focused on the most significant tasks. The major advantage of the method is its simplicity and transparency to implement. Other advantages may include improved predictability, customer satisfaction, and quality management. However, the method is not suitable for dynamic settings, as it does not show the timeframes for individual activities. In addition, failure to keep the Kanban board up-to-date may cause serious miscommunication within the team resulted in further failure in the project execution. This methodology works best for the small project teams collaborating remotely, having many incoming requests that vary in priority and size.

The term Scrum ,as related to project management, was introduced by Hirotaka Takeuchi and Ikujiro Nonaka in 1986 [5].Then

in the early 1990s Ken Schwaber and Jeff Sutherland developed it further to help organisations struggling with complex projects [6]. Scrum methodology emphasises empirical observations and formulates six basic principles: control over the empirical process, self-organisation, collaboration, value-based prioritization, time-boxing and iterative development.

The Scrum methodology involves the use of short "sprints" from which the project cycle is formed. These intervals last from one to two weeks and are designed for teams of 10 people at most. This is the main difference from the Waterfall methodology, where individual tasks are linked to each other by dependencies. The advantages for the method involve its high adaptability and flexibility, encouraging creative working environment, reduced documentation, and improved quality work and customer satisfaction. The disadvantages of the method lie in its focus on individual tasks rather than on the overall project deadline making it difficult to integrate with the traditional project management approach, and requires extensive training of the personnel. The Scrum methodology works best for a wide variety of environments and situations that do not initially have clearly identifiable requirements and require a flexible approach.

Scrumban merges the structure and predictable routine of Scrum with Kanban's flexibility and represents an effective tool for handling large projects by splitting them into smaller chunks. It was first introduced by Corey Ladas in 2008. The advantages of this method is that it enforces transparency, provides effective handling of bottlenecks, implies less control from team managers and reduces the volume of documentation. However, elimination of daily meetings from the routine schedule complicates evaluation of individual efforts and contribution. The Scrumban methodology is a great solution for teams that are looking to structure to their Kanban project management, or for teams looking for a slow transition from Scrum to Kanban.

Lean agile methodology is aimed at eliminating waste and creating a simple project structure. Ultimately, this means being able to do more with fewer resources to improve the efficiency and quality of teamwork. . Lean manufacturing principles were first established and developed by Toyota in the 1950s and applied in the 1970s to combat the energy crisis. Waste reduction was originally applied to physical products. This idea was further extended to project management by James P. Womack and Daniel T. Jones, who introduced five principles which can be used to apply the lean concept to project management in their book "Lean Thinking" published in 1996 [9]. Nowadays this term implies to wasteful ways of doing work. The goal of lean project management is to maximize value while minimizing waste. It is based on three fundamental principles: delivering value as defined by the customer, eliminating waste, and continuous improvement. The concept of Lean was targeted on eliminating three types of deviations that demonstrate inefficient allocation of resources represented by three letters Ms referring to the Japanese words Muda (waste), Mura (unevenness), Muri (overburden). The advantages of the Lean methodologies represent cost reduction, customer interaction enforcement and increased quality. However, it may lead to inventory problems due to low amount of stocks, high implementation costs, and challenges during the transition period of shifting to Lean management. It is recommended for teams experiencing efficiency problems. In general, projects teams of different sizes can benefit from this method.

The Six Sigma, introduced by Bill Smith and Mikel Harry in 1986, focuses on understanding customers' requirements, continuous improvement and eliminating defects and waste [11]. These objectives can be achieved through profound knowledge of

statistics, engineering and scientific management. It is often referred to as a philosophy rather than a methodology. The main advantage of Six Sigma is that it is customer driven and considers the entire process of the project from the raw materials to the final product rather than just final product. The disadvantages may include a requirement for extensive training for employees, processing large amounts of data resulting in increased overall costs. Six Sigma perfectly suits large organizations with hundreds of employees where the need to complete projects without waste becomes an important factor for the organization.

Crystal is an agile framework concentrated on individuals and their interactions rather than processes and tools. It is a direct outgrowth of some values outlined in the Agile Manifesto. It was developed by Alistair Cockburn for IBM in 1991 and included guidelines for team collaboration and communication [12]. The Crystal framework is based on two beliefs:1) teams can find ways on their own to improve and optimizes the workflow, and 2) every project is unique and continually changing so the project's team is the best to decide how to cope with it. The advantages of this approach include the following: teams are free in making decisions; teams may respond well to the changing environment; facilitates direct team communication, transparency and accountability. However, lack of pre-defined plans may lead to scope slow down, and lack of documentation may cause confusion in understanding. This method is ideal for experienced and autonomous development teams.

Extreme programming (XP), introduced by Kent Beck in the 1990s, is a people driven approach rather than process driven approach which allows changing the project plan, budgets and final outcome at any stage of the project development in order to fit the changing needs [7]. This method is widely applied in IT-development industry. The main advantage is that XP significantly saves costs and time required for project realization because project teams do not use much documentation rather come to solutions through discussions within the team. Other advantages of this methodology involve its simplicity as developers use very simple quickly updatable solutions; visibility and accountability of the whole process during the project; improved employees' contribution and satisfaction.

Table 2 summaries the features of the most suitable projects of the given Agile methodologies in project management.

The disadvantage of this methodology is that it assumes high speed of work and stressful environment that may result in employees' exhaustion; less attention to processes may result in defects and quality requirements violation; lack of documentation may lead to unexpected untraceable failures in the future.

The XP method is used for dynamic projects with tight deadlines; work is carried out within short development cycles with many releases. This approach results in high productivity and short lead times.

The variety of the current agile methodologies and their continual growth demonstrate the demand for high level of adaptability of project execution to both changing environments and changing project requirements in on-going projects. Every methodology has very specific areas of application which are limited by project scale, time restrictions, proficiency level of collaborating teams, resource management requirements, desired productivity level, industry type etc.

Table 2 – Summary of suitable project characteristics for Agile methodologies

Method	Suitable project characteristics
Kanban	Projects require quick changes , requirements vary in priority and size; projects are developed for both service and industry by collaborative teams
Scrum	Medium or large size complex projects with changing requirements; the projects can be developed by a collaborative cross-functional small project teams; effective for remote collaborative teams
Scrumban	Projects where difficult to predict the amount of work to be performed; ongoing project chores in uncertain environment; effective for remote collaborative teams
Lean	Complex projects within large organizations where efficiency issues are critical
Six Sigma	Complex projects for large organizations employing hundreds of people where waste free performance is critical.
Crystal	Short-term projects that require rapid delivery of the projects; long-term projects with frequent testing and feedback; project teams of highly experienced professionals
Extreme programming (XP)	Complex projects with uncertain and unpredictable factors and tight deadlines.

Source: compiled by the authors

Hybrid project management methodologies benefit from the rigid structure of the sequential (traditional) approach and the flexibility of the Agile approaches. PMBOK®, PRINCE2 and Spiral represent some of the most popular hybrid approaches in project management. (Fig. 5)

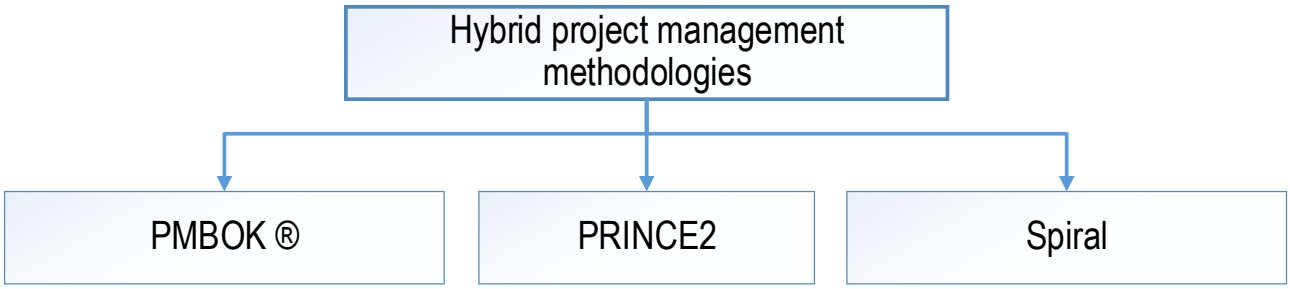

Figure 5. Hybrid project management methodologies

Source: compiled by the authors

In general there are many more approaches which can be classified as hybrid, but this research is limited to the ones listed above.

