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MARKETING DRIVEN PRODUCT INNOVATION

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MARKETING DRIVEN PRODUCT INNOVATION

A Master's Thesis submitted for the degree of
"Master of Business Administration"

supervised by

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Affidavit

I, **Doc. Ing. Štefan Rosina, PhD.**, hereby declare

1. that I am the sole author of the present Master's Thesis, "Marketing Driven Product Innovation", 104 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and

2. that I have not prior to this date submitted this Master's Thesis as an examination paper in any form in Austria or abroad.

Vienna, 15.05.2013

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Signature

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LIST OF ABBREVIATIONS

(in alphabetical order)

AV	Added Value
CO_2	Carbon dioxide
CPV	Customer Perceived Value
EC	European Commission
EU	European Union
GDP	Gross Domestic Product (at market prices)
IPR	Intellectual Property Rights
ISO	International Organization for Standardization
KIA SK	Kia Motors Slovakia
MDPI	Marketing Driven Product Innovation
NO_x	Nitrogen oxides
PSA SK	PSA Peugeot Citroën Slovakia
SBU	Strategic Business Unit
SR	Slovak Republic
ÚPV SR	Intellectual Property Office of the Slovak Republic (in Slovak: Úrad priemyselného vlastníctva Slovenskej republiky)
VDA	Verband der Automobilindustrie e.V.
VW SK	Volkswagen Slovakia
PLCC	Product Life Cycle Curve

Other abbreviations and symbols used in the formulas and figures are explained in the text directly.

ABSTRACT

The impetus for preparing this Master's Thesis was to enhance professional qualification, increase the possibilities of professional activities and improve understanding of functioning of business process environment and SBU (Strategic Business Unit) and its development in business conditions. I consider the notion to actively influence the environment in which they arise and are implemented, reveal their strengths and weaknesses and evaluate the competitiveness of such enterprise in the conditions of globalization of internal domestic, regional and international markets as a challenge.

The work presents theoretical outlets on the field of automotive industry, project, innovation, innovational management, innovational marketing. The work analyses degree of gained knowledge from concerned fields and on the basis of created Model MDPI (Marketing Driven Product Innovation) implements them in the conditions of a specific company.

The main objective of this paper - to propose a new model to improve business processes - was achieved successfully. The model was designed to increase new added value achieved through the innovation process within the context of B2B marketing. MDPI Model has been designed for the needs of automotive industry development. It is versatile and designed so that it can operate in large companies (or just in their SBU) as well as in small companies, in all stages and phases of business processes. Its main contribution is in methodology describing bonds between core milestones of business improvement processes and core processes affecting product creation process. Processing of this methodology also fulfilled all milestones of this paper. Verification of the validity of the proposed model is confirmed by the previous section.

Key words: automotive industry, project, innovation, innovational management, innovational marketing.

1 INTRODUCTION

Strategic Business Unit (hereinafter the "SBU") is the base and the smallest unit of business process, and business creates a continuous process that is constantly evolving, beginning and ending, improving and worsening. Business is carried out through any activity, which aims to create an added value for another person, in order words, to satisfy in a certain way his or her physical or mental needs.

Business is dependent on internal and external conditions, it improves, innovates and evolves with the development of science and technology and it is changing under the influence of globalization and all current megatrends (shortening the innovation cycle of the product). This is a sufficient condition for the competitiveness of enterprises.

In the current information society and 'reduction' of the world, under the threat of escalating local armed conflicts into an absolute extinction of civilization, under the influence of accretion of wealth between developed economies and poor countries, which not only leads to wars, but also to devastating natural disasters as a result of careless treatment of the environment and under the threat of devastating epidemics, it is necessary to get back to the ethical dimension of business. The ethical dimension must be maintained in the entire system. This paper focuses on this ethical dimension.

Trends of reducing the burden on the environment resulting not only from the production process, but mainly from the operation of fleet of vehicles and related service areas have emerged in the last decade in the automotive industry. These are mainly the reduction of CO2 and NOx, fundamental changes in the area of drive assemblies and significant weight reductions by using new ultra lightweight and totally innovative technologies. The aim of the innovations is to increase the added value (hereinafter the "AV") for customers.

1.1 Objectives of the Master’s Thesis

The impetus for preparing this Master's Thesis was to enhance professional qualification, increase the possibilities of professional activities and improve the understanding of the functioning of the business process environment and SBU and its development in business conditions. I consider the notion to actively influence the environment in which they arise and are implemented, reveal their strengths and weaknesses and evaluate the competitiveness of such enterprise in the conditions of globalization of internal domestic, regional and international markets as a challenge.

The Main Objective of the Master's Thesis

- Propose a model to improve business processes in the field of innovation to improve the growth of the added value in the context of marketing.

The Milestones of the Master's Thesis

- Processing of proposal to systematically identify the elements essential in the improvement of business processes.
- Define methods for the analysis of the elements involved in improvement processes in order to improve a new added value.
- Draft a set of key indicators - operators - for measuring and monitoring processes.
- Draft operational model for managing and improving processes.
- Verify the validity of the proposed model.

1.2 Methods Used in Solving the Master's Thesis

Methods of Obtaining Facts

I have used the literary method and content analysis to obtain all information and facts contained herein. These methods help to collect, fixate, classify and generalize the source material for processing theoretical conclusions of other authors and own knowledge (Puškár 1996).

Methods of Processing and Evaluating Facts

I was aware that the accumulated research material gains its value after processing and evaluation. I have used selected mathematical and statistical techniques, methods of substantive analysis and logical conclusions - analysis and synthesis, induction and deduction and method of systematic approach. (Adair 2004), (Slamková 1997)

The overview of all the used methods is given in detail in the annexes.

2 THEORETICAL BACKGROUND

2.1 Introduction

- **Why to innovate?** ↔ Mechanisms for obtaining strategic advantage through innovation.
- **How to innovate?** ↔ Creation and implementation of innovation can be managed.

2.1.1 Why to Innovate?

The present time calls for flexibility; organizations that want to keep up with competitors must have a sustained growth, which is **impossible to achieve** without **innovations**. Innovations not only help companies to grow, but also improves the growth of the whole economy. (Grznár & Gregor 2008)

Promotion of innovations allows a wider use of innovative ideas not only in science and research, but also in government, small family businesses and schools or at home. It is therefore necessary to encourage new ideas and approaches to solving everyday problems. It is a well known fact that in the long run, it is not possible to raise the standard of living and at the same time to base the competitiveness of the economy on low production costs. **The key to a long-term success of the economy is a growth of production based on innovations**. The essence of the knowledge economy is to create an environment, in which education, science, research and business environment are all working together not only to create new ideas but also to implement them into the business practice as fast as possible and convert them to new processes and products. (Grznár & Gregor 2008), (Matiašovský 2013)

Industry represents approximately 27 % GDP, of which automotive industry (Volkswagen Slovakia (hereinafter the 'VW SK'), PSA Peugeot Citroen Slovakia (hereinafter the 'PSA SK'), Kia Motors Slovakia (hereinafter the 'KIA SK')) represents approximately 41 % and together with electrotechnical and metallurgy industry makes up to 80 % of the Slovak republic export (http://www.statistics.sk/).

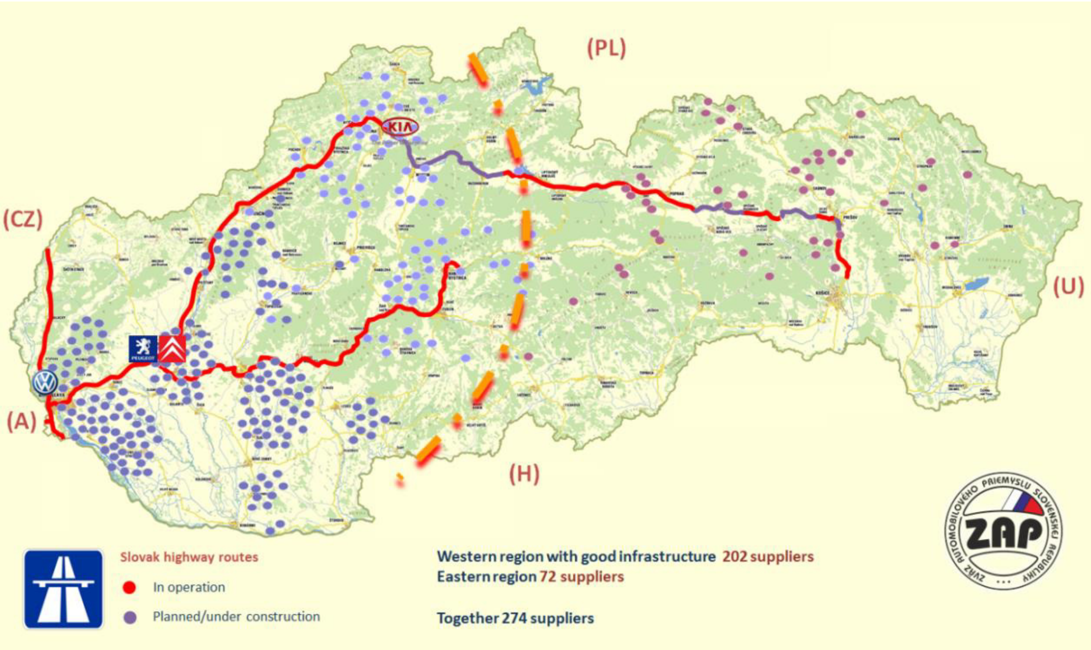

Figure 2.1 Layout of Subcontractors in Slovak Republic (http://www.zapsr.sk/)

Essential in this is the supply chain, which was built at the beginning of the 90s in the context of the Central European automotive cluster, a major industrial area of the European Union (EU) (one of the basic elements of the so-called Triad - Europe, USA and Japan).

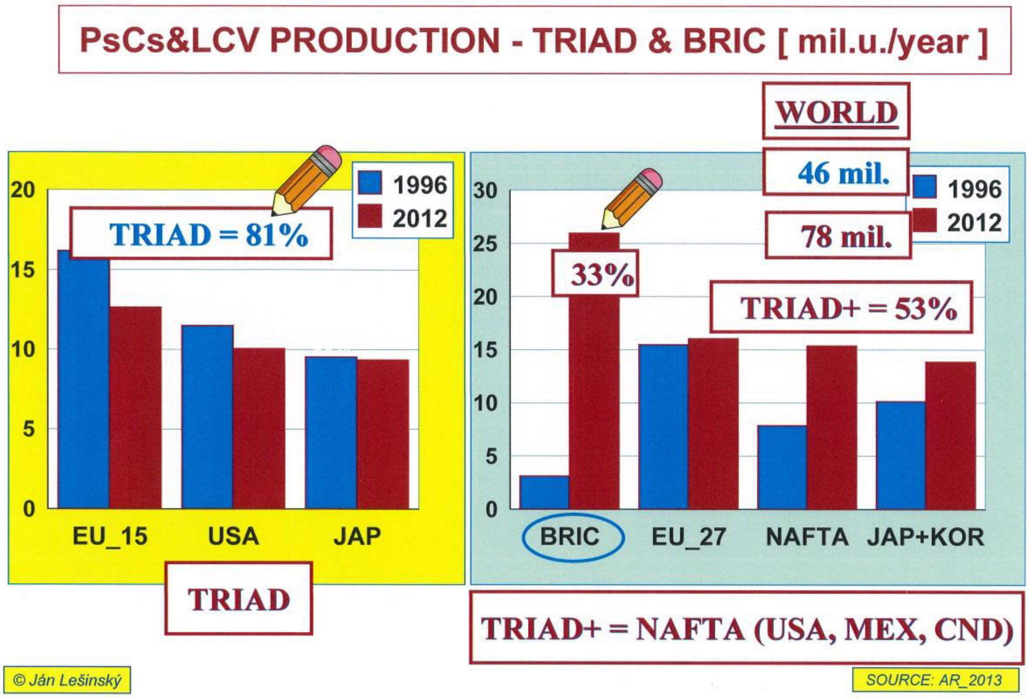

Figure 2.2 Production – TRIAD & BRIC (Lešinský 2013)

The purpose of building a knowledge-based economy is to create an environment in which well-educated people are developing unique ideas and in which their entrepreneurial colleagues would use these ideas to create new jobs and improve living standards through innovation technology companies (Matiašovský 2013).

Understanding the way of thinking of innovators is tied together with an examination of various views on the need for innovation. It is desirable to investigate these needs at least in the perspective of:

- strategic decision-making,
- Code of Conduct,
- new products,
- general innovation opportunities.

2.1.2 How to Innovate?

Several domestic (e.g. Gregor, Grznár, Kováč, Mičieta, etc.) and foreign authors (e.g. Sihn, Tidd, Westkdmper, etc.) are asking this question. Evidence obtained from the examined literature gives an answer to this question in the following scheme:

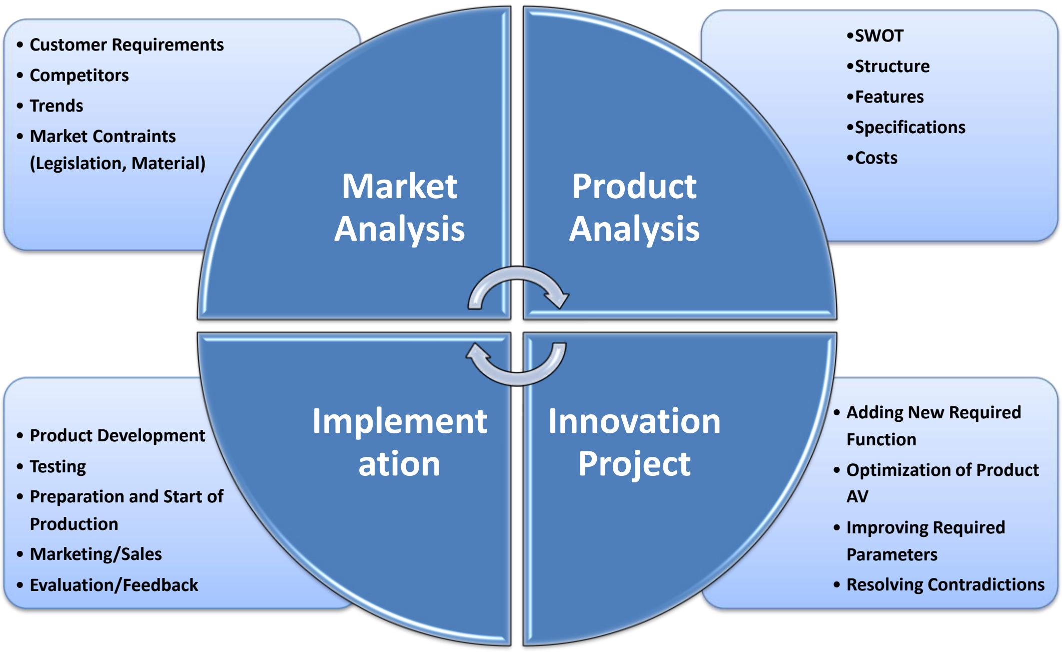

Figure 2.3 (How to Innovate?) (Custom processing)

2.2 Innovation

In the next chapter, we have summarized the theoretical knowledge of the following topics: Innovation Definition, Innovation Types (product, process, system, service), Creativity, new idea generation, IPR, Technology Transfer, Legislation for Innovation (EU, SK).

2.2.1 Innovation Definition

This section and the follow-up chapters contain the analysis of the perception of innovation from technical publications from different authors and other literary sources.

The term **innovation** derives from the Latin 'innovare' and means 'to restore'. Originally occurred in the interwar American sociology and was used to describe changes in social structures.

Number of ways exists to understand innovation. The European Commission (the 'EC') uses the definition that the 'Innovation is the renewal and expansion of a range of products and services and the associated markets, creation of new methods of production, supply and distribution, introduction of change management, organization of work, working conditions and skills of the workforce'. Simpler definition is used for example by the Ministry of Trade and Industry of the UK: 'Innovation is a successful exploitation of new ideas' (CIP EQUAL 2006).

Innovation theory was first prepared and used by Austrian and American economist, who was born in the Czech Republic, **Joseph Alois Schumpeter** (1883-1950). According to the definition, the 'innovation is any change in the company, which leads to a new state' (http://schumpeter.info/). With innovations he explains basic economic categories, such as profit, interest or competition. He considers the innovation to be the basis of economic development. Schumpeter (Kováč 2002), (Schumpeter 1987) called the innovation as a 'promotion of new combinations' and defined five cases (i.e. identified five typical changes):

- use of new technologies, production processes and marketing to ensure production;
- introduction of new products, or original products with new features;
- use of new raw materials and;

- changes in the organization of production, distribution and sale;
- opening of new markets, changes in market structure.

In the world literature, the issue of innovation and innovation management is a focus of many authors, who developed the original Schumpeter's theory and currently these works are mainly focused on the successful innovation management in business. For example, **Baumol** (Adair 2004) has elaborated 'The Free-Market Innovation Machine' based on the original Schumpeter theory of innovation. Baumol considers oligopoly to be the economic structures that encourage innovation. These large companies are competing with each other through price differentiation and thereby stimulate innovation and economic growth. According to him, innovation activity is essential in a market economy for companies to survive.

At the present time, many definitions of innovation exist. According to the survey, there are 200 different definitions of innovation, and the common features of them are mainly (Kováč 2002):

- implementation of a new idea 38 %;
- change (improvement) 28 %;
- new idea 26 %;
- inventiveness 9 %.

This implies that most of the relevant definition of innovation is tied to the **feasibility of innovation**.

The following authors from the Slovak literature are dealing with innovations (Gregor, Grznár, Košturiak, Kováč, Mičieta, Tureková, etc), who, in their publications, describe the following:

- theory of innovation;
- innovation process in business;
- approaches to managing innovation;
- innovation business strategies
- environment conducive to innovation.

Innovations should be distinguished from invention (ingenuity), which is the ability to find new knowledge and see the usefulness of changes. Invention is the first step in a long process, during which the new concept is converted into a widely applicable and effective product or service. Not all new concepts are however successfully implemented, not all new ideas become innovations (Tidd et al. 2007).

2.2.2 Innovation Types

Current knowledge on innovations presented in a variety of literary sources distinguishes different types of innovations. The most common are four basic types that exist according to the Statistical Office of the SR (Statistical Office of the SR: Innovation Activity of Enterprises in the SR (http://www.statistics.sk/) - based on the OSLO Manual 2005):

- **Product Innovation** - Innovative good or service is a product that is either new or significantly improved with regard to its essential properties, technical specifications, used materials, software, components, accessibility for users and other functional features. Aesthetic change is not considered a product innovation.
- **Process Innovation** - This type of innovation includes new and significantly improved production or delivery and distribution systems. It also includes significant changes in specific techniques, equipment or software that are designed to improve the quality, efficiency and flexibility of production or supply activities or to reduce environmental hazards or safety risks. Organizational and managerial change is not considered a process innovation.
- **Organizational Innovation** - Innovations of this type represent the implementation of new or significant changes in the structure of the company. This includes changes in management methods aimed at improving the way the company uses the knowledge to improve the quality of products and services and more efficient use of manpower

potential of the company. They also include significant changes in business practices, job or organization's external relations in order to improve the innovation capacity of the company or performance characteristics, such as quality of efficiency of work procedures and material flows. They are less dependent on technology than process innovation. An introduction of a new technology in a single department of the company is not considered an organizational innovation, as it is classified as innovation process.

- **Marketing Innovation** - Marketing innovation is the introduction of new or significantly improved product design (packaging) or sales methods in order to increase the attractiveness of products and services or to enter into new markets. These innovations include significant changes in the methods of trading with the goods and services, including the changes in design and packaging. Marketing innovations, however, does not include routine and seasonal changes (eg, changes in fashion apparel) or advertising, unless the advertisement is for the first time carried out through a new media means.

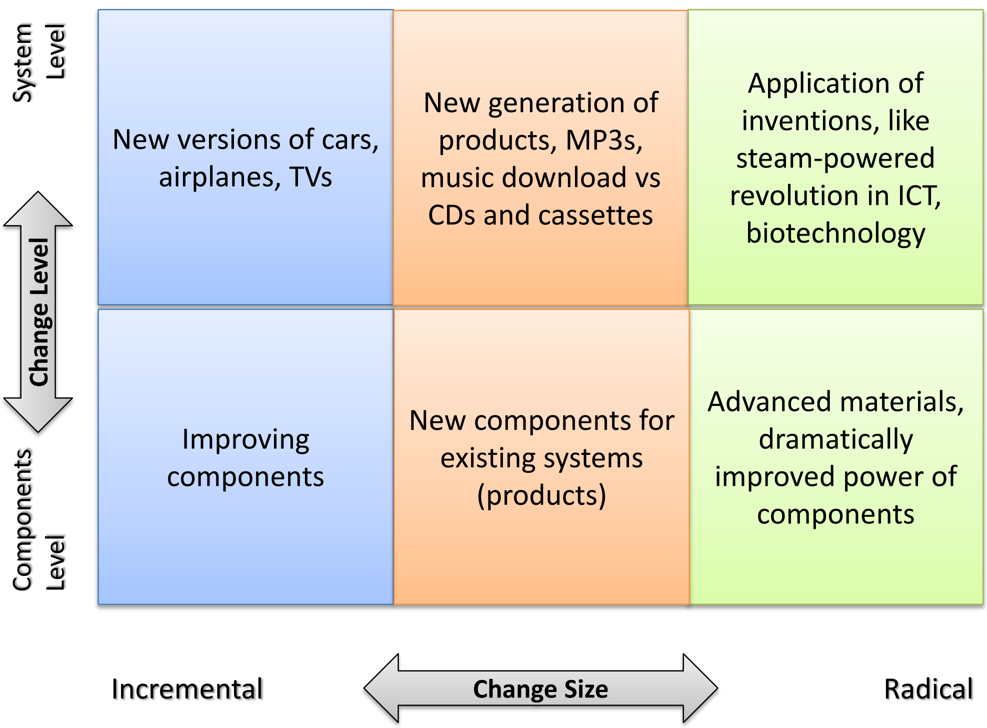

Figure 2.4 Innovation Dimensions (Tidd et al. 2005)

2.2.3 Creativity

The creativity of man is one of the important characteristics of personality and plays a key role in the development of innovations. These processes must bring together expertise with the experience of engineers and their creative abilities, which is a prerequisite for the implementation of engineering activities. Therefore, it is necessary to pay attention to the processes underlying the creative thinking, creative stages of the process, methods of creative thinking as well as obstacles and barriers that restrict or hinder creative thinking. (Janíček 2007)

Creative Thinking	Analytical Thinking
Imagination	Logic
Cumulative Answers	Individual Answers
Divergence	Convergence
Lateral Process	Vertical Approach
Generation of Solutions	Searching for Solutions

Figure 2.5 Creative Versus Analytical Thinking

The following figure graphically shows the stages of the creative process, which is expressed as it gradually progresses from the unknown area of intuition to the realization and professional implementation.

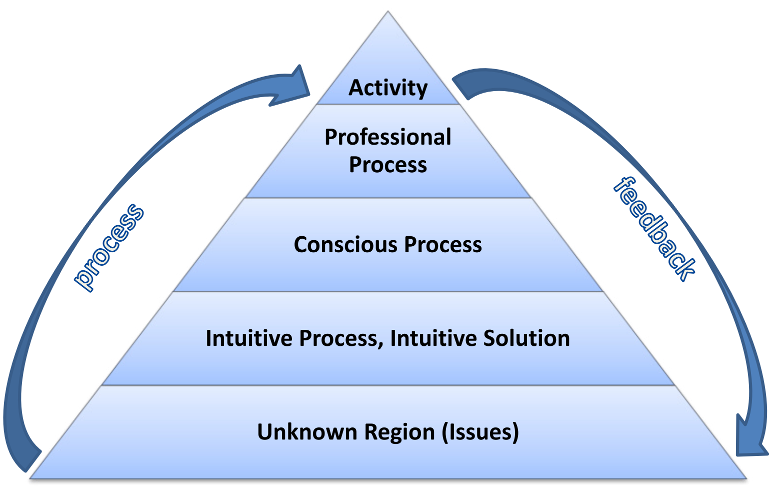

Figure 2.6 Phases of the Creative Thinking Process (Kováč 2002)

2.2.4 New Idea Generation

The starting point of innovations is the identification and formulation of the innovative idea. The idea defines a new need of future users and a method of its exploitation. The generation/creation/search for new ideas (innovative/entrepreneurial) belongs to the classic tasks of systems theory. Findings from literature (Kováč 2002) publications further points out that the generation of new (innovative) ideas are associated with a large number of variants. Analysis and definition gradually reduce this number.

2.2.5 Intellectual Property Rights

The task of the protection of Intellectual Property Rights (hereinafter the 'IPR') is to maintain a competitive advantage of innovation for innovators and constitutes a major component of motivation in enhancing the pace of innovation.

In the context of the EU, the definition of the 'Intellectual Property' or 'Rights to Intangible Assets' in the SR also includes the industrial property rights and rights related to copyright.

