
The Impact of the Internet on User-Driven Innovation Usage in R&D Departments: A Case Study of Poland

Submitted 11/08/20, 1st revision 24/09/20, 2nd revision 18/10/20, accepted 09/11/20

Katarzyna Szopik-Depczyńska¹, Agnieszka Barczak², Izabela Dembińska³, Joanna Wiśniewska⁴

Abstract:

Purpose: The aim of this article is to define the dependencies that occur between the use of the Internet and the effects of innovative activities, the use of the concept of User-driven innovation, as well as features related to the marketing orientation of enterprises.

Methodology: First, research was conducted on a group of 57 R&D departments of Polish enterprises that cooperate with users of their products and services in the field of innovation, and thus use the concepts of user-oriented innovation. Then, the Spearman's rank correlation coefficient was used to investigate the degree of correlation. The determined correlation coefficients were analyzed based on the Guilford classification.

Findings: There is a weak correlation between the use of the Internet and the introduction by a company of a new or improved product or technological process. The use of the Internet in the activities of enterprises is of greatest importance when communicating with many product users to obtain knowledge and opinions about the product.

Practical Implications: Research results identify the interdependencies between internet use and activity. It was found that in the set of 72 out of 14 variables, the use of the Internet in the surveyed enterprises has a large impact. They include, among others, novelty on the enterprise scale, technological innovations, a positive impact on the brand image, therefore, the results can be adopted by the appropriate enterprises.

Originality/value: The added value of the article is the identification of key areas of innovative activity of enterprises that are most influenced by the Internet.

Keywords: Management, innovation, internet, knowledge-based economy.

JEL classification: M21, L91.

¹University of Szczecin, Department of Corporate Management, Institute of Management, Szczecin, Poland, ORCID ID: 0000-0002-3054-0660, e-mail: katarzyna.szopik-depczynska@usz.edu.pl;

²West Pomeranian University of Technology, Department of System Analysis and Marketing, Szczecin, Poland, ORCID ID: 0000-0001-7584-7183, e-mail: agnieszka-barczak@zut.edu.pl;

³Maritime University of Szczecin, Department of Management and Logistics, Faculty of Engineering and Economics of Transport, Szczecin, Poland, ORCID ID: 0000-0001-7618-0018, e-mail: i.dembinska@am.szczecin.pl;

⁴ Same as in 1, ORCID ID: 0000-0002-1607-8721, joanna.wisniewska@usz.edu.pl;

Paper Type: Research study.

Funding: The project is financed within the framework of the program of the Minister of Science and Higher Education under the name "Regional Excellence Initiative" in the years 2019-2022, project number 001/RID/2018/19, the amount of financing PLN 10,684,000.00 and by the Institute of Management, University of Szczecin, statutory funds.

1. Introduction

It follows from the considerations to date that when using the concept of user-driven innovation (UDI) in enterprises, the knowledge is transformed into innovation. Knowledge management is recognized as an essential process in maintaining a competitive advantage in the global knowledge-based economy. In terms of innovation process models based on open innovations, enterprises can access external knowledge from various market partners such as customers (including users), suppliers, and competitors or science-based partners such as research centers and universities. The variety of openness concerns the number of external sources involved in the innovation process, and the intensity of partnership relations can be treated as the depth of these connections. The openness to innovation can also be explained in terms of the willingness to cooperate, namely the propensity of the enterprise to be open to many forms of this cooperation and with regard to the trust developed with external partners, primarily such as the key users of enterprises' products and services.

In the foundations of the theory of innovation processes, namely in the chain model developed until the 1980s, it was emphasized that the development of innovation is influenced by both scientific research and market demand. However, it was not until the 1990s and the integrated models implemented at that time that the information flow and information sharing began to be highlighted. That was the basis for an increase in the efficiency of information processing in network models, which, due to significant technological advances, transformed into a model based on the diffusion of knowledge. Much of this progress is still taking place in the field of electronic communication systems, including universal access to electronic tools and the Internet. Thus, networks have become indispensable in creating interactions also in the UDI process. Since the implementation of the UDI process is mostly determined by the structure of the knowledge and information flow.

An essential element in the information transfer process and the driving force in the field of UDI is the development of new communication channels. First, it became possible to implement electronic media-based communication between business partners. The Internet and Extranet were used for this purpose. The Internet facilitated the dissemination of information with a simultaneous fast pace of its transmission and low transmission costs. Once shared on the web, the information remains there for a long time, thus enabling continuous access. Consequently, the ease of communication is gained, and its effectiveness is strengthened, also through the possibility of

acquiring a broad, territorially unlimited market (Kotler, 2005). A diagram of the consumer's connection with the "network" is presented below (Figure 1).

Therefore, UDI uses the Internet as a technical tool for its own use, in the field of contacts with virtual communities, which significantly reduces the costs of communication, coordination, and data transfer. The determinant of the popularity of open innovation models is undoubtedly the dynamic development of new Internet communication channels (Jelonek, 2014; Włodarczyk, 2016; Sharmaab *et al.*, 2018; Goldfarb and Tucker, 2019).

