Approaches to the classification of high-tech companies from the negative and positive point of view

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Abstract

Purpose of the article The article analyzes approaches to demarcation and defining high-tech companies from the point of view of economic activities, research and development, international patent classification, their readiness for a period called Industry 4.0 and their real behavior. It analyzes the specifics of the individual classifications, compares them and focuses on defining this concept towards future research to determine the use of current approaches in the management of these companies, revealing their specifics and recommending tools suitable for successful enforcement of these companies in global competition.

Methodology/methods Content analysis, including methods and rules for defining the term high-tech company.

Scientific aim The main objective is to define a specific group of economic entities - high tech companies - from the perspective of classification of economic activities, according to international patent classification, realization of its own research and development, according to readiness within Industry 4.0 for identifying the application of current marketing approaches in the management of these companies.

Findings In order to define the term high-tech company, we meet many approaches and different definitions, mostly aimed at a particular intent or determination, not a generic term. The article analyzes the individual approaches in detail and on the basis of their mutual comparison and evaluation, for the future research was chosen the intersection of three basic views within the Czech Republic.

Conclusions Following the definition of high-tech companies, which is necessary to analyze and apply current marketing approaches in the management of these companies, the next step in the implementation of the research will be the validation of the capability of the existing criteria and the addition of other, statistically significant criteria defining the high-tech company.

Keywords: high-tech company, high-tech product, CZ NACE, economic activities, research and development, Industry 4.0.

JEL Classification: M15, M21

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Introduction

As a feature of a matured society, the importance and position of high-tech industries in the economy are often highlighted. „High technology firms play an enormous role in the economic growth of many countries“, (O´Regan, Sims, 2008) „occupy a central position in modern economies“ (Grinstein, Goldman, 2006). Many agree that high-tech companies are different from others, but the definition of how or how much they differ is not so clearly described in the professional literature. Within many professional and economic definitions, we can meet evaluations set according to profits, added value products, the impact and benefits of these businesses and their products for quality human life. The American Electronics Association (2004) brings an apt characteristics of high-tech products: „The impact of high tech products on people´s everyday lives is immeasurable. High-tech products keep people safer and healthier, enable them to be more productive at home and on the job and contribute to a better quality of life“.

The article deals with searching, analyzing and defining the various factors characterizing high-tech companies, from the definition of this group of companies on the basis of literary and professional research, according to economic activities of CZ NACE, according to the international patent classification, according to the realization of own research and development, implementing activities within Industry 4.0 or by engaging in projects targeting high-tech industries and industry 4.0. The article deals in detail with all these areas, clarifies particular classifications and explains their different aspects.

The aim is to define a group of high-tech companies within which the surveys of the application of current marketing approaches in the management of these companies will be held.

As a method we used Qualitative Content Analysis. It is a simple, adaptable, systematic and objective analysis, which can be applied to practically any set of data for which the use of investigative methods is not appropriate. Content analysis is based on a quantitative way of exploring using qualitative techniques. „Qualitative Content Analysis as described in published literature shows conflicting opinions and unsolved issues regarding meaning and use of concepts, procedures and interpretation. Illustrate the use of concepts related to the research procedure, and proposes measures to achieve trustworthiness throughout the steps of the research procedure“ (Graneheim, Lundman, 2003). „The goal of content analysis is to provide knowledge and understanding of the phenomenon under study. Content analysis using a directed approach is guided by a more structured process than in a conventional approach - to validate or extend conceptually a theoretical framework or theory. Existing theory or research can help focus the research question. It can provide predictions about the variables of interest or about the relationships among variables, thus helping to determine the initial coding scheme or relationships between codes. Using existing theory or prior research, researchers begin by identifying key concepts or variable as initial coding categories. Qualitative Content Analysis goes beyond merely counting words to examining language intensely for the purpose of classifying large amounts of text into an efficient number of categories that represent similar meanings.“ (Hsieh, Shannon, 2005; Scherer, 2004).