The Project Management Body of Knowledge (PMBOK®) methodology represents a modification of a traditional approach enhanced by agile insertions. It is a document containing standard terminology, best practices and process guidelines around project management as defined by the Project Management Institute (PMI). It dates back to 1969 when the Project Management Institute (PMI) was founded. In 2021 the organisation published the seventh edition, the latest version, of the guide. While the traditional approach follows the PDCA (Plan-DO-Check-Act) workflow management processes developed by M. Porter, PMBOK involves five processes that include Initiating-Planning- Executing – Controlling and Monitoring – Closing. Figure 5 depicts the workflow process with implied PMBOK® methodology.

Unlike the traditional approach, the five processes in PMBOK® may overlap and

interact throughout the project. In addition, PMBOK® implies three main categories on key aspects of the project: core areas, facilitating areas and coordination areas which facilitate managing the five processes effectively. The main advantage of PMBOK® is that it is a guide prepared by management professionals which introduces the best insights and practices in a standardised manner; it is regularly updated and suits for any team with disregard of the organisation size of industry. The PMBOK® Guide can be used as a basis for developing an own approach to project management.

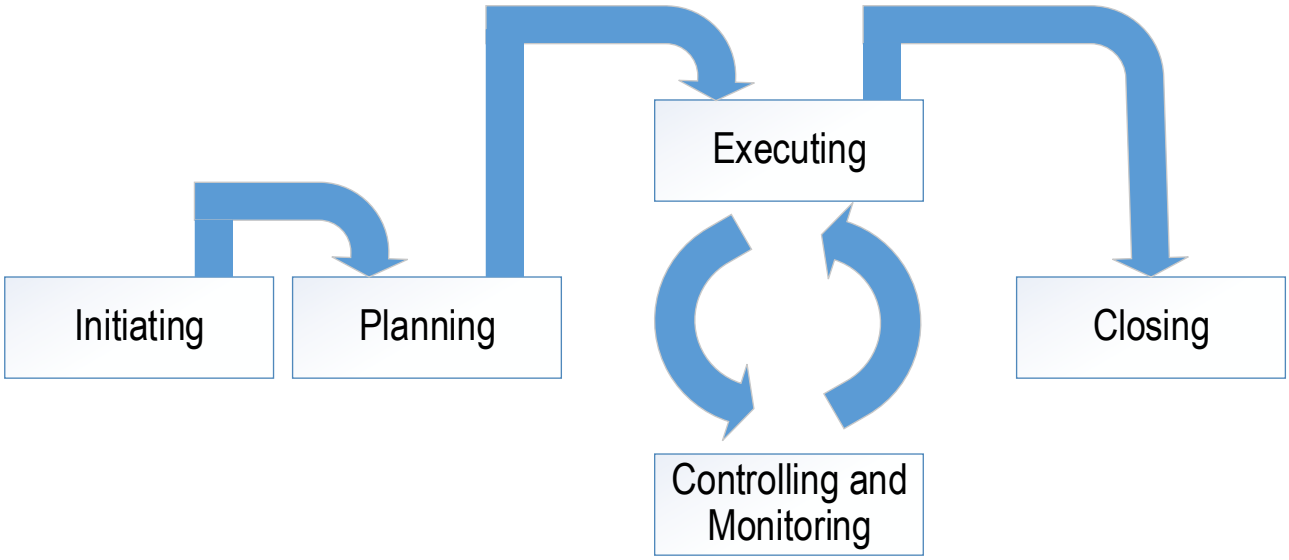

Figure 5 – The core project management processes defined by PMBOK®
Source: updated from [14]

PRINCE2 (the acronym stands for "PRojects IN Controlled Environments") is one of the most widely practiced project management methodology worldwide. Initially it was developed in the late1980s by the UK Government in order to manage IT-teams and was named PRINCE. It was reviewed in 1996 and received the current name of PRINCE2. The methodology emphasises organisation and control and represents a linear and process-based framework, focusing on moving initiatives through predefined stages [16]. Like in the traditional methodology, the records from every stage are documented into six reports to the project board and help to stay organized and on track. Like in the Scrum Agile approach, the project people are assigned three main roles, six supplementary roles and uses both qualitative and quantitative measures of performance. The controlled performance targets comprise the following variables: Time, Cost, Quality, Scope, Benefits, Risks which form a comprehensive project management process with clearly defines roles. This is an effective methodology for implementation of corporate projects, individual project tasks including milestone control, product transfer management and project initiation and closure. The advantages of this methodology involve its worldwide recognition; completeness as it combines agile and traditional approaches; principles are universal and applicable to projects of any scale; adaptable, enables effective communication with stakeholders and teammates. The disadvantages include its limitation to technical skills and neglecting soft skills; unlike PMBOK® which introduces over 100 project management techniques, it is limited to two techniques; the method assumes a lot of documentation to maintain and adapt. This method works best for large

enterprises with a great number of stakeholders.

Spiral, introduced by Barry Boehm in 1986, is the most preferred SDLC (Systems Development Lifecycle) model for long-term and high-risk software development projects [13]. It combines prototyping and architecture in phases and functions as a synergy of the Waterfall and Agile models because shifting to the next phase is performed according to the initial plan even if the previous phase has not been completed yet. The model involves a repetitive cycle which executes the phases repeatedly until the project is fully completed. Figure 6 visualises the iterative implementation process of the Spiral model.

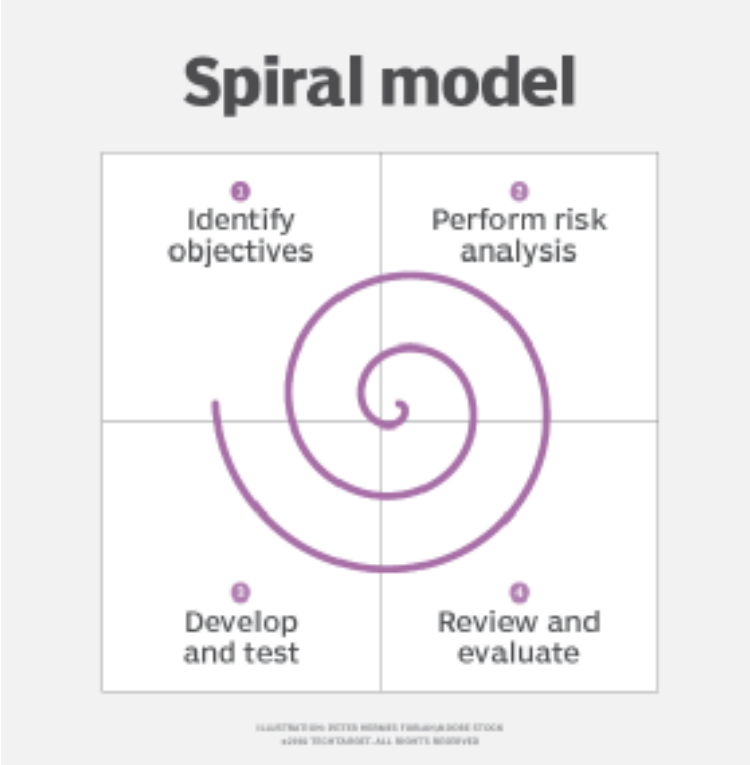

Figure 6. Spiral model diagram
Source: [22]

The obvious advantage of the model is its flexibility to possible changes followed by risk handling at every phase and increased customer satisfaction as the model facilitated customer feedback. The disadvantages may include high costs, which makes it unfavorable for small projects, dependence on risk analysis, complexity and inefficient time management.