Figure 1. The consumer's connections with the "network."



Source: *Biznes społecznościowy*, 2012.

However, Internet users do not constitute a homogeneous group in terms of the preferences for using communication solutions, and each of them individually decides whether the proposed offer of communicating with the enterprise is convenient for him and whether he will use it. This new, wide range of services has been collectively referred to as Web 2.0. - a developing second-generation network.

Currently, the most commonly known and widely used online means of communication with the customer are e-mail, a blog on the company's portal, forms

on the company's website, chat on the company's website, video call via Skype, Zoom, MS Teams. Social networks and user collaboration platforms in innovation are gaining more and more importance. (e.g., Facebook, Instagram or Twitter). Enterprises use social media as a useful tool for acquiring new and retaining existing customers and encouraging them to share suggestions and ideas and engage customers in the creation and development of products and services (Jelonek, 2014; Włodarczyk, 2016).

Reinhold and Alt (2012) emphasize that social media can be successfully used as a cooperation platform within UDI, which facilitates and supports the cooperation of members of virtual communities, e.g., in order to create innovation, develop new products, or an idea for a marketing campaign. Social networking sites generate large amounts of data about users, and all their activities and efforts can be a potential source of knowledge for a company (Jelonek and Pawełoszek, 2013; Pennington, 2020).

The concept of "open innovation" has helped spread specific technologies. The recent access to fuel cell patents from Toyota and Tesla can be considered one such move. Focused on opening the market for connected and smart products - fits in with the Internet of Things (IoT) paradigm. It is about expanding technological opportunities to improve people's lives, create a digital ecosystem where billions of people, things, and sectors (automotive, health, public safety, governments, and households) and devices used in their respective sectors are connected via the Internet. IoT is about the ability of devices to interact with each other to generate and share data, leading to technological convergence - a strong correlation with open innovation. Companies like Microsoft, Samsung, and Google are already showing how multi-billion dollar giants compete for smart device space using platforms that use an organized and open community of scientists and developers (Mattern and Floerkemeier, 2010; Wortmann and Flüchter, 2015).

The Internet of Things (IoT) concept has generated much excitement in recent years (Kim and Kim, 2016). Overall, IoT can be considered a series of breakthrough digital technologies that affect the daily lives of both individuals and enterprises. In line with this phenomenon, enterprises are becoming more intelligent in developing, adopting, and adapting breakthrough technologies in their business processes, in order to increase their efficiency and innovation through knowledge flow and data/information collection (Malhotra, 2000; Vrontis *et al.*, 2012). In the face of the modern economy based on knowledge and technology - characterized by trends such as globalization, technological, and industrial convergence - successful enterprises use specific mechanisms for knowledge management (Scuotto, 2016). In practice, extensive research and applied interest in organizational knowledge have focused primarily on the issues of knowledge management to increase organizational benefits.

In UDI, the basis for acquiring knowledge is its exchange, and the primary goal of acting is to accelerate the innovation process. This concept is gaining importance with the development of Web 2.0 technology. The tasks carried out under the UDI concept

can be supported by social networking sites, which are now treated as a new business model that allows entrepreneurs from various sectors to connect with the scientific community (scientists, researchers, inventors) and the creative consumer community. Created platforms, such as NineSigma.com, Innocentive.com, innopena.pl, or innowacyjnamedycyna.pl, are often the result of projects financed by the European Union. In the business model, the platforms include bidders (enterprises and institutions looking for solutions to problems), prosumers (users submitting solution proposals), and platform administrators (supporting prosumers' contact with bidders). The users are individuals and enterprises, supporting independent consultants and research centers (Jelonek, 2012).

On the other hand, virtual communities, another of the tools supporting the UDI process, are created, and operated within social media. It allows users to create content. Many different platforms (blogs, videoblogs, microblogs, social networks) are used to create a prosumer community as a knowledge transfer environment (Rheingold, 2000). Another tool is crowdsourcing, as one of the three main ways of creating innovation by the user, where the organization delegates its tasks in an open form to a large specialized group of people, treating it as a tool for engaging users in the innovation process. The company does not employ specialists but communicates with a wide range of consumers via internet platforms. In this way, it gains many different solutions and specific ideas. Often, the best-selected projects are implemented (Howe, 2008). An example of such a platform is Sprinet.pl, where specific tasks to solve (open invitation using Web 2.0 tools) are sent to an unidentified group of people.

Web 2.0 tools allow for consumer involvement (Muncy and Hunt, 1984), which is defined from the point of view of their reactions, individual states, and undertaken cognitive activities. Individual response is associated with emotions (permanent or situational) experienced for a specific product or brand (Celsi and Olson, 1988). Individual states relate to psychological reactions triggered by a product or brand - involvement is conditioned by emotional state, which allows determining the validity of a given object for the user (Mittal and Lee, 1988). The cognitive approach means involvement, treated as the relationship between the user and the object, most commonly the active participation in the process of searching for and processing information about the product, less often participating in the decision-making process. However, this only applies if the user is actively involved in the purchase (Böhner *et al.*, 2004; Krugman, 1965). Therefore, the development of social media plays a significant role, which allows the user to respond to the content posted by the company. Preliminary information about the product or service gives the sum of the reactions - it consists of likes and the number of comments. In this way, the so-called engagement index is created (Tkaczyk, 2015; Tkaczyk, 2009; Tkaczyk, 2007).