1 Research of professional literature – definition of high-tech company, product according to different authors

Contemporary knowledge in the field of high-tech companies is described by a number of expert publications. The topic is addressed by a number of foreign and domestic authors as part of expert articles and professional publications linking different perspectives to a wide range of related aspects such as research, technological difficulty, technology transfer and commercialization, economic growth, education and production. The definition of high-tech companies is closely linked to their own products, their specifics and placing on the market, as they are predominantly placing new or significantly innovative products, which are mostly in stage of seeking for customers, marketing of these companies and their products plays a specific role. Both of these accompanying concepts are also part of the expert discourse with which the definition of high-tech companies is linked. The descriptions and conclusions from the works of individual authors are briefly summarized in the text and the individual parameters are then summarized in Tables 1 and 2.

The publication named High technology organization – what it is, what it isn´t from Baruch (1997) is devoted to definition of term high-tech, where, based on research and discussion he summarizes the advantages and drawbacks of previous approaches used for such classification. The result of his analysis is to propose a set of three criteria for this classification - more than 10% share of university graduates, more than 5% share of R & D investment and selected industrial activity. These criteria are one of the few quantified variables and can therefore be used in international comparisons.

O´Regan and Sims (2008) in his article „Identifying high technology small firms“ describes in detail the characterization according to “four factors to capture the essence of high technology firms an input perspective: Degree of emphasis on and Investment in R+D, Innovation, Capabilities.“ However, these definitions, compared

to the previous ones, include a similar idea, i.e. the basic innovative direction with an emphasis on research, but no measurable quantities are given when the firm becomes high-tech, this definition is therefore rather intuitive.

Kraftová and Kraft (2008) in an article „High tech companies and wealth creation in EMEA countries“ Defines a set of technologically advanced subjects by business subject in the field of advanced technologies, the number of university educated workers above the country average, R & D expenditure above the country average and the increase in sales for outputs and own products in the country. This is a definition within the country where the company operates. This comparison is therefore rather national.

In the framework of research on the implementation of market orientation in high-tech companies, Chalupský et al. (2009) map high-tech companies according to two specific features, defined as orientation on products with high value added and utilization of qualified work and latest technical and technological knowledge, which „ creates a prerequisite for a more pronounced differentiation of such companies, increasing competitiveness and building a long-term competitive advantage on both national and international scale." However, this assessment is not measurable and does not allow a clear breakdown.

Other authors, who are involved in defining high-tech in terms of common characteristics are Mohr, Sengupta, Slater (2005) in book *Marketing of High-technology Products and Innovations*. They describe three basic parameters – Market uncertainty, Technology uncertainty, Competitive volatility. These features are characteristic for part of the newly offered products, but for Apple, for example, this trend is not exactly the same because most of their new products are characterized by a high degree of novelty based on their own innovative and research base, but the news is impatiently expected on the market and the customers search for it themselves, which largely denies the uncertainty of the market. If we use the same example to assess the uncertainty of technology, we cannot even confirm this assessment unambiguously, because most of the new technologies introduced by the company become a technology standard. However, these criteria are not quantifiable and can vary widely across countries.

Zarzewska-Bielawska (2012) in her article, when making clear „the strategic dilemmas of innovative enterprises“ describes high-tech sector as an environment, which cannot exist without R&D, Technology development, Innovation development and Knowledge development. Also in this case we are talking about generally perceived criteria for high-tech sectors whose quantifiability is not precisely defined, and therefore a "transition band" must necessarily occur in the definition of high-tech companies, it is not possible to precisely determine this set. Jungin, Sooyoung, Hyunseok, (2015) characterized high-tech industries primarily through enterprises, especially high-tech enterprises, that should try to develop new products that can provide the differentiated values with the lower price, and product innovation is an essential driver for the purpose. Summary of all criteria by individual authors is clearly outlined in Table 1.