Table 3 summarizes the features of the most suitable projects of the given Hybrid methodologies in project management.

Table 3 – Summary of suitable project characteristics for Hybrid methodologies

Method	Suitable project characteristics
PMBOK®	Standard projects with small teams; large projects in combination with other PM methods
PRINCE2	Large and complex enterprise projects with a great number of stakeholders and initially well-defined goals; avoid for small projects
Spiral	Perfect for large expensive and complicated projects in IT industry

Source: compiled by the authors

The research shows that hybrid approaches in project management are applicable to large-scale complex projects which incorporate high costs and consider a variety of stakeholders, the feature deemphasized while applying consistently traditional or agile approaches.

Conclusions. Project management methodologies do not represent an established permanent know-how tool rather a flexible and continually modified and updated framework which success is assessed from three perspectives – stakeholder, project team and end user. The most used methodologies can be categorized as sequential/traditional/classical and iterative/flexible/agile. The traditional approaches (Waterfall, Critical Path/PERT Methods, Critical Chain Method) were established for product-oriented projects and did not involve stakeholders and end users during the development and implementation phases as they had clearly stated objectives, task wordings and stable precedence of activities. These methods are vulnerable to uncertain and unexpected factors as they lack flexibility during the development and implementation stage. These methods work effectively for projects with easy identifiable deliverables during the planning stage, complex projects with limited resources or projects with independent activities which durations easy to predict where delivery terms and deadlines are critical. Agile project management methodologies gain more and more popularity for both IT-related and non-IT-related industries as they are more client oriented, satisfy the interests of the three parties of the project and allow flexible and changes in on-going projects. They work best in applications related to projects requiring quick changes, which vary in priority and size; complex projects influenced by uncertain and unpredictable factors and involving cross-functional collaborative teams working remotely. The major popular Agile methodologies are represented by Scrum, Kanban, Scrumban, Lean, Six Sigma, etc. Nowadays, there is a steady trend of implementing hybrid methodologies which combine the benefits and transparency of traditional approaches and flexibility of agile approaches. They are represented by PMBOK®, PRINCE2, Spiral and others. The latest statistical data demonstrate a growing popularity of the latter ones as they can be used for large complex projects with a great number of stakeholders. Generally, the selection of the most suitable project management methodology depends not only on the industry type rather on the project features, size and priorities.

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SECRETS OF SUCCESSFUL IMPLEMENTATION OF 5S

Oleksandr Lysenko, Dmytro Lebedev, Volodymyr Davydenko, Anatoliy Miroshnychenko. "Secrets of successful implementation of 5S". *The article is devoted to the analysis of the possibilities of implementing 5S at the organization. The component of the 5S system is considered. The article describes the theoretical and practical aspects of the transition to the 5S system. Classical approaches are highlighted, the main reasons that lead to the occurrence of resource losses are considered. An analysis of the basic tools and methods that can be applied during the implementation of the transition to the 5S system was carried out. The possibilities of obtaining benefits from the introduction of the 5S system are considered. Approaches to using the system of organization and rationalization of the 5S workplace in practice were proposed. Recommendations for further research are provided.*

Keywords*:* 5S system, phases of 5S application, sorting criteria, lean production, standardization.

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***Олександр Лисенко, Дмитро Лебедев, Володимир Давиденко, Анатолій Мірошниченко.* «*Секрети успішного впровадження 5S*».** *Стаття присвячена аналізу можливостей впровадження 5S на підприємстві. Розглядається складова системи 5S. У статті викладені теоретичні і практичні аспекти переходу на систему 5S. Висвітлено класичні підходи, розглянуто основні причини, які призводять до виникнення ресурсних втрат. Проведено аналіз базових інструментів та методів, які можуть бути застосовані при запровадженні при переході на систему 5S. Розглянуто можливості отримання переваг від запровадження системи 5S. Було запропоновано підходи до використання системи організації та раціоналізації робочого місця 5S на практиці. Надано рекомендаці подальших досліджень.*

Ключові слова: система 5S, фази застосування 5S, критерії сортування, ощадливе виробництво, стандартизація.

***Александр Лысенко, Дмитрий Лебедев, Владимир Давыденко, Анатолий Мирошниченко.* «*Секреты успешного внедрения 5S*».** *Статья посвящена анализу возможностей внедрения 5S на предприятии. Рассматривается составляющая системы 5S. В статье изложены теоретические и практические аспекты перехода на систему 5S. Отражены классические подходы, рассмотрены основные причины, приводящие к возникновению ресурсных потерь. Проведен анализ базовых инструментов и методов, которые могут применяться при внедрении при переходе на систему 5S. Рассмотрены возможности получения преимуществ от внедрения системы 5S. Были предложены подходы к использованию системы организации и рационализации рабочего места 5S на практике. Даны рекомендации дальнейших исследований.*

Ключевые слова: система 5S, фазы применения 5S, критерии сортировки, экономное производство, стандартизация.

Introduction. The term "5S" became popular in the 1980s in the Japanese manufacturing sector. At that time, the success of the Toyota Motor Corporation was reasonably associated with the Toyota Production System (TPS) - a production quality management system. One of the components of TPS was the regulated way of organizing the workplace - "5S". Currently, 5S is widely used all over the world [1-3], and is a recognized method that promotes productivity and occupational safety. What is its essence, practical benefit, as well as the difficulty of applying it in practice? In this article we will answer these questions.

Being, it would seem, a set of simple and obvious rules, 5S is designed to shape a certain culture. This is more than instructions, it is part of the ideology of caring for yourself and your work environment.

1. Sorting. Freeing the workspace from unnecessary items. In a standard scenario, all workplace items are divided into several groups, depending on the frequency of their use:

- unnecessary;
- sometimes necessary;
- needed often.

Based on the analysis, a decision is made to store the object (tool) at the workplace. At the same stage, a "Temporary warehouse" is created, on the territory of which items awaiting a decision on their further use or disposal are collected.

2. Observance of order. In the 5S workplace organization and rationalization system, this principle means the rational placement of objects within the working area (see Figure 2). It is important to ensure safe and convenient access to work items and objects. A lot of attention is paid to visualization: storage areas are signed, highlighted with color or light, etc.

3. Keep the workplace clean. Complete cleanliness of production and office premises, maintenance of equipment and tools in

working order. It is important to ensure regular inspection of workers to maintain order and the presence of malfunctions.