The use of Web 2.0 tools and the possible involvement of users thanks to them enables the creation of the so-called collective intelligence (Glenn, 2009), which is defined as “the phenomenon of creating new knowledge resources based on the combined skills

and abilities of individuals. Collective intelligence is the ability of virtual communities to raise the level of knowledge and expert competence of their members through cooperation and large-scale debates (Cisek, 2009). Thus, it can be said that an enterprise can use not only the unique knowledge of a narrow group of experts but also the combined knowledge of a large group of users. Each of them, contributing their knowledge, participates in the creation of a solution to the discussed problem.

The UDI concept is closely related to the open-source communities. These communities are the successors of the first genuine communities of hacker and programming enthusiasts who developed the first software to advance computer but non-profit traffic (Cheesbrough, 2006). The Internet operates without interruption, and thus enables real-time communication. R&D employees who participate in the process of exchanging knowledge and information with users have often been used to more “traditional” contact tools, mainly based on campaigns planned well in advance, telephone calls, and personal contact. However, social media have changed all that.

Nowadays, an immediate response is required, we can say colloquially - 24/7. Despite new, difficult challenges, such new possibilities are also a unique opportunity - reaching engaged users who contribute to the image of the company in the media (Biznes społecznościowy, 2012). Therefore, employees of R&D departments do not have to rely only on traditional media, which so far allowed them to reach a selected group of users. Today, they can even form groups of involved users and be much closer to them. If they consistently build the image of the company with an attractive and honest message and additionally conduct an open dialogue with users of social networks, then they have a chance to gain their trust, which will undoubtedly affect good relations in the field of joint implementation of R&D projects.

All UDI projects, especially crowdsourcing, are carried out via the Internet, thanks to the new possibilities of Web 2.0. It is worth mentioning that they can be implemented on the company’s website or use intermediary platforms that connect companies with problems and people with solutions. One of the success factors in these cases is the ability to gain “critical mass” (e.g., in crowdsourcing), which can be a barrier for companies with only one crowdsourcing project implemented on their own website, due to high investment in the promotion of the project (Toral *et al.*, 2009). The most popular crowdsourcing platforms are Amazon Mechanical Turk (mturk) and InnoCentive. Research by Karim Lakhani of Harvard Business School shows that InnoCentive helped solve 29.5% of problems that could be solved by an R&D enterprise (Lakhani *et al.*, 2007). InnoCentive services are used by giants such as Procter & Gamble. Enterprises implement the “Connect and Develop” strategy as a reaction to the opportunities offered by the UDI concept (Dodgson *et al.*, 2006). Information and communication technologies enable the exchange of dispersed sources of information in an open innovation process focused on contact with users. It turns out that a suite of new technologies for data mining, simulation, prototyping, and visual representation, a kind of “innovation technology,” helps support the UDI process at Procter & Gamble.

Organizational openness is fundamental in UDI, allowing free contact and exchange of knowledge with other participants in the innovation process. It is a model that can be implemented in all enterprises - also those that do not have their own R&D departments. The deep involvement of customers, however, requires the development of an appropriate model of cooperation and the creation of solutions allowing not only for free communication but also the integration of the community with the company. It is also necessary to use incentives not only to share information but also to actively co-create products. Thanks to the Internet, the concept of user involvement is becoming more and more common as it facilitates taking on such roles. As a result, the phenomenon of presumption appears, consisting in the involvement of users in activities carried out so far by experts. In this way, the customer is not only a consumer but also a producer (Tapscott and Williams, 2006), participating in the creation of an innovative and creative cooperation system. Presumption allows products to be tailored to the specific needs of users. The benefit for users must be not only the improved product but also the right to make changes and often the related remuneration. UDI allows for the collection of ideas but requires a constant analysis of users' needs and preferences. The assessments made may affect the changes implemented within the enterprise, as well as the usefulness and quality of products placed on the market. Obtaining information requires the involvement of specific resources and means, and the obtained effects affect the revenues achieved by the enterprise (Flowers, 2010; Szopik-Depczyńska, 2018).

In connection with the above considerations, a need arose to examine the relationship between Internet use and the attributes of enterprises relating to innovation. Therefore, the article aims at determining the relationship between Internet use and the effects of innovative activities, the use of the concept of user-driven innovation, as well as features related to the marketing orientation of enterprises. The survey was conducted on a group of 57 research and development departments operating within enterprises in Poland, which cooperate daily with users of their products and services in the field of creating innovations, thus using the concept of user-driven innovation.