It is clear that a high-tech company is also bringing high-tech products to the market that is what is expected of it. Here as well, professional literature seeks to define such a product, mostly in connection with its marketing, i.e. with company marketing.

Table 1 Definition of High-tech company according to individual authors

O´Regan, Sims, 2008	Degree of emphasis on and Investment in R+D
	Innovation
	Creativity
	Capabilities
Baruch, 1997	Investment into R&D more than 5 % of overal revenue
	10% share of employees with university degree
	Product based on advanced, unique or leading technology
Kraftová, Kraft, 2008	The subject of business is the area of advanced technologies
	The number of university graduates is higher than the country average
	R & D expenditure exceeds the country average
	Revenue growth
Chalupský et al., 2009	Orientation on products with a high added value
	The use of qualified work and the latest technical and technological knowledge

Mohr, Sengupta, Slater, 2005	Market uncertainty Technology uncertainty Competitive volatility Network externalities and the importance of industry standards
Zarzewska-Bielawska, 2012	R+D development technology development innovation development knowledge development
Jungin, Sooyoung, Hyunseok, 2015	development diferentiated (higher) values of products lower price of products the essential driver is inovation

Source: own work

Viardot (2004) in his book Marketing Strategy for high-tech firms in answer to question „What is a high-tech product“ defines seven parameters, which do characterize high-tech product, and those are: The Incorporate of sophisticated technology, short life cycle, Innovation - evolution and revolution, High investments in research and development, Market specificity, Product diversity in high technology and Government involvement in the high-tech sector. Yuan, Shen, Ashayen (2010) in the article Dynamic simulation assessment of collaboration strategies to manage demand gap in high-tech product diffusion describe high-tech product as compared with the traditional product as Product´s R+D cycle, witness a sharp increase in demand and product´s maturing and declining stages. Minakov et al. (2017) in the article Dynamic management model of innovations generations within the research task of dynamic management of innovations in the sphere of high-tech industries have defined the perception of high-tech products using dynamic properties, dynamical distribution a managerial decisions on the market launch of a new generation of innovative products. In each of these definitions, different approach is depicted reflecting the ultimate aim and purpose of the scientific work. In short, the high-tech product can be described as a product that is made using state-of-the-art technology and knowledge (Table 2).

Table 2 Definition of High-tech products by individual authors

Viardot, 2004	Incorporate A short life cycle products Innovation - evolution and revolution High investments in research and development Market specificity Product diversity Government involvement
Yuan, Shen, Ashayen, 2010	Product´s R+D cycle Witness a sharp increase in demand Product´s maturing and declining stages
Minakov, Lobanov, Makarchuk, Minakova, Leonova, 2017	Dynamical properties Dynamical distribution Managerial decisions on the market launch of a new generation of innovative products

Source: own work

The launch of new high-tech products on the market has its own specific features, which are closely related to the specifics of the high-tech sector as a whole in a number of professional publications. Therefore, it is not possible when defining high-tech company to forget to look at the production portfolio itself and the marketing of high-tech companies and their products.

2 Analysis of high-tech sector according to ČSÚ

Efforts to define this more and more enforceable concept have contributed to defining within The Organization for Economic Cooperation and Development (OECD), defining „high tech in terms of the ratio of R+D expenditures to value added of a particular industry.“ The definition of a high-tech sector includes economic activities using highly developed technology. Within the Czech Republic, the definition of the high-tech sector reflects the definition of the OECD processed through the CZ-NACE Classification of Economic Activities (this classification replaces the older Branch Classification of Economic Activities of the OKEČ) and the International Patent Classification (MPT) definition.

