ESG concept as a tool for optimising spare parts stocks in car service centres in the Republic of Cyprus

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Abstract. The article proposes a comprehensive analytical study of the potential for the use of the ESG concept as a tool for optimizing spare parts stocks in car service centers of the Republic of Cyprus. The study is based on the materials of the Statistical Service of the Republic of Cyprus, on the information provided in the relevant scientific literature, as well as on the results of the empirical research.

An analysis of the management accounting data of 12 car service centers of the Republic of Cyprus was carried out, including 4 dealer networks, 4 independent multi-brand companies and 4 family businesses. The directions of implementation of the environmental part of the ESG concept at car service enterprises of the Republic of Cyprus are specified. A comparative assessment of the profitability of stocks and CO₂ emissions in the business processes of managing auto parts stocks has been clarified. Expert assessments of the state of ESG management in the spare parts inventory management system in the analyzed car service centers are presented.

It is recommended to conduct optimization of spare parts inventory management in car service centers of the Republic of Cyprus to multiply the economic and social effects from the development of the elements of the ESG concept based on the author's CDMD model: Systematisation - Decentralisation - Monitoring (measurements) - Digitalization. The introduction of the proposed CDMD model should provide economic benefits, expressed in an increase in the profitability of inventories and various ESG gains.

1 Introduction

Optimization of supplies and stocks of spare parts is the most important direction for improving management in car service enterprises, especially in a country with a high level of motorization of the population and business, such as the Republic of Cyprus. The management of relevant business processes is influenced by many heterogeneous factors, such as the form of business organization, access to centralized warehouses and distributed supply, specialization of car service enterprises (mono-brand, multi-brand), the state of demand and customer relations, the possibilities of automating inventory management and their actual implementation [1-4]. Some recommendations have been developed to improve the management of spare parts stocks in car service enterprises [5-8], but each company and...

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industry are still in search of better solutions. Considering aspects of optimizing business processes for the supply and management of spare parts inventory in car service centers in the third decade of the 21st century, one should take into account development megatrends, such as digitalization opportunities and management based on the ESG paradigm.

The issues of the influence of the ESG concept on the formation and management of stocks of spare parts in the automotive business are considered fragmentarily [9, 10], and in relation to the automotive service in the Republic of Cyprus, they remain unexplored and will be disclosed in this study. The purpose of this article is providing and discussing results of comprehensive analysis of the potential of using the ESG concept as a tool for optimizing spare parts stocks in car service centers of the Republic of Cyprus.

2 Materials and methods

The study is based on the materials of the Statistical Service of the Republic of Cyprus, on the information provided in the relevant scientific literature, as well as on the results of an empirical author's research. The study analyzed management accounting data from 12 car service centers in the Republic of Cyprus, including 4 dealer networks, 4 independent multi-brand companies and 4 family businesses. The Carbon Emissions Calculator tool was used to estimate carbon emissions in the absence of corporate accounting data. During the study, an assessment was made of the statistical relationship between the indicators of profitability of spare parts stocks and CO\(_2\) emissions in their management. The expert assessment was carried out based on the general methodology presented in [11] and adapted to the needs of the study, including the selective accounting of managerial influences localized within the business processes for supplying car service centers of the Republic of Cyprus with spare parts and their use in a car service. The scores were given on a scale from 1 to 10, in accordance with the identification of the advanced nature of management in the ESG areas (where a higher score corresponded to more advanced management). As the resulting assessment, the arithmetic mean of the expert assessments was taken, the relevance of the assessment was checked by calculating the concordance coefficient.

3 Results and discussion

The Republic of Cyprus is a relatively small island state with a highly developed network of roads and a relatively high level of motorization per capita (1.54 people per passenger car in 2020 [12]). To date, over 8 thousand companies are registered in the Republic of Cyprus, whose activities relate to car service. There is no more precise information, which is related to the liberal administration of business, the absence of an excessive burden on the part of inspection bodies, including, as a rule, the need to confirm the main activity without an objective need (for example, to receive industry support measures that were provided during the COVID-19 pandemic).