Intellectual property is a property of intangible nature created as a result of the process of human thought. It is possible to include here original ideas, suggestions, guides and solutions to change the external or internal world of man. The value of intellectual property depends mainly on the extent of subsequent use and benefit to individuals, society and the ability to induce the production of other products. The basis for legislation in the Slovak Civil Code by referring to the Copyright Act. Copyright Act responds to new technological phenomena in the literary, scientific and artistic work and is based on the principle of intellectual freedom and the need for effective protection of its results in the current circumstances. Intellectual property rights agenda contains specialized information on the so-called **industrial rights** (patents, utility models, industrial designs, trademarks, product origin) in the copyright and related rights. (http://portal.gov.sk/)

Intellectual Property Office of the Slovak Republic (ÚPV SR) is the central state administration in the field of industrial property pursuant to Act No 575/2001 Coll., on the Organization of the Activities of the Government and Organization of the Central Public Administration, as amended. One of its tasks is to support the development of technical creativity and the protection of its achievements, education and popularization in the area of intellectual property. (http://www.indprop.gov.sk/)

2.2.6 Technology Transfer

Literary sources provide differentiated approaches to technology transfer and innovation. Practical experience shows that this transfer like other reengineering methods is significantly goal-oriented and requires careful preparation, project analysis and management of transfer implementation.

According to the general definition, (Kováč 2002) the technology transfer and innovation process, during which the results of research and development are transformed into commercially applied technologies, new products or other innovations. It is associated with the transfer of knowledge from one place or organization to another. In general, they are divided into **vertical transfer** (from research and development into practical application) and **horizontal transfer** (between organizations all belonging to the same level).

Main incentives of the development of transfer are:

- overcome the lack of own resources for research and development;
- reducing the cost of research and development;
- radically shortening training innovation;
- significantly reducing the risk of innovation.

Institutional Form of Support	Description
Brokers	Independent companies that seek outputs from universities, research institutes, enterprises and purchase the rights to use them and subsequently sell them to companies. They usually manage a database with potential projects and mediate various forms of businesses with innovation
Office in Contact with Industry	They are organizational units of R & D companies or universities. Their mission is to identify research outputs for industrial applications and organize research and development according to customer requirements.
Scientific and Technological Parks	Focus of small innovative companies connected to sources of innovation transfer using a common infrastructure (facilities, services, information). An important feature is the establishment of new companies.
Innovation Centres	Their mission is to seek innovative projects to assist in the establishment and start-up of new companies and take of them for 3-5 years. They are basically business incubators that have a specific mission to promote innovative business.
Business Incubators	Large companies establish special companies for innovative intentions.
Technological and Technical Centres	Their activities focus on the coordination of national and regional research programs. They also typically provide advice on innovative business and technology transfer.
Other Institutions	Type of chambers of commerce, information centres and foundations concerned with the promotion of transfer.

Figure 2.7 Institutional Systems for the Support of Transfer of Innovations and Technologies (Typical in Western Europe, and also Slovakia) (Custom processing according to: Kováč 2002)

2.3 Product Innovation

Next chapter contains theoretical knowledge of the subject area.

2.3.1 Product Life Cycle Curve (PLCC), Innovation Planning

Life cycle is characterized by fluctuations in sales volume and profit. Product life cycle is the basis for the planning of marketing strategies, whether a timely deployment of new products or various measures extending the life cycle of a product (price reduction, advertisement promotion, new forms of sales, new markets, etc) (Tomek & Vávrová 2001).

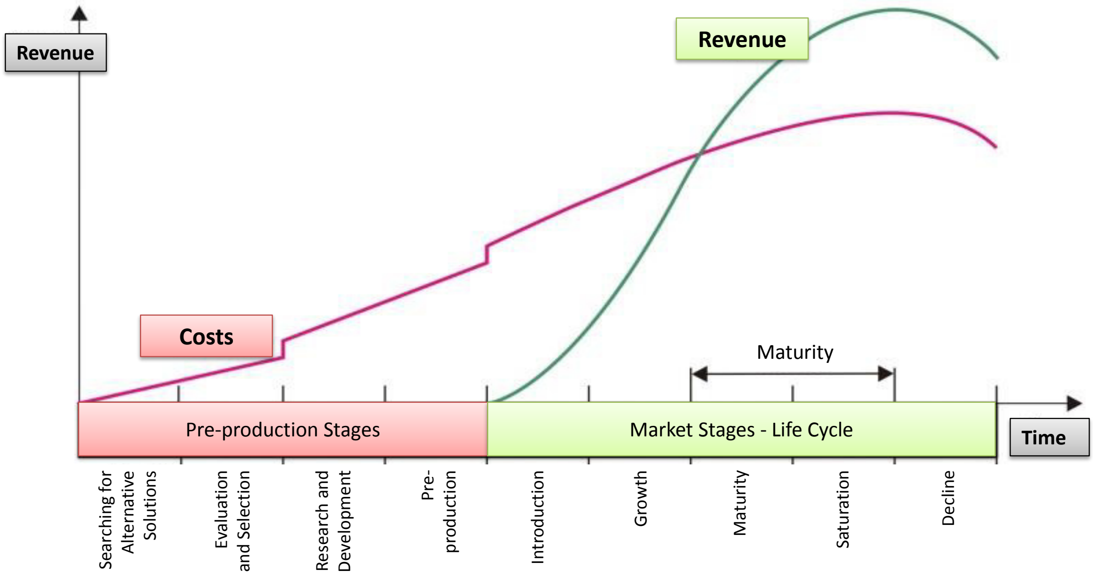

Figure 2.8 Product Life Cycle Curve (Tomek & Vávrová 2001)

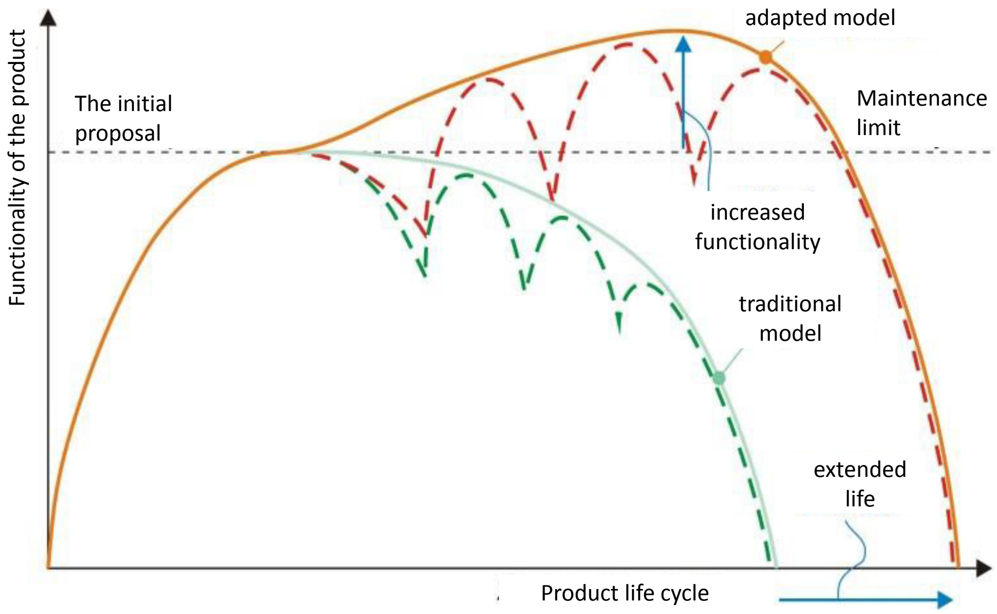

Figure 2.9 Comparison of Traditional and Adaptive Methods of Product Design (Elmaraghy & Elmaraghy 2006)

2.3.2 Product Innovation Process

Models of innovation inherently respond to changes in the innovation environment laying a base for many different models. Many documents define classical models of innovation initiated by the pressure of scientific and technological knowledge or pull of customer demand (so-called first generation). Publications on the development of innovative models classify models into the following generations (Innovation models patterns 2013):

- Traditional linear models of innovation
  - **Pressure** - science initiates innovation (new knowledge - innovative design - production - customer).
  - **Pull** - demands of potential customers - innovation comes from customers' unmet needs (customer - innovation idea - production).
- Interactive models
  - Currently, the basic model for managing innovation is interactive. The second generation innovation model is a combination of the pressure of science and pull of customer demands through feedback loop. Research, development and marketing are in balance. Innovations of scientific and technological development that do not meet the future needs of customers, fail to address current needs or do not use research and development are ineffective. The increasing complexity of innovation has led to the fact that the interactive models are further subdivided. Tidd (Tidd et al. 2005) states 5 generations. In addition to standard models, pull and pressure, it also distinguishes modifications of interaction models.

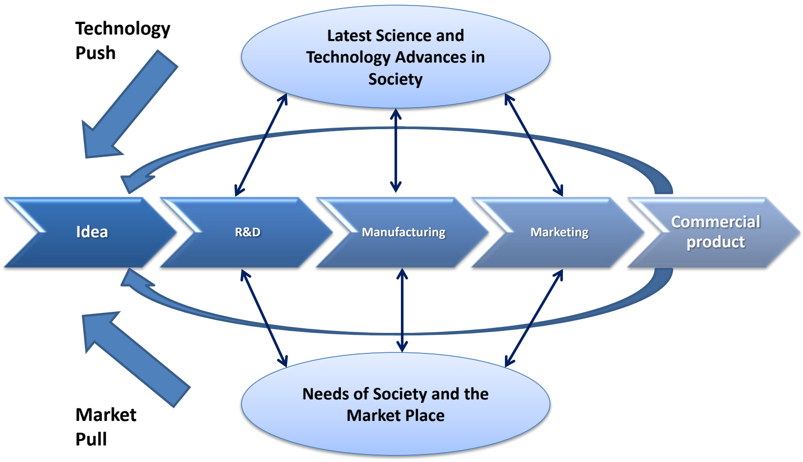

Figure 2.10 Interactive Innovations Model (Custom graphic design according to: Tidd et al. 2005)

2.3.3 Trendology, Technology Foresight

Comprehensive view (systemic approach) on the issue of predicting / forecasting of technological assumptions gives the so-called scenarios, in which mathematical models represent only a small part. Professional literature portrays examples of forecasts of different companies. (innovations mostly from the telecommunications segment appear in the innovations of other segments).

2.3.4 Support Tools and Techniques for Product Innovation

Intuitive Procedures	Systematic Procedures
• Brainstorming • 635 • 6 hats	• Morphological analysis • TRIZ[1] • Systematic analysis

[1] 98% of Innovations utilizes a principle of already known solutions. Only 2% of innovations are 'pioneering' discoveries. innovations can only be find through a systematic approach. As the result of 40 years of research of over 300 people (and still ongoing) - TRIZ is used for example by Boeing, Lockhead Martin, NASA, Procter & Gamble, Samsung, Mitsubishi, etc.

• Synectics	• WOIS
• Brainwriting	• Bionics
• Lateral thinking	• Six Sigma
• Mind Mapping	• TOC
• Method of control questions	• …
• …	

Figure 2.11 Selected Innovative Methods

2.3.5 Innovation Audit, Innovation controlling

Knowledge about innovation audits is shown in the following chart:

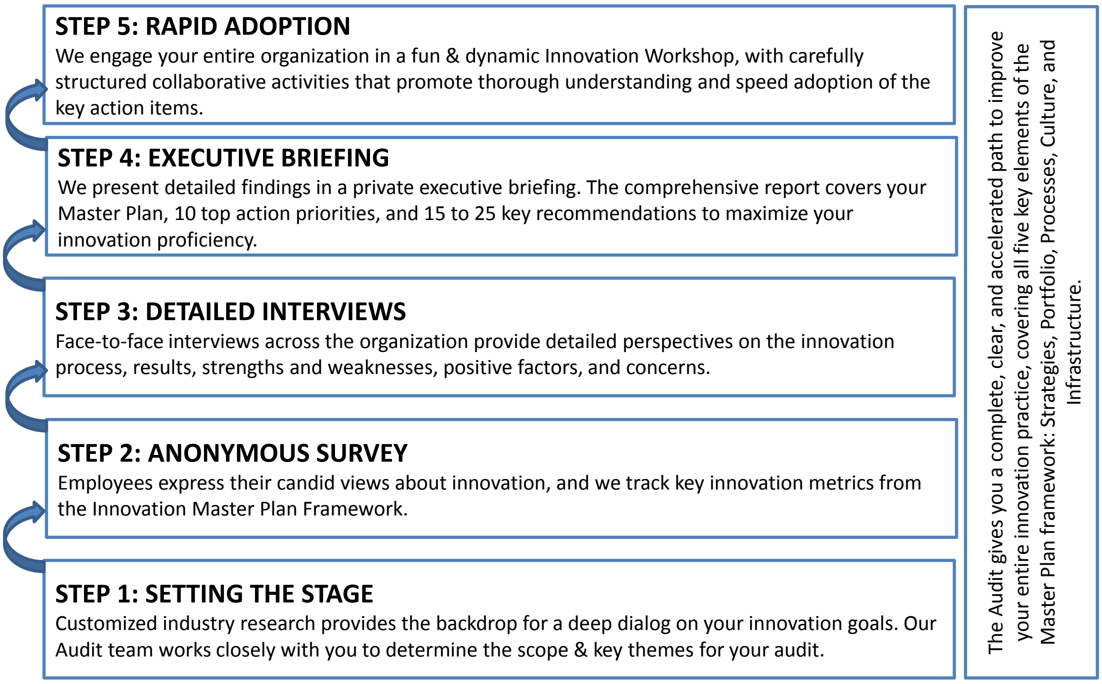

Figure 2.12 The 5-Step Audit Process (http://www.innovationlabs.com/)

Literature for managing innovation shows that scientists are looking for ways to deal with complex information in an uncertain environment. This is something that designers are quite used to. Designing is often ambiguous with ill-structured problems and undefined results. Designers need to set out priorities and comprehensive information and eliminate clusters of contextually ambiguous formulations when solving a problem. Therefore, a network of innovation partners is the current trend of dealing with complex problems in the business environment. So, in accessing innovation in the network, it is necessary to cooperate with partners in ambiguous and ill-structured issues related to innovations and to think comprehensively on innovations with a strong focus on future development and on potential needs of future customers.

2.3.6 Enterprise Innovation Performance Measurement

How to measure and validate innovation? This paper has already dealt with the definition of innovation/product innovation and with the classification of different types of innovations But how to actually find out that something is innovative, and how to measure whether this innovation will succeed? In order to measure the innovative features, it is necessary to first select the method of measurement. In professional literature (http://www.equal.ecotec.co.uk/), the most frequent is the so-called benchmarking made at the beginning of the project, i.e. determination of current state, which will be compared with any future change. Benchmarking allows to use the results of already executed market surveys to process and evaluate own market research, carry out research of available resources/materials, survey target audiences, publish questionnaires on websites, etc.

During the implementation of the project and at the end of it, the achieved results are compared with the benchmark. In the assessment of the innovation, it is encouraged to define in addition to quantitative indicators (eg number of newly trained staff, number of certifications, etc) the qualitative indicators (eg improvement in customer satisfaction, increase in language skills, etc).

2.3.7 Product Innovation

2.3.7.1 Obstacles and Threats

The innovation of product(s) is connected with **threats** and **obstacles** that are referred to in the professional literature as the risk of innovation. These risks are associated with the hope of achieving extremely high benefits on the one hand, and with the risk of failure and loss on the other.

According to statistical analysis, that are often displayed in the professional literature, (eg. Kováč 2002) as much as **62 %** of upcoming innovations were unsuccessful, of which 15% were due to technical risks and 47% due to commercial risks. The most important innovations (new generation of products) have even lower rate of success, only about 10%.

The sources of risks (Kováč 2002):

- **Change in demand** – e.g. changes in consumer preferences, input substitution products, reduction of purchasing power of customers, competition entry, etc.
- **Changes in price / cost changes** – eg. material energy, wages, capital equipment, etc.
- **Changes in technology** – eg. materials, structures, processing technology, etc.
- **Macro-economic and political environment** – e.g. tax laws, inflation, etc.

2.3.7.2 Valley of Death

With the increasing number of failed innovation projects, the professional literature began to describe them as the '**Valley of Death'.** Document No 14887/12 from 12 October 2012 of the EU Council in Brussels (http://register.consilium.europa.eu/) describes the Valley of Death as the gap between the creation of basic knowledge and its subsequent commercialization in the form of marketable products. Furthermore in this document and also in other documents of the EU Council 'stresses the importance of an integrated approach to KEY (Key Enabling Technologies) to intensify synergies between relevant EU policies and instruments related to research, development and innovation, in particular the Horizon 2020 and Structural Funds, including the European Regional Development Fund and the European Investment Bank.

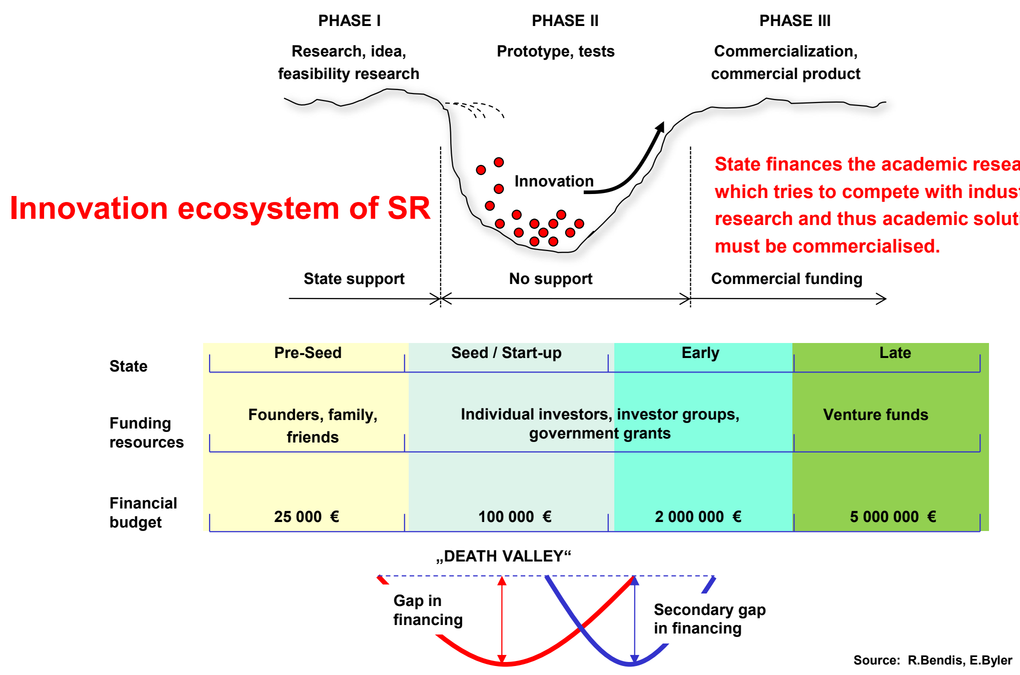

Figure 2.13 The commercialization of innovation (Gregor & Medvecký 2010)

This approach covers the entire value chain, focusing on the gap called the Valley of Death, with the intention of helping to make the research more easily converted into innovation goods, services and solutions applicable on market and beneficial for the society, and, where appropriate, provide the exploitation of opportunities arising from public-private partnerships and venture capital instruments.

2.4 Demand

Demand (usually referred to as 'D') means the quantity of goods/products, which is a buyer willing to buy at a certain price, at a certain time in a certain place. The demand is divided into **elastic demand** (flexible), which significantly and rapidly respond to changes in prices (usually regarding expendable and easily replaceable goods) and **inelastic demand**, which slowly responds to a change and in a limited way (usually regarding products, which are hard to substitute, such as drinking water and salt). Unit elastic demand is a special variant, when the change in the price of the given product proportionally leads to a change in the demanded quantity.

Demand is an expression of the relationship between the required amount of goods and their market price (it is important to distinguish the terms 'demand' and 'required amount'). Demand function is expressed by a range of prices corresponding to the range of quantities. This can be either displayed in tabular form or graphically.

According to Samuelson, two reasons exist for the decrease in the quantity when price increases:

1. **Substitution effect**, if the price of goods increases, it is natural that we want to replace it with another, similar (e.g. pork by poultry).
2. **Retirement effect**, when the price increases, we feel poorer and therefore we limit the consumption.

However, more **factors determine market demand** for goods; apart from the availability of substitutes, the individual passions, social status, prestige and the like. Price, however, is a special category that substantially affects human behaviour and the overall economy.

Price elasticity of demand (supply) is defined as the relationship between price and quantity of goods. The flexible change means when only a small change in price causes a big change in quantity. Price elasticity of demand (supply) is defined by the coefficient of elasticity as the ratio of:

$$k_p = \% \text{ change in Q} / \% \text{ change in P}$$

If:

- kp = 0, absolutely inelastic demand,
- kp > 1, elastic demand,
- kp < 1, inelastic demand,
- kp = 1, unit (constant) elastic demand.

2.4.1 Customer Behaviour Model and Its Influence on Demand

Basic/key issues that should be answered regarding customer behaviour are the following:

- WHO is important to decide on purchasing?
- WHY do customers purchase?
- WHAT are the selection criteria of their purchase?
- WHERE do they purchase?
- WHEN do they purchase?

Answers to these questions can be obtained by personal contact with the customer, however new methods from the marketing research are being increasingly used.

Key selection criteria used by the customer in purchasing are described in the following table.

Selection Criteria			
Technical	**Economical**	**Social**	**Personal**
• Reliability • Durability	• Price • Value	• Status • Membership of a	• Self-assessment • Minimizing the

• Performance • Appearance • Comfort • Delivery Method • Practicality • Taste • ...	• Value in the Society • Price During the Life Cycle • ...	Social Class • Social Rules • Trendiness • ...	Risk • Morality • Emotions • ...

Figure 2.14 Key Selection Criteria for Purchasing (Custom processing according to http://www.podnikajte.sk/)

2.4.2 Long term – Kondratiev Waves, Business Cycles

Schumpeter distinguished three basic types of economy cycles, each of which corresponds to a different group of innovation. These are the following types of innovations (Schumpeter 1989):

- short Kitchin cycles (lasting approximately 3 years/40 months);
- middle Juglar cycles (lasting 9 - 10 years);
- long Kondratiev cycles (lasting 50 - 60 years).

Schumpeter is not considered to be a discoverer of economic cycles, but he created a system consisting of a variety of long cycles. Each wave of the same order is composed of the sum of multiple waves of a lower order together with a number of waves of the same order it creates a wave of a higher order (Schumpeter 1987). Schumpeter in his scheme considered sufficient to use three waves, i.e. the Kitchin, Juglar and Kondratiev Cycles and, therefore, he decided not to apply Wardwell Wave. Valenta (Valenta 2001) has added a missing wave to this scheme.

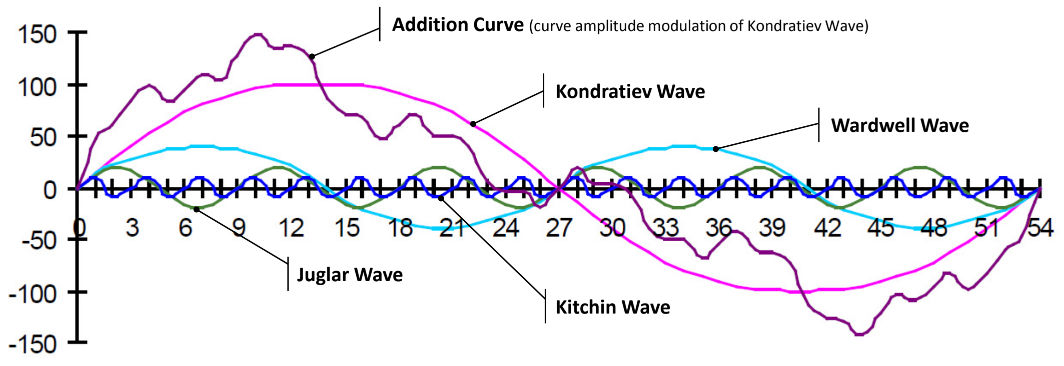

Figure 2.15 Illustration of Multicyclicity of Business / Economic Development (Schumpeter's Scheme of Economic / Business Cycles, Waves of Different Lengths) (Valenta 2001)

The image shows that one Kondratiev Wave (Cycle) lasting 54 years consists of two Wardwell (Kuznets, Frisch) Waves (Cycles), each of which consists of three Juglar Waves. Each Juglar (Labrouss) Wave (Cycle) subsequently consists of three Kitchin Waves (Cycles). Addition curve is amplitude modulation curve of Kondratiev Wave.

The content of the previous theoretical knowledge is connected with the definition of the EU for the so-called Business Cycles: Business Cycle is a cyclical movement of various economic variables (such as national income, inflation, money market, investments) over several years (http://www.euroekonom.sk/).

2.4.3 Possibilities to Influence the Demand

In recent years, the technology and innovation policy represents a complex system taking into account long-term interests of the company and its impact on future developments, as well as systematic analysis and evaluation of development (Klas 2006). It includes measures to support the supply, i.e. development of innovation, measures aimed to stimulate demand, i.e. introduction of innovations to the market, as well as measures to develop pro-innovate business environment.

