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Multidimensional project portfolio management in the context of the current Covid-19 situation in the automotive industry. A case study.

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***Abstract**: In recent times, the economic situation has changed significantly. The ubiquitous pandemic has caused numerous problems not only with human resources, but also with access to components necessary to produce the final product for the customer. Managing projects or portfolios of projects in the automotive industry in connection with the current situation is a challenge not only for the project management team but also for all departments and individuals involved in its implementation. Therefore, due to the complexity of the product, the diversity of the supplier market and the diversification of customers there is a need to develop a matrix that will allow efficient and effective management of the project portfolio from the concept phase to the final implementation at the customer. In order to do that an in-depth analysis of all customers contributing to BorgWarner Poland's profit, analysis of internal and external requirements as well as an overview of the process for achieving milestones is necessary.*
TheCovid19situationmadeitnecessarytodevelopaschema/matrixthatcouldbea universaltoolthatcouldbeimplementedforanygroupofprojectsorprogramsintheorganization.
Therefore, the purpose of this article is to develop such a matrix that will allow to assess whether the project is carried out from the initiation phase to the completion phase in accordance with norms and internal standards as well as customer requirements and whether the appropriate allocation of resources took place.
This matrix is intended to be a universal tool that can be implemented in other industries as well.

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I. Literature Review

Project or portfolio management (Brzozowski 2014, Pietras, Szmit 2004) in the current situation is based on the lack of access to complete information, lack of staff and in the face of uncertainty. Professor Taleb's Black Swan metaphor is a signature of what is imprecisely uncertain, marked by abstraction and instability (Taleb 2012, Musiol 2018). Every rare, even mundane event is, according to the American economist, tantamount to uncertainty, for on the ground of social life, "almost all processes now occur through rare but pregnant shocks and changes" (Taleb 2012). This situation is most definitely reflected in project management, where inputs are sometimes provided imprecisely(Lock 2020).. This is not due to the inexperience of the team, but to the general situation that affects the quality of this data (Rowe 2020). Hence, project portfolio management is now a challenge that every organization must face (Duszynski 2020, Mączyńska 2020). The same is true, Taleb argues, for our organizations. When a company avoids stress and thinks primarily about ensuring its own safety, its unused "muscles" become weaker and weaker (Mielech 2020, Beck2016). As a result, as many historical examples show, companies fail to cope in a changing, dynamic environment. Therefore, writes Taleb, an organization must keep looking for opportunities to give in to "positive" stress by dosing it in appropriate amounts (Taleb 2020).

Many companies allow themselves to be surprised by new competitors, unexpected events, or disruptive innovations that change the rules of the market game. This is not surprising, since most organizations-especially large ones managed with portfolios-are inflexible. Such companies do not like randomness and instability, which in the current reality disqualifies them and sooner or later ends in tragedy for them (Mączyńska 2020, Gorynia 2020).

We live in times of VUCA (an acronym for volatility, uncertainty, ambiguity, and complexity), which forces us to look for new strategies of action and respond to increasingly complex situations - difficult to predict and sometimes even to imagine. But why is it that some organizations do much better at doing business in such conditions, while others disappear from the surface of the business landscape? It is because of a well-developed

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process of project or project portfolio management from the moment of conception to the final product delivery to the customer (Cabała 2018, Jałocha 2014).

Therefore, it is extremely important to consciously manage the project portfolio, which is to lead ultimately to the delivery of the product in accordance with customer requirements. The portfolio management system includes decision-making rules for project start-up and closure(Hillson2020).. These rules ensure that the implemented projects are consistent with the current strategy of the organization. Properly configured portfolio management process guarantees optimal use of resources, including elimination of unnecessary, cost-consuming and time-consuming projects (Lesniak 2001, Pitagorsky). In this way, favorable conditions are created for those initiatives that generate added value. Transparent principles of portfolio management are also of motivational importance, they mobilize employees to seek opportunities, submit ideas and obtain professional support from properly prepared services employed in the project office or other organizational units(Kerzner 2005).

The differences between a project, a program and a portfolio are important. Project portfolios are created to strategically manage an organization's project activities. Their scope and objectives, unlike individual projects, change as the strategic objectives of the organization change (Sjekavica, Radujković 2017). Programs and portfolios are not identical terms and cannot be used interchangeably. Programs in a way can be considered a manifestation of the strategic activities of the organization, but usually in one, narrowed area, and not holistically, as in the case of project portfolios (Trotsky 2003, Wysocki 2005).