2. Methodology

Correlation may be described as the degree of association between two variables. In general, we can say that the study of interdependence leads to the investigation of correlations (Asuero *et al.*, 2006). Correlation analysis is a term used to denote the association or relationship between two (or more) quantitative variables. This analysis is fundamentally based on the assumption of a straight line [linear] relationship between the quantitative variables. Like the measures of association for binary variables, it measures the "strength" or the "extent" of an association between the variables and also its direction (Gogtay and Thatte, 2017).

Spearman's rank correlation coefficient r was used to study the degree of correlation in the study. This coefficient is defined as the Pearson correlation coefficient calculated for the ranks of the variables, where a rank is a number corresponding to

the order each feature is placed. It enables the measurement of monotonic dependencies also between quality features. It is determined using the formula:

$$r = 1 - \frac{6 \sum_{i=1}^n d_i^2}{n(n^2 - 1)} \quad (1)$$

where:

d_i^2 is the difference between the respective ranks of the variable items.

The percentage influence of one feature on another was also investigated, which can be determined using the determination coefficient R. It is determined from the formula:

$$R = r^2 \cdot 100\% \quad (2)$$

where:

r - correlation coefficient.

The determined correlation coefficients were analyzed based on the Guilford classification (Barczak *et al.*, 2019), according to which:

$|r| = 0$ - lack of correlation

$0.0 < |r| \leq 0.1$ - dim correlation

$0.1 < |r| \leq 0.3$ - weak correlation

$0.3 < |r| \leq 0.5$ - average correlation

$0.5 < |r| \leq 0.7$ - high correlation

$0.7 < |r| \leq 0.9$ - very high correlation

$0.9 < |r| < 1.0$ - almost full correlation

After determining the correlation coefficients, it is necessary to check the monotonic relationship between the examined statistical features. For this purpose, the significance test for the Spearman's rank correlation coefficient is used. The following hypotheses are made: H_0 : $r=0$ (features are not correlated - they are statistically significant) and H_1 : $r \neq 0$ (features are correlated - they are statistically insignificant). The test statistic is as follows:

$$p = \frac{r}{\sqrt{\frac{1-r^2}{n-2}}} \quad (3)$$

It has a t-Student distribution at $n - 2$ degrees of freedom.

The decision to accept or reject the main hypothesis is made by comparing the results of the obtained statistics with the assumed level of significance (the study adopted $\alpha=0,05$). Hypothesis H_0 is rejected in favor of the alternative hypothesis H_1 if $p \leq \alpha$ (statistically significant), and no reason to reject H_0 is when $p > \alpha$ (statistically not significant).

3. Empirical Results and Discussion

72 variables presented in Table 1 were used for the study.

Table 1. List of variables from the survey

<i>Index</i>	<i>Variable</i>
A10	Did the company launch a new/improved product/service to the market in 2015-2017?
A11	Number of launched product innovations
A12	A novelty on the enterprise scale
A13	A novelty on a national scale
A14	A novelty on a global scale
A15	The innovations were: Radical (groundbreaking)
A16	The innovations were: Incremental (evolutionary, improving)
A17	Did the company introduce a new or significantly improved technological process to the market in 2015-2017?
A18	Number of launched technological innovations
A19	Technological innovations concerned the area of the production method
A20	Technological innovations concerned the following areas: logistics, distribution, quality standards
A22	Technological innovations related to the area of supporting systems (e.g., software for designing in the R&D department or IT software for accounting)
A23	Technological innovations concerned the area of human resources
A24	Technological innovations concerned the area of finance
A25	Technological innovations related to the area of research and development
A26	Technological innovations related to the area of others, e.g., the applied technical tools
A31	Theoretical and experimental research, are primarily conducted to acquire new knowledge of the foundations of phenomena and observable facts without focusing on direct practical application,
A32	Research of an experimental nature undertaken in order to acquire new knowledge focused primarily on applying it in practice, e.g., solutions that are developed and tested in laboratories and experimental cells.
A33	Works related to the transfer of R&D research results to business practice (creating projects, plans, documentation for creating new or improved products/services, developing prototypes with potential commercial use, pilot projects)
A34	Number of employees in the R&D area
A35	Number of employees - doctoral degree
A36	Number of employees - academic degree of habilitated doctor
A55	What percentage of revenues was allocated to R&D in the last three years?
A77	Number of R&D projects completed in 2015-2017
A108	User involvement in the R&D process in order to identify and understand his needs (co-creation of products/services)
A109	Communicating with a large number of users of the company's product/service in order to obtain knowledge, opinions about the product/service (user feedback)
A110	Adapting a single product or service design to the user's needs and skills (customization)
A125	Increased sales
A126	Reduction of product/service dissatisfaction
A127	Creating closer relationships with users
A128	Limiting the costs of research and development
A129	Users' help to solve product/service-related problems
A130	Positive impact on the brand image
A131	Acquiring ready solutions
A132	Improving existing products/service
A133	Evaluation of implemented products/services