2.1 Definition of high-tech sectors according to classification of economic activities (CZ-NACE)

Classification of economic activities (CZ-NACE) was defined in „Sdělení“ from Český statistický úřad dated 18th September 2007 through Collection of Law No. 244 on the introduction of the Classification of Economic Activities with effect as of 1st January 2008. The CZ-NACE classification was developed according to the International Statistical Classification of Economic Activities in accordance with Regulation 1893/2006 of the European Parliament and of the Council. This classification takes into account the technological development and structural changes of the economy, it is more relevant with regards to economic reality and better comparable to other international classifications. Currently, a second revision of this classification is used and serves primarily for the unification of economic activities within the European Union and for better comparability of statistical data between individual states.

The high-tech sector is thus defined by the Czech Statistical Office (ČSÚ, 2007) as CZ-NACE as a "set of economic activities that use advanced technologies to their production. At the same time, the development of outputs from these activities is accompanied by high costs either for innovation and / or R & D. Such economic activities also create higher added value." (ČSÚ, 2007)

According to the sectoral classification of economic activities, two main groups are defined - the manufacturing industry and services.

- High-tech manufacturing industry
  - Production of pharmaceuticals, chemicals, herbal preparations and other medical devices
  - Manufacture of office machinery and computers
  - Manufacture of radio, television and communication equipment and apparatus
  - Production of medical, precision, optical and time-measuring instruments
  - Manufacture and repair of aircraft and spacecraft
- High-tech services
  - Communications
  - IT activities
  - Research

The total number of enterprises which include in their activities one of the areas included in the high-tech category is 36 566 in the Czech Republic, of which only 10% is in the manufacturing industry (Table 3).

Table 3 Overview of the number of high-tech businesses by economic activity and industry

CZ NACE	Industry	No. of companies
21.	Production of pharmaceutical products	81
26.1.	Manufacture of electrical components and boards	829
26.2.	Manufacture of computers and peripheral equipment	289
26.3.	Production of communication equipment	806
26..4.	Production of consumer electronics and optical instruments	297
26.7.	Production of optical and photographic equipment	121

26.8.	Production of magnetic and optical media	124
26.5.	Manufacture of measuring, testing and navigating devices; Manufacture of clock instruments	722
26.6.	Manufacture of irradiation, electro-medical and electrotherapeutic equipment	47
30.3.	Manufacture of aircraft and their engines, spacecraft and their equipment	69
	High-tech manufacturing industry total	3 385
59., 60.	Audiovisual activities	3 829
61., 62.	Activities in ICT sector	23 975
63.	Information activities	4 354
72.1.	Research and development in the field of natural and technical sciences	977
72.2.	Research and development in the field of social sciences and humanities	46
	High-tech manufacturing industry total	33 181

Source: ČSÚ, 2007

Based on the knowledge of the content and the subject of the production assortment of specific companies, the completeness and accuracy of the CZ-NACE data provided was verified as part of the Extract from the Register of Economic Activities of ČSU in ARES. As a result of inquiries and questioning, it was found that the specific assignment of CZ-NACE is proposed by the organization itself, and the specific selection is mostly intended to cover the widest range of possible activities rather than their exact characterization. This point of view is undoubtedly logical and understandable from the perspective of the companies, in a sense of use of the classification of economic activities for the definition high-tech companies, we must necessarily conclude that the set obtained cannot be used without further supplementary detailed investigation. As an example, I would like to mention a specific company that markets unique electron microscopes that are the result of their own research and development and are protected by a number of international patents. This company, however, has CZ-NACE 26: Manufacture of computers, electronic and optical devices and equipment, which includes a whole group of detailed divisions from which only some are classified for the definition of high-tech companies. As a result, this company does not appear among the selection of high-tech companies according to the CZ-NACE classification, even though it definitely belongs to this group. The opposite finding is, for example, s.r.o., commonly referred to as "OPTIKA", which deals with eye care, mediation and business activities, advertising and marketing. None of these activities clearly does not characterize the high-tech company, yet this company has, according to CZ-NACE classification, registered activity 26.7: Manufacture of optical and photographic equipment and devices. Therefore, it is clear from the above survey that it is not possible to use the classification according to economic activities of CZ-NACE for follow-up investigations within the high-tech companies without a significant error.