A certain number of car service companies belong to the non-observed sector of the economy of the Republic of Cyprus, including family micro-enterprises, handicraft services. The rather high number of car service companies is due to both the relatively high level of motorization of business and the population of Cyprus, as well as due to consumer traditions. The car service market in the Republic of Cyprus is expanding every year. In recent years, there has been a pronounced trend towards an increase in the number of vehicles in personal use, mainly passenger cars. According to the Statistical Service of the Republic of Cyprus in the country, the number of cars in 2020 was 759,268 [12]. Because the average age of registered cars in the country is 13.2 years (Fig. 1), it becomes necessary to apply to car service centers, considering the high mileage of cars.
The production of automotive parts and accessories in the Cyprus industry is estimated at €6.0 million and ranks 26th in Europe in 2022 (out of 26 EU countries). The industry ranking (26th) has remained unchanged since 2017. As for the traditions of consumption, they determine, first, the prevalence of small and micro-network enterprises in the structure of the auto service business of the Republic of Cyprus. It is very important for local car owners to establish long-term contact with representatives of service companies. Servicing is often done by entire families and dynasties. Auto service business often becomes a family matter, being passed down from generation to generation. Business in this area remains vulnerable to many environmental factors, including a permanent increase in the cost of materials and components, rise of the labor costs. One of the directions for ensuring the organizational sustainability of car service enterprises is the rationalization of inventory management, which is more relevant than ever for the market of the Republic of Cyprus, where more than half of the car service centers are not protected by a network form of business or a franchise, and service cars of various brands with different operating conditions.

A relatively new aspect of business management of car service centers in the Republic of Cyprus is the introduction of the ESG concept. As in many other sectors with a high proportion of small businesses, work in this area faces a lack of entrepreneurs’ understanding of the need for it to be carried out and a significant lack of competencies necessary, among other things, to turn the implementation of ESG management into the economic benefit of the company. However, the supply of car service centers of the Republic of Cyprus with spare parts is an important area of potential application of the ESG concept.

The main directions for the implementation of the environmental part of the ESG concept at car service enterprises in the Republic of Cyprus, as well as around the world, should be:

– Overall responsible consumption of resources.
– Ensuring energy efficiency of the main and service business processes.
– Reduction of harmful emissions into the environment and, above all, reduction of the climatic load from the activities of service centers.

Today, a key aspect of the implementation of the paradigm of environmental responsibility in the auto service business of the Republic of Cyprus is the provision of a low-carbon transition. Cyprus is implementing measures to progressively achieve a low-carbon transition, including in the transport industry. The basis for the application of these measures...
The Green Europe strategy, implemented within the framework of the European Union [13], includes measures to tighten standards for CO\textsubscript{2} emissions, encourage responsible consumption, and discuss economic mechanisms for green nature management, including through green taxation [14]. However, as of yet, the road transport industry, despite its high carbon intensity (accounting for more than 5% of GDP [12]), has not been a focus of severe government enforcement action on the energy transition. This is due to the unique infrastructure of Cyprus, where road transport lacks reasonable and economically viable alternatives for goods and passenger transportation [15].

It would be incorrect to say that the reserves for the transition of the transport sector to low-carbon consumption have been completely exhausted. For example, in 2022, 22.6% of cars in Cyprus used engines not based on hydrocarbons [12]. Nevertheless, it is necessary to form a understanding that designing measures to reduce the carbon footprint of the road transport industry, in addition to switching to alternative fuels, is key to successful environmental transformations in the future. We are talking about the time when the resources of low-carbon transition due to changes in engine types will be generally exhausted, and the tasks of zero CO\textsubscript{2} emissions will still not be solved [16].

For car service enterprises, the corresponding issue cannot be attributed to the long-term perspective, as opposed to, for example, carrier companies, where the share of fuel emissions in CO\textsubscript{2} emissions is generally insignificant. For the surveyed companies, the share of fuel CO\textsubscript{2} emissions in total carbon emissions amounted to 11.9% ± 7.2% and increased slightly (on average by 3.2%) compared to 2021, despite a 5.9% increase in the volume of services. On the contrary, non-fuel supply accounted for 56.2% ± 5.17% of all CO\textsubscript{2} emissions from the surveyed car service centers in 2022. An assessment of the five-year dynamics of the share of non-fuel supply of car service centers in CO\textsubscript{2} emissions in Cyprus concluded that the indicator increased slightly in relative terms against a slight (on average 5.8%) decrease in absolute terms (see Fig. 2).