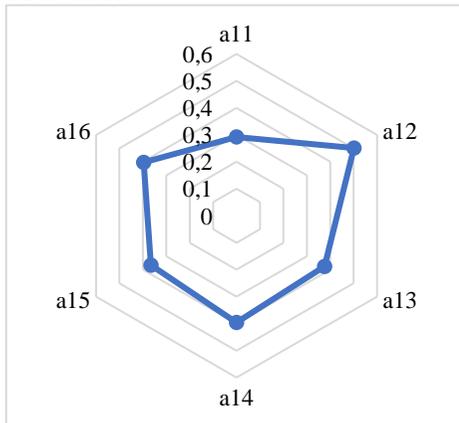
A134	Personalization of the offer
A135	Better matching the offer to the users' needs
A136	Following trends visible among users
A137	Gaining knowledge about current users
A138	Gaining knowledge about potential users
A139	Lowering the cost of acquiring customers
A145	It was used for the needs of the company (e.g., process optimization, costs)
A146	It was used to create (improve) products/services offered on the market
A147	It was used to obtain feedback from the client on the implemented product/service
A148	It was used in terms of user participation in the R&D process
A149	It was used in product testing
A150	It was used in the field of product prototyping
A151	It was used in the field of product exploration
A152	It was used to familiarize with the ideas of users
A163	Internet (e.g., forum)
A191	Using communication tools with users of their products/services
A192	The company's involvement in marketing activities
A193	The level of expenditure financed on marketing activities
A194	Employment in the area of marketing
A195	Connecting the marketing strategy with R&D activity
A196	Defining constant and changing customer requirements and studying the influence on the purchase decision
A197	Analysis of customer behavior if the customer resigns from traditional and recognized products
A198	Recognizing the forms of pressure and motivation that encourage customers to reorient and innovate
A199	Acquiring knowledge about secondary factors influencing the customer's purchase decision (e.g., the influence of institutions and organizations, legal regulations and standards)
A200	Taking into account regional differences in customer behavior, which may result, for example, from attachment to tradition, universal judgments or the willingness to try something new
A201	Checking the financial capacity of customers for further purchases (financial condition and creditworthiness)
A202	Informing R&D teams about buyers' requirements
A203	Cooperation with marketing in the development of products desired by buyers
A204	Informing about buyers' reactions to product performance characteristics
A205	Together with marketing, determining the ranking of the most desirable functional features of products
A206	Informing R&D teams about competitors' product strategies
A207	Assessment of the concept of new products together with marketing
A208	Informing R&D teams about the results of market research
A209	Design modifications under the influence of market signals
A210	Searching for commercial applications of new ideas and technologies
A211	Generating ideas for new products together with marketing

Source: *Own elaboration.*

The analysis showed that there is a weak correlation (0.4276) between Internet use and the fact that a company introduces a new or improved product or service (A10). The influence of the Internet on the analyzed issue is only 18.28%. The relationship between the use of the Internet and the introduction of a new or significantly improved technological process to the market is similar - A17 (0.3417 - 11.68%). A weak correlation is shown regarding the impact of using this tool on the percentage of

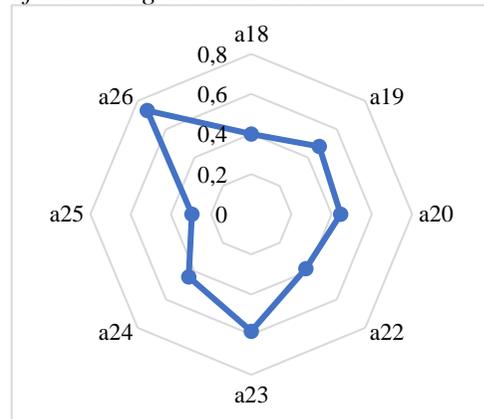
revenues allocated by the surveyed entities to R&D in the last three years - A55 (0.2429 - 5.90%) and the number of similar completed projects - A77 (0.2507 - 6, 29%). The remaining dependencies, determined based on correlation coefficients, between the use of the Internet in the activities of enterprises and the variables characterizing innovative processes in the examined entities are shown in Figures 2-9.

Figure 2. Relationships between the use of the Internet and the nature of product innovation



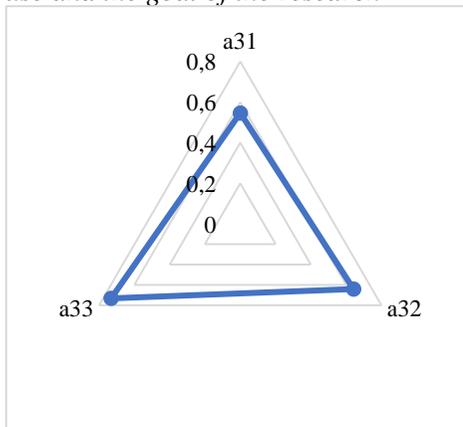
Source: own elaboration.