In line with the theme and because of the limited range of the analytical part of this paper, the following paragraphs contain only a brief description of the measures aimed to support demand and opportunities to influence demand.

Measures aimed to support demand (technology push policy) are geared to support enterprises introducing innovations to the individual markets and ensure sufficient profits of companies for assuming risk. They include for example: supporting the establishment of new, innovative and small or medium-sized business, existing innovative businesses, technology transfer, creation, protection and exploitation of intellectual property rights, etc. (European Commission 2002).

2.4.4 Demand Forecasting

Many authors deal with the issue of forecasting classification methods. If is a long-term demand forecast, it is called a **prediction** (period of 5 or more years), if it is a short-term demand forecast (year, quarter, month), it is called a **forecast** (Vorhersagen in German). Forecasting is part of a marketing analysis and is based on the information obtained from marketing. The task of forecasting is to estimate future demand for products or services. Forecasting methods are often applied to other areas.

3 AUTOMOTIVE INDUSTRY SITUATION ANALYSIS

According to the analysis of Privatbank (http://www.privatbanka.sk/) "the automotive industry is for many years a major pillar of the European economy. According to the Statistical Yearbook of the European Automobile Manufacturers' Association (ACEA) for the year 2011, this industry employs directly over 2 million people and over 10 million indirectly. More than 200 European plants produce a quarter of the world's production and greatly contribute to a positive trend balance of the Europe with the rest of the world. The old continent is involved up to three-fifths of the world's total innovation in the automotive industry'.

In the given analysis, but also in other analyses, it is indicated that 'over the past 15 years (1997-2011) in the countries of today's European Union and the European Free Trade Association (Norway, Switzerland, Iceland, Liechtenstein), the average of 15 million passenger cars has been registered annually, of which the most was in the year 1999 and the least in 2011. For a comparison, a similar number of cars have been sold in the U.S., but the U.S. population is less than 2/3 of Europe. The difference between the strongest and weakest in the reporting 15 year-long period in Europe was only 1.5 million cars, whereas in the U.S., it was 7 million. Finally, while the European market stagnated on the onset of the crisis (stimulated by the so-called Scrappage Program) and is now declining, the U.S. market fell sharply at first and now is slowly growing'.

To conclude this section related to the thesis of this paper, it shall be noted that the 'degree of mobilization in each century is unique and varies very slowly. Recession in Europe, however, pushes the decrease in demand in some countries. Among the most vulnerable countries are Belgium, Slovenia and France. Although Italy has made a major correction, it still performs above average compared to Spain for instance. And vice versa - Slovakia and Iceland has the potential to increase the performance at the above-average pace. Furthermore, the decline in sales results in an increase in volatility[2]. This is true even for larger economies' (http://www.privatbanka.sk/).

3.1 The European Automobile Industry Development

According to ACEA (ACEA 2012), in 2012, 16 automobile manufacturers produced their cars in 22 countries across Europe in 210 vehicle assemblies and engine production plants. The automobile industry is a leading EU export sector with a net trade contribution of € 92 billion (2011). The automobile industry offered in 2012 at least 12 million jobs (2 million direct jobs, 10 million indirectly in connection with manufacturing and other sectors). Europe is the world's largest vehicle producer with an output of over 17 million passenger cars, vans, trucks and buses per year, or 24% of world vehicle production.

Technological innovation is one of the key factors in terms of competitiveness of the EU industry.

European automobile producers represent the largest private investment in R&D, investing annually more than €30 billion into innovations.

The progress of new passenger cars registrations in the EU and the development of GDP growth are shown in Figure 3.1.

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[2] **Volatiliy** is a fluctuation. Rate of uncertainty. It is an imperative factor for investments. The basic principle that the higher the income, the higher the volatility serves as a basis for the investment horizon, which is longer for high-risk assets. (http://financie.etrend.sk/)

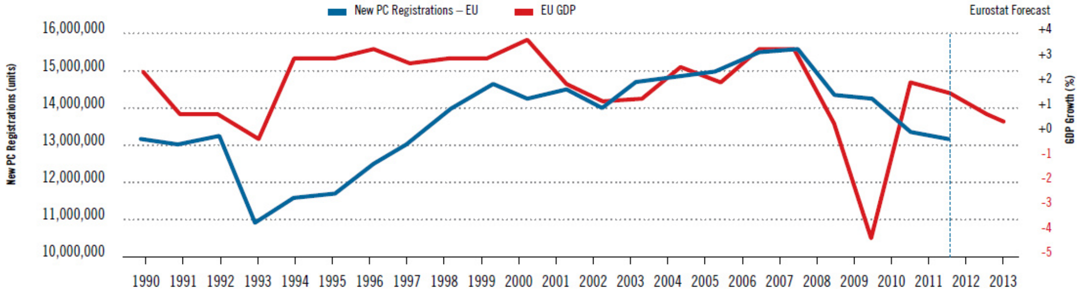


Figure 3.1 New Passenger Car Registration in the EU and GDP (ACEA 2012)

Figure 3.2 shows the world trend in production of passenger cars.

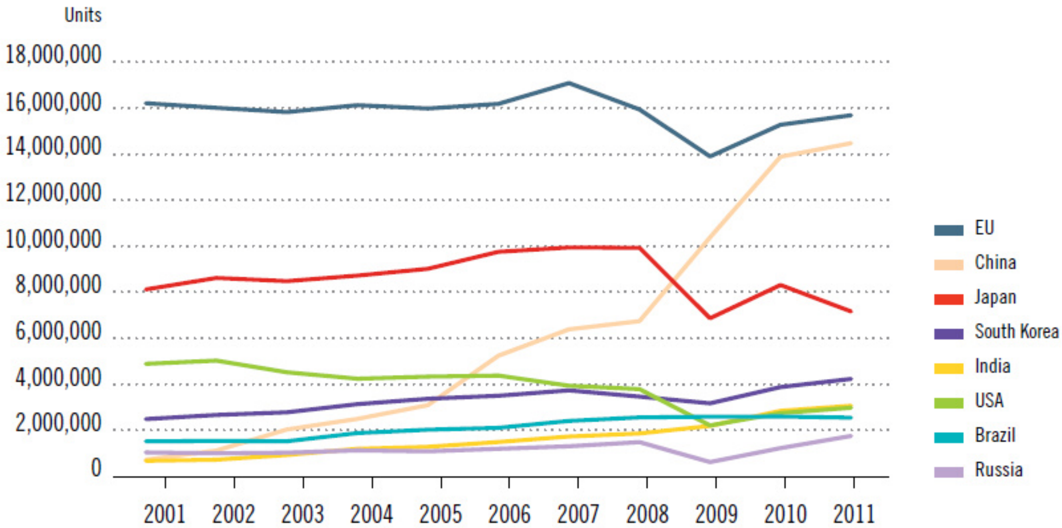


Figure 3.2 World Passenger Car Production Trend (ACEA 2012)

The Slovak Republic is among the largest world producers of cars, being on the first place in terms of the amount of produced cars per 1000 inhabitants, as it is shown in Figure 3.3.

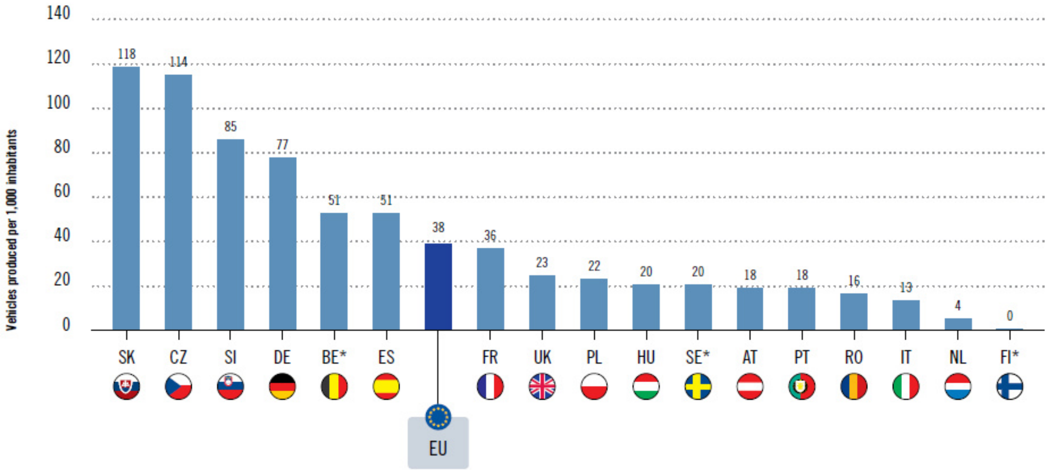


Figure 3.3 Motor Vehicle Production per 1,000 inhabitants in 2011 (ACEA 2012)

The automobile industry is a highly innovative sector with over 8568 patents filed in 2011 at the European Patent Office. The following Figure shows the portion of patents in automobile industry filed in 2011 worldwide.

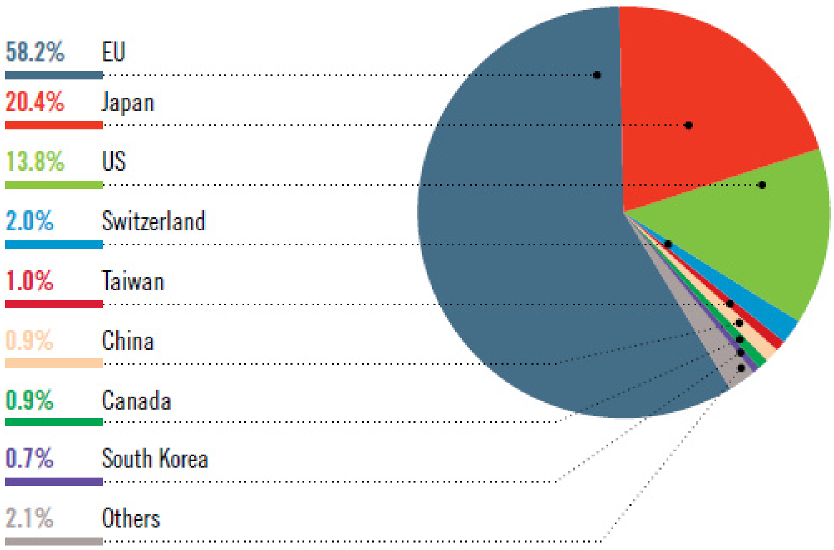


Figure 3.4 Patents in Automobile Industry in 2011 (ACEA 2012)

3.2 Future Directions of European R&D Activities in Automotive

The surveys conducted in automobile industry show that the fast innovation in automobile industry is shifting to more complex and comprehensive solutions and requiring increasingly less time to implement, which is dependent on powerful market research and development activities. The growing importance of R&D in the Europe was underlined by EC in its strategic document Horizon 2020 (with a proposed budget of €80 billion), in which three main strategic directions were determined: excellent science, **leading industrial research** and social challenges. Horizon 2020 is a major initiative on breakthrough technologies (including, among others, electrification of combustion engines, hybrid and electric vehicles, fuel cells, electrical and electronic systems).

European Technology Platform ManuFuture defined in its Strategic Agenda 2020 three main research programmes for manufacturing. The following Figure shows ManuFuture future research orientation.

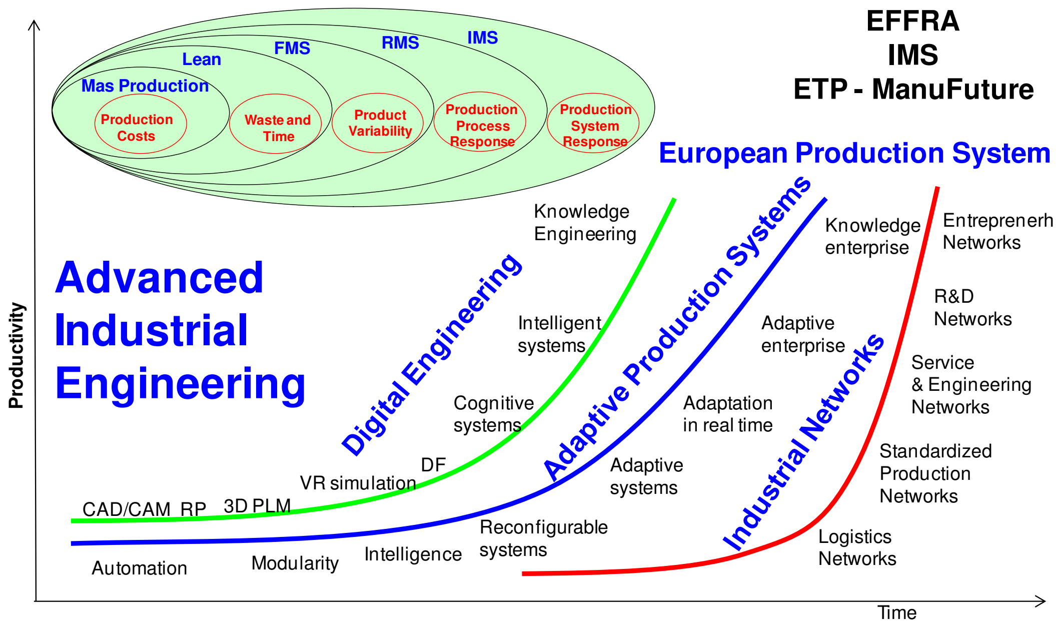


Figure 3.5 Future Research in Manufacturing Industry (Gregor & Medvecký 2010)

A special financial support is given to R&D in EU automotive industry through CARS 2020 program. The European Commission plans to invest more than € 20 billion in R&D in automotive industry till 2020.

The focus of automotive R&D projects is to produce concrete results for the industry, which can then be further developed or exploited directly in product development (EUCAR 2011). This focus on achieving R&D results should continue in future public R&D programmes. In order to address the challenges as described above, the following R&D areas are of major interest for the automobile industry:

- Mobility and Transport in Urban Areas, Extra-urban Corridors and Interfaces,
- Enhanced Power trains and Alternative Fuels,
- Electrification of the Vehicle,
- Safety Applications in Co-operative Systems,
- Suitable Materials and Efficient Manufacturing for Automotive Applications.

As an example of the future R&D research directions serves the stakeholder projections (EUCAR 2011) for the penetration of alternative power train technologies over the next decades, which confirms that a large proportion of newly sold light duty vehicles will continue to incorporate an internal combustion engine (ICE), a substantial proportion of which with an ICE as the sole source of propulsion.

Raw materials will play an important role of the future, especially innovative materials and light-weight structures used for further improvement of the vehicle’s efficiency.

The European technology leadership in virtualization and digitization will continue and will significantly support the competitiveness of European automotive companies, especially a growth will be observed in the application and complexity in Digital

Factory and Rapid Prototyping Technologies. The simulation and emulation is supposed to be the technology of the 21. Century. The solutions based on Artificial Intelligence will become a part of all the vehicles in the future.

The following Figure shows a new concept of future Digital Factory solutions, developed in the framework of the FP7 research project.

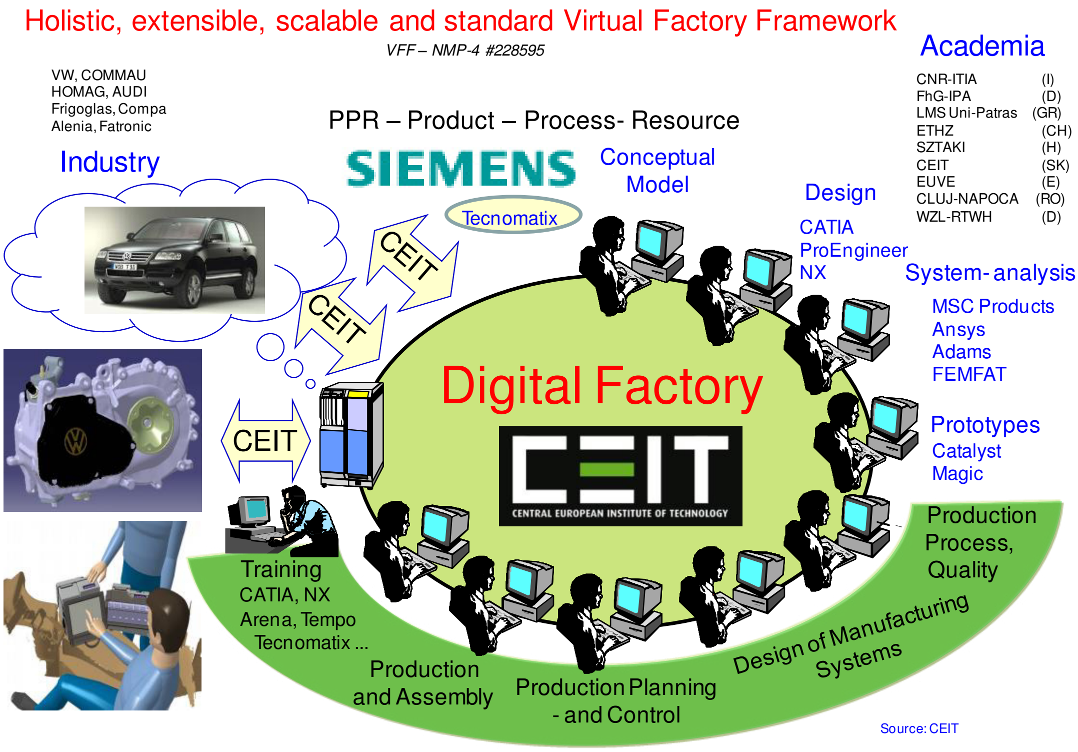


Figure 3.6 Virtual Factory Framework (Gregor et al. 2007)

The Digital Factory, as a new technology, will have to be used in all phases of development and utilization of real products. M.Taich (Gregor et al. 2007) introduced a total approach for application of the Digital Factory technologies in the whole process of the Product Lifecyle Management (PLM).

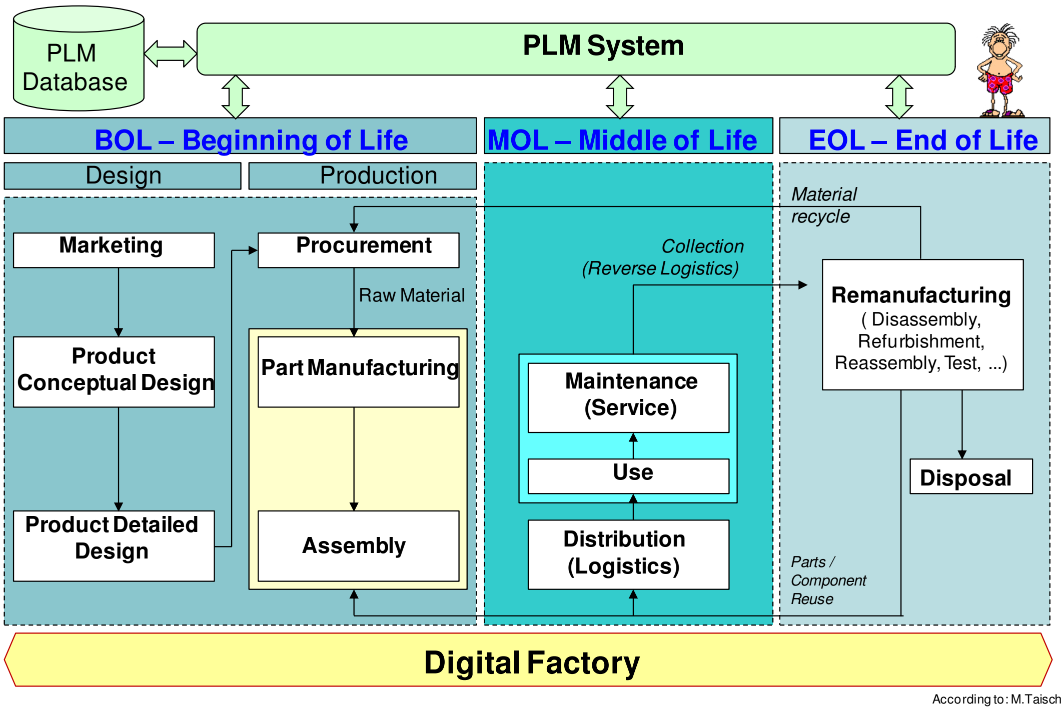


Figure 3.7 PLM for Future Factories

Gregor (Gregor et al. 2007) described application of new virtual technologies in the whole supply chain, as it is shown in Figure 3.8.

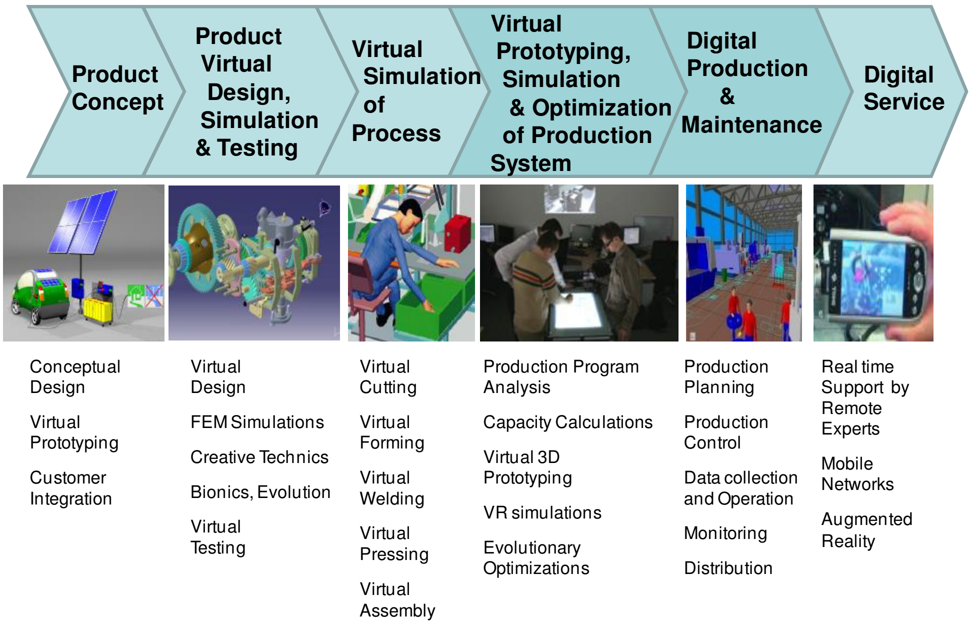


Figure 3.8 Supply Chain supported by Digital Factory Technologies (Gregor et al. 2007)

A heavy competitive environment in automotive industry requires new and radical innovations. The European automotive companies will have to utilise more synergy potentials and integration. A good example is BMW whose new car carries 70 new innovations and 61 new patents. The main targets of innovations are the innovations in mechanical, electrical and electronics, innovations in drive systems, new chassis solutions based on light new materials and new manufacturing competencies with fast setups based on reconfigurability, enabling dramatic cost cuttings. That is why the future orientation of European research will be focused more into radical innovations, as it is shown in the following Figure.

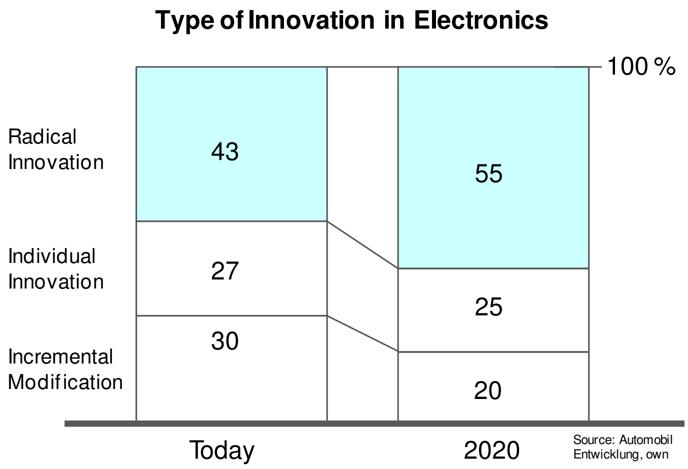


Figure 3.9 Type of Innovation in Electronics

The innovations in automotive industry are continually shifted from a single innovation to more complex system innovations as it is shown in Figure 3.10.

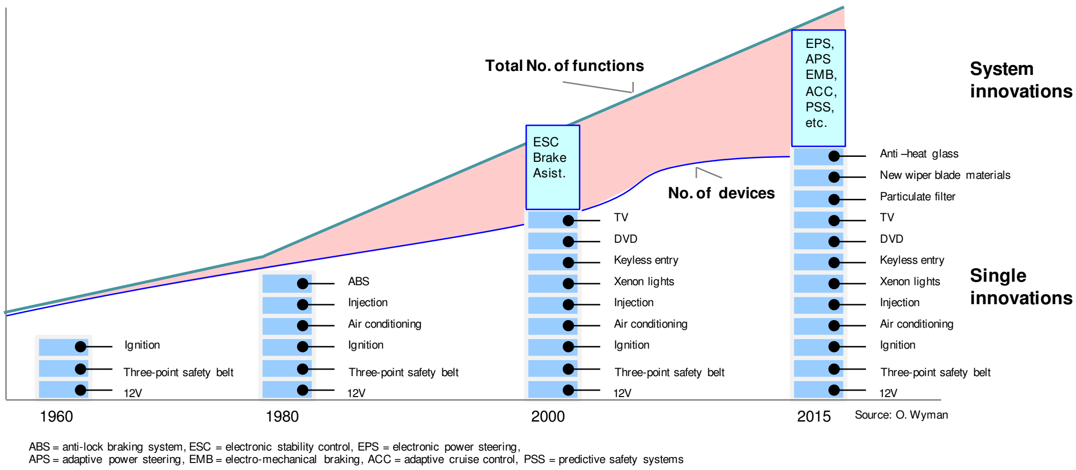


Figure 3.10 Shift from Single to System Innovations

McKinsey company did a comprehensive research (Naeher et al. 2002) which has shown that maturity problems at ramp-up /SOP have significant influence on a cumulative profitability (see Figure 3.11).