Research framework and data collection

Managing a portfolio of projects in the current situation is a challenge not only in the automotive industry. High demands from both internal and external customers, lack of availability of components, problems with human resources are only few of the problems that portfolio manager has to face. Analyzing the available information about the number of projects and their complexity one can assume that each product and the final customer is unique and for each of them an appropriate set of management tools should be chosen.

The preliminary analysis was based on the collection of information about all projects carried out in the company, divided into the number of projects per customer for passenger cars and commercial vehicles.

The results of this analysis are presented in the pie charts below.

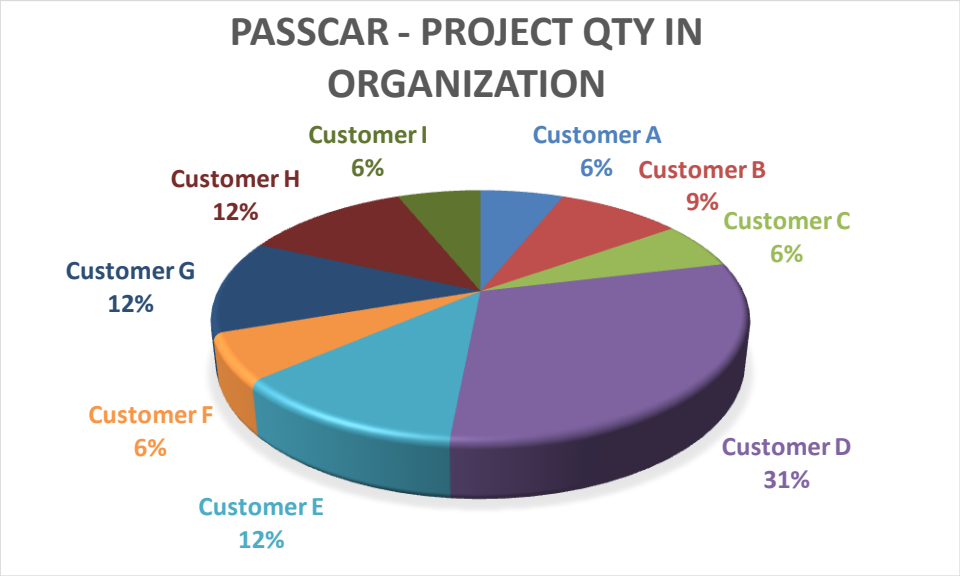

Fig.1 Summary of all projects for passenger cars carried out in the company

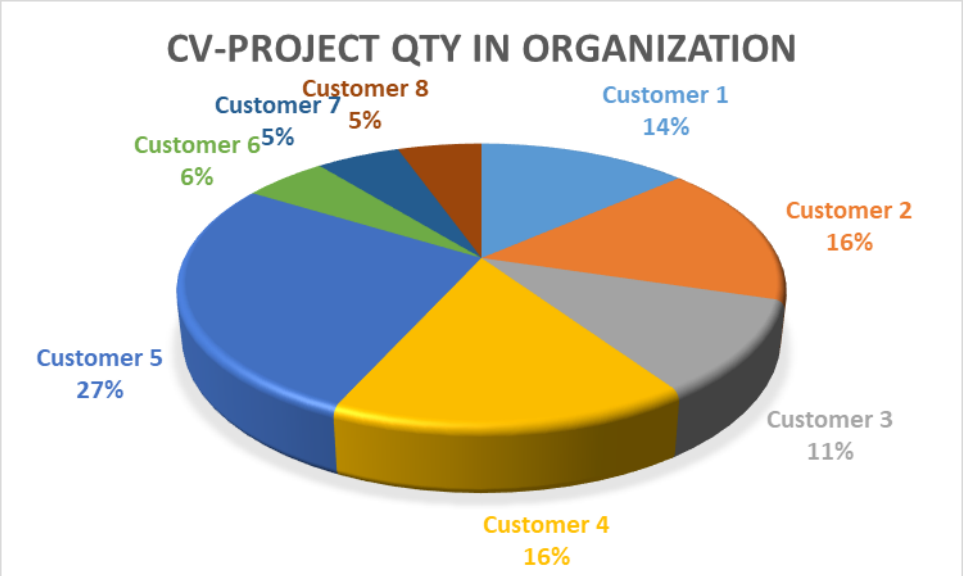

Fig.2 Summary of all commercial vehicle projects in the company

The graphs presented show that the range of products delivered to customers is diverse and therefore, the analysis of the project portfolio management will also be complex.