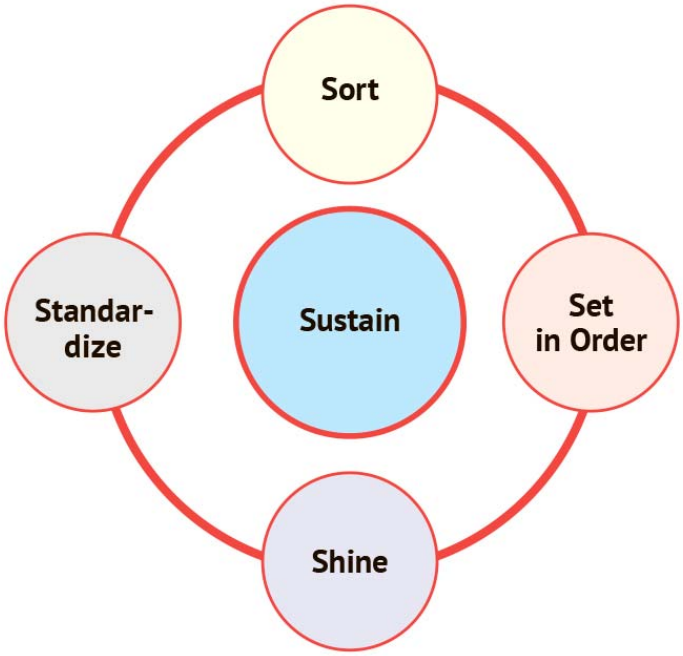

Figure 1 – What is the 5S system

4. Standardization. Regulation of gains of previous principles. It is necessary to form a package of documents, for example:

– information stands (Figure 2);

– schemes indicating the location of objects in the working area;

– signs indicating dangerous zones, zones of temporary warehouses and defective products;

– orders, check sheets of auditors;

– other warnings and important instructions;

– short instructions and reminders.

Figure 2 – An example of an information board

5. Improve. Support and improvement of the implementation of the established procedures of the first four points. The most important part of the 5S workplace organization methodology. Usually, company employees are able to make a one-time heroic effort and implement complex processes. But the inevitable mistakes of the first application and the power of formed habits quickly return the processes to their original position.

This principle is designed to turn successful 5S solutions into a culture [4,5]. For this, it is necessary to continue to monitor the implementation of the provisions of the adopted regulations, to create conditions for proposals and their timely analysis, to be ready to admit one's mistakes and change.

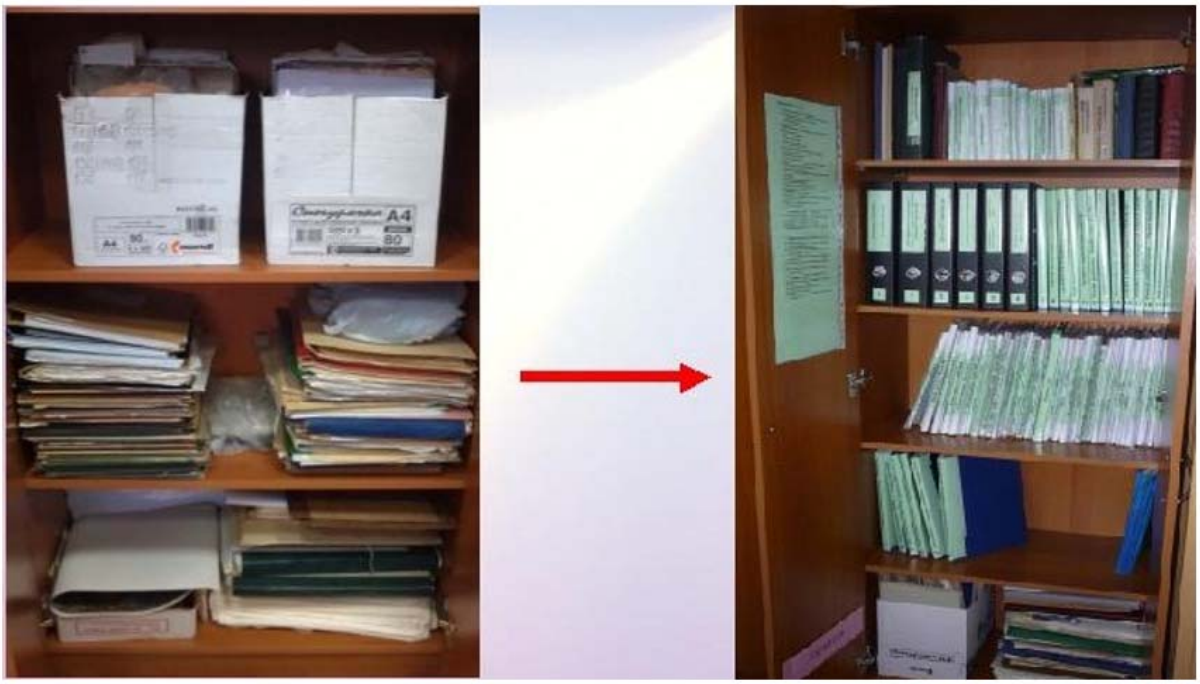

Figure 3 – Organization of work space in the office. Before and after 5S

The purpose and tasks of the research. The purpose of this article is to consider approaches to the introduction and management of the 5S system as a component of effective management of the company's activities.

Main material and results. The implementation of 5S principles in the company takes place in several stages, the structure and names of which are left to the discretion of the company. A good generalization of the possible options will be a presentation in the form of a standard P-D-C-A cycle (Plan/Prepare – Do – Check – Act, see Fig. 4) [6,7].

The result of the standardization should be a package of documents regulating the previous phases of 5S, a system of visual control and informing employees.

Phase 1. Preparation. Performs the following tasks:

1. A decision is made to implement 5S.
2. The project leader is determined.
3. A project team is formed.
4. Target areas of changes are determined.
5. A training plan is created and implemented.
6. The current condition is diagnosed, photo reports are created.
7. Target indicators are determined.

8. The staff is informed about the planned changes.

Each step is important. Emphasis should be placed on explaining how 5S can contribute to increased safety, prevention of workplace accidents, reduced costs, easier work, etc. The engine of change will be the top management of the company, so the project leader needs to build effective communications first of all with them.

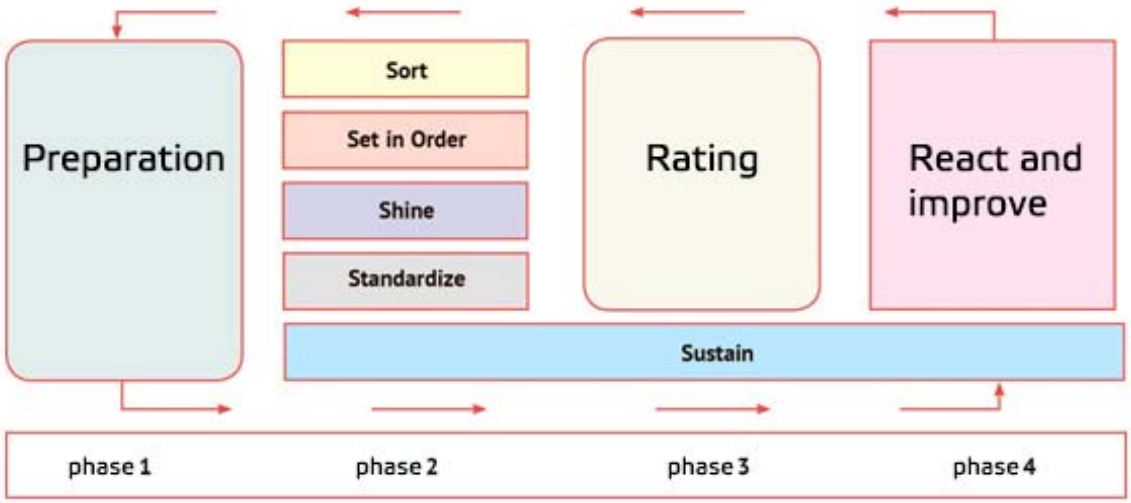

Figure 4 – Phases of 5S application

Phase 2. Implementation. Detailed planning and implementation of 5S principles.