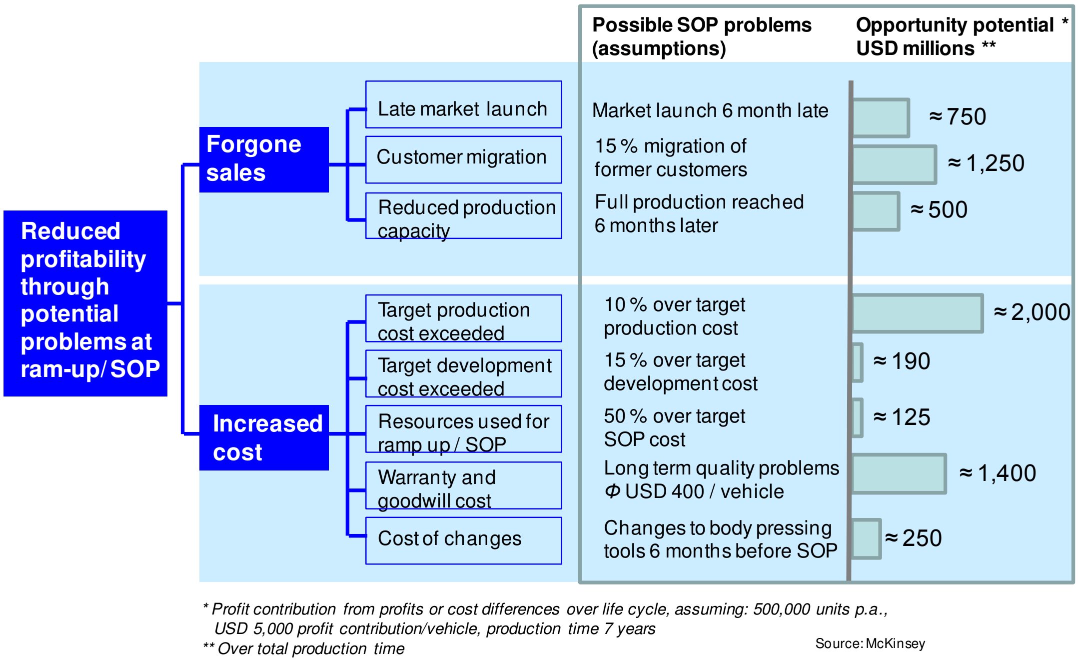


Figure 3.11 Influence of Significant Factors on Company Cumulative Profit

The traditional product development process (see Figure 3.12) in automotive industry has to be dramatically shortened.

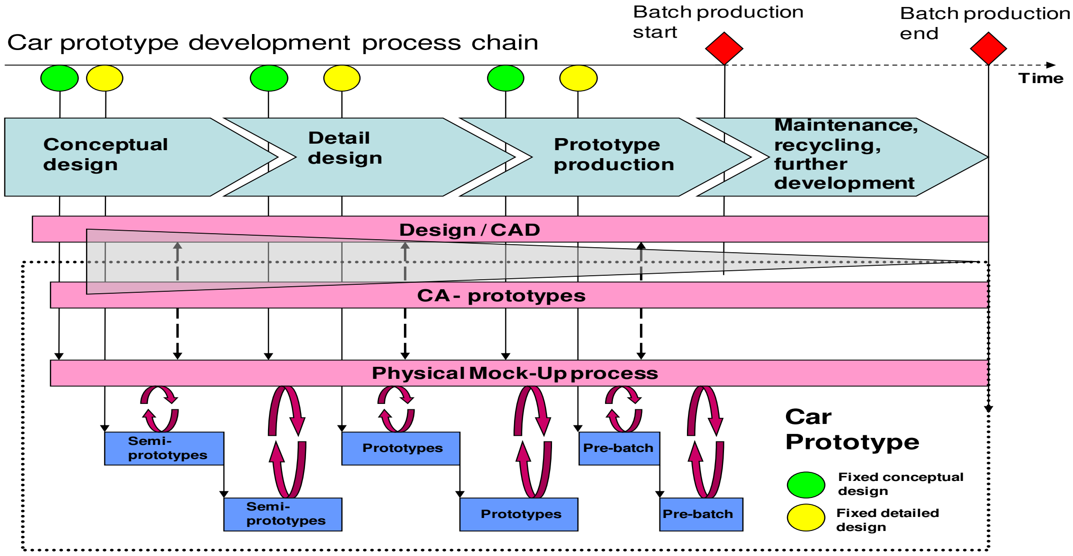


Figure 3.12 Traditional Product Development Process in Automotive Industry

The new opportunities for further reduction of car development time lie mainly in broader application of IT in development process of new cars. Recent advanced technologies of Digital Factory, supported by Virtual Reality, Augmented Reality, immersive technologies and computer simulation enabled to realize virtual development and testing of new cars. The Virtual Commissioning supported shortening of Ram Up Time of new cars. New reconfigurable and adaptive production systems resulted in short launch production periods. According to McKinsey&Company analysis, (Naeher et al. 2002) the car development time was reduced significantly between 1988 and 2005. The long term target for next reduction is shown in Figure 3.13.

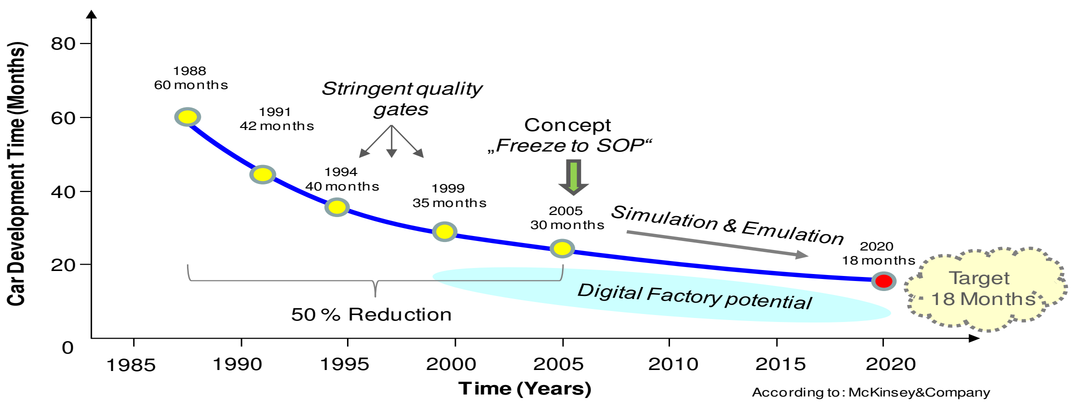


Figure 3.13 Reduction in car development time

4 EVALUATION OF DATA OBTAINED FROM ANALYSIS, CONCLUSIONS AND SUGGESTED SOLUTIONS OF THE WORK

4.1 Analysis of the Acquired Knowledge

This paper deals with a wide range of issues; therefore it required a deep and broad view of the issues of innovation from different perspectives, from the theory of industrial engineering, business processes, operational structures to economics, business finances, marketing and logic, philosophy and the philosophy of business ethics, including a range of other miscellaneous disciplines.

Several areas of the paper are not covered, or are only covered marginally in theoretical conclusions of key areas. The reason for this is the limited scope of the paper.

Many theoretical sources that were examined in connection with this paper lead to the following conclusions: it turned out that the competitiveness of enterprises depends on many factors. It also has been shown that in these processes, several elements regularly emerge and there is an infinite set of these elements. They always appear in relation to one another, mutually overlap, influence, supplement or exclude. Enterprises that understand the need for ongoing marketing activity and continuous innovation are on a good way to increase their competitiveness despite a wide range of similar products on the market and to become unique and exceptional and have a higher chance to break into the market. In terms of added value, the profit and productivity are not the only important aspects, but also the overall performance and sustainability on the market. New developments in marketing emerge from the globalization of sales and distribution, monitoring and reduction of logistics costs, focus on quality processes, application systems of rapid response, integration of supply chain (Supply Chain Management), and use of the latest information technology, outsourcing or environmental marketing. Companies that fail to adapt as soon as possible to these conditions have no chance to 'survive' in the fierce competition of the market.

4.2 Final Evaluation of Acquired Knowledge

Product innovation in relation to marketing and customer orientation of existing processes and the level of customer satisfaction with the speed, quality and safety of provided services shall be the main driving force of the organization / enterprise; planning and management of all activities shall be the alpha and omega of all processes at all levels (primary, secondary and other). Ongoing processes (especially innovation) shall be subject to ongoing monitoring. Quantitative indicators are one of the tools to monitor the quality of rendered services, which are described in the professional literature.

However, it turns out that the indicators for the level of customer service do not affect all aspects of business and innovation processes.

In addition to customer satisfaction, the company must also be interested in other aspects of ongoing processes - innovation, performance, reliability, productivity and quality of all activities. Several authors described the image of a complex system of these processes. Neither of these authors, however, deals with the comprehensive description of the creation of product innovation in relation to demand or marketing.

What is the trend of the development? It is possible to answer this question by the following scheme:

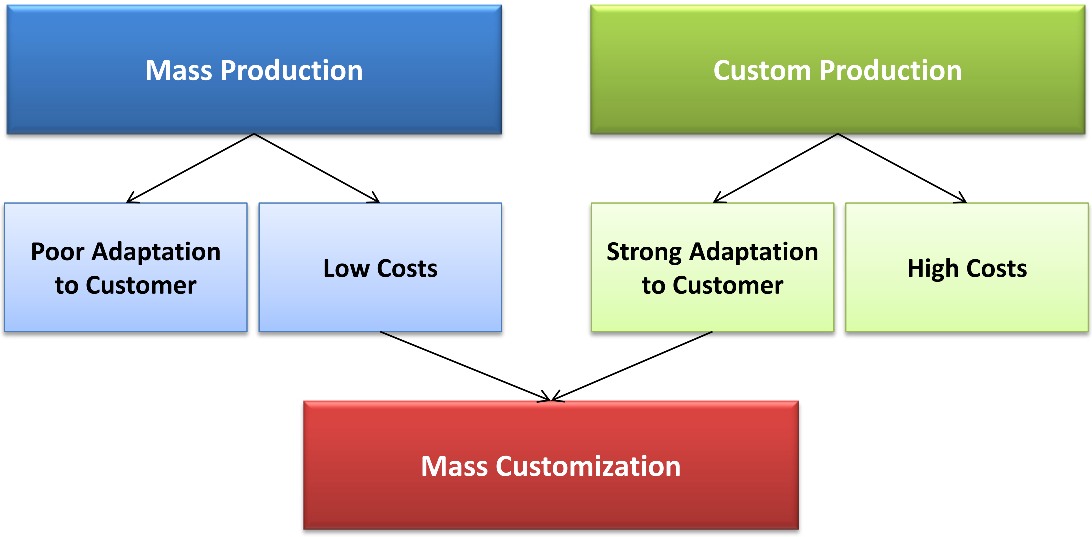
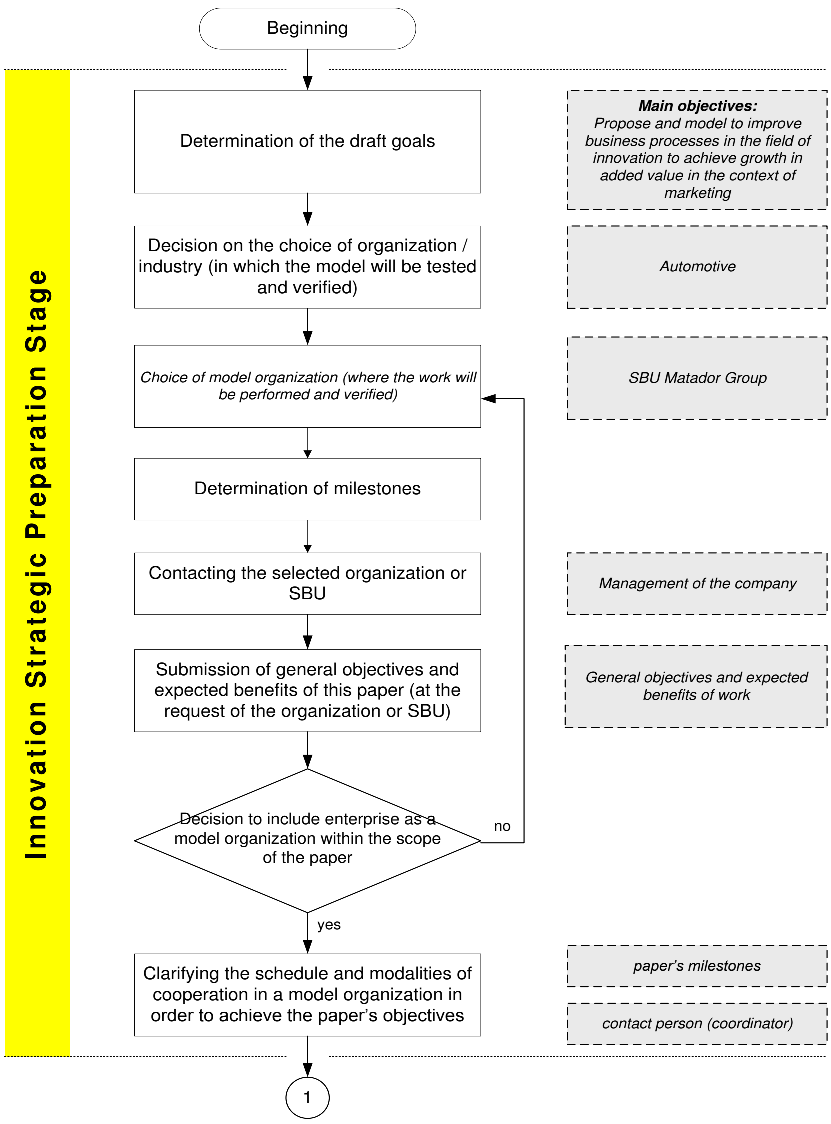


Figure 4.1 Mass Customization (Custom processing according to Košturiak 2012)

5 PROPOSED SOLUTION (DRAFT SECTION)

Proposed solution of the model aimed at improving business processes includes innovation process in companies focusing on the automotive industry, its factors, characteristics and success. The model is designed for the purpose of supporting or innovating known facts and introducing or improving the synergy effect, i.e. the so-called butterfly effect and existing processes of product creation in the automotive sector. My approach to the draft section is shown in the following algorithm.



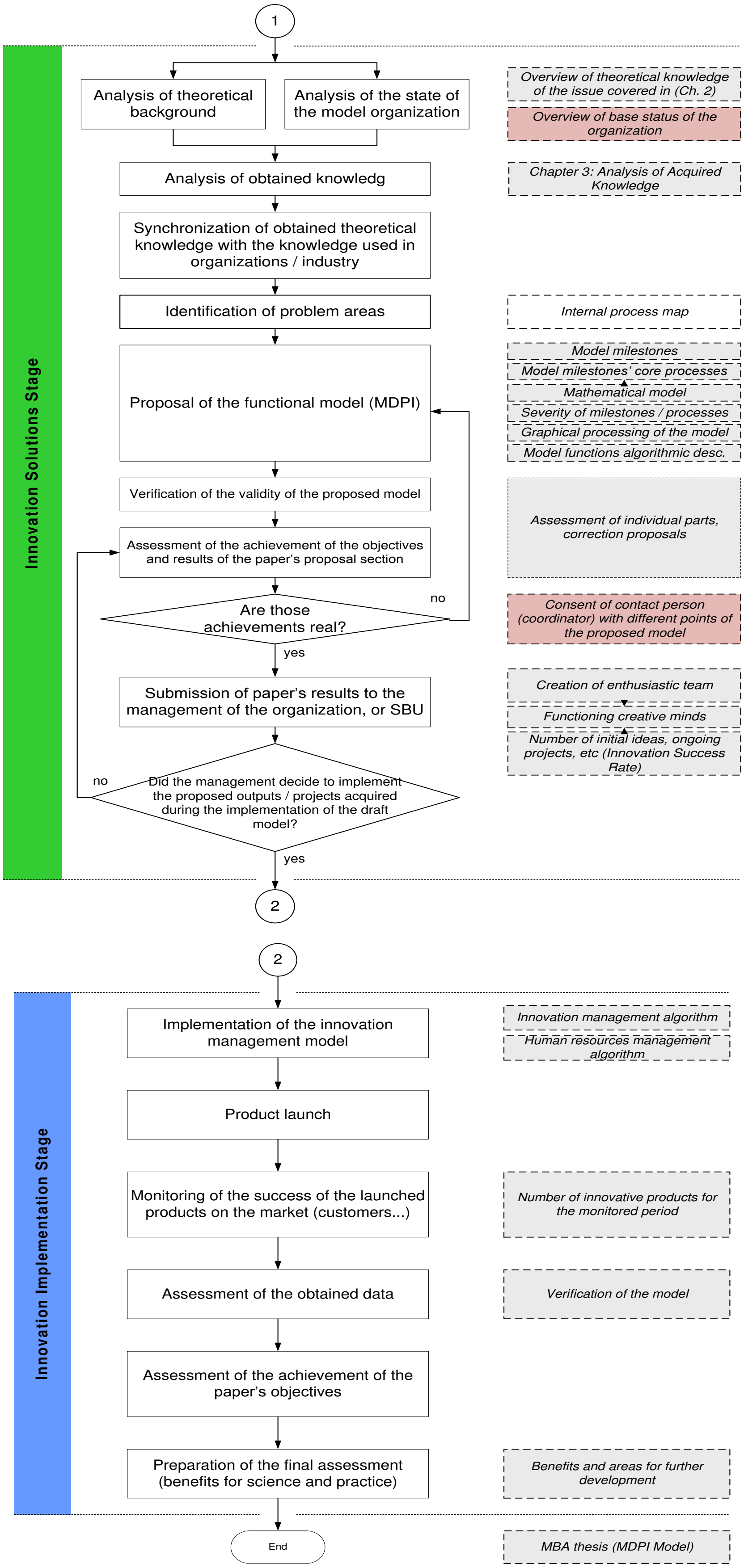


Figure 5.1 Draft Section Approach Procedure

5.1 Product Creation Process

To achieve stable product creation process, it is essential to establish standardized (benchmark) procedures that form the basis of the assessment of the specific project in the relevant projects in managing innovation process of product creation. These standards are called benchmarks and are core processes to assist in planning and managing innovation product projects in line with the set objectives. Activities of the product are structured and managed by milestones. When they are reached, a report on the current state of innovation project is submitted to relevant decision-making bodies.

Incremental milestones are important intermediate data inside the primary and incremental processes of the product creation. They also assist in managing individual projects. (Brůžek 2009), (Form 2012), (Machan & Brůžek 2011), (Westkdmper et al. 1998).

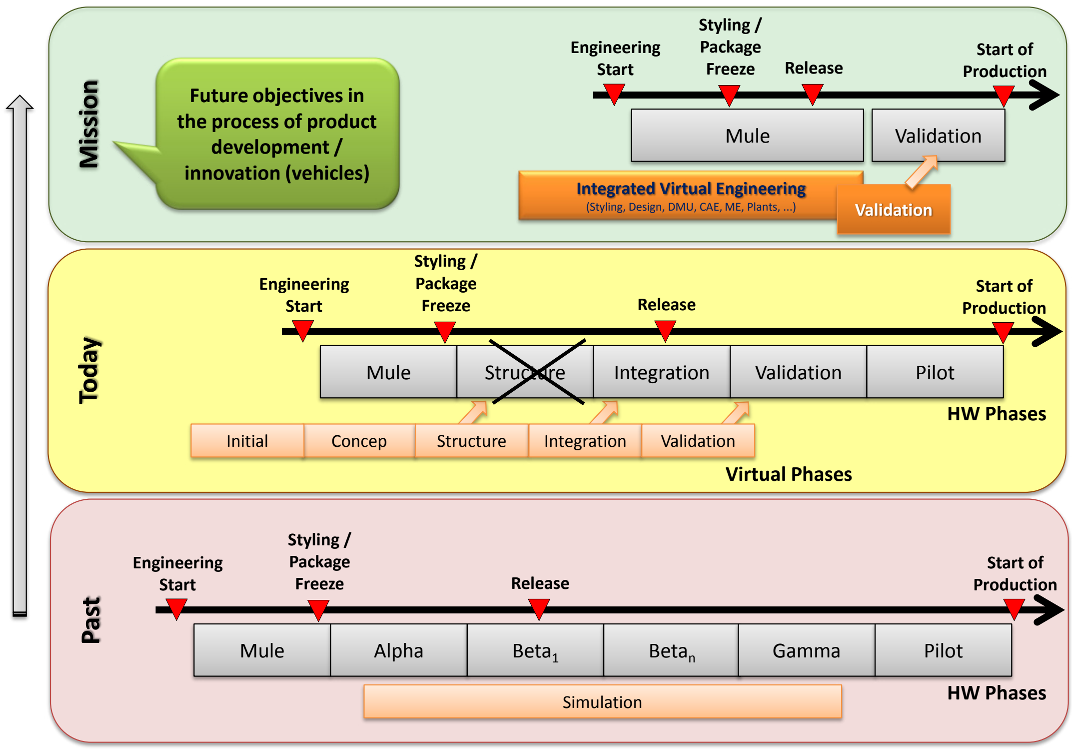


Figure 5.1 Objectives Development in the Process of Vehicle Development

5.1.1 Vehicle Creation

The main output of the product creation process in automotive industry is the vehicle. If we generalize the knowledge of the given industry, the vehicle creation process is broken into the following phases:

- Strategy Phase (PPS – SP).
- Concept Development Phase (SP – PE).
- Concept Implementation Phase (PE – V1PT).
- Mass production Development and Preparation Phase (V1PT – ME).