Figure 3. Relationships between the use of the Internet and the number and types of technological innovations



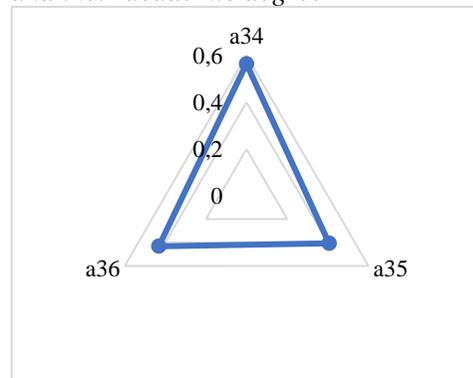
Source: own elaboration.

Figure 4. Relationships between Internet use and the goal of the research



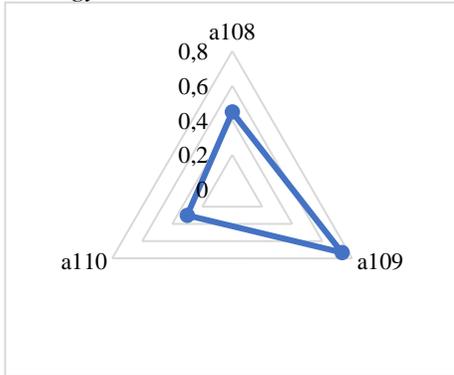
Source: own elaboration.

Figure 5. Correlation between Internet use and the number of people employed and their academic degree



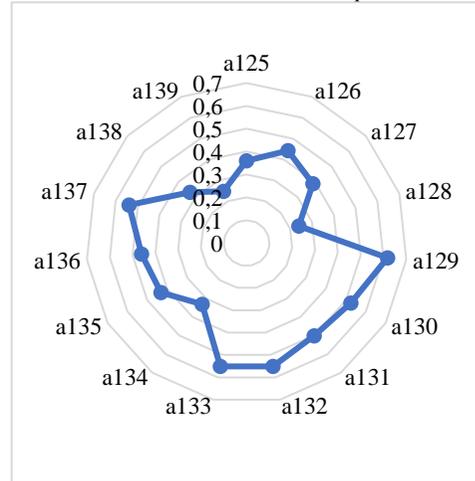
Source: own elaboration.

Figure 6. The relationship between Internet use and the way the UDI concept is implemented in the company's strategy



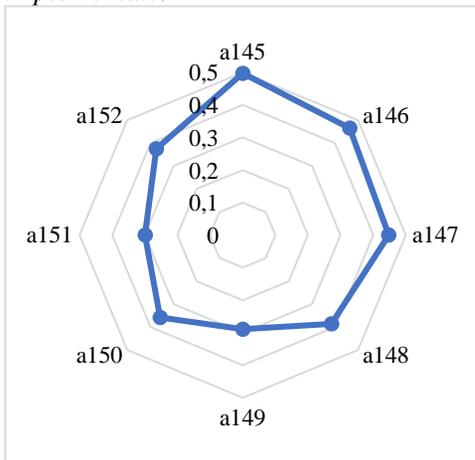
Source: own elaboration.

Figure 7. Relationship between Internet use and to use the UDI concept



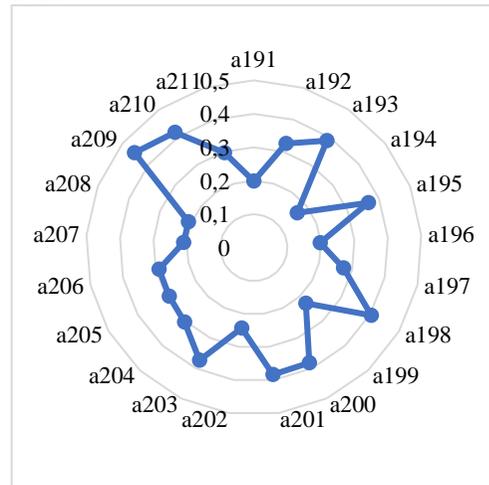
Source: own elaboration.

Figure 8. Relationship between Internet use and the effects of UDI implementation



Source: own elaboration.

Figure 9. Dependencies between Internet use and the assessment of the company's marketing orientation and the use of marketing research results in the R&D area



Source: own elaboration.

When analyzing the relationships concerning the nature of innovation (Figure 2), it was noticed that only product innovations that are new on the enterprise-scale (A12) are characterized by a high correlation in connection with the use of the Internet (0.5012 - 25.12%). The number of introduced product innovations (A11) shows a weak correlation. In the remaining cases, the study showed an average correlation.

While examining the relationships regarding the number and type of technological innovations (Figure 3), it was noticed that technological innovations in the area of human resources are characterized by a high and very high correlation - A23 (0.5828 - 33.97%) and in the other area, e.g., applied technical tools - A26 (0.7318 - 53.55%). In the remaining cases, the variables are characterized by a weak and medium correlation.

All variables presented in Figure 4 are characterized by a high or extremely high correlation with Internet use in the company's operations. In the case of enterprises conducting theoretical and experimental research undertaken primarily in order to gain new knowledge about the foundations of phenomena and observable facts without focusing on direct practical application (A31), the correlation coefficient is 0.5468, which causes an impact in 29.90%. When enterprises conduct experimental research, aimed at acquiring new knowledge, oriented primarily at applying it in practice (A32), the impact is 41.18% (correlation at the level of 0.6417). In the case of entities carrying out work related to the transfer of R&D research results to business practice (A33), this impact is 53.55% (correlation coefficient equal to 0.7318).