2.1. Sorting: sorting criteria are determined, temporary warehouses are organized for conditionally redundant items, sorting is performed, disposal of unnecessary items is organized (see table 2).

2.2. Keeping order. The total inventory continues with the accompanying placement of things in certain positions. Examples of new rules can be as follows:

– marking tools, equipment and materials in any visible way, for example, using a color code *(For example, to place a sample to compare partially similar parts. The parts that are taken out or put in the box must be compared with the sample.*

Such parts should be kept at a considerable distance. If similar parts cannot be separated, inform the operator in advance about the location of similar materials, he should compare them with samples or photos);

– storage of objects near the place of their use in accordance with the sequence of the production process;

– similar objects (tools) are kept together;

– the stock of each type of required items is determined;

– it is forbidden to store objects in bulk, in deep containers;

– free access to frequently used items is provided;

– tool boards are used;

– placement of objects must be safe.

Items and their labeling should be prepared for employees who use them on a regular basis. Convenient access to the item and marking should be arranged for any employee who has the appropriate right to use the item (tool).

The result of the standardization should be a package of documents regulating the previous phases of 5S, a system of visual control tools and informing employees.

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Table 4 – An example of sorting criteria

Decision	Frequency of use of the item	Criterion
Unnecessary	Hasn't been used in the last year	Temporary composition for further decisions
	Not used in workflow	Temporary composition for further decisions
Not subject to repair	Remove	
Rarely needed	It was used no more than 3 times in the last six months	Keep within the working area at a medium distance
	It is used no more than 2 times a year	Keep within the work area at a remote distance
Necessary often	Used weekly	Keep within the working area at a close or medium distance
	Used daily	Keep within the working area at a close distance
	Used every hour	Keep in close proximity or carry with you

2.3. Keeping it clean. This point can play a key role in production sites with high requirements for cleanliness. For example, microbiological production is particularly sensitive to contamination by foreign microorganisms, including COVID-19. The degree of regulation and control is determined by the specificity of the technological process. Several common steps can be identified:

1. Assignments for waste collection and disposal are delegated. Cleanliness is the responsibility of each employee and workplaces are divided into different zones according to the degree of cleanliness requirements.

2. A schedule for equipment cleaning and diagnostics is formed.

3. Objects of cleaning and checking for functionality are detailed.

4. The methods, tools and materials used in cleaning and checking the equipment are determined.

5. Cleaning is practiced every day, but if possible it does not take much time.

The combination of cleaning functions and diagnostics of defects and breakdowns leads to a more comfortable and safe environment, creates better conditions for visits by third-party visitors (for example, customers).

2.4. Standardization. Not a big deal for companies. Decades of bureaucratization of processes have formed a high level of competence in regulating the actions of employees. But often the meaning of the standardization stage, which consists in continuous improvement of the process, is lost behind the thick volumes of provisions and regulations. At this stage, the following are documented or improved:

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– job duties to ensure cleanliness and safety of working with equipment;

– instructions for working with the equipment, operating rules;

– maintenance and diagnostics schedules;

– means of visual control;

– work area audit procedures.

The result of the standardization should be a package of documents regulating the previous phases of 5S, a system of visual control tools and informing employees.

Phase 3 and 4. Evaluation and improvement. The purpose of these phases is to transform the decisions made into a way of thinking, into a culture of lean attitude towards the production process, employees, materials and equipment. It is necessary to find a balance between discipline and the employees' own participation in the perception of new values.

3.1. Rating. The audit of the implementation of the adopted decisions is a mandatory part of the 5S project. An example is a check sheet that can be used at this stage.

3.2. React and improve. If the process does not work, then do not rush to look for reasons in the employees. Often there are objective reasons about which employees for various reasons cannot inform the management. It is important to stimulate employees to generate new ideas, but not to the detriment of the main duties. And here it is important not to leave initiatives unanswered.

When we talk about 5S, we are talking about a change in thinking. As a result, the reasons for unsuccessful implementation are often subjective. And it is primarily about the management of the company.

The use of the 5S workplace organization and rationalization system in practice has its own features and approaches.

5S is a soft transition to lean production. Ideally, lean production goals are achieved through training and team participation, but in practice control, orders, and the imposition of minor fines often prove effective. Why does this happen?

The fact is that when we talk about 5S, we are talking about a change in thinking. As a result, the reasons for the unsuccessful implementation of the new are subjective reasons. And it is primarily about the management of the company.

The use of 5S with the subsequent transition to the stages of applying lean production reveals most of the "diseases" common to one degree or another, but in all enterprises.

Let's formulate the most frequent limitations that we have to face in practice [8-10]:

– Lack of support from the first person of the company or its reluctance to participate in the project. Such an important issue should not be left to chance or the level of a formal approach.

– Inefficient combination of activities by managers. Executives who have income or interests "on the side" cannot devote adequate time to the company. Losses from hiring such workers do not necessarily exceed benefits, but are practically underestimated.

– "Management by phone". If you are building something new, prepare at least 70% of the time to be "in the field", in this case - on the production site.

– Misconception that culture is formed for subordinates, specialists, but not for management. Culture is formed for everyone in the company, team spirit is cultivated. The desire to draw an unnecessary line between top management and specialists can harm the project.

– Unpreparedness of the first person to make serious personnel decisions. In any enterprise there is a manager who passively or actively sabotages change. Sooner or later you have to get rid of such subordinates, but sometimes it happens in a timely manner.

– Unfair decision in favor of needy people. The decision is made not from the principle of "better for the company", but from the principle of "better for me". Whoever

is more necessary is the right one. For example, a specialist in the occupational health and safety department at a furniture factory insisted on a significant reorganization of work and changing the positions of equipment, considering the current situation to be dangerous. However, the chief engineer flatly refused to make changes, citing disruption of production plans. The general director, understanding his dependence on the chief engineer, decided in favor of the current situation. As a result, there was an accident, as a result of which, thanks to a lucky chance, people were not injured, but the equipment was damaged. In the end, the occupational safety specialist's comments were taken into account, but the company suffered losses.

– Violation of discipline by the manager himself.

– Public replacement of the manager's decisions with another decision. If you do not like the decision of the subordinate manager, it is better to discuss with him personally. This is a problem of general management of the company, but it is often exacerbated during the implementation of 5S. For example, the chief engineer decided within his competence and 5S principles to replace obsolete equipment as unsafe. The CEO publicly overturned this decision, citing the budget, even though the cost of the equipment was small and the chief engineer was acting within his authority. As a result, the 5S implementation project was implemented without fully observing the principles of employee safety.

– Inability to delegate tasks. This is a general problem, but it is exacerbated during the implementation of the 5S project. The application of 5S affects all divisions of the company and is time-consuming. If you are unable to set priorities, the project risks being delayed, and may even cause absurd discussions. Using an example from real practice: at the working meetings of the 5S project, the general director paid priority attention to the rules for using the office kitchen and dining room. Instead of leaving the solution to the relevant services and focusing directly on the production site.

– Lack of resources to implement the 5S implementation project.

Reluctance of top management to change the rules and complete unpreparedness for risks. Working according to 5S standards always means additional costs and changes. In other words, it is an investment with its own risks. Rearrangement of equipment, loading of production personnel may seem too high risks and lead to abandonment of the project.

– Prejudice against certain employees, functions or departments. Let's give an example. In the mandatory inventory during the implementation of 5S, accounting employees participated, with whom the laboratory "did not develop relations". As a result of unnecessary clarification of relations, the decision regarding a simple task was delayed for a month.

– Misunderstanding of the principles of work of new methods by the first person and top management of the company.

– Non-fulfillment of promises and commitments by management.