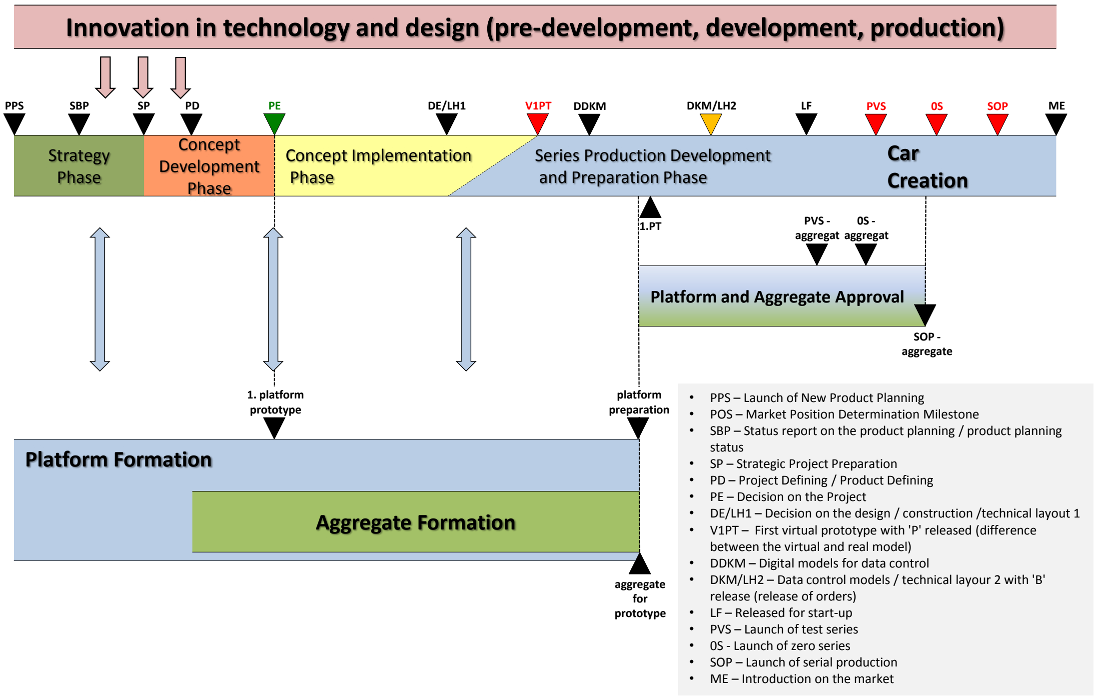


Figure 5.2 Benchmarking of Processes in the Product Creation Process

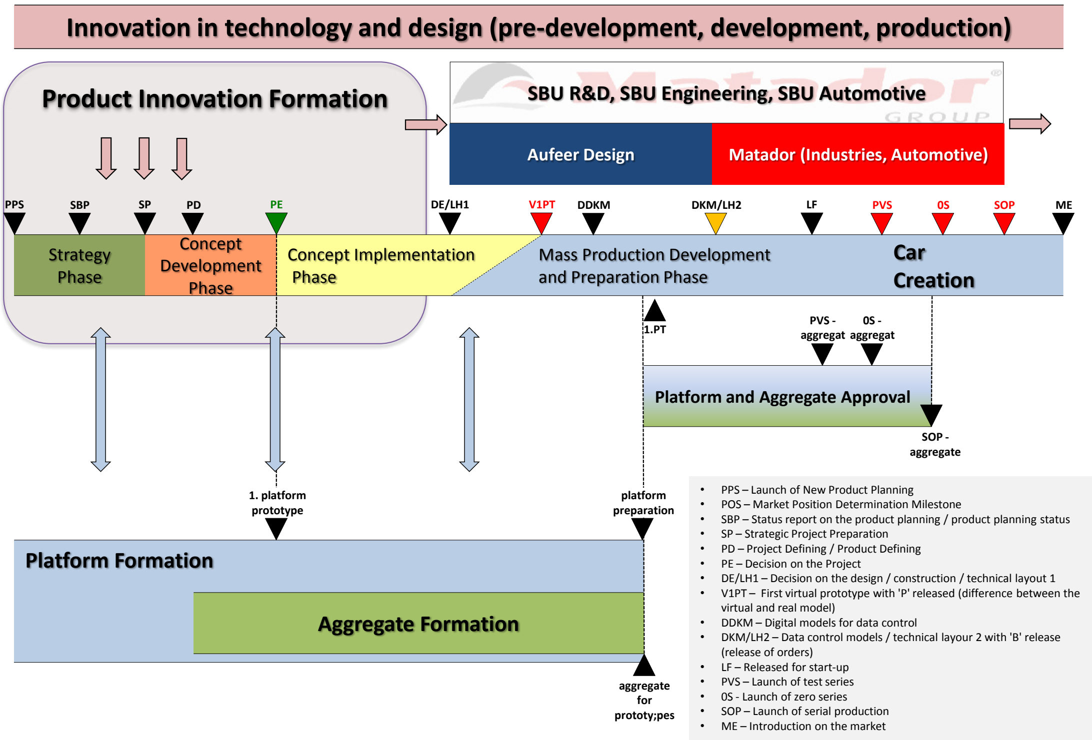


Figure 5.3 Benchmarking of Processes in the Product Creation Process in Model Organization

5.1.1.1 Strategy Phase

At the beginning of the preparation of a new product (PPS), Product Branding Department initiates a project-oriented product strategy on the basis of an approved brand (cyclic plan), with the assistance of the team for product planning composed of members of relevant specialized departments.

VAP (Product Planning Board Committee) will decide on the basis of the milestone 'Product Planning Situation Report (SBP)' on the direction of further conceptual alternatives.

In the subsequent milestone 'Strategic Project Preparation (SP)', VAP will decide on the final conceptual variant and determine to continue to develop the concept and design model.

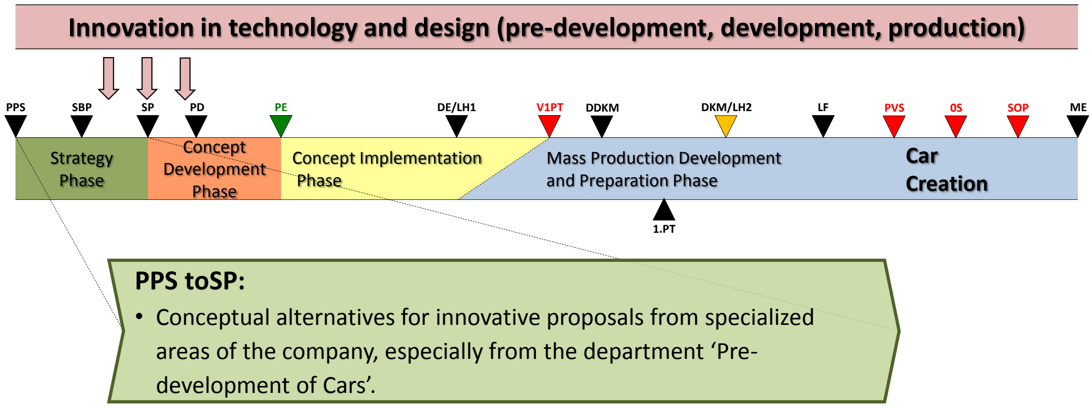


Figure 5.4 Strategy Phase

5.1.1.2 Concept Development Phase

To achieve the milestone 'Project Definition (PD)', the product concept is prepared in terms of technical content, start-up date and markets.

Following documents are incorporated into the milestone 'Project Decision (PE)' in assistance with specialist departments in coordination with GS Department:

- product technical description;
- design models;
- vehicle package and concept;
- production and logistics concept with respect to the place of production;
- draft objectives (complexity) of the defined construction groups decided upon by the relevant department, i.e. 'Brand Strategy Committee (PSK)'.

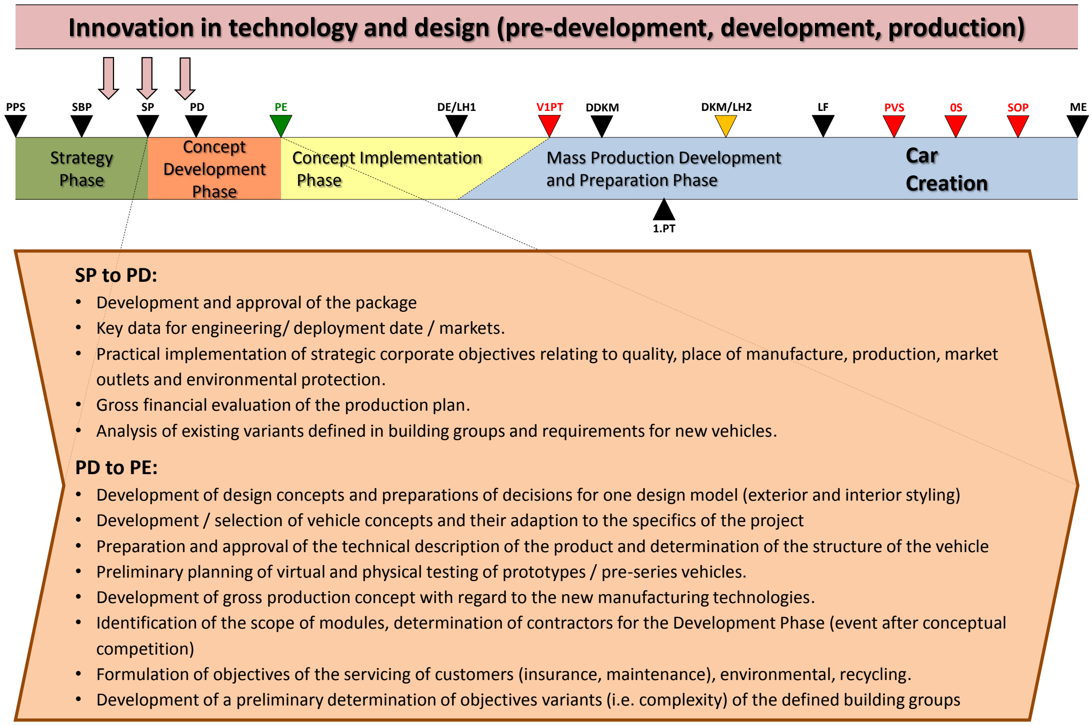


Figure 5.5 Concept Development Phase

5.1.1.3 Concept Implementation Phase

In the implementation phase, details of the design model connected with the PE (Project Decision) Milestone are being adjusted. PSK approves the design model and a binding specification (Lastenheft 1 (LH1)) and the Corporal Product Strategy Committee will decide on the DE/LH1 Milestone (Design Decision / LH1).

Approved design model is smoothed (geometric description of the surface) and serves as the basis for the design of digital and physical data control models (DKM) and prototypes. In parallel with this is the ongoing development and construction of concept vehicles. The construction is based on calculations and simulations (e.g. electrical / electronic). Refinement of variants of building groups is being carried out at the same time. Objective variants of building groups essential for the beginning of mass production (SOP) are approved and added to the DE/LH1 Milestone. Additional conceptual changes (within the change procedure) must take into account the complexity of the product and efficiency.

New important milestone is the approval of the so-called 'First Virtual Prototype (V1PT)'. After reaching the V1PT Milestone, the preparation and implementation of individual parts may commence. Order for the production of 1 physical prototype (Production of Prototype Tool) is carried out.

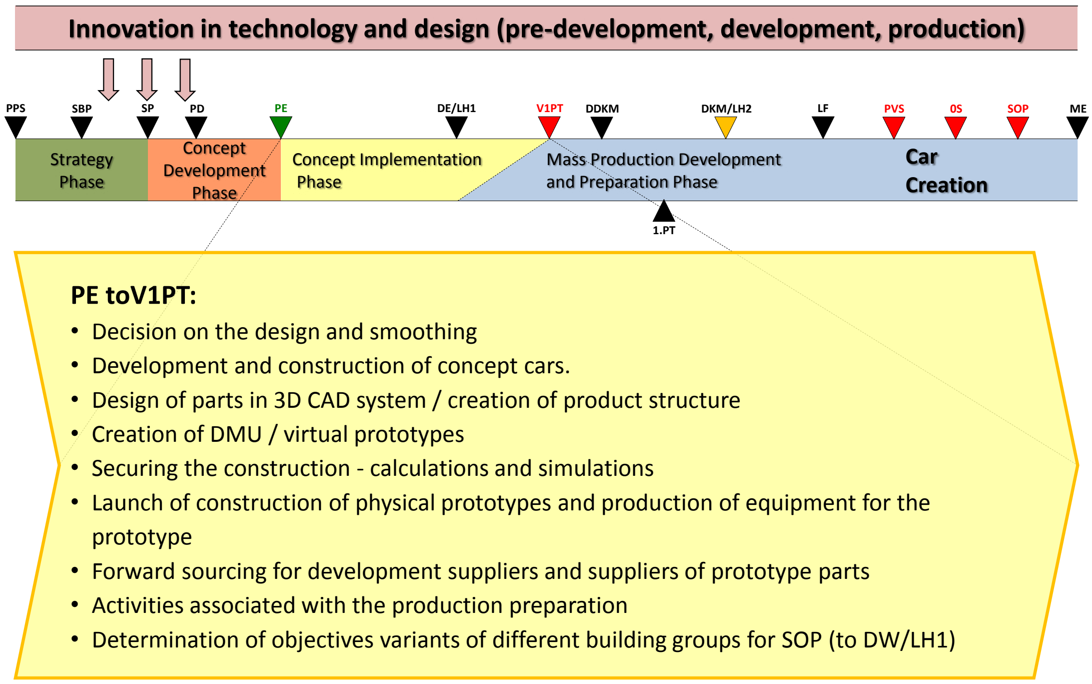


Figure 5.6 Concept Implementation Phase

5.1.1.4 Mass production Development and Preparation Phase

Takeover of control model digital data (DDKM, approximately 25 months before SOP) means that the all vehicle parameters are available in the CAD data that can be seen by the customer. Concurrently, the production of and testing of physical prototypes begin, which were at the Concept Implementation Phase processed virtually. Technical changes to the product must take place in accordance with organizational directives 'Change Management in the Product Development Process (pre-series)' (within about 3 months since SOP) and 'Change Management (series)'. When evaluating changes, the impact on the change of variants (complexity) of the product must be taken into account.

Upon takeover of the data control model (DKM, approximately 19 months before SOP) and after the initiation of material preparation of the production for individual parts (so-called B initiation), the creation and production of serial operating resources (tools and equipment), which must be of sufficient quality for the test series (PVS) begins.

Milestone 'Launch Release (LF)' (approximately 13 months before SOP), the manufacturability of the product and required availability and quality of parts conforming Starting Plan are confirmed. LF Milestone is designed to ensure continuous initiation.

The production of test series (PVS) can begin only when corresponding operational tools are available.

For zero series (0S), operational tools have to be available. Important parameters of the process, such as a the so-called 'two-day production', are being verified in order to ensure the initiation of the production in the required quality and number of units. The time of the selection of parts for the 'two-day production' of the given process is determined by the magnitude and is dependent on whether pre-production parts and equipment are available, which also applies to the decision on the quantity of produced parts, duration and deadline.

The so-called 'two-day production' begins after the decision on the release set forth by the Quality Department in order to ensure the quality standards. Pre-series vehicles are used to verify the quality by the means of testing rides and type and other development tests. After corporate takeover ride (KAF) (approximately 2 months before SOP) follows the final release into production.

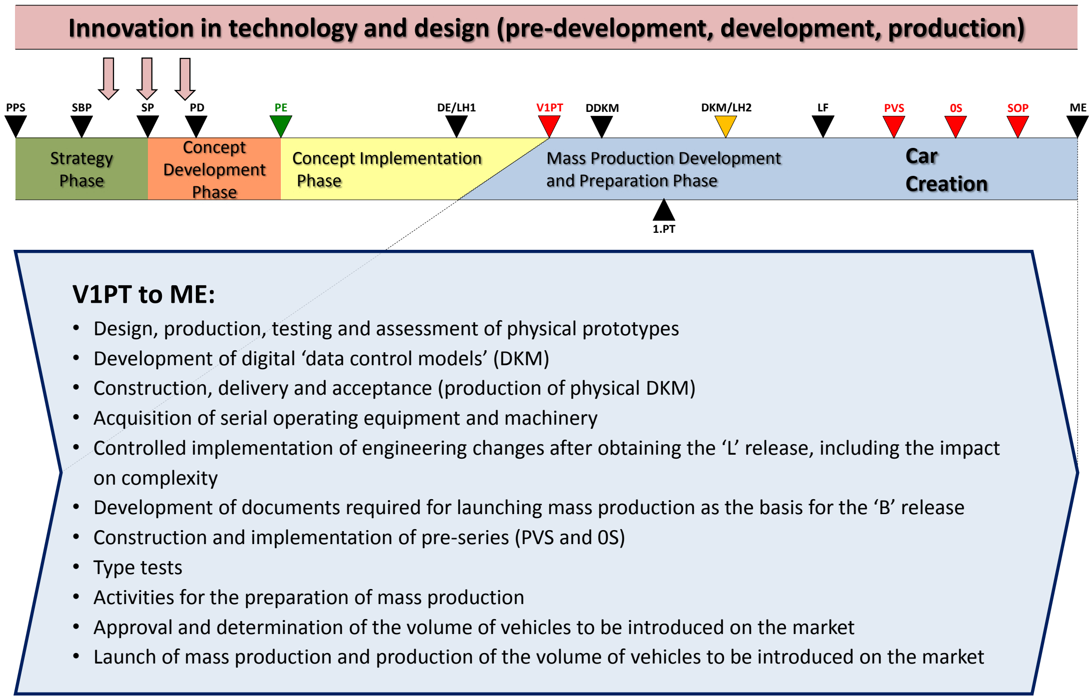


Figure 5.7 Mass production Development and Preparation Phase

5.2 MDPI Model Creation

The creation of the model itself is preceded by my decision to create such a model that would generalize a large number of theoretical and practical knowledge connected to this issue. It is an issue of business processes, business organization, economic efficiency, marketing, constant needs for innovation and industrial engineering and its application in terms of automotive sector, large industrial behemoths and big shopping centres, as well as in terms of small businesses that do not have expensive computing systems to manage their processes and a large foreign capital backing them up. Since I participated in several projects in many major industrial companies, I considered the possibility of applying my expertise in business process modelling in automotive conditions to be my personal challenge.

By collecting and studying a huge amount of available literature, using a thorough analysis of information available on the internet and on the basis of many years of active work in the automotive industry, which is currently the supporting industry of Slovak and European economy, I have decided to create a model tailored to the specific conditions in the process of product creation with an emphasis on product innovation in the context of marketing and especially the so-called B2B marketing (Business to Business), as described in this paper.

Through the creation of this model and its application in automotive sector, I have set a goal to develop a system of basic milestones of innovation processes, which would show that product innovations are also available in smaller companies and can be implemented even without spectacular investments if they are based on the use of inexhaustible human capital.

Based on the study of literature, I have created a network of milestones that occur in business processes, which the innovation process is part of, i.e. such process of improvement of business processes that leads to increased competitiveness in the area of knowledge and the use of legislative business standards and new technologies of virtual reality. I called it the **Model MDPI** (**M**arketing **D**riven **P**roduct **I**nnovation).

The following section shows an algorithm of the product creation process, which contains a process of general current steps, which is enhanced by a custom solution that covers the so-called '**MIVE**' (**M**atador **I**ntegrated **V**irtual **E**ngineering).

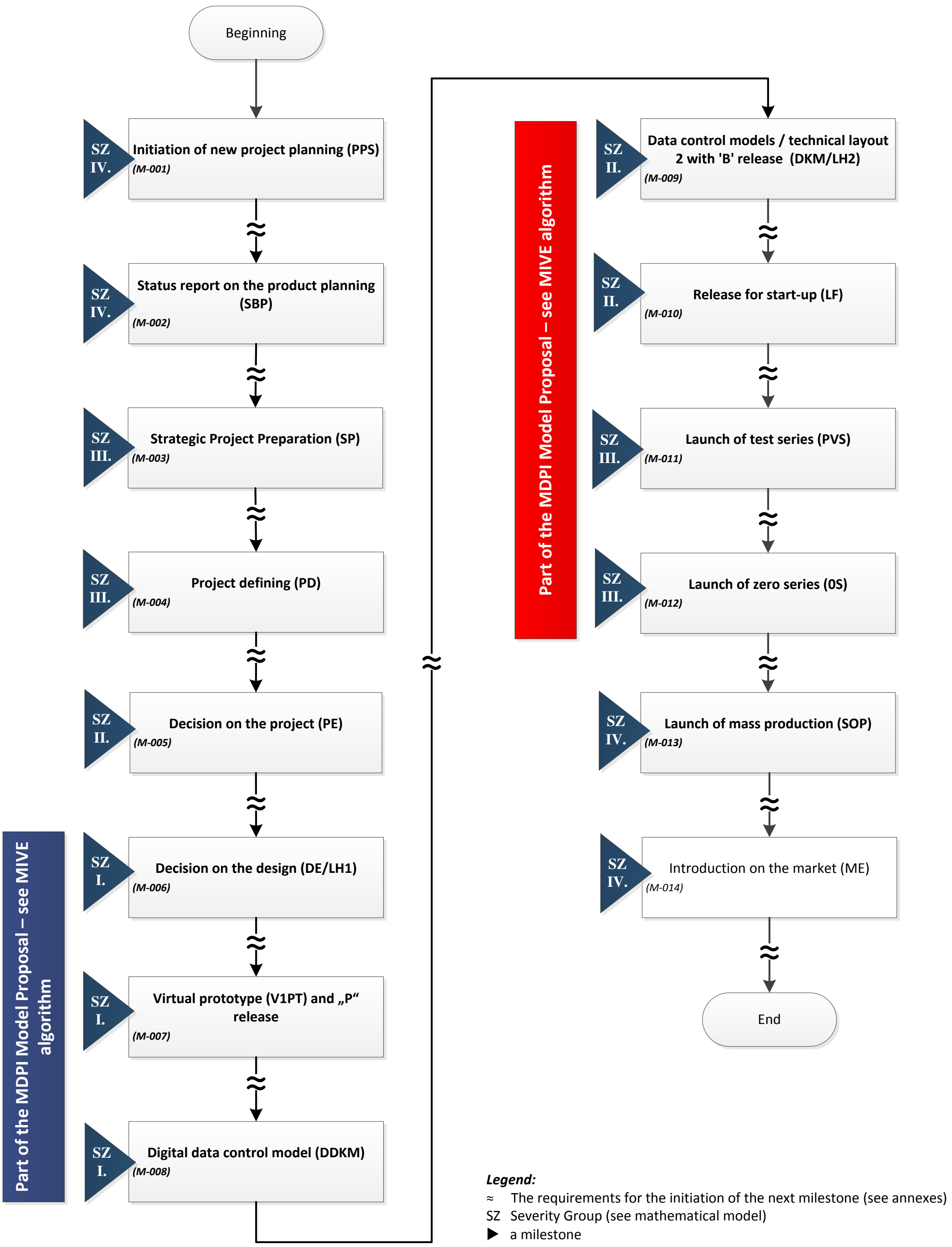


Figure 5.8 Generalized Algorithm of the Existing Product Creation Process

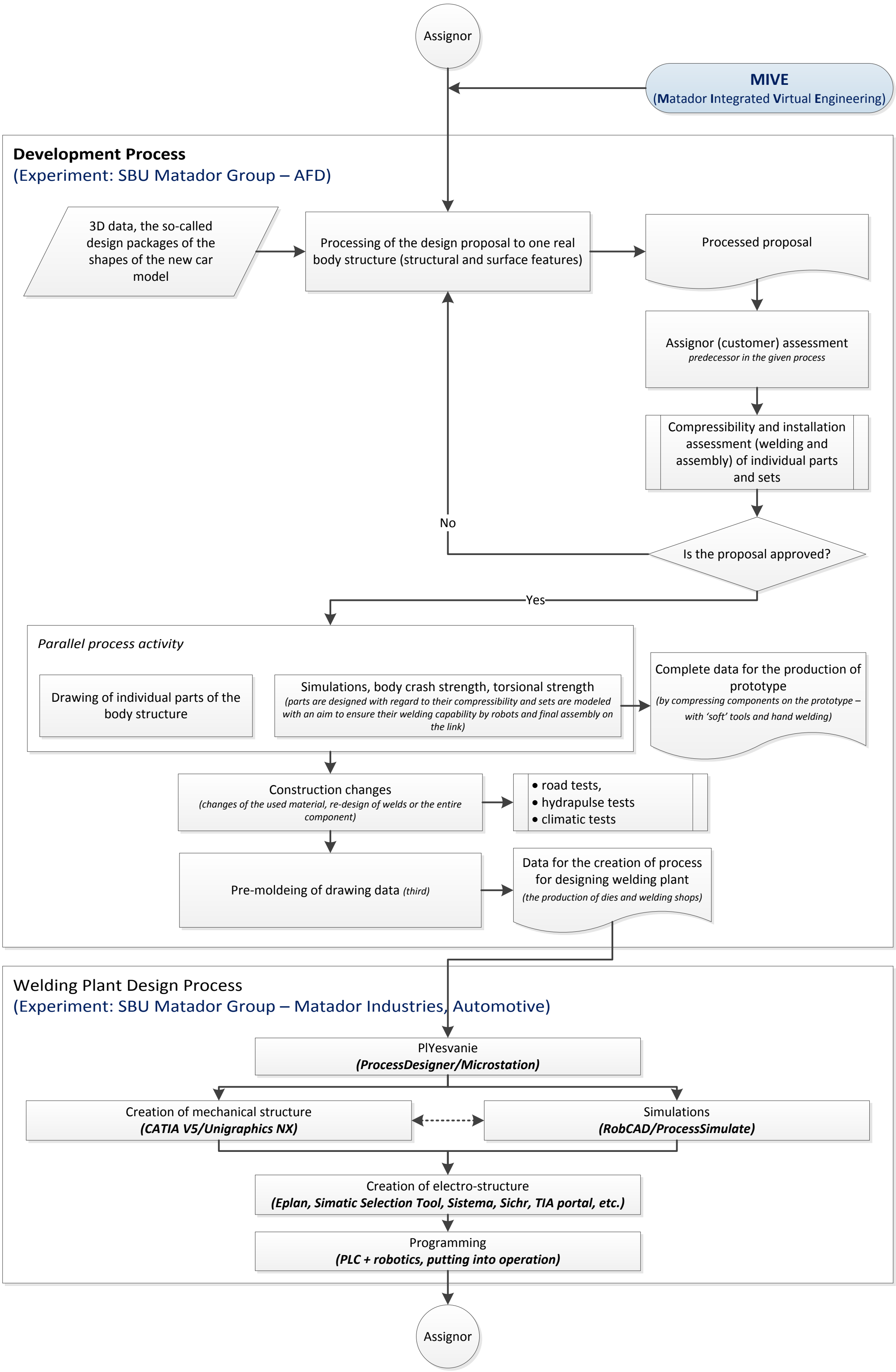


Figure 5.9 Proposed Solution Model Algorithm

5.2.1 Model MDPI & Digital factory

The future outlook shows that digital manufacturing can benefit next generation products. Any type of process elements are stored so that as modifications are made at any stage of product development, they are made to the entire design and manufacturing process. Current research requires huge investment. The governments support innovative research only partially. Our industry requires already Digital Factory solutions, unfortunately till now it has not been woken up and the willingness for investment into research and development does not exist, besides exceptions.

Any change, even the smallest one, brings risk of success. The change has to be realized by real people who do mistakes as well. The quality and speed of changes can be supported by 3D digital models of production systems. The Digital Factory system utilises 3D digital models of real objects (DMU – Digital Mock Up). FMU (Factory Mock Up) makes it possible to greatly enhance the communication among the design teams, to lower the risks evoked by making wrong decisions and to speed up innovation and increase the efficiency of the innovation process by improving the performance.