2.2 Classification according to international patent classification

The second possible definition of high-tech areas according to the CZSO is the definition according to the International Patent Classification (MPT), as follows:

- Computers and Automated control devices – B 41 J, G 06 C, D, E, F, G, J, M, N, T, G 11 C
- Aviation – B 64 B, C, D, F, G
- Microbiology and genetic engineering – C 12 M, N, P, Q
- Lasers – H 01 S
- Semiconductors – H 01 L
- Communication technologies – H 04 B, H, J, K, L, M, N, Q, R
- Biotechnologies – A 01 H 1/00, 4/00, A 61 K 38/00, 39/00, 48/00, C 02 F 3/34, C 07 G 11/00, 13/00, 15/00, C 07 K 4/00, 14/00, 16/00, 17/00, 19/00, C 12 M, N, P, Q, S, G 01 N 27/327, 33

The definition of high-tech areas according to the international patent classification, as well as the previous definitions, collide with some specific features characteristic for this area. Studies have shown, that firms´ patent filing strategies are directly limited to co-operative practices with the number and type of patents varying according to competitive and collaborative rationales (Angue, Ayerbe, Mitkova, 2013).

While according to CZ NACE is the most represented high-tech area ICT with a total of 72% of the represented enterprises, in terms of international patent classification, the area of the Czech Republic is significantly less

represented because, according to Czech patent legislation, IT inventions are mostly not by their very nature " Patentable ", and the success of patent procedures is, in this case, highly uncertain. While software patents are commonly granted in the US, Europe, including the Czech Republic, has a more conservative approach in this respect. Computer programs as such cannot be patented in the Czech Republic - software is commonly protected as a literary work according to the Copyright Act. However, as well as audio-visual and information activities, the patent does not protect the work / activity in question and therefore the IT share varies considerably in this defined area. On the contrary, the results of research and development in the field of natural and technical sciences are dominant within the international patent classification.

According to data published annually by the Czech Republic's Industrial Property Office in the Annual Report, CZ has been granted around 700 national patents annually since 2010, most of which are filed with a CZ entity. On the other hand, international / European patents validated for the territory of CZ are more than 4 thousand, of which CZ is about 0.5%. However, patents are across the entire industrial spectrum. If, therefore, the CSO definition defines the high-tech areas according to the international patent classification and this classification concerns only Czech entities, patents from the high-tech area in recent years account for about 4% of all granted and validated patents of Czech entities for the territory of the Czech Republic. The most numerous are Microorganisms and genetic engineering sections with more than 10 patents granted and validated, as well as Telecommunications, Computers and Automated Business Equipment and Aviation, with units of granted and validated patents annually. Taking into account the fact that approximately half of all patents within the Czech Republic are administered and owned by universities and institutes of the Academy of Sciences, this industrial high-tech sector is defined by an international patent classification inappropriately smaller than the CZ NACE classification.

The reason for this difference is the fact that companies prefer confidentiality protection above patent protection, a form that does not allow competitors to discover the uniqueness of the solution from the patent specification that is accessible to everyone after the grant and publication of the patent, as well as the fact that it is not always such a unique technical solution, even if it meets the high-tech features, that it can be protected by a patent. Therefore, even the selection of high-tech companies under the International Patent Classification cannot be used for the follow-up investigation, because the sample would not very likely have these companies included.