![Fig. 2. Dynamics of volumes and share of non-fuel supply of car service centers in Cyprus in their CO\textsubscript{2} emissions (according to the results of the survey, the average value per company)](image-url)
The reason for this situation is the lack of a breakthrough in reducing carbon emissions along the supply chain of car service centers with spare parts against the backdrop of more successful implementation of saving technologies in other business processes. It should be noted that the carbon load is formed by the following elements of the process of supplying spare parts to car service centers and managing warehouses: manufacturing and packaging, transportation of spare parts, temporary storage in distribution warehouses, storage in a car service center warehouse, disposal of packaging and spare parts themselves in case of defects, violations rules of circulation or due to the expiration of storage periods. Part of the load is provided by the irrational organization of business processes, and, above all, by the unreasonable packing of local warehouses, as well as the opposite phenomenon - the need for urgent delivery of a spare part to a service center bypassing the system of planned deliveries from distribution warehouses (in which, as will be shown below, it is possible to organize supply processes so as to reduce CO₂ emissions). In both cases, the increase in climatic load occurs against the background of a parallel decrease in the profitability of inventory management, as well as reputational risks, loss of customers in the absence of spare parts, etc. It should be borne in mind that the prompt delivery of missing components, assemblies to a car service center may require organizing direct offshore delivery. For a territorially isolated island located on the remote southeastern border of the EU, such a supply should be carried out by air transport, with the possibility of long-distance transportation, which leads to additional financial costs and an exponential increase in carbon emissions. Thus, the optimization of spare parts management links the economic interests and the interests of the sustainable development of car service centers of the Republic of Cyprus.

Despite the importance of the environmental aspect of inventory management in the car service centers of the Republic of Cyprus, it is impossible not to cover role of social management and the improvement of corporate governance in the context of ensuring more rational approaches to the implementation of strategy and business processes in the field of automotive spare parts stocks. Aspects of social responsibility may be underestimated in the practice of management in car service centers in the Republic of Cyprus. However, it was said above about the peculiarities of the historical tradition of consumption of services by the population and entrepreneurs of Cyprus. Through the systematic implementation of corporate social responsibility measures, owners and managers of car service companies get the opportunity to know their customers much better, establish trusting relationships with them and strengthen mutual trust. It must be understood that, taking into account the level of motorization of the country's population, all representatives of society are potential consumers of car services in the present or in the future, or at least those who will guide others in choosing a service company. Through contacts with the nearest society, car service centers of the Republic of Cyprus receive additional information about the demand, including through improved knowledge about the portrait of the target audience of consumers. Close community relations support and strengthen customer loyalty, thereby improving the ability to predict the cost of spare parts in auto service centers based on an assessment of the most stable part of demand generated by long-term customers. In combination with digital customer relationship management tools, in particular the Internet of things, representatives of car service centers will be able to plan long-term service based on an intelligent assessment of the frequency of changing a car and choosing a new vehicle. Finally, the development of corporate governance also has the potential to influence the processes of optimizing spare parts stocks in the car service centers of the Republic of Cyprus, and this potential has not yet been fully used to date. Meanwhile, changes in corporate governance are closely related to the optimization of resource management of car service centers, including inventory. As will be shown below, for example, for small non-network car services, one of the promising options for solving the problem of optimizing spare parts inventory management is total digitalization using the principles of the sharing E3S Web of Conferences 402, 10001 (2023) TransSiberia 2023
The introduction of network models and methods of managing independent enterprises will lead to changes in the organization of top management, types of organizational structures, and will affect the organizational culture of the company. While it is advisable to outsource certain management processes, including to digital systems, maintaining a liberal type of corporate culture that stimulates long-term trusting relationships with customers is an important task.

Fig. 3 shows expert assessments of the ranked values of the ESG management state in the spare parts inventory management system in the analyzed car service centers of the Republic of Cyprus (concordance factor 0.843).

It can be stated that the weak side of ESG management in the business processes of supplying spare parts to car service centers in the Republic of Cyprus is the environmental component. The conclusion is supported by the above results of the analysis of the dynamics of CO2 emissions generated by the provision of these business processes. At the same time, there are extensive optimization opportunities in this area, including thanks to the accumulated competencies and various economic and statistical information.

Due to the availability of reserves for improving the environmental component in the spare parts inventory management system in auto service centers of the Republic of Cyprus, in order to clarify these reserves, as well as to determine the impact on the corporate economy, an additional assessment of statistical relationships between the growth of the economic effect from the optimization of spare parts inventory management was carried out in auto repair shops (defined in particular through the return on inventory ratio) and progress in the field of ESG. The following statistically significant patterns were identified.

Over the past five years, the profitability of spare parts inventory management has increased on average by 1.11±0.85% (T=0.0; p<0.001), while CO2 emissions have decreased by 5.8±1.18% (T =0.0; p<0.01). A higher spread between the growth of profitability of stocks and the reduction of carbon emissions was found in network dealer car services in comparison with independent ones (U=45.5; p<0.01).

At the same time, considering the specifics of corporate governance in most car service companies in the Republic of Cyprus, this factor was not further analyzed in this paper.
However, it should also be taken into account, for example, when assessing the impact of the ESG concept on the optimization of spare parts stocks in car service centers of the Republic of Cyprus in large companies, including dealer networks. The relevance of the issue will increase as the practices of specialized ESG management are introduced in small car services in Cyprus, including when deciding on the transfer of professional management to outsourcing.