Such solution (model MDPI/MIVE) will support the education of future designers, designers of manufacturing systems, technologists and managers. Any university/SBU is obliged to educate students who will be able to design competitive products and production systems by the application of advanced information technologies. Determining tool of the MDPI model is modelling and simulation. The model is in cooperation with Digital Factory and one of the major methods of use is DMU/FMU. MDPI model determines the guide how to do it and mathematic model serves for evaluation of importance of individual indicators of the model.

5.3 Mathematical Model of the Proposed Solution

Mathematical model describes the steps to determine the severity of milestones ('M' elements) and underlying processes ('P' operators) of the MDPI Model, determines the necessary links between specific milestones and essential process (hereinafter the 'Process') of the model. It allows the evaluation of a larger amount of data important for the process improvement. Its use has helped to locate and remove the so-called loopholes in the information base relating to the problem.

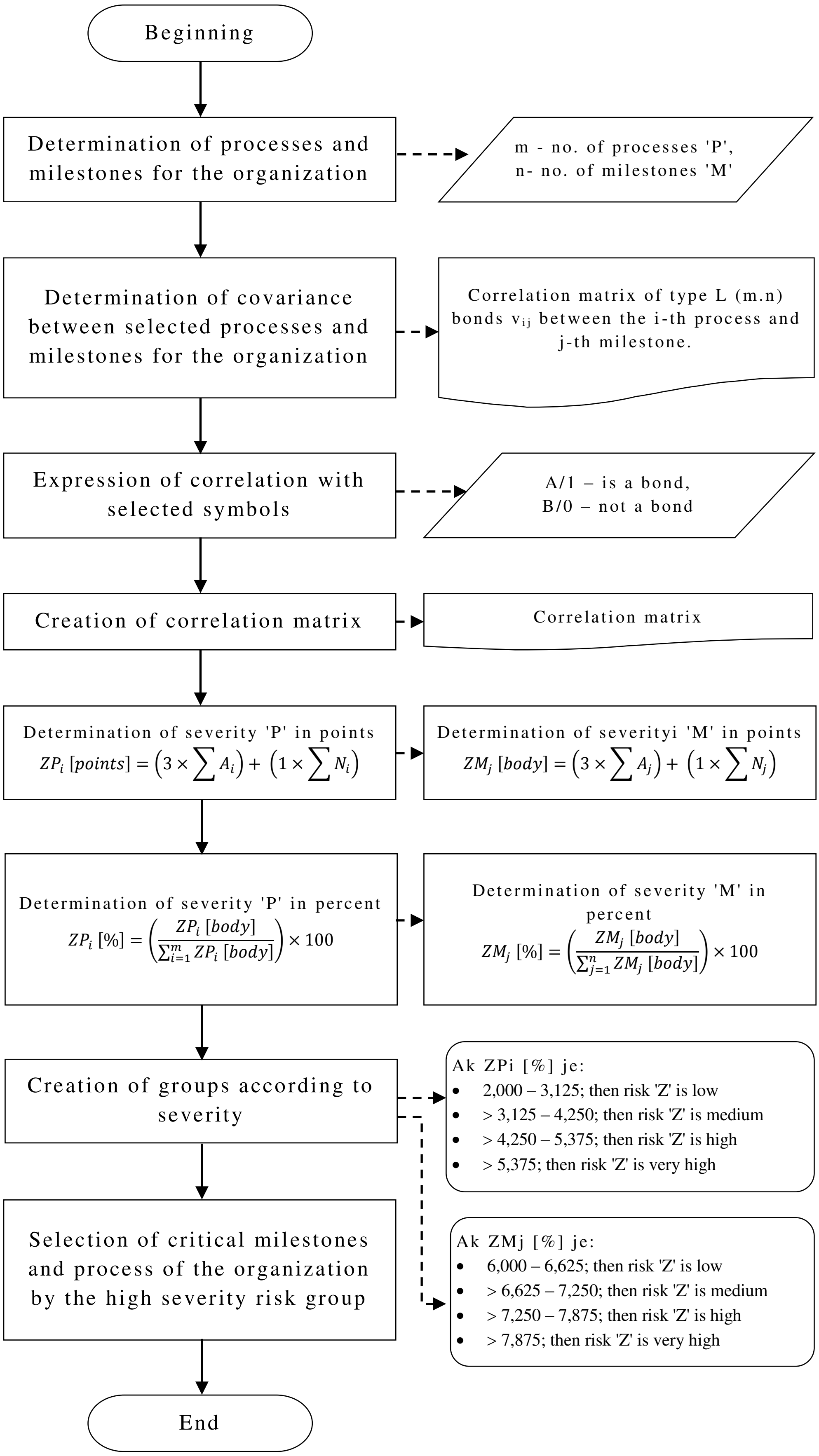


Figure 5.10 Mathematical Model Algorithm of the Proposed Solution

5.3.1 Determination of Severity and Bonds between Milestones and Essential Processes in the Product Creation Process of the MDPI Model

The first step in determining the seriousness of milestones and processes of the MDPI Model was to set bonds between the specific milestones and model process. Matrix diagram was used in the determination of this bond, which is used for holding and evaluating a large amounts of data that refer to two or more connected areas. Its use helped to locate and then remove the so-called loopholes in the information base relating to the problem. The matrix was progressively designed, developed and consulted with executives in selected companies. Individual results of the matrix were used as inputs for detailed analysis of severity of individual elements. Final results of the analysis, which are an integral part of the proposed MDPI Model were verified and applied in the implementation of the model as a whole in the selected company (see Chapter 'Model Implementation').

Matrix Diagram Preparation Procedure:

1. Draft Questions Reflecting the Bond between Milestones and Processes.

- For investigating the covariance between milestones and MPDI Model processes, the following question was given: 'Is the given process required to achieve the milestone?' (Answer - 'yes, given process is required to achieve the milestone' or 'no, given process is not required to achieve the milestone').

2. Suitable Type of Matrix Proposal

- To assess the bonds between milestones and processes, the correlation matrix of the 'L' type was used.

3. Proposals of Symbols Expressing Bonds between Milestones and Processes.

- To streamline the designation of bonds between milestones and processes, symbols whose legend is shown in the matrix diagram legend were used.

4. Matrix Development.

- Correlation matrix of the type L(m,n).
- 28 (m = 28) processes are shown in rows
- 14 (n = 14) milestones are shown in columns
- symbols that express the bonds between the i-th process and j-th milestone are shown in matrix cells, where i = 1, 2, ..., m; j = 1, 2, ..., n.

			Product Creation Milestones														Total	
			PPS 001 Initiation of new product planning	SBP 002 Status report on the product planning / product planning status	SP 003 Strategic project preparation	PD 004 Project Defining / Product Defining	PE 005 Decision on the project	DE/LH1 006 Decision on the design / construction / technical layout 1	V1PT 007 First virtual prototype with 'P' released (difference between the virtual and real model)	DDKM 008 Digital models for data control	DKM/LH2 009 Data control models / technical layour 2 with 'B' release (release of orders)	LF 010 Released for start-up	PVS 011 Launch of test series	0S 012 Launch of zero series	SOP 013 Launch of zero series	ME 014 Launch of zero series	A	N
Core Processes	001	Planning, monitoring and project	1	1	1	1	1	1	1	1	1	1	1	1	0	0	12	2
	002	Planning, monitoring and process management	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	13
	003	Design (interior, exterior)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	5	9
	004	Package and concept development	1	1	1	1	1	0	0	0	0	0	0	0	0	0	5	9
	005	Construction of interor / exterior, simulations, calculations, DMU, control units	0	0	0	0	1	1	1	1	1	1	0	0	0	0	6	8
	006	Release processes	0	0	0	0	0	0	1	1	1	1	0	0	0	0	4	10
	007	Data smoothing (Strak)	0	0	0	0	1	1	1	1	0	0	0	0	0	0	4	10
	008	Data control model	0	0	0	0	0	1	1	1	1	1	0	0	0	0	5	9
	009	Concept cars	0	0	0	0	1	1	0	0	0	0	0	0	0	0	2	12
	010	Prototypes	0	0	0	0		1	1	1	0	0	0	0	0	0	3	11
	011	Prototypes and pre-production vehicles	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	12
	012	Tests	0	0	0	0	0	1	1	1	1	1	0	0	0	0	5	9
	013	Pre-production vehicles	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	12
	014	Type tests	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	13
	015	Preparation of production, equipment, logistics	0	0	0	0	1	1	1	1	1	1	1	0	0	0	7	7
	016	Forward sourcing for externally developed components and purchase of operating equipment	0	0	0	0	1	1	1	1	0	0	0	0	0	0	4	10
	017	Production preparation	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	13
	018	Care of series products	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	13
	019	Production of vehicles	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	12
	020	Program Readiness	0	0	0	0	0	0	1	1	1	1	1	1	1	1	8	6
	021	Industrial, technological and logistic concepts	1	1	1	1	0	0	0	0	0	0	0	0	0	0	4	10
	022	Purchase concept	1	1	1	1	0	0	0	0	0	0	0	0	0	0	4	10
	023	Environmental protection	0	0	1	1	1	1	1	1	0	0	1	1	1	1	10	4
	024	Marketing, sales, servicing	1	1	1	1	1	1	1	1	1	1	1	1	1	0	13	1
	025	Pre-Launch	0	0	0	0	0	0	0	0	0	0	1	1	1	0	3	11
	026	Launch	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	13
	027	Servicing	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	13
	028	Measures for ensuring quality	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14	0
Total	A		7	7	8	8	11	12	13	13	10	10	8	9	7	7		
	N		21	21	20	20	17	16	15	15	18	18	20	19	21	21		

Legend:

- '1' – 'Yes' ('A'), given process/milestone is required to achieve the process/milestone*“;*
- '0' – 'N' *(„N“),*given process/milestone is not required to achieve the process/milestone
- 'A' – no. of bonds 'A' processes with given milestones

- 'N' – no. of bonds 'N' processes with given milestones

Figure 5.11 Matrix of Bonds between Processes and Milestones of the MDPI Model (Correlation Matrix)

5.3.1.1 Matrix Data Analysis

Analysis of the matrix data was carried out in two phases. Both phases were based on mutual bonds between milestones and processes of the model. In the first phase, an analysis was conducted to determine the severity of the individual milestones of the model, and in the second phase, the severity of individual processes of the MDPI model was determined.

This examination required the gathering of figures of the considered milestones and processes of the model. It was based on the previous correlation matrix, whose results served as the basis for the determination of bonds between individual milestones and processes of the MDPI Model. In the evaluation of the actual correlation matrix, graphic symbols were used that were assigned with strength / severity of individual bonds in order to perform more detailed analysis on the severity of individual milestones and processes. The following expression was used:

1	=	A	=	3	=	strong / necessary correlation
0	=	N	=	1	=	weak / unnecessary correlation

5.3.1.2 Milestone Severity Determination

Milestone severity determination is based on the mutual bonds between milestones and processes of the MDPI Model. Sum of the individual bonds are shown in the rows for the corresponding elements of the correlation matrix.

The severity of the milestones was determined by the relations:

- Milestone severity determination (in points)

$$ZM_j\ [points] = \left(3 \times \sum A_j\right) + \left(1 \times \sum N_j\right)$$

where: $ZM_j\ [points]$ – severity of j-th milestone in points

$\sum A_j$ – total number of bonds 'A' of the j-th milestone

$\sum N_j$ – total number of bonds 'N' of the j-th milestone

- Milestone severity determination (in percent)

$$ZM_j\ [\%] = \left(\frac{ZM_j\ [points]}{\sum_{j=1}^{n} ZM_j\ [points]}\right) \times 100$$

where: $ZM_j\ [\%]$ – severity of j-th milestones in percent

$ZM_j\ [points]$ – severity of j-th milestones in points

$\sum_{j=1}^{n} ZM_j\ [points]$ – sum of severities of all milestones in points

Results from the correlation matrix are shown in table (Figure 5.12). Sorting of the milestones according to their severity is shown in table (Figure 5.14).

ID	Milestone	Abbr	No. of Bonds		Severity	
			A	N	ZM_j [points]	ZM_j [%]
001.	Initiation of new product planning	PPS	7	21	42	6,44
002.	Status report on the product planning / product planning status	SBP	7	21	42	6,44
003.	Strategic project preparation	SP	8	20	44	6,75
004.	Project Defining / Product Defining	PD	8	20	44	6,75
005.	Decision on the project	PE	11	17	50	7,67
006.	Decision on the design /	DE/LH	12	16	52	7,98

ID	Milestone	Abbr	No. of Bonds		Severity	
			A	N	ZM_j [points]	ZM_j [%]
	construction / technical layout 1	1				
007.	First virtual prototype with 'P' released (difference between the virtual and real model)	V1PT	13	15	54	8,28
008.	Digital models for data control	DDKM	13	15	54	8,28
009.	Data control models / technical layout 2 with 'B' release (release of orders)	DKM/ LH2	10	18	48	7,36
010.	Release for start-up	LF	10	18	48	7,36
011.	Launch of test series	PVS	8	20	44	6,75
012.	Launch of zero series	0S	9	19	46	7,06
013.	Launch of mass production	SOP	7	21	42	6,44
014.	Introduction on the market	ME	7	21	42	6,44
				Sum	**652**	**100,00**

Figure 5.12 Milestone Severity Determination (Sorted by Function in Individual Phases)

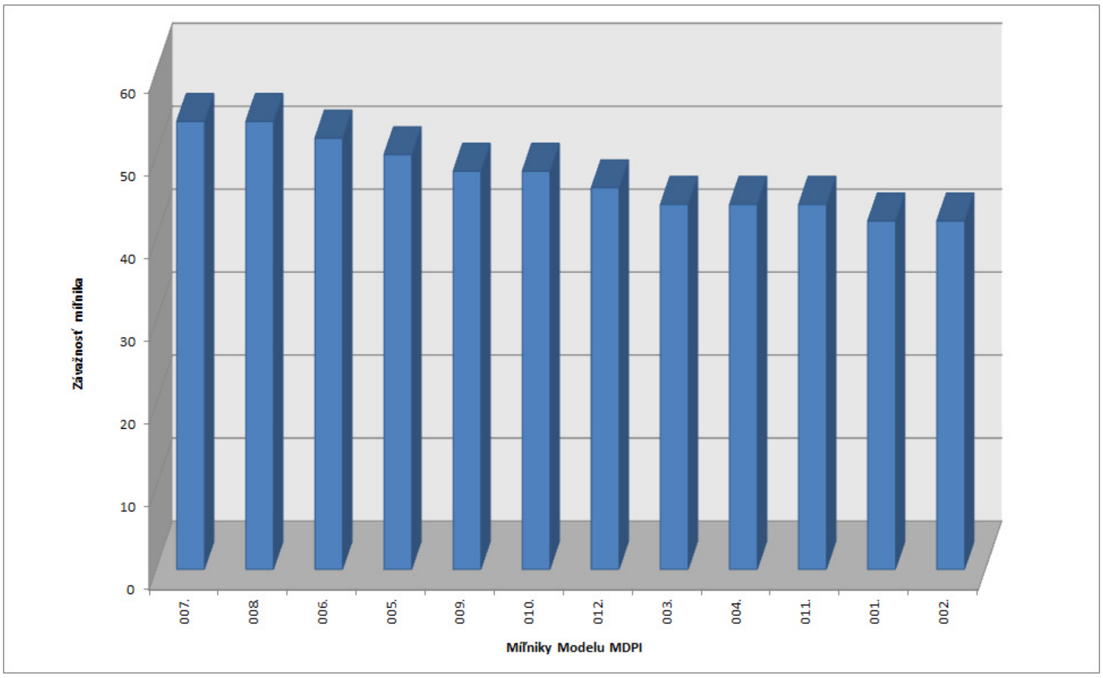


Figure 5.13 Milestone Severity Depiction in Points ((Sorted by Function in Individual Phase

Rank	ID	Element	ZP_j [%]	Severity Group (SZ)
1.	007.	First virtual prototype with 'P' released (difference between the virtual and real model)	8,28%	I.
2.	008.	Digital models for data control	8,28%	
3.	006.	Decision on the design / construction / technical layout 1	7,98%	
4.	005.	Decision on the project	7,67%	II.
5.	009.	Data control models / technical layout 2 with 'B' release (release of orders)	7,36%	
6.	010.	Release for start-up	7,36%	
7.	012.	Launch of zero series	7,06%	III.
8.	003.	Strategic project preparation	6,75%	
9.	004.	Project Defining / Product Defining	6,75%	
10.	011.	Launch of test series	6,75%	
11.	001.	Initiation of new product planning	6,44%	IV.
12.	002.	Status report on the product planning / product planning status	6,44%	
13.	013.	Launch of mass production	6,44%	
14.	014.	Introduction on the market	6,44%	
		Sum	**100,00**	

Figure 5.14 Ranking of the Milestones by Severity

SZ	Milestones Risk	Interval	No. of Milestones*	% of all Milestones**
IV.	Low	6,000 – 6,250 %	4	25,77 %
III.	Medium	> 6,250 – 7,250 %	4	27,30 %
II.	High	> 7,250 – 7,875 %	3	22,39 %
I.	Very High	> 7,875 %	3	24,54 %

Figure 5.15 Risk Determination (Severity Group) of the Milestones

* Number of milestones is based on the previous table (Figure 5.14)
** % of all milestones = (number of milestones in the given interval / total number of all milestones) * 100 [%]

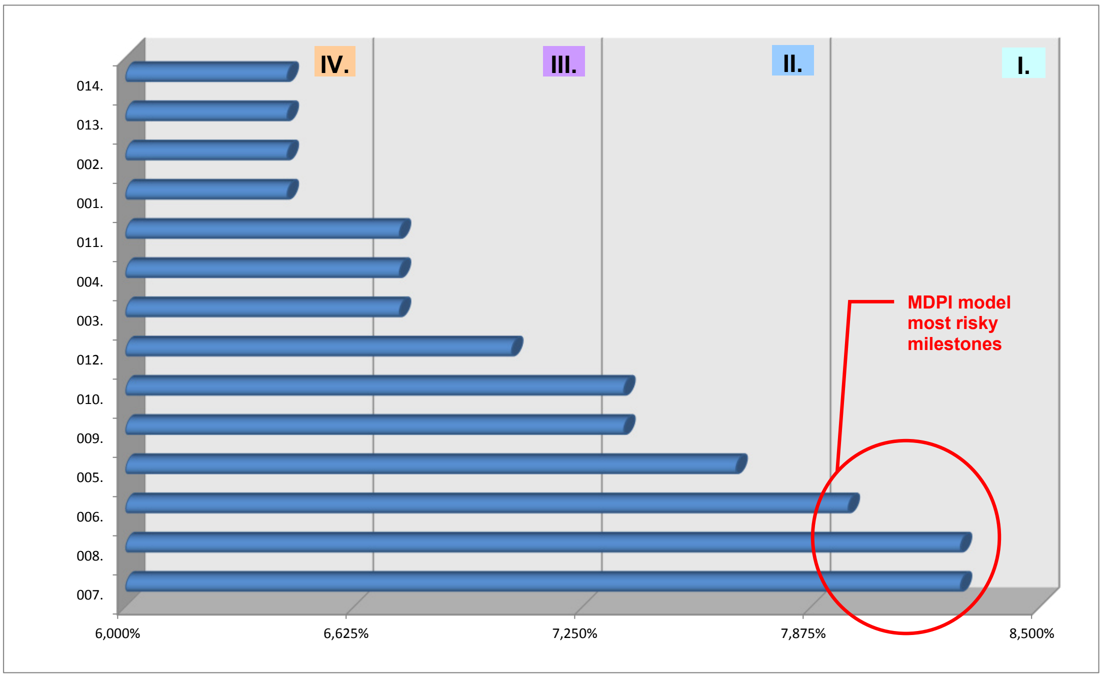


Figure 5.16 Risk Determination (Severity Group) of the Milestones

5.3.2 Process Severity Determination

Process severity determination is based on the mutual bonds between processes and milestones of the MDPI Model. Sum of all bonds of processes are shown in columns for the corresponding processes of the correlation matrix.

Severity of individual processes was determined by the relations:

- Process severity determination (in points)

$$ZP_i\ [points] = \left(3 \times \sum A_i\right) + \left(1 \times \sum N_i\right)$$

where: $ZP_i\ [points]$ – severity of the i-th process in points

$\sum A_i$ – total number of bonds 'A' of the i-th process

$\sum N_i$ – total number of bonds 'N' of the i-th process

- Process severity determination (in percents)

$$ZP_i\,[\%] = \left(\frac{ZP_i\,[points]}{\sum_{i=1}^{m} ZP_i\,[points]}\right) \times 100$$

where: $ZP_i\,[\%]$ – severity of the i-th process in percents

$ZP_i\,[points]$ – severity of the i-th process in points

$\sum_{i=1}^{m} ZP_i\,[points]$ – sum of severities of all processes in points

Results from the correlation matrix are shown in table (Figure 5.17). Sorting of the processes according to their severity is shown in table (Figure 5.19).

ID	Processes	No. of Bonds		Severity	
		A	N	ZP_j [points]	ZP_j [%]
001.	Project planning, monitoring and management	12	2	38	5,83%
002.	Process planning, monitoring and management	1	13	16	2,45%
003.	Design (interior / exterior)	5	9	24	3,68%
004.	Package and concept development	5	9	24	3,68%
005.	Construction of interior / exterior, simulations, calculations, DMU, control units	6	8	26	3,99%
006.	Release processes	4	10	22	3,37%
007.	Data smoothing (Strak)	4	10	22	3,37%
008.	Data control model	5	9	24	3,68%
009.	Concept cars	2	12	18	2,76%
010.	Prototypes	3	11	20	3,07%
011.	Prototypes and pre-production vehicles	2	12	18	2,76%
012.	Tests	5	9	24	3,68%
013.	Pre-production vehicles	2	12	18	2,76%
014.	Type tests	1	13	16	2,45%
015	Preparation of production, equipment, logistics	7	7	28	4,29%
016	Forward sourcing for externally developed components and purchase of operating equipment	4	10	22	3,37%
017	Production preparation	1	13	16	2,45%
018	Care of series products	1	13	16	2,45%
019	Production of vehicles	2	12	18	2,76%
020	Program Readiness	8	6	30	4,60%
021	Industrial, technological and	4	10	22	3,37%

ID	Processes	No. of Bonds		Severity	
		A	N	ZP_j [points]	ZP_j [%]
	logistics concepts				
022	Purchase concept	4	10	22	3,37%
023	Environmental protection	10	4	34	5,21%
024	Marketing, sales, servicing	13	1	40	6,13%
025	Pre-Launch	3	11	20	3,07%
026	Launch	1	13	16	2,45%
027	Servicing	1	13	16	2,45%
028	Measures for ensuring quality	14	0	42	6,44%
			Sum	**652**	**100,00**

Figure 5.17 Processes Severity Determination (Sorted by Function in Individual Phases)

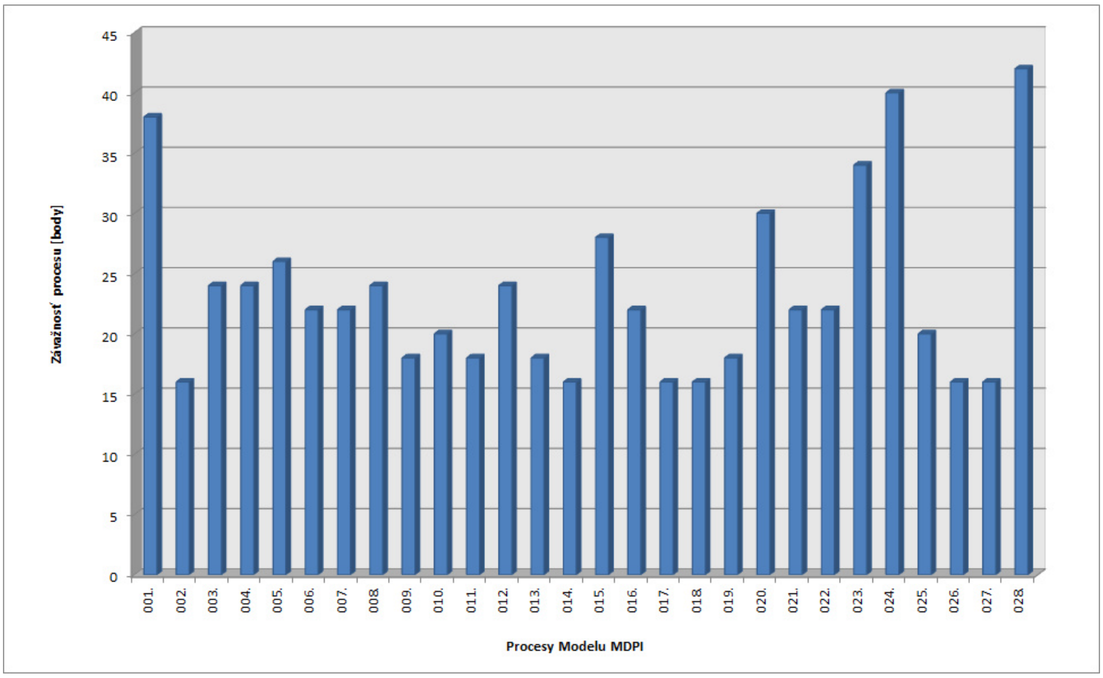


Figure 5.18 Processes Severity Determination in Points (Sorted by Function in Individual Phases)