– Open or covert sabotage of individual managers. In this case, the project manager implementing 5S is helped by working with one of the subordinates of such a manager "directly". At the same time, the order must fix responsibility on the manager himself to ensure his involvement. The general director requires a report not from a specialist, but from a sabotaging manager, without violating the principles of subordination.

– "Outsourcers in the state." It is about employees who are not focused on results. If there is a reason that will allow them to postpone the task, they will definitely use it. If possible, such employees will transfer the elimination of the causes to management, regardless of how serious the cause is. Because management is often overwhelmed, solving an important issue is delayed, and the

"outsourcer" gets a legitimate reason to do nothing.

Conclusions. 5S is a way of organizing the workspace, based on the principles of frugal treatment of employees, communications, equipment and materials. Implementation of 5S is a process of changing the mindset of all company employees. Most often, the success of the project depends on the availability of resources and the readiness of the company's management to change. Great attention should be paid to communicating with employees and monitoring the implementation of decisions.

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CIRCULAR ECONOMY AND RENEWABLE BUSINESS MODELS

Tetyana Mostenska, Volodymyr Davydenko. "Circular economy and renewable business models". *The article is devoted to the analysis of the possibilities of using circular economy tools. The current state of the circular economy is considered. The article describes the theoretical and practical aspects of the circular economy. An analysis of the basic tools and methods that can be applied in the introduction of the circular economy has been carried out. A chain of creation of added value is proposed. A model of using the circular economy is proposed. The main strategic goals of introducing the circular economy are defined. An additional model is considered - SmartCitiesMarketplace. The possibilities of obtaining benefits from the introduction of the circular economy are considered. Recommendations for further research are given.*

Keywords*:* circular economy, circular business models, waste management, resource management, cyclical production management, SmartCities Marketplace.

Тетяна Мостенська, Володимир Давиденко. «Циркулярна економіка та відновлювальні бізнес-моделі». *Стаття присвячена аналізу можливостей використання інструментів циркулярної економіки. Розглядається сучасний стан циркулярної економіки. У статті викладені теоретичні і практичні аспекти циркулярної економіки. Проведено аналіз базових інструментів та методів, які можуть бути застосовані при запровадженні циркулярної економіки. Запропоновано ланцюг створення додаткової вартості. Запропоновано модель використання циркулярної економіки. Визначені основні стратегічні цілі запровадження циркулярної економіки. Розглянуто додаткову модель - Smart Cities Marketplace. Розглянуто можливості отримання переваг від запровадження циркулярної економіки. Надано рекомендації подальших досліджень.*

Ключові слова: циркулярна економіка, циркулярні бізнес-моделі, управління відходами, управління ресурсами, управління циклічністю виробництва, Smart Cities Marketplace.

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Татьяна Мостенська, Владимир Давыденк. «Циркулярная экономика и обновительные бизнес-модели». *Статья посвящена анализу возможностей использования инструментов циркулярной экономики. Рассматривается современное состояние циркулярной экономики. В статье изложены теоретические и практические аспекты циркулярной экономики. Проведен анализ базовых инструментов и методов, которые могут применяться при внедрении циркулярной экономики. Предложена цепь создания добавленной стоимости. Предложена модель использования циркулярной экономики. Определены главные стратегические цели введения циркулярной экономики. Рассмотрена дополнительная модель – Smart Cities Marketplace. Рассмотрены возможности получения преимуществ от введения циркулярной экономики. Даны рекомендации дальнейших исследований.*

Ключевые слова: циркулярная экономика, циркулярные бизнес-модели, управление отходами, управление ресурсами, управление цикличностью производства, Smart Cities Marketplace.

Introduction. Before the global pandemic, active efforts were made in Europe to develop a circular economy, in particular, to develop infrastructure on a more sustainable and economical basis. Even if today's reality of Ukraine has corresponding problems in promoting this idea, at the same time there is an opportunity to expand opportunities to promote innovative solutions that will allow attracting investments, to move towards a green economy, thereby contributing to future economic prosperity.

Greening the economy is increasingly becoming a strategic priority for governments around the world. As part of efforts to promote a green economy in the pan-European region, the Committee on Environmental Policy (CEP) of the Economic Commission for Europe of the United Nations (UNECE) with the support of the UNECE and the United Nations Environment Program (UNEP), as well as in cooperation with other key participants, such as the Organization for Economic Co-operation and Development (OECD) and the European Environment Agency (EEA), developed a pan-European strategic framework for greening the economy. These strategic frameworks are the basis for a comprehensive regional vision, goals and results for the promotion of the green economy [6].

Closed-loop economy or circular economy, based on the rational use of resources and limiting the harmful impact of manufactured products on the environment. The main approach is the maximum use of raw materials in circulation for a long period of time, until they lose their properties. With this approach, the amount of waste generated can be minimized. At the end of a product's life cycle, all its residues should remain in the economy, as there is a high probability that they can be reused.

The reuse of materials is an extremely attractive prospect from a financial and environmental point of view. This can be a significant breakthrough in the transition from the linear model of the economy that exists today, where the necessary raw materials are first collected, then transformed into a product, distributed and exploited, and finally thrown away.

Using a closed value chain model, instead of producing disposable products, used parts are recovered or materials are remelted to return them to a new marketable form. This makes them reusable, sometimes even in a completely different industry. It is worth noting that the circular economy model offers many advantages for modern business. By implementing such a model, companies can spend less financial resources on certain types of raw materials, contribute to environmental protection and minimize the impact of prices on the market.

Analysis of recent research and publications.

The urgency of researching issues related to the implementation of circular approaches

is due to the limitation of world resources and the increase in their consumption.

Research and development in the field of circular economy, focus mainly on some topical issues of logistics, production and processing technology, in the works of U. Stahel, R. Lifset, Paula, and others.

Domestic researchers and scientists in the field of circular economy mostly refer to the analysis of foreign experience.

The purpose and tasks of the research.

The purpose of this article is to study the application of business models for the introduction and management of circular processes in the economy.

Main material and results. The model of the circular economy is a model of production and consumption that involves the joint collective (or repeated) use, rental, repair, restoration and recycling of existing materials and products for as long as possible (Figure 1).

The circular economy takes a long-term perspective and covers all industrial sectors at global, regional and local levels. This is one of the directions that will allow to reduce consumption and at the same time extend the service life of products and resources and is based on three basic principles (Figure 2):

– opportunities to design and construct products in such a way that they can be reused or upgraded in the future, which prevents the increase of waste and environmental pollution;

– possibilities of increasing the time of use of products and materials;

– opportunities to restore natural systems and create circular (closed) business models or a closed supply chain.