In the second step necessary to develop the matrix, the structure of the PDP process was analyzed, which shows all the steps necessary to bring a product into serial production. It is a canon of rules, to be followed for a successful project. Therefore , it should be foundation that a well-prepared outline of the necessary steps will allow the project to lead to implementation, and the entire preparation process will take place without additional human and financial expenses, which in turn will raise the financial indicators higher than it is assumed in the case of implementation of projects in the automotive industry.

Matrix will be tested on the basis of a project portfolio, dedicated to passenger cars.

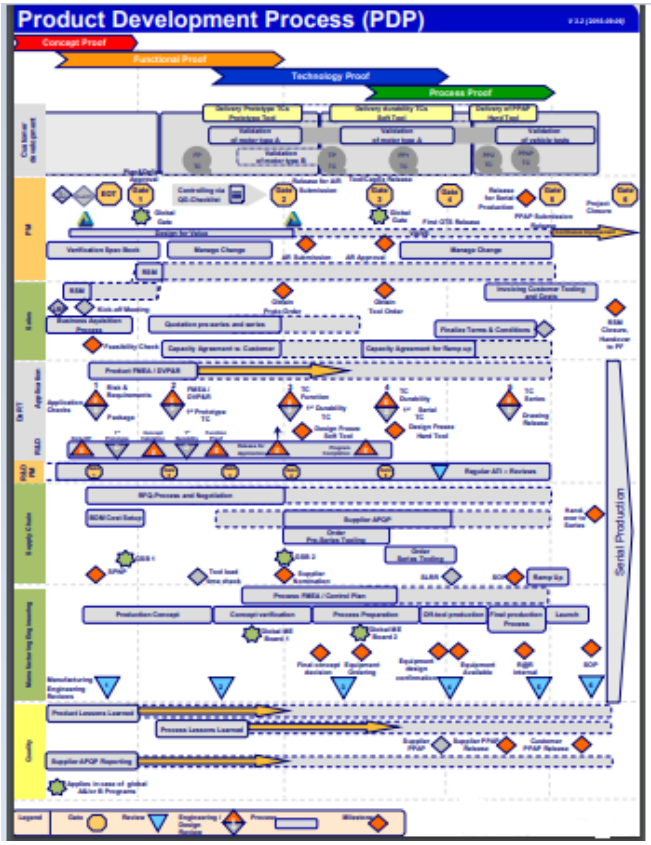

Fig. 3 PDP process (sourceinternaldocumentsoftheorganization)

The PDP process is a set of rules that should be implemented for each project in order to verify the individual steps of bringing the projects to serial production.
The above presented elements used in the company are the foundation to specify the requirements, which will then be collected in a matrix and can be confidently implemented in all projects carried out in the company.

Research problem
Inrelationtotheobjective, theresearchproblemwasformulated:
Howshouldtheproductmanufacturingprocessbestructuredfromtheconceptphasetothemassproductionphase?

Inaddition, supportingquestionswerealsoposedfordeeperanalysis:
- Howshouldtheproductdevelopmentprocessbesystematizedintheconceptualphase?
- Howshouldtheproductmanufacturingprocessbesystematizedinthefunctionalphase?
- Howshouldtheproductmanufacturingprocessbesystematizedinthetechnologicalphase?
- Howshouldtheproductmanufacturingprocessbesystematizedintheprocessphase?

Toformulatethemethodology, theresearchproblemwasadaptedand basedonthecasestudy, theresearchproblemwassolved. Theconductedresearchalsoservestofilltheresearchgapidentifiedonthe basisofliteratureresearchandrelatedtoprojectmanagementintheautomotiveindustry.

II. Research Method

In most of the projects carried out in an organization, the approach is similar whether it is for car or service projects. However, sometimes this general approach does not work in different types of projects, where the boundary conditions are significantly different. Hence the idea to create a universal set of principles, rules, milestones that can be applied to all projects in an organization. Various data acquisition techniques were used to conduct the study : interviews and data analysis.