Rank	ID	Element	ZP_j [%]	Severity Group (SZ)
1.	028.	Measures for ensuring quality	6,44%	I.
2.	024.	Marketing, sales, servicing	6,13%	
3.	001.	Project planning, monitoring and management	5,83%	
4.	023.	Environmental protection	5,21%	II.
5.	020.	Program Readiness	4,60%	

Rank	ID	Element	ZP_j [%]	Severity Group (SZ)
6.	015.	Preparation of production, equipment, logistics	4,29%	
7.	005.	Construction of interior / exterior, simulations, calculations, DMU, control units	3,99%	III.
8.	008.	Data control models	3,68%	
9.	012.	Tests	3,68%	
10.	003.	Design (interior / exterior)	3,68%	
11.	004.	Package and concept development	3,68%	
12.	007.	Data smoothing (Strak)	3,37%	
13.	006.	Release processes	3,37%	
14.	016.	Forward sourcing for externally developed components and purchase of operating equipment	3,37%	
15.	021.	Industrial, technological and logistics concepts	3,37%	
16.	022.	Purchase concept	3,37%	
17.	010.	Prototypes	3,07%	IV.
18.	025.	Pre-Launch	3,07%	
19.	009.	Concept cars	2,76%	
20.	011.	Prototypes and pre-production vehicles	2,76%	
21.	013.	Pre-production vehicles	2,76%	
22.	019.	Production of vehicles	2,76%	
23.	002.	Process planning, monitoring and management	2,45%	
24.	014.	Type tests	2,45%	
25.	017.	Production preparation	2,45%	
26	018.	Care of series products	2,45%	
27.	026.	Launch	2,45%	
28.	027.	Servicing	2,45%	
		Sum	**100,00**	

Figure 5.19 Ranking of the Processes by their Severity

SZ	Processes Risk	Interval	No. of Processes*	% of all Processes**
IV.	Low	2,000 – 3,125 %	12	31,90 %
III.	Medium	> 3,125 – 4,250 %	10	35,58 %
II.	High	> 4,250 – 5,375 %	3	14,11 %
I.	Very high	> 5,375 %	3	18,40 %

Figure 5.20 Risk Determination (Severity Group) of the Processes

* Number of processes is based on the previous table (Figure 5.19)
** % of all processes = (number of processes in the given interval / total number of all processes) * 100 [%]

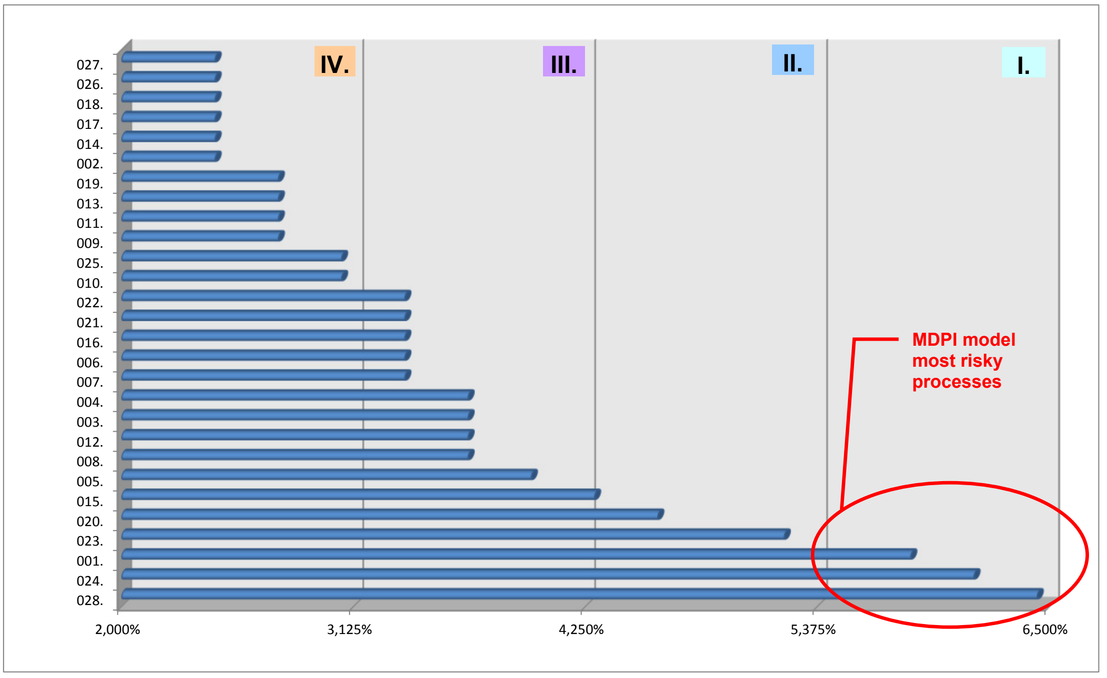


Figure 5.21 Risk Determination (Severity Group) of the Processes

6 MODEL IMPLEMENTATION (EXPERIMENTAL SECTION)

Proposed model was elaborated / validated in the conditions of an independent industrial and investment group **Matador Group/Matador Holding, a.s**. in its selected strategic business units (SBU) **Aufeer Design, s.r.o.** headquartered in Mlada Boleslav, Czech Republic and **Matador Industries, a.s.** Dubnica, Slovak Republic.

The model was based on the main objective of the paper, which was:

- Propose a model to improve business processes in the field of innovation to achieve a growth of the added value in the context of marketing (B2B marketing).

Paper Milestones:

- Draft system identification of the elements essential in the improvement of business processes.
- Define methods for the analysis of the elements involved in improvement processes in order to improve a new added value.
- Draft a set of key indicators - operators - for measuring and monitoring processes.
- Draft operational model for managing and improving processes.
- Verify the validity of the proposed model.

6.1 History and Company Profile

Matador Holding, Ltd. s the mother company of the group and serves as its headquarters as well. It ensures services for other group companies in the area of human resources, accounting and finance and procurement. (http://www.matador-group.eu/)

Aufeer Design, Ltd., a company headquartered in Mlada Boleslav, Czech Republic specializes in design, engineering, development, simulation and computation works for various automotive OEMs and their Tier-1 system suppliers. More than 120 designers and engineering professionals provide services to customers either on the company's site and in its branches or directly on customers´ premises world-wide. Matador Group bought into Aufeer Design, s.r.o. in 2006 with an objective to provide its customers with the additional value through early supplier involvement link, development and engineering services relevant to its new product offerings. As a result, the Matador Group has been aspiring to become a full-service system supplier with an ability to cater its clientele with comprehensive turn-key solutions.

Activities of **MATADOR Industries, a.s**. include customized and low-volume mass production in the general engineering, industrial automation and production of press dies. With company´s equipment, the company is prepared to provide its customers with quality products for variety of industries - the automotive, aerospace, energy and precise products for the petrochemical industry, food industry, or also manufacturing program of medical technology.

6.2 Validity Verification

Prior to the massive deployment of CAD technology, there were approximately 24 months (from the planning to SOP).to deliver classic welding lines to the car company. In this period, the planning and design of welding plant was based entirely on empirical experience gained in previous projects. For instance, welding guns were fabricated by using cardboard models of these guns. The line was designed according to previous experience (without the possibility to check it in 3D) and, indeed in the reality (during the construction in the plant), all technologies were tested and tuned directly during the assembly. This method was very inefficient and tedious. Deployment of CAD technologies and 3D simulations (RobCAD) shortened the time needed to deliver lines to 12 months. Today, it goes without saying that all the things that were previous made in the plant are now prepared, designed and verified during the pre-production stages, as described in the Welding Plant Procedure. Of course, the deployment of those new virtual technologies helped to achieve significant savings even in the production stages and significantly decreased a percentage of errors, and as was already mentioned, massively shorten the time needed to implement welding lines.

The monitored company used CAD SW in the construction of lines but not simulations. The deployment of simulations (virtual reality - simulations (Robcad)) brought the following savings for the company:

Time Required for:	**Shortened by: [%]**
Design and creation of plants / layouts, etc.	-20 %
Programming of robots using offline program.	-25 %
Putting of links into operation	-15 %

Costs Associated with:	**Decreased by: [%]**
Production of consoles, plants, grippers, etc.	-8 %
Workload of programmers	-25 %

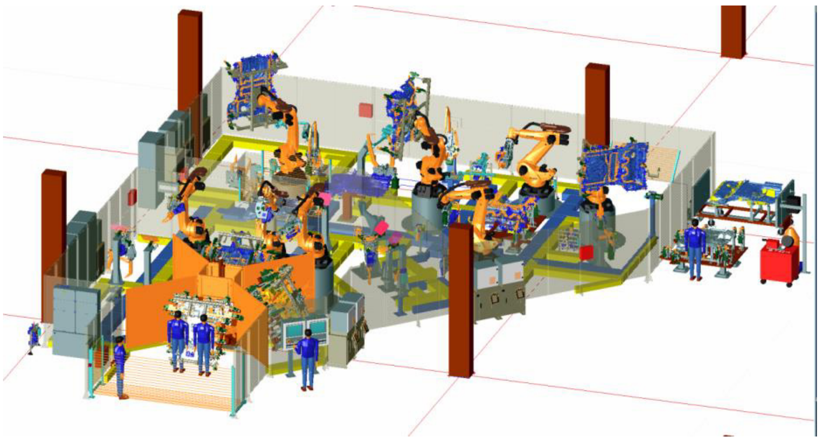


Figure 6.1 Demonstration of Implemented Part by Using the Proposed MDPI Model

It is beneficial to do everything in one company. That way, it is possible to exploit all the synergies and know-how, for example from melding to body of an automobile and so on. It is essential to consistently use all new materials, processes, software and hardware.

7 ASSESSMENT OF THE PROPOSED SOLUTION OF THE MASTER'S THESIS

The main objective of this paper was to propose a new model to improve business processes. The model was designed to increase new value added achieved through the innovation process within the context of B2B marketing. The main objective of this paper was achieved. MDPI Model has been designed for the needs of the development of automotive industry. It is versatile and designed so that it can operate in large companies (or just in their SBU) as well as in small companies, in all stages and phases of business processes. Its main contribution is the processing of methodology describing bonds between core milestones of business improvement processes and core processes affecting product creation process. Processing of this methodology also fulfilled all milestones of this paper. Verification of the validity of the proposed model is confirmed by the previous section.

7.1 Theoretical Benefits

Theoretical benefits of this paper are especially in the unusual incorporation of theoretical conclusions in various basic and application scientific disciplines into a single entity - innovative mapping of the issue. This innovative processing without the use of too many formulas, calculations and engineering terminology is what I believe to be an essential contribution that can facilitate and streamline practical use of age-diverse work categories - from first-year university students to managers and small business owners or factory team leaders. Despite several simplifications, I have followed all technical terminology and my theoretical conclusions were based on a large amount of literary sources written by best known experts on the issue of business processes.

I see additional theoretical benefits in the use of older scientific papers and their use in new context with latest works and translations of foreign literature and popular scientific books.

Benefits for the Development of the Theory:

- creation of a model for improving business processes to achieve growth through new added value of the innovation process;
- processing of system identification of the elements (milestones) essential in the improvement of business processes ;
- creation of methodology for defining method groups for the analysis of elements (milestones) active in the improvement of processes;
- development of set of key indicators -- basic processes -- for the measurement and monitoring of bonds between processes and milestones;
- creation of a mathematical model for determining the severity of the processes and milestones in a company;
- development of a set of algorithms for continuous systematic approach to process improvement model (MIVE and the like.).

7.2 Practical Benefits

Practical benefits of this paper are such that the conclusions from various disciplines are summarized in the MDPI Model, which can be used in teaching vocational subjects, e.g. management, marketing, information systems, information technology and others, or to be issued separately as a practical study tool. The practical importance of the paper lies also in its computer presentation.

Practical benefits:

- mapping of the innovation process elements in the SBU;

- determination of the conditions for rapid mobilization of active elements of the innovation process;
- processing of the manual for process improvement through the elements;
- use of manual for various educational activities;
- verification of validity of the proposed solution in practice.

7.3 Recommendations for Further Research

Currently, research and development grows in importance in order to achieve competitiveness due to various driving forces, such as: customers prefer novelty products and services as a strong buying incentive; with the same technology and business conditions due to globalization, innovations are the most important source of gaining competitive advantage; general trend of shortening innovation cycles of products and services in response to changes in the business needs and conditions; products and accompanying services are becoming increasingly more complex: they have complex interdisciplinary relationships (new materials, information technology, environmental science, structural configurations, socio-economic factors, etc.); research and development as a knowledge-creating value with a high added value and market potential. In its model of improving business processes, I suggest to create conditions for improvements as a certain business cluster. Despite the fact that the efforts of the European Commission focus on the creation of regional clusters, no significant results of the research were achieved. Shortcoming of this research is the quantity of fragmented capacities. Therefore, my main recommendation for further research in terms of MSP / SBU is a better cooperation with the monitored companies, which will have a positive impact on the innovations and competitiveness; growth and long-term business momentum. I suggest focusing the research on informal social mechanisms that encourage competition through innovation.

Very interesting area is the incorporation of the proposed solution into digital enterprise system and creation of software support, as a tool for supporting knowledge base for the development of a wide range of innovation management. The proposed model allows each worker to assess individual responsibility for a specific process and specific milestone through a responsibility matrix.

8 CONCLUSION

Science and innovation are key factors that will help Europe to gradually achieve smart, sustainable and inclusive growth and to address urgent social challenges. However, Europe is struggling with a number of significant shortcomings in its science and innovation system, which aggravates the problem. The key causal factor are gaps in the structure of innovation in Europe - compared to its competition - Europe has a poor performance in patenting and lags in development of new products, processes and services. Increase of the productivity and growth necessarily requires the creation of breakthrough technologies and their conversion into new products, processes and services. Europe has taken early on leadership in technology in a number of key technology areas; however, in an environment of increasing competition, it loses its edge as it fails to convert it to innovation and leading competitive position. If Europe wants to remain competitive and bridge the 'valley of death', it needs to adopt timely and targeted European policy.

In conclusion, the development of innovative models is completed. The development of science, research, business environment and customer needs will result in the development and establishment of new models.

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http://www.matador-group.eu/

http://www.oecd.org/

http://www.podnikajte.sk/

http://www.privatbanka.sk/

http://www.statistics.sk/

http://www.sutn.sk/

http://www.zapsr.sk/

LIST OF FIGURES

LIST OF APPENDIXES

Appendixes 1: Methods Used in the Solution

Facts Obtaining Method

These are methods that provide the collection, fixation, classification and generalization of the source material for processing theoretical conclusions of other authors and own knowledge.

- **Literary Method -** Literary Method, also called the study of literature (Višňovský 1998) is considered to be a method for the preparation of the scientific and research activities. It was used in the study of literary sources (scholarly publications, scientific studies, articles, web portals) and legislative documents to gain basic knowledge on the subject and also a brief analysis of the examined area.

- **Content Analysis -** It focuses on the content of the text units, which are evaluated in terms of their qualitative and quantitative parameters. Quantitative indicators of the text are generally used as partial auxiliary variables.

  Content of the evaluation tools was analyzed using the method of content analysis, which focuses mainly on the analysis of written texts (Gavora 2001).

Processing Methods and Evaluation of Acquired Information

Accumulated research material gains its value after a proper processing and evaluation. We applied mathematical and statistical techniques, methods of material analysis, methods of logical conclusions (analysis, synthesis, induction, deduction, etc. and heuristic methods, etc (Grznár & Gregor 2008).

- **Analysis and Synthesis -** According to Skalkova (Skalková et al. 1983), the analysis of processes and phenomena means the separation of the whole into individual parts. It allows us to separate the essential from the unimportant, to distinguish persistent phenomena from random phenomena. Furthermore, it allows to detect various aspects and features of phenomena and processes and also to set forth its stages.

  After a certain analytical process, we again try to achieve the original unit. Therefore, there is a synthesis, which is defined as the joining of parts, separated through the analysis, into a single unit.

  In this paper, we have used the analysis in the collection, processing and analysis of information that we have acquired from the study and research of the above resources and economic reports, business documents and legislative documents. We have used the synthesis during the overall evaluation.

  We have also applied the method of analysis wherever it was necessary to carry out a proper analysis. We have it used it when analyzing the process improvement methods, as well as when analyzing the knowledge in the area of innovation management. We have also used the analytical method when mapping the processes during the data collection and analysis of the current state.

  We have used synthesis wherever it was necessary to derive general principles from drawn conclusions. Synthesis was fully exploited in the paper and its output is the designed Model MDPI.

- **Induction and Deduction -** In the process of learning, the induction and deduction always jointly emerge. They are two tightly coupled and mutually conditioning moments of the complex dialectical process of cognition.

  The term induction refers to the traditional sense of logic judgment, from partial to general. It is a complicated way of inferring conclusions from known hypothetical claims of phenomena, facts and events that we acquire during experiments and observations (Skalková et al. 1983).

We have applied the induction method in drawing general conclusions in order to learn the observed phenomena and to reveal its essential principles. We have used the deduction in deducing the consequences of hypothesis, whose truth we verified, and in justifying our conclusions.

Induction method was also used wherever general conclusions were drawn.

Deduction method was also used wherever specific cases were derived from general principles.

- **Some Mathematical and Statistical Methods -** The use of mathematical methods in science leads to an accurate quantitative descriptions of the phenomena contributing to the development of clear concepts and their relationships (Skalková et al. 1983).

  For better understanding, we have visualized the evaluated facts in charts and graphs. We have used the Microsoft Office suite to process statistical data (Excel 2010).

- **Simulation Methods -** They have been used in the design and implementation of the verification model. Through simulation methods, we have extracted real processes into virtual processes, in other words, into models that were subject to our experiments (Kováč 2002).

Appendixes 2: Legislation for Innovation (EU, SK)

EU/European Research and Innovation:

- European Commission initiative (the 'EC') called '**Innovation Union**' presented in Brussels on 6 October 2010 sets out a strategic approach to innovation, which is supported at the highest political level. Europe's efforts and cooperation with third countries will focus on challenges such as climate change, energy and food security, health and aging of population through the Innovation Union. Public sector interventions are used to stimulate the private sector and to remove barriers that hinder the idea of penetrating the market. Such barriers include lack of finances, fragmented research systems and markets, under-use of public procurement for innovation and slow setting of standards. The Innovation Union is a pilot project for Europe 2020. (http://europa.eu/)
- **CORDIS** stands for information services on research and development in the Community. It is an interactive information portal (http://cordis.europa.eu/) to promote European cooperation in research and innovation.
- **Oslo Manual** – presents suggested guidelines for collection and interpretation of data on technical innovation. (http://www.oecd.org/).

SR – Documents, Standards and Laws:

- Innovation Policy of the SR for the years 2011-2013.; Innovation Strategy of the SR for the years 2007-2013/2014-2020; Strategy of the SR 2020. (http://www.economy.gov.sk/)
- STN EN 1325-1: Value Management Dictionary, Value and Functional Analysis. Part 1: Value and Functional Analysis. Bratislava, SÚTN 1999.; STN EN 12973: Value Management. Bratislava, SÚTN 2001. (http://www.sutn.sk/)
- Collection of Laws No 402/2002. Act of 26 June 2002 amending and supplementing Act No 435/2001 Coll.; Collection of Laws No 435/2001. Act of 4 October 2001 on Patents, Supplementary Protection Certificates, as amended (the 'Patent Law').

Appendixes 3: The Reference to Automobile Producers in Supply Chain

The final producers of automobiles, making a final product for the consumer marketplace are often referred as **OEM producers** (OEM – Original Equipment Manufacturer).

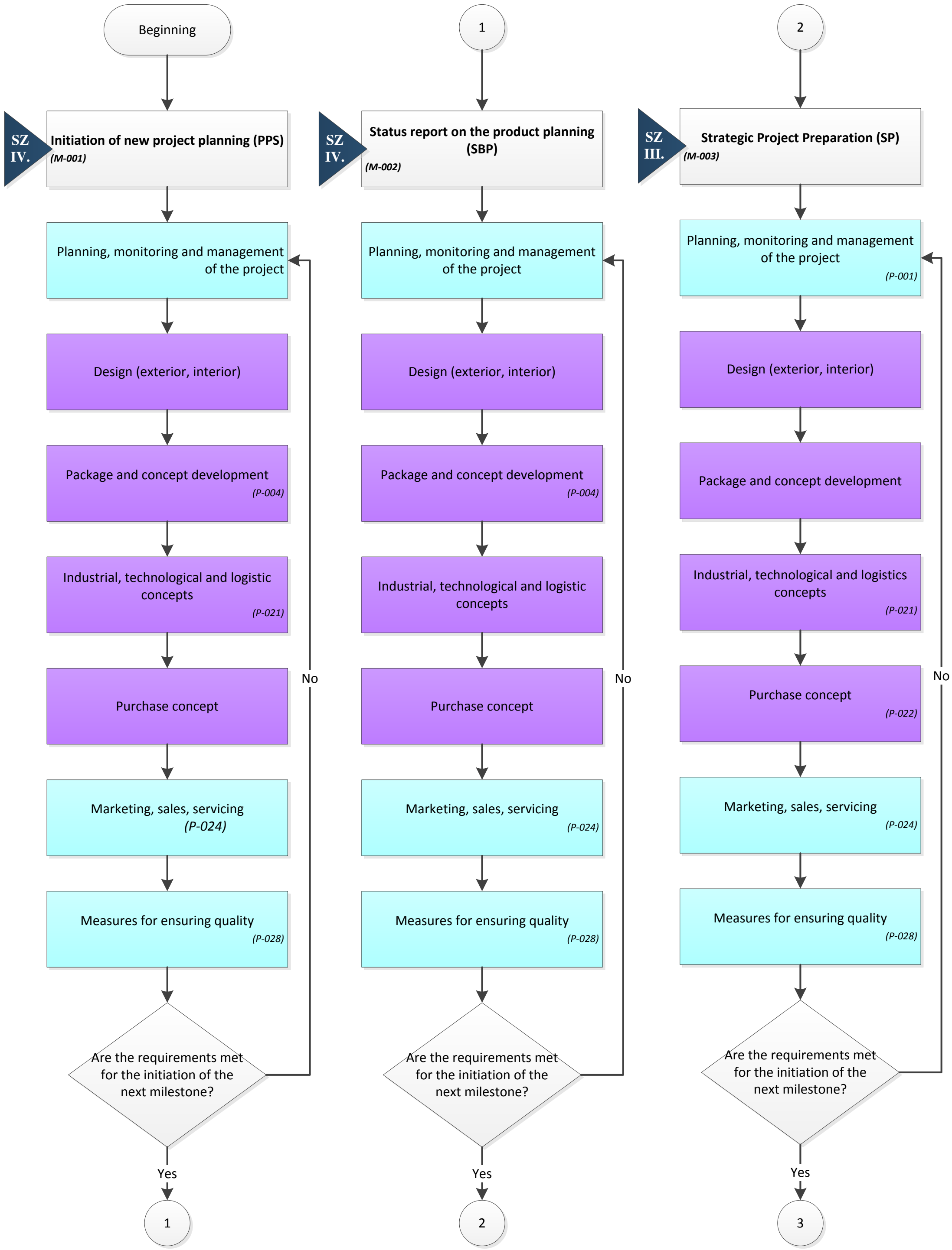
Sarokin (http:/www.oecd.org/) has introduced that OEMs refer to companies in their supply chain as tier one and tier two suppliers.