Table 4 Statistics of national and international patents granted, number of patents according to the international patent classification - high tech fields

	2010	2011	2012	2013	2014	2015	2016
National granted patents	911	687	670	613	688	749	781
- thereof domestic applicants	279	325	401	408	471	576	637
EP patents validated in the CZ	3 697	4 348	4 660	4 603	4 548	4 829	5 964
- thereof domestic applicants	16	14	22	27	22	29	39
NP + EP in CZ origin	295	339	423	435	493	605	676
Granted national patents and EP validated in CZ in selected high-tech fields	2010	2011	2012	2013	2014	2015	2016
Computers and Automated business equipment	2	4	4	1	2	6	5
Aviation	1	1	1	2	0	2	1
Telecommunications	10	5	2	5	5	4	6
Microorganisms and genetic engineering	39	39	25	15	20	13	12
NP + EP in CZ origin in high-tech fields	52	49	32	23	27	25	24
High-tech rate	18%	14%	8%	5%	5%	4%	4%

Source: ÚPV, 2017

3 Research and development as a sign of high-tech companies

While according to CZ-NACE, a total of 36,566 enterprises belonging to the high-tech group are included in one of the above mentioned areas in their economic activities, another criteria that is undoubtedly high-tech, is their own research activity.

Within the Czech Republic, according to CZ NACE, the designation is defined by research and development activities 72.1. and 72.2., recorded a total of 1,023 enterprises that have research and development in their economic activities. According to CZSO data, there are a total of 2,870 science and research (R & D) departments in the Czech Republic, divided into the business, governmental, university and private sectors. Because the only sector that is currently engaged in research and business activities is the business sector, we can compare the number of enterprises that have R & D in their economic activities with the number of R & D workplaces in the business sector.

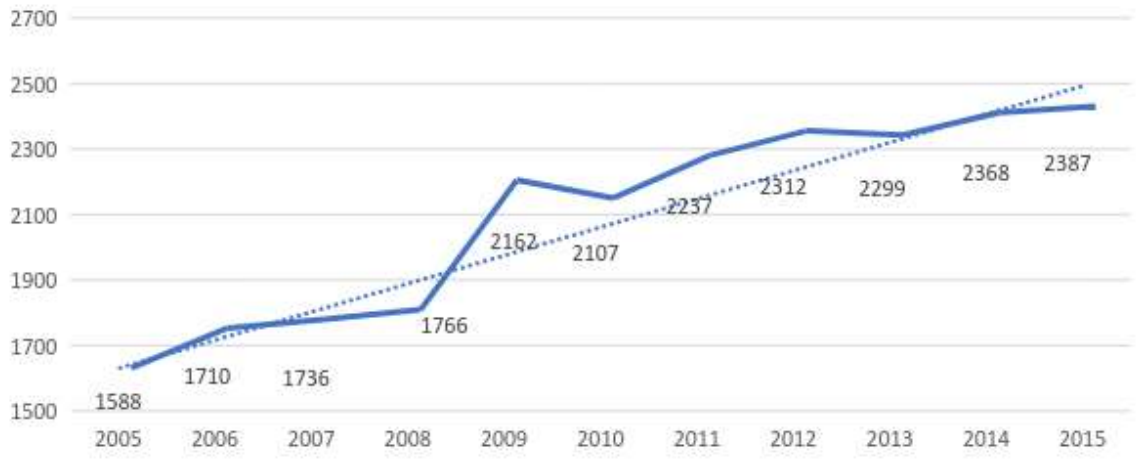


Figure 1 Development of the number of science and research workplaces within the Czech Republic (acc. to 31.12.2015)

Comparing the total number of high-tech enterprises according to CZ NACE with the number of science and research workplaces in the Czech Republic, we will find a fundamental difference. This difference may be due, for example, to the number of more individual R & D workplaces within a single enterprise that specialize in different areas of research. That is why we will not address separate R & D workplaces for further focus. Another reason is the fact that we do not have the possibility to find detailed information about the activities of the individual workplaces - there is no other additional evidence available about them. Nevertheless, it was verified during the investigation and questioning, that while mentioning the classification of economic activities according to CZ-NACE, errors do not occur here.

4 High-tech companies from the point of view of Industry 4.0

Another possible form of delimitation of the high-tech segment is the affiliation and implementation of activities to "the trend towards Industry 4.0 or the fourth industrial revolution". It is a label for several new developments in automation and data exchange in manufacturing technologies that bear the potential to substantially transform industrial production and value chains as they exist toda“ (Walendowski, Kroll, Schnabl, 2016). Because this is a new trend, the precise and detailed definition of the term is difficult to be phrased.