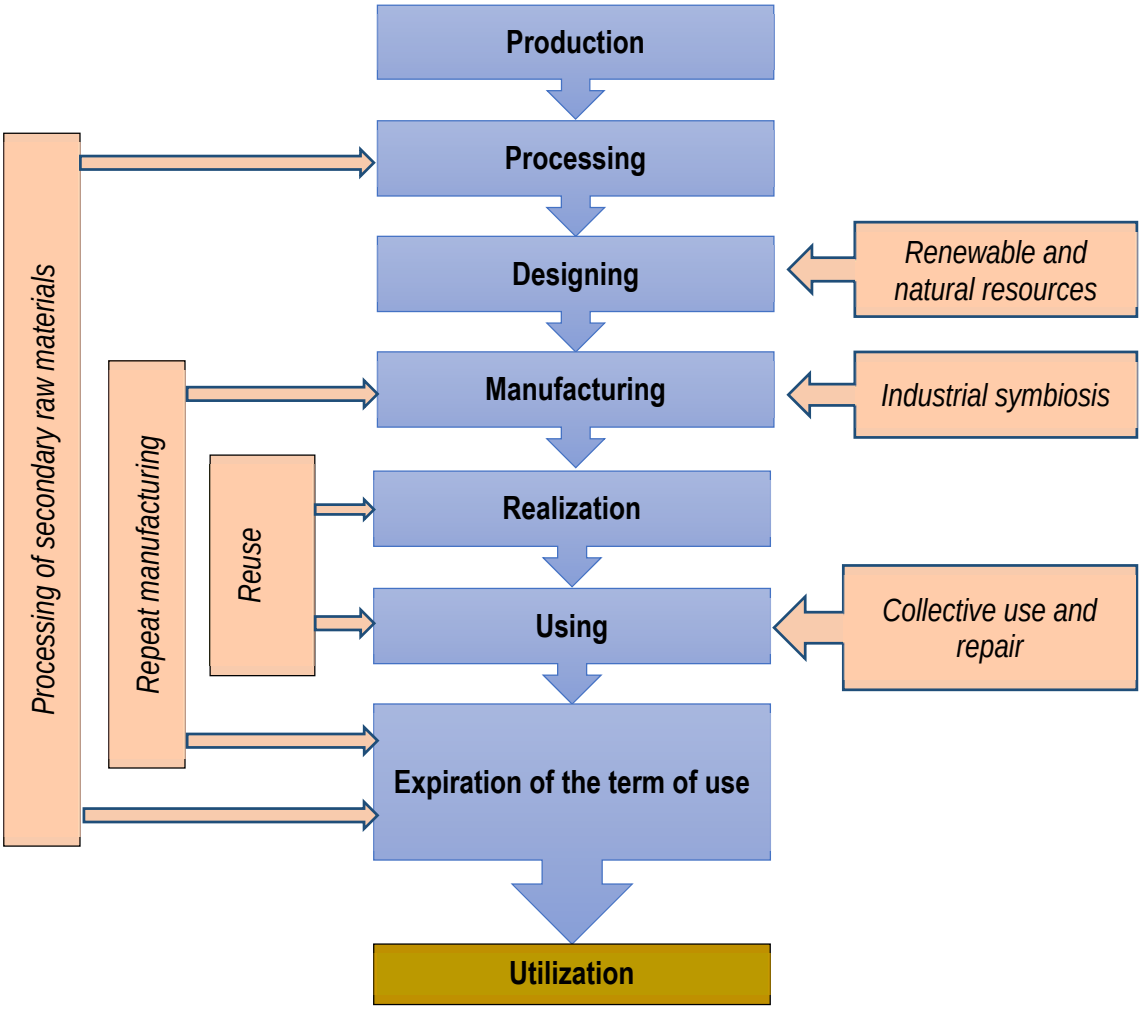

Figure 1 – The chain of creation of additional value based on the introduction of elements of the circular economy

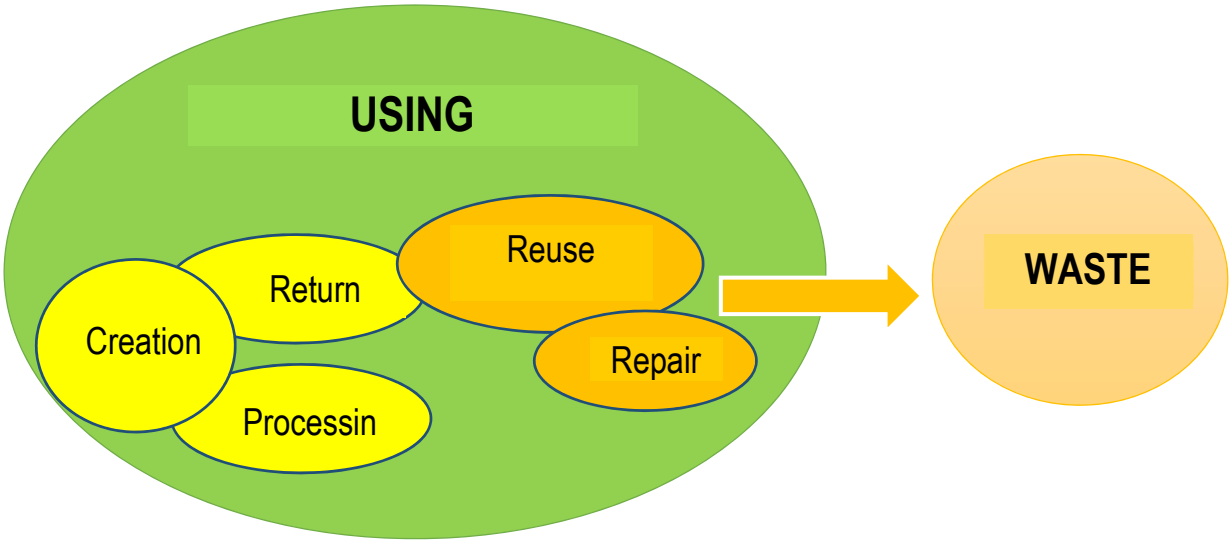

Figure 2 – Circular economy usage model

In addition, the use of the insert "possibility" (not as affirmative and binding principles) defines the desire to implement the specified principles, within the limits of financial and technological capabilities, using both internal and external resources [2].

The multiannual European financial framework for 2021-2027 and the "Next Generation EU" include a recovery plan that is set to be the biggest stimulus package ever funded in Europe. A total of €1.8 trillion should be dedicated to rebuilding a greener, digital and sustainable Europe. It is planned that about €374 billion will be allocated to finding ways to preserve natural resources and the environment. In addition, European countries have pledged to shift from fossil fuels to green energy, buildings, transportation and other investments as a recovery strategy worth about $295 billion. Such concerted approaches by Europeans demonstrate an unprecedented opportunity to efficiently allocate current resources and provide more efficient recovery to fill infrastructure investment gaps, with clean energy or ecosystem-restoring infrastructural solutions [4, 7].

Taking into account the common readiness to implement the principles of the circular economy, the European Union has defined the main strategic goals in this direction:

– simplification of collection and sorting of various materials for reuse and recycling, turning this system into a mandatory one;

– reducing the amount of food waste;

– implementation of financial incentives to encourage reuse and recycling of packaging;

– prohibitions on burning and burying waste collected for recycling or reuse;

– setting higher goals for recycling and reuse of goods;

– oblige manufacturers to pay more for the collection and recycling of packaging waste;

– establishment of a more accurate methodology for assessing the degree of processing.

It should be noted that the specified areas should be laid down in the basis of state policy, taking into account the use of infrastructure, digital technologies, investments and process management. The state should create (primarily investment) opportunities for the circular economy, support sustainable and environmental initiatives, create opportunities for the development of public and private partnerships with a focus on circular projects.

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At the micro level, businesses need to implement the following steps:

– to implement strategic and tactical approaches to achieving environmental sustainability;

– conduct systematic research and development, design products and services in accordance with the circular economy;

– raise awareness of its employees, customers, consumers and the community about the opportunities to participate in the global project to introduce a circular economy.

In the system of scientific search for circular economy implementation directions, the researchers proposed the following business models [1, 5]:

– ***Circular supply***. Replacement of traditional raw materials with organic or renewable ones, and long-term use of resources. Production waste should become raw material for new production processes.

– ***Restoration of resources***. Recovery of raw materials and processing of waste from secondary raw materials, so that waste is transformed into raw materials and not disposed of - in this case, companies create new products from waste. This model is the most adapted.

– ***Extending the service life of products***. Here we are talking about resource recovery and waste minimization. And thanks to the modernization or resale of products on secondary markets, their service life increases. This also includes repair and reuse.