Attention is drawn to the existing higher profitability of spare parts inventory with a lower carbon footprint from their provision, observed in car service dealer networks in comparison with independent multi-brand car service enterprises. A hypothesis can be put forward that, due to the specifics of organizing the supply of spare parts through distributed warehouses, dealer auto service networks represent a specific laboratory for testing low-carbon technologies, including at an unconscious, intuitive level. An in-depth analysis of the factors that could lead to a simultaneous increase in the profitability of inventory management and a decrease in the carbon footprint in the supply of spare parts to car service dealer networks led to the conclusion that the effects are provided by the specific network nature of the organization of supply. This is a distributed supply model, at each stage of which the potential for reducing the carbon burden is realized intuitively or consciously, while the initial goal of the supply model was the total optimization of inventory management (cost reduction).

The relevant circumstances can be illustrated by the following actual data, which took shape in the III-IV quarters of 2022 on the surveyed dealer auto service networks of the Republic of Cyprus:

- The average distance between the central distribution warehouse and the hub distribution warehouses was 39.6 km, while the parent companies, implementing the ESG approach, are striving to transfer deliveries over medium distances mainly to environmentally friendly transport. Electric vehicles such as Lion 6 and Lion 8 electric trucks, e-Crafter vans, Mercedes-Benz eVito and the larger E-Sprinter, Voltia electric vehicles (Nissan e-NV200 with a larger body) can be used to reduce the carbon footprint.

- The average distance between the nodal distribution warehouses and end users was 5.6 km, the parameters of the average delivery batch were: weight 15.5 kg, volume 4.9 liters. This allows transferring most of the planned deliveries to the sharing format (one delivery covers all consumers with minimizing the number of trips), and small batches and single emergency deliveries are carried out by couriers on bicycles, or moving using micro mobility devices, or even on foot.

Some progress in the field of reducing the carbon footprint has already been achieved today: in the analyzed supply chains, they are used as courier delivery of small loads on bicycles and on foot, as well as joint delivery of goods to several car service enterprises on a single waybill. However, innovation is applied selectively. Namely, only for delivery over short distances, and for planned deliveries, the parameters of which can be predicted in advance, and the routes will be pre-planned. Finally, the distribution warehouses were designed in the early to mid-2010s and did not take into account environmental aspects. Due to the specifics of the geography of the Republic of Cyprus, the organization of the road network (which has an almost perfect linear character for more than 75% of its length), the location of the system of warehouses for car service dealer networks may be suitable for the requirements of environmental standards of the 2020s. However, to ensure this, as well as to take appropriate optimization measures, it is necessary to ensure that a comprehensive environmental audit of the location of the warehouse system of dealer networks is carried out.

The recommendations presented above can be used to reduce the carbon footprint of current automotive parts distribution systems at auto repair dealerships. At the same time,
updated warehousing technologies will ensure the rationalization of corporate management will reduce non-productive costs.

To multiply the economic and social effects from the development of the elements of the ESG concept, it is advisable to recommend the optimization of spare parts inventory management in car service centers of the Republic of Cyprus based on the author's CDMD model: systemic-decentralization-monitoring (measurements)-digitalization (Fig. 4). The CDMD approach integrates the best achievements of the theory and practice of ESG management and the tasks of economic optimization of spare parts, considering the identified mutual influence of reducing the carbon burden and increasing the profitability of auto parts stocks at auto service enterprises.

Fig. 4. CDMD approach to the optimization of spare parts inventory management in the car service centers of the Republic of Cyprus to multiply the effects of the development of elements of the ESG concept (author's development)

"C"-aspect (consistency) is organizing in this model. The point is that every company, to constantly benefit from management optimization opportunities, must ensure strategic consistency and professional operational management in the field of ESG. It is advisable to develop a general and special corporate ESG strategy (special in terms of managing non-fuel reserves as the area of the most carbon-intensive business processes now). It is recommended to provide for professional ESG management with the appointment of a trained ESG officer in small enterprises or by creating a working group, department (relevant for larger businesses).

The first "D" in the model characterizes the decentralization of supply, which should affect the distribution models of spare parts for all car service centers that are not part of the dealer network and provide for the refinement of dealer supply models to a reasonable level of decentralization (see above).