The analysis should begin with the selection of a test group, in this case a group of Customer A projects carried out in the company. It should be noted, however, that the presented algorithm / matrix is to apply to new projects that will be in the quotation phase. Applying this matrix to existing projects does not make any sense because of the possibility of repetition of the same errors. Therefore, a completely new project, the so-called pilot project, must be proposed for analysis.
The analysis will be based on 4-dimensional verification, namely:
1. conceptual verification phase
2. functional verification phase
3. technological verification phase
4. the process verification phase

An in-depth analysis of all four levels will allow us to fully answer the question of whether the proposed matrix can be fully used for all projects in the organization.
In the conceptual phase it is necessary to verify the assumed objectives, customer requirements and the possibility of implementation in production conditions. In the functional phase it is necessary to conduct internal tests to verify the customer's original assumptions. In the technological phase it is necessary to conduct validations and tests on prototypes. In the process phase it is necessary to verify the product that is finally to be delivered to the customer.
The conducted analysis of the research method will allow to prepare a matrix of steps necessary to implement the product from the conceptual phase to the process phase without any disturbances, according to the project management standards and taking into account the methodological approach.

Outputs and results
Given the complexity of the project, this matrix must be based on taking into account both the client's requirements, i.e. the timeframe imposed in advance, and the production capabilities defined by internal procedures, standards.
Therefore the matrix will include both steps, internal milestones and those defined by the customer.

Milestone	Date contracted	Date planned	Comments, suggestions	Person responsible	Status (green, yellow, red)
Application verification (1)	23.11.2018	23.11.2018		**Application Engineer**	
Review prior to project quotation	24.11.2018	24.11.2018		**Program Manager**	
Verification by capacity (0)	05.12.2018	05.12.2018		**Program Manager**	
Internal validation (0)	10.12.2018	10.12.2018		**Application Engineer**	
Selection of suppliers for the prototyping phase	07.01.2019	07.01.2019		**Program Launch Buyer**	
Verification from production capacity side (1)	08.01.2019	08.01.2019		**Manufacturing Engineer**	
Internal validation (1)	11.01.2019	11.01.2019		**Application Engineer**	
Verification by application (2)	15.01.2019	15.01.2019		**Application Engineer**	
Delivery of prototype samples	11.02.2019	11.02.2019		**Program Manager**	
Verification by production capacity (2)	09.07.2019	03.07.2019		**Manufacturing Engineer**	
Internal validation (2)	26.07.2019	26.07.2019		**Application Engineer**	
Verification by production capacity (3)	24.01.2020	24.01.2020		**Manufacturing Engineer**	
Product design freeze	29.02.2020	18.02.2020		**Program Manager**	
Customer tooling and fixtures freeze	14.11.2019	28.02.2020		**Program Manager**	
Release of tooling for serial production	10.01.2020	29.05.2020		**Program Manager/Sales**	
Verification by application (3)	28.08.2020	28.08.2020		**Application Engineer**	
Internal validation (3)	28.09.2020	28.09.2020		**Application Engineer**	
Final selection of suppliers for serial production	30.10.2020	30.10.2020		**Program Launch Buyer**	
Proposal of the distribution of expenses in the project (tools, tooling)	16.12.2020	16.12.2020		**Program Manager/Sales**	
Budget approval	15.01.2021	15.01.2021		**Program Manager/Sales**	
Delivery of prototype parts to customer	28.01.2021	28.01.2021		**Program Manager**	
Release of customer thermodynamic processes	11.12.2019	23.03.2021		**Application Engineer**	
Verification from the side of production capacity (4)	19.03.2021	31.03.2021		**Manufacturing Engineer**	
Application verification (4)	29.03.2021	26.04.2021		**Application Engineer**	
Internal validation (4)	11.06.2021	11.06.2021		**Application Engineer**	
Approval of suppliers for serial production	11.06.2021	23.06.2021		**Program Launch Buyer**	
Delivery of first production samples	09.07.2021	09.07.2021		**Program Manager**	
Internal release from engineering side	23.07.2021	23.07.2021		**Application Engineer**	
Internal audit in production to verify capacity required by customer	06.08.2021	06.08.2021		**Customer Quality Engineer**	
Application side verification (5)	13.08.2021	13.08.2021		**Application Engineer**	
Validation and verification of tests carried out on the product	15.09.2021	15.09.2021		**Manufacturing Engineer**	
Production validation	05.11.2021	05.11.2021		**Application Engineer**	