It can be concluded that while the relationship between the use of the Internet and the number of employees in the R&D area (A34) is at the level of 31.90% (correlation coefficient at the level of 0.5648 - high correlation), the level of employees' education (A35, A36) is no longer so important. These dependencies are characterized by an average correlation (Figure 5).

The Internet use in the activities of entities is of the most significant importance when communicating with a large number of users of the company's product/service in order to obtain knowledge, opinions about the product/service (user feedback) - A109. The impact is 53.55%, with a correlation coefficient of 0.7318 (very high correlation). In other cases, the impact on the method of implementing the UDI concept is insignificant - average correlation (Figure 6).

The use of a global network has the greatest impact on the use of UDI to:

- help users solve problems related to the product/service (A129). The determination coefficient is here 38.17% (correlation at the level of 0.6178);
- improving existing products/services (A132) - impact of 30.38%;
- evaluation of implemented products/services (A133) - impact at the level of 30.38%;
- learning about current users (A137) - impact at the level of 29.04%.

In the case of the remaining variables, a weak and medium correlation was noted (Figure 7).

In the case of the relationship between Internet use at work in an enterprise and the effects of using UDI in it, it can be noticed that for all variables there is average and weak correlation, and the impact of using the Internet does not exceed 25% (Figure 8).

Similarly, in the case of the effects of using UDI in the work of an enterprise, the relationship between Internet use and the assessment of the company's marketing orientation and the use of marketing research results in the R&D area is characterized by only a weak and average correlation. The highest correlation was noted in the case of design modifications under the influence of market signals (A209), where the correlation coefficient is 0.4549, which gives an impact of 20.69% (Figure 9).

A significance test was performed for all correlation coefficients, which allows to state that only the variables characterized by a very weak and weak correlation are statistically insignificant.

4. Summary and Concluding Comments

The study assumes that the use of the Internet has an impact on the analyzed areas when the determined correlation coefficient indicates a high, very high, or almost complete correlation, and thus the influence of one feature on another exceeds the threshold of 25%. In other cases, the Internet, as a tool used to learn about users' needs, does not have a significant impact on the studied areas. The group of fourteen variables that are most influenced using the Internet in the surveyed entities includes:

- A12 - a novelty on the enterprise scale,
- A23 - the technological innovations concerned the area of human resources,
- A26 - technological innovations in the area: other,
- A31 - theoretical and experimental research undertaken primarily to acquire new knowledge about the foundations of phenomena and observable facts without focusing on direct practical application,
- A32 - research of an experimental nature undertaken to acquire new knowledge, focused primarily on its application in practice, e.g., solutions that are developed and tested in laboratories and experimental cells,
- A33 - work related to the transfer of R&D research results to business practice (creating projects, plans, documentation for creating new or improved products/services, developing prototypes with potential commercial use, pilot projects),
- A34 - number of people employed in the R&D area,
- A109 - communicating with a large number of users of the company's product/service in order to obtain knowledge, opinions about the product/service

- (user feedback),
- A129 - helping users to solve problems related to the product/service,
 - A130 - a positive impact on the brand image,
 - A131 - obtaining ready-made solutions,
 - A132 - improving existing products/services,
 - A133 - evaluation of implemented products / services,
 - A137 - learning about current users.

In summary, the most important benefit of using new communication channels for enterprises is that it provides a broader base of ideas and technologies. Enterprises generally view open innovation as working closely with external partners - customers, users, researchers, or others who may contribute to the company's future. The main motives for joining forces between companies are to seize new business opportunities, share the risk, pool complementary resources, and realize synergies. Acquiring new knowledge through new communication channels gives enterprises greater flexibility and speed of response, without the necessity to incur huge costs. The primary limitations so far, i.e., the technical possibility of obtaining and collecting data, are quickly forgotten.

However, it should be remembered that in addition to collecting information, it is essential to use it appropriately. In today's competitive and dynamic environment, user knowledge is rapidly losing value. Therefore, it is crucial, apart from reaching the right information, also to continually monitor it. That means the necessity to use active information processing instead of passive collection of information in order to implement it optimally during the research and development process. Nowadays, the Internet and the new communication channels created thanks to it must be treated as indispensable tools facilitating the contact of the company with the current and potential users of its products and services (Szopik-Depczyńska, 2018).