– ***Platform for shared use***. In this model, the product itself carries the raw material and increases the possibility of its use, that is, it can be used by many consumers, not just one person. Access to this product is sold here.

– ***Product as a service***. A product is no longer something that belongs to one person, but can be used by one or more customers on a subscription basis (not a product, but a service). Here, various subscriptions are introduced, the costs of maintaining such services and management are reduced, and additional value is obtained after the end of the product life.

By studying the proposed business models, which are proposed for use in the implementation of the circular economy, a model was discovered that can be an effective element in the implementation of the circular economy, and in integration acquires a wide discussion study.

Such a model is "Smart Cities Marketplace" - Smart City.

This concept involves the integration of information and communication technologies, including IoT (Internet of Things), for the purpose of effective management of the city's infrastructure (transportation, security, medicine, utility system, etc.). The purpose of introducing this model is to improve the quality of life of city residents and reduce the costs of work processes, using modern technologies to meet the needs of citizens [8].

The application of "smart city" technology is being developed in order to improve the management of urban flows and quick response to complex tasks. Therefore, a "smart city" is more prepared to solve problems than in a simple "operational" relationship with its citizens. Nevertheless, the term itself remains unclear in its specifics, and therefore involves controversial discussions.

Smart Cities Marketplace allows city authorities to interact directly with communities and city infrastructure, and monitor what is happening in the city, how the city is developing, and what tools allow improving the quality of life. Through the use of sensors integrated in real time, the accumulated data from city residents and devices is processed and analyzed. Collected information is the key to solving inefficiencies.

Smart Cities Marketplace are used to increase the quality, productivity and interactivity of city services, reduce costs and resource consumption, and improve communication between city residents and the state [3].

Smart Cities Marketplace is a city that cares about the planet. Caring for the environment begins with controlling the consumption of energy resources. In a smart city, different tools can be used to effectively implement this control:

– smart lighting (lights on the streets turn on and off automatically, reacting to the approach of a person);

– use of leakage sensors;

– optimized conditioning;

– automation of water consumption (smart sensor mixers);

– automation of the distribution network;

– use of intelligent thermostats, etc.

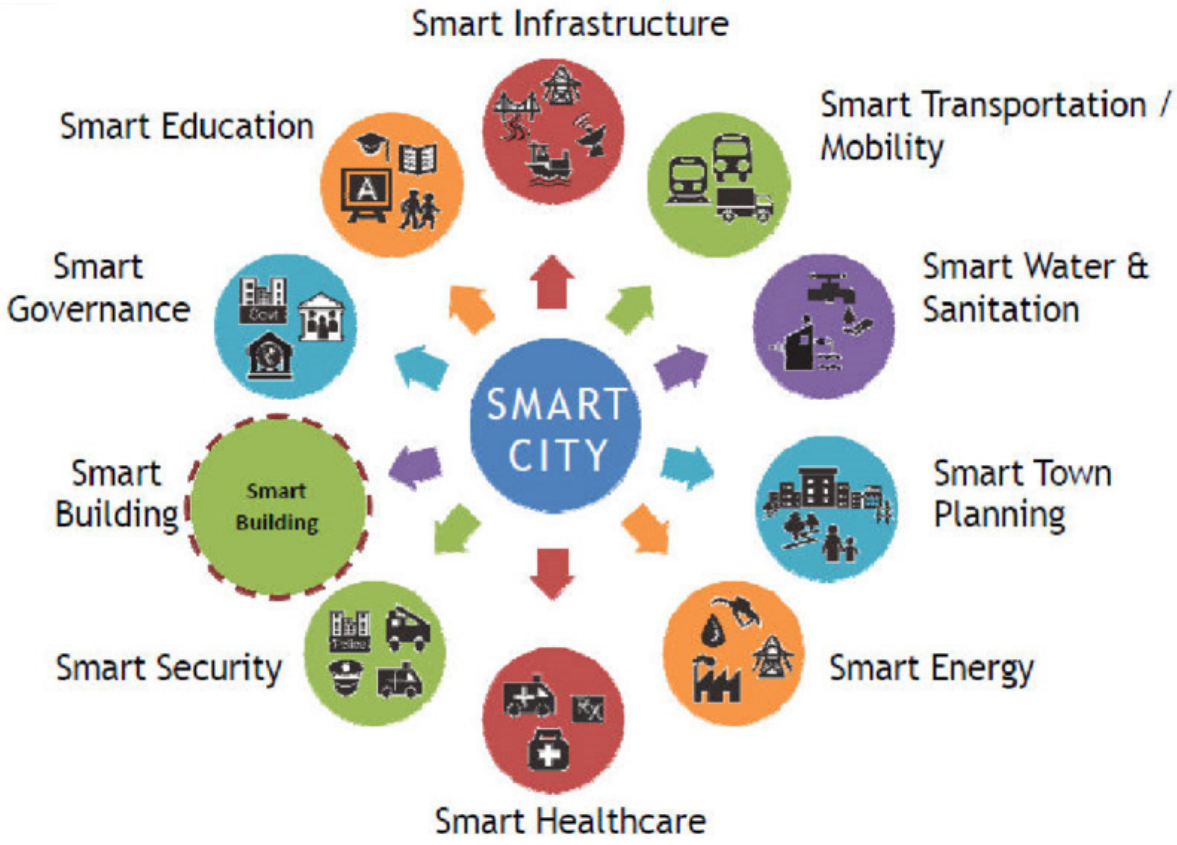

Figure 3 – Components of Smart Cities Marketplace [8].

The introduction of Smart Cities Marketplace improves the quality of life of citizens, increases the competitiveness and energy efficiency of cities and industry, and also improves the ecological climate of the urban environment (Table 1).

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Table 1 – Functional elements Smart Cities Marketplace

Energy	Energy consumption meters	Management of final consumption	Electric transport	Distributed generation	Cogeneration	Renewable generation
Transport	Intelligent transport systems	Infrastructure payment systems	Automated and intelligent parking	Public information notice	ECO cars	Ecological transport
Water supply, gas supply	Smart meters	Automatic/remote consumption control	Definition of breakthroughs	Management of emergency situations	Reducing the level of losses from breakthroughs	Innovative cleaning methods
Urban environment	Video surveillance and security	Smart lighting	Smart waste disposal	Management of urban development	Efficient hospitals	Social service provision
Dwelling	Integrated automation	Remote housing management	Smart devices	Smart applications and services	Energy-efficient construction	Energy-efficient restoration of construction objects

An example of the practical application of Smart Cities Marketplace elements in Ukraine is the use of such an application as the "Diya" application, which belongs to the ecosystem of the "Digital State" project from the Ministry of Digital Transformation.

The ecosystem also includes:

– state portal «Diya»;

– «Diya Education» — portal with online courses: basic digital literacy;

– «Diya Business» — a portal to help small and medium-sized businesses and others.

Conclusions. The circular economy is based on three principles. First, it is a reduction in the amount of waste or its elimination altogether. To achieve this, products must be durable and optimized for recycling and reuse. For this, they must be made from quality materials.

Second, products and materials must be in constant use in the ecosystem. Biological materials, such as food or clothing made from natural fabrics, return to the ecosystem naturally through decomposition. Man-made materials such as plastic are recovered in eco-chains through reuse, repair or recycling (in practice this means, for example, pumping out an old Smartphone rather than buying a new one).

Third, the energy used to operate the circular economy must be renewable. This reduces dependence on finite resources (for example, oil) and increases the sustainability of the system.

In general, the circular economy can contribute to economic prosperity. It reduces the cost of resources - both human and energy - for the production of products. Carbon emissions in the supply chain also decrease. Furthermore, the circular economy makes the economy more sustainable in the long run.

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