(5)					
Validation release on product	17.12.2021	17.12.2021		**Application Engineer**	
Internal validation (5)	17.12.2021	17.12.2021		**Application Engineer**	
Release to serial production	08.01.2022	08.01.2022		**Application Engineer**	
Pre-series tests on production	22.01.2022	22.01.2022		**Manufacturing Engineer**	
Final customer approval	01.02.2022	01.02.2022		**Customer Quality Engineer**	
Delivery of first serial parts to customer	03.02.2022	03.02.2022		**Program Manager**	
Start of production in the organization	11.02.2022	11.02.2022		**Program Manager/ Application Engineer**	
Start of production at customer's premises	04.03.2022	04.03.2022		**Customer Quality Engineer**	
Final production approval (6)	11.03.2022	11.03.2022		**Program Manager/ Application Engineer**	

The table / matrix above summarizes the individual steps of the seven project phases that must be met for a project to be successful. For better verification of the various stages, the nomenclature has been adopted :
- "0" when the project is in the quotation phase
- "1" when the project is in the preliminary verification phase
- "2" when the project is in the phase of delivering the first prototype pieces
- "3" when the design is frozen
- "4" when the project is in the pre-series phase
- "5" when the serial phase has occurred in the project
- "6" at the end of the project, when the product has already been shipped and all internal validations, verifications have been successfully completed.

Thewholeprocessconsistsof4phases:
- Conceptphases (markedingreen)
- Functionalphase (markedin blue)
- Technologicalphase (markedgrey)
- Processphase(unmarked)

Theprocess beginswithverificationofthefeasibilityofagivenproductandendswithfinalverificationonthecustomerside. Aninternallyorexternallyvalidateddateshallbeincludedinthematrix. Thisallowsyou tokeeptrackofallchangestotheprojectandmonitorpotentialdelaysinrealtime. Inaddition, apersonresponsibleforeachtaskisassignedtoeachone, andheorsheis, sotospeak, theownerofthattask. Eachtaskisalsoassigneda3-gradescale:
greenmeansthateverythingisrunningaccordingtotheschedulewithoutanyinterruptions.
Yellowindicatessomedeviationsthatmustbecontrolledandmonitored.
Redisalreadyasignaltotakeactiontominimizerisk, toreturntotheassumptionsfromthe beginningoftheproject. Thematrixissetupsothateachtaskhasapredecessorwithoutwhichitisimpossibletoperformthenexttask. However, itislikelythatcertaintasksmayberedundantintheprocessdependingonthecomplexityoftheproject.
Suchadecisionalready belongstotheproject/programmemanager, whoverifiesandmonitorsthescopeofworkonanongoing basisforprojectmanagement.
The matrix is a very easy yet accurate tool that can be used in many projects and programs to support the project management process for the Project or Program Manager.
It is a universal tool, which can be more or less developed depending on the needs, but it will surely be such a map for every project manager.

III. Summary

The developed matrix is a tool which only provides an outline for further management of the project or project portfolio from the conceptual phase to the product phase in mass production. It is a canon of milestones that allows for a complete verification of all project activities. Such an overall view allows the project manager to look at the project on a macro scale, and thus verify whether the steps performed by his team are sufficient for the project to achieve the intended success, i.e. meet the customer requirements.

This matrix is constructed so that appropriate resources can be assigned to individual activities. This approach will certainly facilitate the work and monitoring of the project progress. However, it is worth noting that the matrix has been developed for passenger car projects, where the validation and application scope is

slightly different from that of commercial vehicles. In case of commercial cars it is necessary to verify if all steps are necessary, if they are unnecessary they should be removed and at the same time further design steps should be verified.

In the case of implementing this matrix in other industries it is necessary to verify the entire project, check the development phases of the project and possibly adjust the requirements to customer or industry standards.This matrix is nevertheless a standard that can be adapted to the project or the project portfolio depending on the industry specifics.

An important aspect here is also the allocation of resources, as the matrix allows for the precise assignment of appropriate resources to individual steps. This in turn will affect the management of resources and their appropriate allocation in the project.

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