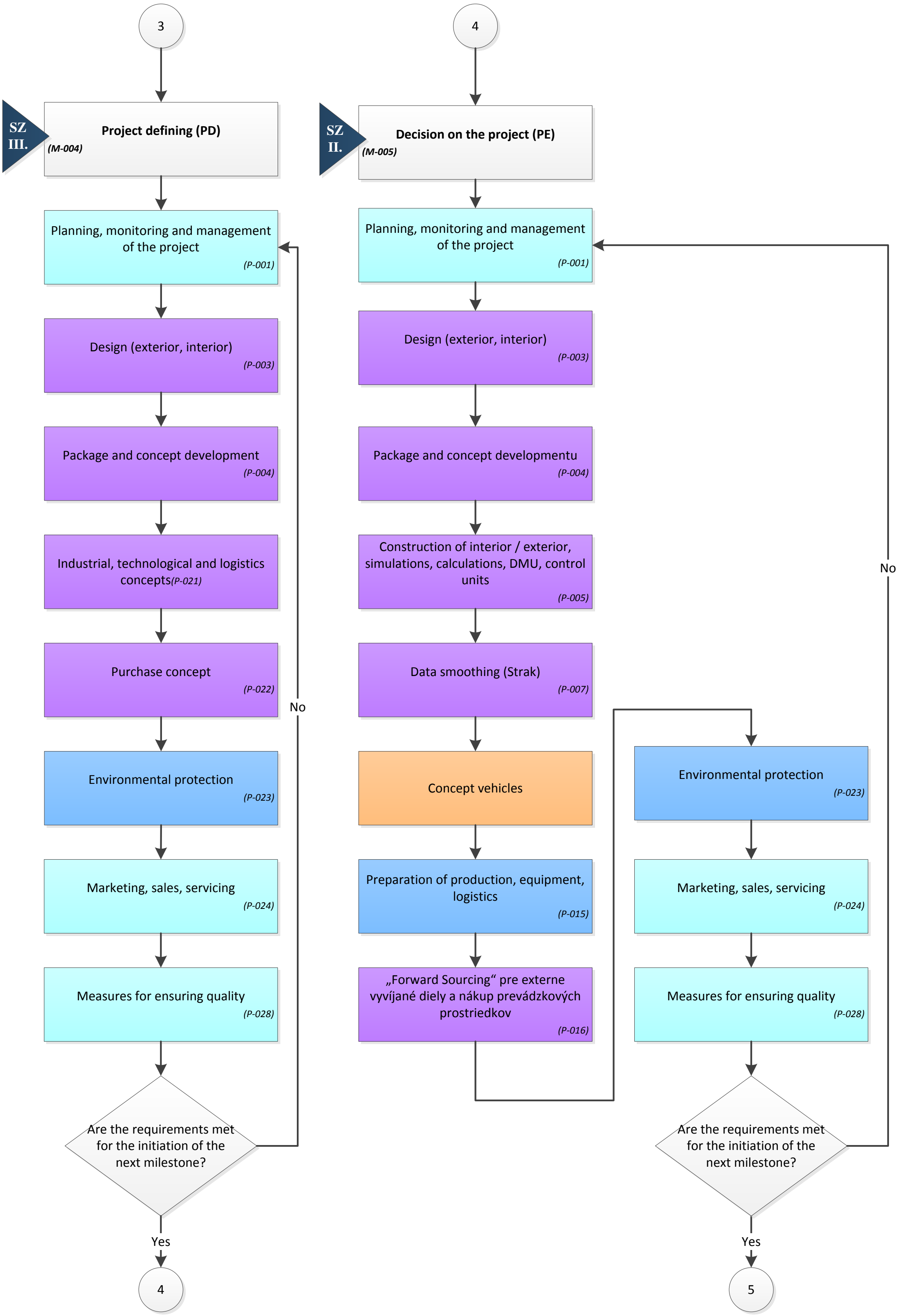
Tier one companies are major direct suppliers of parts and aggregates to OEMs. They create backbone of the supply chain with the aim to link important business functions and processes in the supply chain into an integrated business model for OEM. Tier one companies are generally the largest or the most technically-capable companies in the supply chain. They have the skills and resources to supply the critical components that OEMs need and they have established processes for managing suppliers in the tiers below them. Tier one companies and OEMs also develop joint strategies for improving supply chain performance and they often take responsibility for functions originally carried out by OEMs.

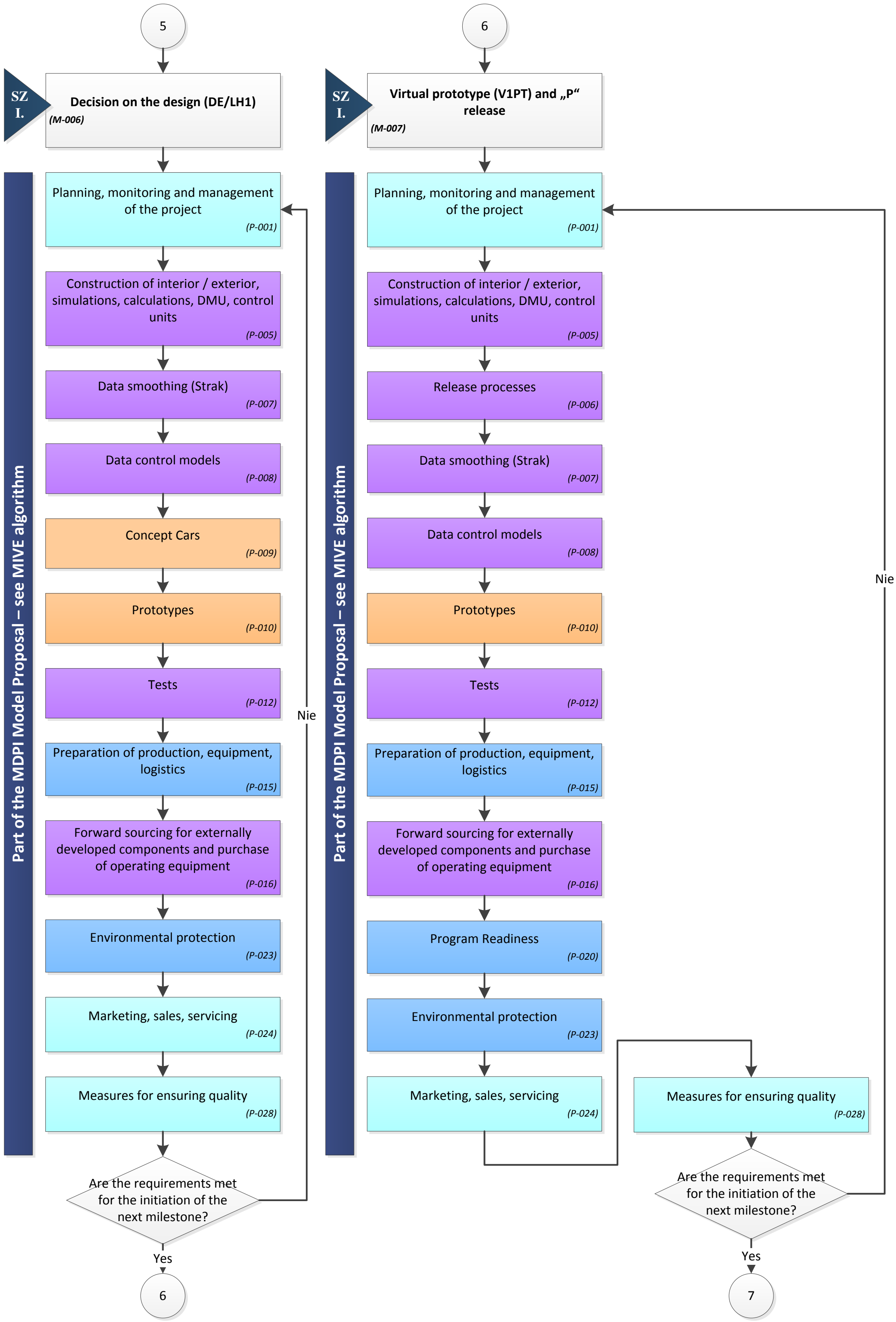
Tier two companies are the key suppliers to tier one suppliers, without supplying a product directly to OEM companies. However, a single company may be a tier one supplier to one company and a tier two supplier to another company, or may be a tier one supplier for one product and a tier two supplier for a different product line.

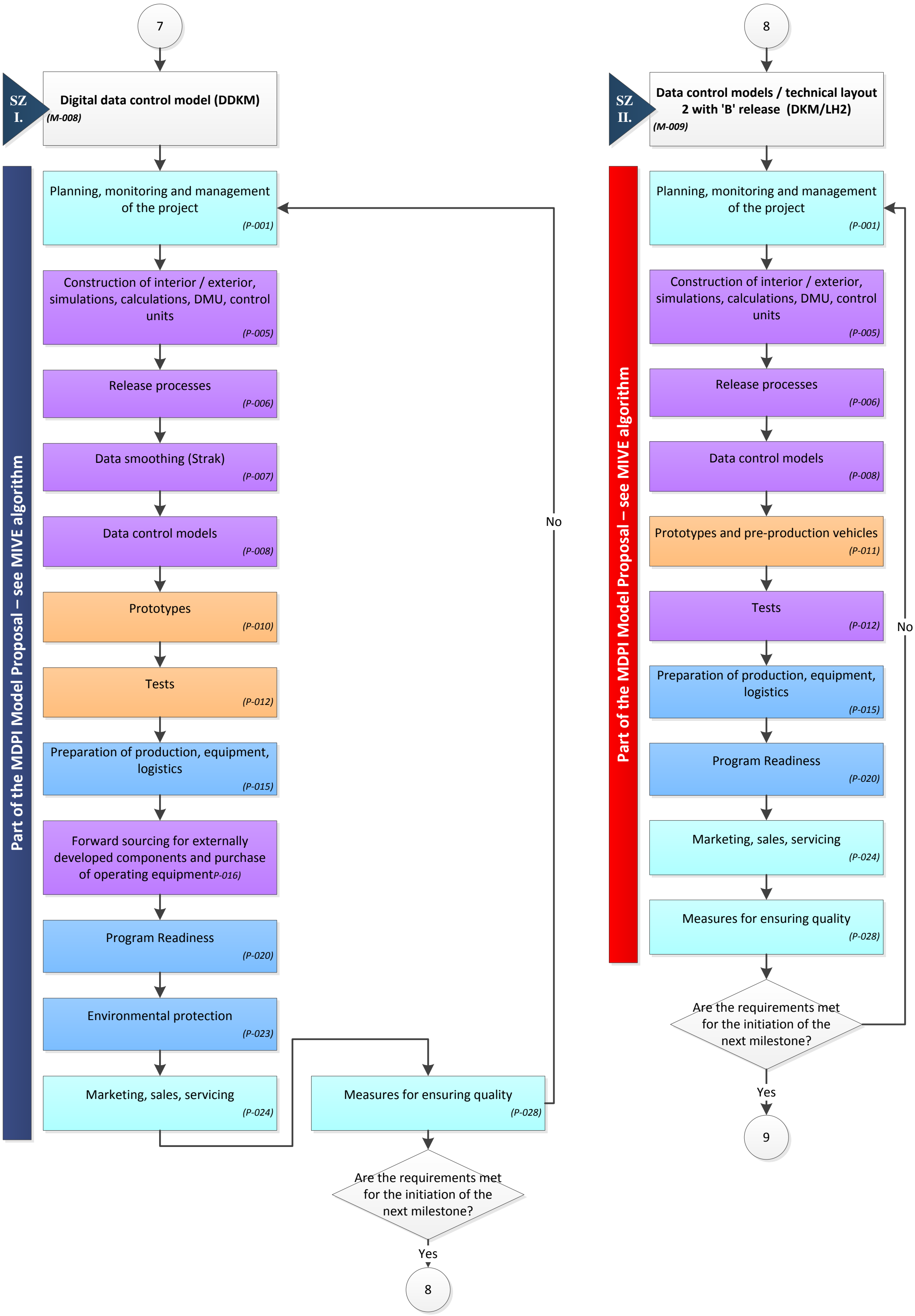
Companies sometimes find it convenient to distinguish other tiers. Tier three companies are supply tier two firms. Tier four companies are the providers of basic raw materials, such as steel and glass, to higher-tier suppliers.

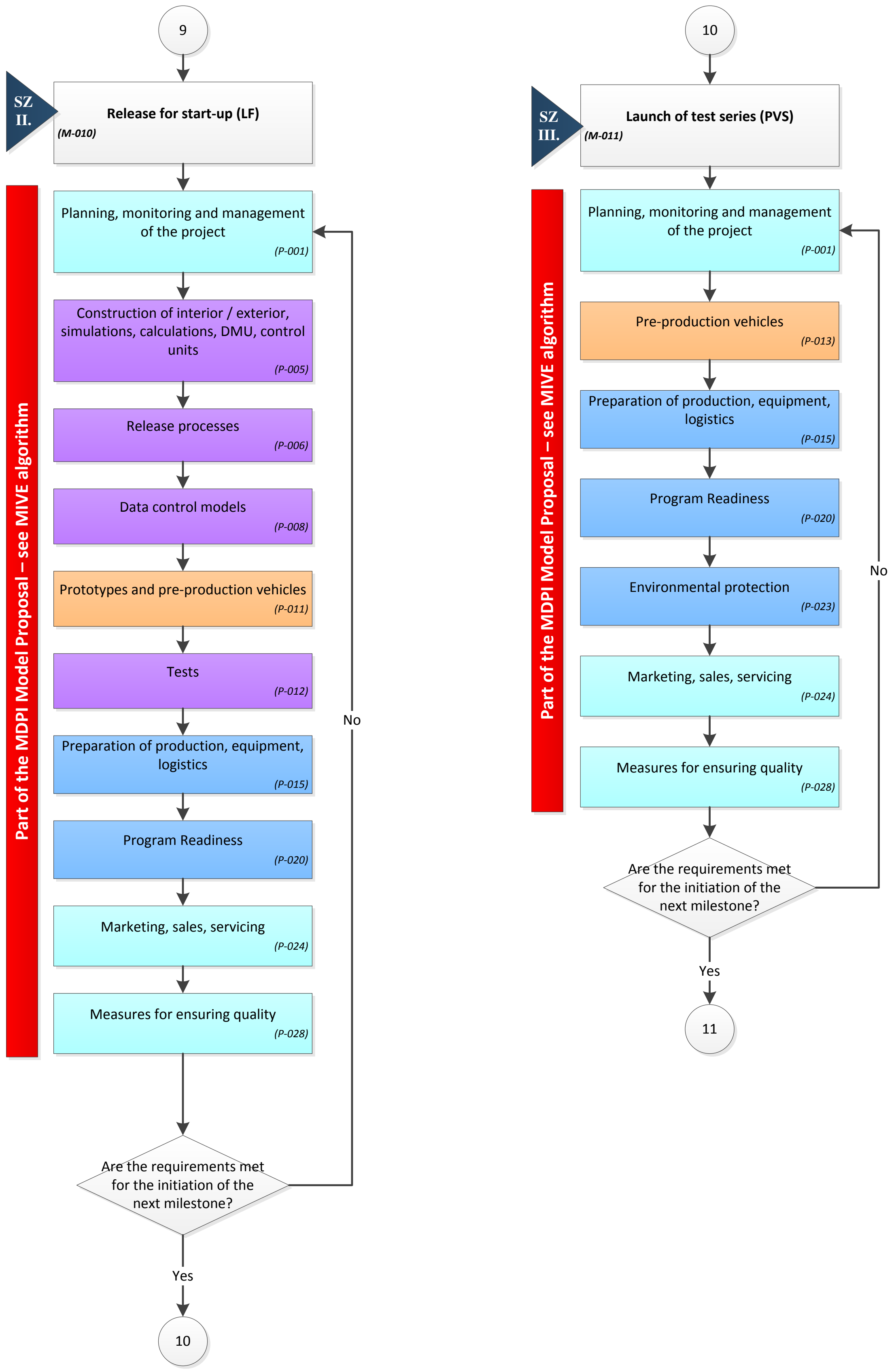
Appendixes 4: Generalized Algorithm of the Existing Product Creation Process

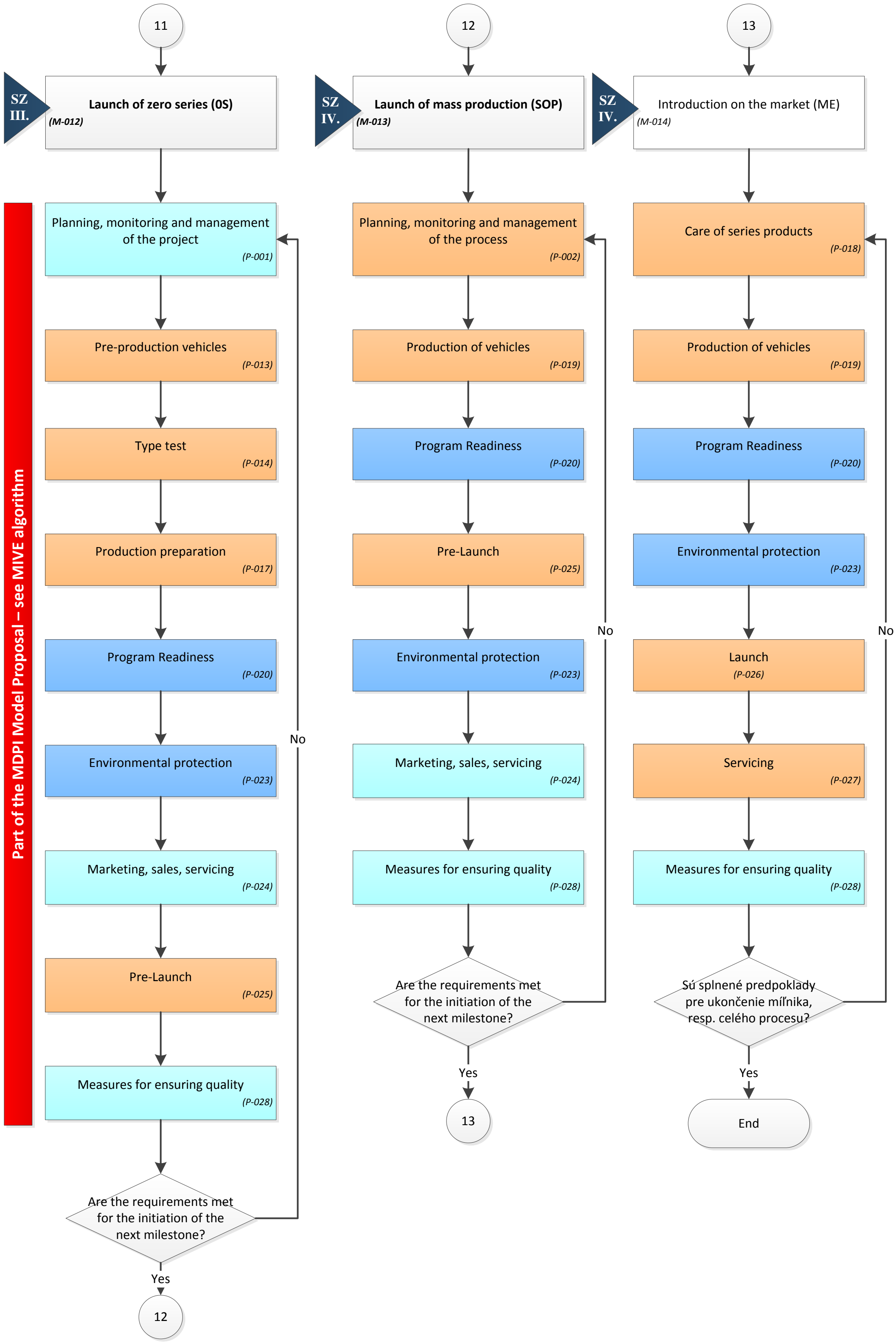



3
SZ III.
Project defining (PD)
(M-004)
Planning, monitoring and management of the project
(P-001)
Design (exterior, interior)
(P-003)
Package and concept development
(P-004)
Industrial, technological and logistics concepts(P-021)
Purchase concept
(P-022)
Environmental protection
(P-023)
Marketing, sales, servicing
(P-024)
Measures for ensuring quality
(P-028)
Are the requirements met for the initiation of the next milestone?
No
Yes
4
4
SZ II.
Decision on the project (PE)
(M-005)
Planning, monitoring and management of the project
(P-001)
Design (exterior, interior)
(P-003)
Package and concept developmentu
(P-004)
Construction of interior / exterior, simulations, calculations, DMU, control units
(P-005)
Data smoothing (Strak)
(P-007)
Concept vehicles
Preparation of production, equipment, logistics
(P-015)
„Forward Sourcing“ pre externe vyvíjané diely a nákup prevádzkových prostriedkov
(P-016)
Environmental protection
(P-023)
Marketing, sales, servicing
(P-024)
Measures for ensuring quality
(P-028)
Are the requirements met for the initiation of the next milestone?
No
Yes
5


5
SZ I.
Decision on the design (DE/LH1)
(M-006)
Part of the MDPI Model Proposal – see MIVE algorithm
Planning, monitoring and management of the project
(P-001)
Construction of interior / exterior, simulations, calculations, DMU, control units
(P-005)
Data smoothing (Strak)
(P-007)
Data control models
(P-008)
Concept Cars
(P-009)
Prototypes
(P-010)
Tests
(P-012)
Preparation of production, equipment, logistics
(P-015)
Forward sourcing for externally developed components and purchase of operating equipment
(P-016)
Environmental protection
(P-023)
Marketing, sales, servicing
(P-024)
Measures for ensuring quality
(P-028)
Are the requirements met for the initiation of the next milestone?
Nie
Yes
6
6
SZ I.
Virtual prototype (V1PT) and „P“ release
(M-007)
Part of the MDPI Model Proposal – see MIVE algorithm
Planning, monitoring and management of the project
(P-001)
Construction of interior / exterior, simulations, calculations, DMU, control units
(P-005)
Release processes
(P-006)
Data smoothing (Strak)
(P-007)
Data control models
(P-008)
Prototypes
(P-010)
Tests
(P-012)
Preparation of production, equipment, logistics
(P-015)
Forward sourcing for externally developed components and purchase of operating equipment
(P-016)
Program Readiness
(P-020)
Environmental protection
(P-023)
Marketing, sales, servicing
(P-024)
Measures for ensuring quality
(P-028)
Are the requirements met for the initiation of the next milestone?
Nie
Yes
7


7
SZ I.
Digital data control model (DDKM) (M-008)
Part of the MDPI Model Proposal – see MIVE algorithm
Planning, monitoring and management of the project (P-001)
Construction of interior / exterior, simulations, calculations, DMU, control units (P-005)
Release processes (P-006)
Data smoothing (Strak) (P-007)
Data control models (P-008)
Prototypes (P-010)
Tests (P-012)
Preparation of production, equipment, logistics (P-015)
Forward sourcing for externally developed components and purchase of operating equipment P-016)
Program Readiness (P-020)
Environmental protection (P-023)
Marketing, sales, servicing (P-024)
Measures for ensuring quality (P-028)
No
Are the requirements met for the initiation of the next milestone?
Yes
8
8
SZ II.
Data control models / technical layout 2 with 'B' release (DKM/LH2) (M-009)
Part of the MDPI Model Proposal – see MIVE algorithm
Planning, monitoring and management of the project (P-001)
Construction of interior / exterior, simulations, calculations, DMU, control units (P-005)
Release processes (P-006)
Data control models (P-008)
Prototypes and pre-production vehicles (P-011)
Tests (P-012)
Preparation of production, equipment, logistics (P-015)
Program Readiness (P-020)
Marketing, sales, servicing (P-024)
Measures for ensuring quality (P-028)
No
Are the requirements met for the initiation of the next milestone?
Yes
9


9
SZ II.
Release for start-up (LF)
(M-010)
Part of the MDPI Model Proposal – see MIVE algorithm
Planning, monitoring and management of the project
(P-001)
Construction of interior / exterior, simulations, calculations, DMU, control units
(P-005)
Release processes
(P-006)
Data control models
(P-008)
Prototypes and pre-production vehicles
(P-011)
Tests
(P-012)
Preparation of production, equipment, logistics
(P-015)
Program Readiness
(P-020)
Marketing, sales, servicing
(P-024)
Measures for ensuring quality
(P-028)
Are the requirements met for the initiation of the next milestone?
No
Yes
10
10
SZ III.
Launch of test series (PVS)
(M-011)
Part of the MDPI Model Proposal – see MIVE algorithm
Planning, monitoring and management of the project
(P-001)
Pre-production vehicles
(P-013)
Preparation of production, equipment, logistics
(P-015)
Program Readiness
(P-020)
Environmental protection
(P-023)
Marketing, sales, servicing
(P-024)
Measures for ensuring quality
(P-028)
Are the requirements met for the initiation of the next milestone?
No
Yes
11


11
SZ III.
Launch of zero series (0S)
(M-012)
Part of the MDPI Model Proposal – see MIVE algorithm
Planning, monitoring and management of the project
(P-001)
Pre-production vehicles
(P-013)
Type test
(P-014)
Production preparation
(P-017)
Program Readiness
(P-020)
Environmental protection
(P-023)
Marketing, sales, servicing
(P-024)
Pre-Launch
(P-025)
Measures for ensuring quality
(P-028)
Are the requirements met for the initiation of the next milestone?
No
Yes
12
12
SZ IV.
Launch of mass production (SOP)
(M-013)
Planning, monitoring and management of the process
(P-002)
Production of vehicles
(P-019)
Program Readiness
(P-020)
Pre-Launch
(P-025)
Environmental protection
(P-023)
Marketing, sales, servicing
(P-024)
Measures for ensuring quality
(P-028)
Are the requirements met for the initiation of the next milestone?
No
Yes
13
13
SZ IV.
Introduction on the market (ME)
(M-014)
Care of series products
(P-018)
Production of vehicles
(P-019)
Program Readiness
(P-020)
Environmental protection
(P-023)
Launch
(P-026)
Servicing
(P-027)
Measures for ensuring quality
(P-028)
Sú splnené predpoklady pre ukončenie míľnika, resp. celého procesu?
No
Yes
End

Appendixes 5: Core Mission and Scope of Activities

Vision and values of the group are shown in the following figure.