The implementation of a supply decentralization scheme for non-network car service centers in the Republic of Cyprus, as it seems, can be carried out according to the model of virtual joint ownership of the distribution warehouse system. In essence, a network distribution model will be implemented, which is used, for example, in car service dealer networks, but serves a large number of unrelated service centers (consumers). The model is based on the principles of sharing (sharing economy), and can be applied both in the supply of spare parts of a certain brand, and in the multi-brand service for the needs of car service centers in spare parts. The basis of the model is formed by a system of public distribution warehouses. Auto service centers participating in the decentralized management system finance the start-up stocks of spare parts and determine the needs for service stocks. From the general funds, the management company is financed, and the digital management...
The platform operates, through which management commands are transmitted, for example, to replenish stocks or to deliver to a specific user of the system (in this case, the mechanism will be approximately the same as deliveries to service points of dealer networks from central and nodal distribution warehouses). The founders of the service will have the opportunity to participate in solving strategic management issues based on the principle of voting by shareholders, while it is not at all necessary to create a special organizational form, instead of which a digital management tool, such as a smart contract, can be used. For new users of the distributed warehouses service, it is advisable to provide two options: either becoming a full-fledged founder, or as periodic buyers with a subscription to the service (like how it is organized in a sharing economy). In the event of a shortage of specific spare parts to satisfy all current requests, priority will be given to the founders of the service, as well as customers who purchase a special, more expensive subscription to guaranteed deliveries (if any).

However, transferring the management of distribution warehouses to a digital platform (artificial intelligence) under the control of experts in the field of sharing business will reduce the likelihood of a systemic shortage of inventory for distribution to an absolute minimum. This will happen due to the use of continuous machine learning technologies, which will constantly improve the algorithms for estimating the optimal batches of orders and stocks based on high-precision analysis of statistics. Additional profit received by virtual shareholders from the service can be used to finance continuous updates of digitalization tools. Digitization of distribution network management should be a source of improvement for networked dealerships and service centers in terms of further ensuring carbon neutrality on similar principles.

"M" in the model means the organization of monitoring the achievement of the ESG indicators of the concept for car service centers and for key business processes, primarily the supply of auto parts stocks. Monitoring should consider the known knowledge of the high carbon footprint generated by the current implementation of business processes for the delivery and warehousing of spare parts. It involves clearly identifying key indicators, measuring their actual values, setting optimization goals and tracking progress towards achieving goals. It is advisable to carry out monitoring using digitalization tools. At the same time, it is important to consider the synergistic effect of monitoring, which allows improving the management of business processes in a car service center:

- The formation of a measurable goal is the most important step towards its achievement. This is evidenced by the provisions of strategic management, the concept of SMART and others.
- Management of reserves based on indicators of carbon emissions contributes to the convergence of economic, managerial, and social optimization goals. At the same time, none of the goals comes to the fore, as it could be, for example, when measuring goals and their achievement in hard currency. This is the best way to orient responsible persons to achieve results.
- One of the important results, although by no means the only one, in this case is the adjustment of the motives for the professional activities of employees, including through the revision of the system of key performance indicators. If a progressive system of motivation has not yet been introduced, then an impulse will be formed for an early decision in this area.

Finally, the second "D" - digitalization (digitalization) in the presented model is at the same time a means of solving the problems of setting professional ESG management, ensuring decentralized supply of car service centers with spare parts, a tool for monitoring ESG indicators and a way to ensure steady improvements in the environment of professional management of car service companies. The potential of digitalization is not limited to the presented areas. Considering the relatively high risks of counterfeit products in the auto parts supply system [17], it is advisable to introduce digital identification and traceability systems.
for spare parts. The managerial and social effect of this innovation is obvious (improving the quality of services, customer confidence and satisfaction, a radical reduction in social risks).

The economic effect will be reflected in the growth of profits due to the strengthening of trust from regular customers, lower costs for possible lawsuits and in connection with administrative liability. The environmental effect will be expressed in the absence of the need to dispose of counterfeit products, along with an increase in the frequency of technical inspections and scheduled repairs. Both directions will reduce the carbon burden generated by the auto service business.

4 Conclusion

The results of the study confirm that ESG convergence and the tasks of economic optimization of spare parts stocks form the contours of the win-win strategy for car service centers, the industry as a whole and its key stakeholders. The implementation of the proposed CDMD model should in itself provide economic benefits, expressed in an increase in the profitability of reserves, even despite a certain increase in costs associated with conducting environmental, social and management audits, setting up monitoring systems, as well as creating in large service centers, in management companies specialized units for ESG.

With the introduction of environmental and social monitoring systems in car service centers of the Republic of Cyprus, an extensive array of statistical data will be obtained and accumulated, based on which there will be additional opportunities for conducting new, more in-depth research in the subject area.

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