Industry 4.0 is a global global challenge that is characterized by many fundamentally new features in industrial production. This is not a mere extension of digitization, but Industry 4.0 systems have more other features:

- The production does not only take place on serially sorted individual automated units, but it is optimized from the point of view of the entire production department, workshop or whole plant, i.e. it takes place in a continuously optimized complex environment..
- Sensors, machines, semi-finished products and products are represented by software modules that communicate and negotiate together to find the optimal solution, even in the context of the horizontal integration of value chain creation elements that can go beyond the boundaries of one company.
- Individual elements involved in the production, business and design process automatically and asynchronously data exchange according to current needs (not just within the strict control hierarchy).

- Thus, asynchronous direct online data exchange and negotiation between any units of the horizontally integrated value chain, vertically integrated internal chain (from real-time machine control to top management) and the entire integrated development process chain are taking place.
- Manufacturing and business systems configure themselves in real-time, apply data analysis to predict possible errors or failures.
- Products are clearly identifiable and localizable in the value chain, they know their history and current status, they have (in their software representations) knowledge that allows alternative paths to create themselves.

Industry 4.0 is not leading to centralized systems but total decentralization of production makes it possible to control production without a central decision-making unit, but also to produce the same product anywhere in the global production area:

- Response to demand for products is immediate.
- Individual customer requirements are easy to respect without loss of efficiency.
- Production can remain massive, but at the same time it is deeply individualized.
- There are completely new forms of ties between the customer, the manufacturer and the supplier, certain professions disappear and others are created.
- There are new ways to create creative value added, the entire development process of the product is fully integrated.

Within the definition of the Technology Agency of the Czech Republic, innovation projects in the high-tech sector fall under the Industry 4.0 initiative, if the applicant will address at least one of the following topics (TAČR, 2017):

- Integrate the Internet of Things process, where each element of the physical process has its own digital image (software representation) capable of autonomous interaction.
- Create or apply software modules representing physical elements and the services they provide to each other or which they invoke through the Internet of Services.
- Integrate the additive manufacturing (3D printing) elements in the manufacturing process, in particular in connection with development processes.
- Apply Augmented Reality elements in object manipulation or as a service.
- Design or apply advanced sensors, for example, to capture and measure shapes and dimensional quantities, machine vision, image recognition and manipulation, mechanical sensing and transfer, analyzer biosensors or predictive diagnostics sensors, and directly connect them to complex manufacturing Systems within horizontal or vertical system integration.
- Apply cybernetic and artificial intelligence processes for managing complex processes (not to be confused with mere ICT), cognitive, autonomous or learning skills, using the principles of intelligent analysis of large data.
- Design and use autonomous robotic systems as cooperative elements of complex manufacturing solutions.
- Ensure dynamic planning and scheduling of activities in order to achieve a global optimum in production and commercial space.
- Contribute to enhancing computer or system security in the design and implementation of production segments, businesses, or chains using Artificial Intelligence, taking into account the needs of Industry 4.0.

The number of subjects who submitted their project to the TAČR and declared their membership to the Industry 4.0 platform was 239 subjects / companies, universities and research institutions / for the whole Czech Republic. This view - from the realistic behavior of innovative companies in the high-tech field - provides an interesting opportunity for closer examination and description of the target group. Applicants must meet clearly defined criteria and the grantor is scrutinized in detail. Because the projects are funded from public funds, we also have information about the identity of the subjects and the research projects. In addition, these companies also reflect other markers that define high-tech companies, both the specific classification of economic activities and the definition according to the international patent classification, as well as the existence of their own research and development, which seeks the appropriate subsidy program (TAČR, 2017).

5 Discussion

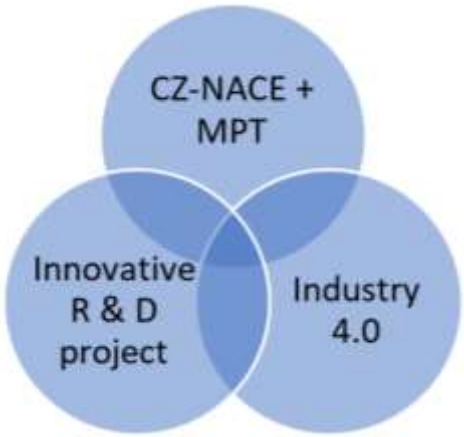
The analyses made have key importance as they form the basis for defining the sample for follow-up research. We want to research:

1. Verify defined hypotheses
2. Map the real status of marketing of high-tech companies and their products.
3. Perform definition of high-tech companies and marketing processes, tools and activities.

Based on the analyses, we can use and take into account these criteria to define the term high-tech company:

1. It can be a company that uses the latest instrumentation and control equipment for its own production.
2. Or the company that produces the latest products with high added value
3. Or it may be a company that has R & D and it is directly implemented in its products.
4. Or the company that increases the amount of R & D expenses.
5. The number of own employees in research and production can also be measured.
6. It can also be a thriving, highly profitable business.
7. Or a company that has a short production cycle, which implies continuous innovation and high added value of products.

All these criteria can characterize a high-tech company, but also none of them, as indicated by the above analysis. For the follow-up survey, therefore, the penetration of all the views described above within the Czech Republic was chosen. The sample will include high-tech companies according to CZ-NACE classification and international patent classification. Companies that meet at least one of the key criteria for Industry 4.0 defined by TAČR. The third is the involvement of the company in an innovative project aimed at applying the R & D result in practice or implementing a similar type of project. The same sample of companies that do not fall into the high-tech category will be approached to compare results and more detailed analysis. Comparing these two groups will be a basic test for verifying the use of marketing approaches for company management.



Source: own work

Figure 2 Intersection of sets of defined definitions for high-tech companies

For each area of the definition, the questionnaire and answer operation will be performed. At the same time, it is a prerequisite to obtain further detailed data on companies for in-depth analysis of the potential identifying features of a high-tech company. The focus will be on the following problem areas:

- Utilization and sharing of existing public infrastructure for science and research /versus own capacity;
- Involvement in international scientific cooperation - formal / in the form of projects / informal / in the form of exchange of experience, consultations;
- Creating and participating in cluster and technology platform activities;
- Talent Management programs for talent acquisition;
- Popularization of science and research by firms;
- Collaboration with non-formal education centers - science and visitor centers;
- Implementation of "Open Innovation" activities.

Conclusion

The definition of high-tech firms that is necessary to analyse their marketing tools is currently ambiguous and does not reflect the fully realistic state of the market. Therefore, it will be the next step in the realization of the research, which will, among other things, verify the validation capability of the existing criteria and complement other, statistically significant criteria that define the high-tech firm.

From the above data, it is possible to sum up the positives defining the high-tech firm in that there are several mutually different and at the same time interrelated definitions because the diversity of industries for which a single precise definition would apply to a high-tech firm could not include all industrial areas. According to CZ NACE, this definition is met by 3 385 firms, the existence of own research and development is declared by 1 023 companies, according to international patent classification is about 150 companies (25 patents per year assuming that 95% of these patents are submitted by different entities and The average duration of patent implementation is 5 to 10 years depending on the type of industry), it is 717 subjects according to the involvement in projects supporting industry activities 4.0. As a certain negative, it may be that each set independently characterizes a different number of entities, and the penetration of these sets only includes a fraction of the total number of companies that correspond to one of the above-mentioned definitions for a high-tech firm. From the above described, it can be stated that a high-tech company must be considered as any one that meets at least one of the definitions defined for industrial enterprises within the Czech Republic.

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