References:

- Asuero, A.G., Sayago, A., Gonzalez, A.G. 2006. The correlation coefficient: An overview. *Crit. Rev. Anal. Chem.*, 36, 41-59.
- Barczak, A., Dembińska, I., Marzantowicz, Ł. 2019. Analysis of the Risk Impact of Implementing Digital Innovations for Logistics Management. *Processes*, 7(11).
- Biznes społecznościowy – nowa era w komunikacji biznesowej. 2012. Report based on the study *Polskie przedsiębiorstwa na Facebooku - portale społecznościowe w komunikacji marketingowej polskich przedsiębiorstw*. Deloitte Polska.
- Böhner, M., Böhner, M., Wänke, M. 2004. Postawy i zmiana postaw. GWP, Gdańsk.
- Celsi, R.I., Olson, J.C. 1988. The role of involvement in attention and comprehension processes. *Journal of Consumer Research*, 15, 210-224.
- Cheesbrough, H.W. 2006. *Open business models*. Harvard Business School Press, Boston.
- Cisek, S. 2009. Dzielenie się wiedzą w Internecie. *Bibliotheca Nostra, Śląski Kwartalnik Naukowy*, 3-4.
- Dodgson, M., Gann, D., Salter, A. 2006. The role of technology in the shift towards open innovation: the case of Procter & Gamble. *R&D Management*, 36(3), 333-346.

- Flowers, S., Von Hippel, E., De Jong, J., Sinozic, T. 2010. Measuring user innovation in the UK. The importance of product creation by users. NESTA.
- Glenn, J.C. 2009. Collective intelligence - one of the next big things. *Futura*, 4, Finnish Society for Futures Studies.
- Gogtay, N.J., Thatte, U.M. 2017. Principles of correlation analysis. *J. Assoc. Phys. India*, 65, 78-81.
- Goldfarb, A., Tucker, C. 2019. Digital Economics. *Journal of Economic Literature*, 57(1), 3-43.
- Howe, J. 2008. Crowdsourcing: Why the Power of the Crowd Is Driving the Future of Business, *Crown Business*. Czym jest crowdsourcing. <http://mojaprzedPrzedsiębiorstwa.infor.pl/manager/zarzadzanie-zespolem/305965,Czym-jest-crowdsourcing.html>.
- Jaśkowska, B. 2008. O kulturze konwergencji słów kilka. *Biuletyn EBIB*, 1(92). <http://www.ebib.info/2008/92/a.php?jaskowska>.
- Jelonek, D. 2012. The role of the internet in open innovations model's development. *Business Informatics*, 1(23), 38-47.
- Jelonek, D. 2014. Ocena internetowych kanałów komunikacji z klientem w procesie współtworzenia innowacji. *Informatyka ekonomiczna*, 1(31).
- Jelonek, D., Pawełszek, I. 2013. Technologie semantyczne w zarządzaniu platformą otwartych innowacji, *Informatyka Ekonomiczna*, E., T. Macauley, J. Świrski-Korłub (ed.) Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu Wrocław, 4(30), 169-180.
- Kim, S. 2016. A multi-criteria approach toward discovering killer IoT application in Korea. *Technological Forecasting and Social Change*, 102, 143-155.
- Kotler, Ph. 2005. *Marketing*. Rebis Publishing House, Poznań.
- Krugman, H.E. 1965. The Impact of Television Advertising: Learning without Involvement. *Public Opinion Quarterly*, 29(3), 349-356.
- Lakhani, K.R., Jeppesen, L.B., Lohse, P.A., Panetta, J.A. 2007. The value of openness in scientific problem solving. *Harvard Business School Working Paper*, No. 07-050.
- Lerner, J., Tirole, J. 2002. Some simple economics of open source. *The Journal of Industrial Economics*, 50(2), 197-234.
- Malhotra, Y. 2000. Knowledge management for e-business performance: advancing information strategy to "internet time". *Information Strategy. The Executive's Journal*, 16(4), 5-16.
- Mattern, F., Floerkemeier, C. 2010. From the internet of computers to the internet of things. *Informatik Spektrum* 33(2), 107-121.
- Mittal, B., Lee, M.S. 1988. Separating brand-choice involvement from product involvement via consumer involvement profiles. *Advances in Consumer Research*, 15(1), 43-49.
- Muncy, J.A., Hunt, S.D. 1984. Consumer involvement: Definitional issues and research directions. *Advances in Consumer Research*, 11, 193-196.
- Pennington, N. 2020. An examination of relational maintenance and dissolution through social networking sites. *Computers in Human Behavior*, 105, April, Article 106196.
- Reinhold, O., Alt, R. 2012. Social customer relationship management: State of the art and learnings from current projects. 25th Bled eConference eDependability: Reliable and Trustworthy eStructures, eProcesses, eOperations and eServices for the Future, Bled, Slovenia.
- Rheingold, H. 2000. *The Virtual Community: Homesteading on the Electronic Frontier*. MIT Press, London.

-
- Scuotto, V., Ferraris, A., Bresciani, S. 2016. Internet of Things: Applications and challenges in smart cities: a case study of IBM smart city projects. *Business Process Management Journal*, 22(2), 357-367.
- Sharmaab, D., Pandeya, S.K., Chandwanib, R., Pandeya, P., Joseph, R. 2018. Internet Channel Cannibalization and its influence on salesperson performance outcomes in an emerging economy context. *Journal of Retailing and Consumer Services*, 45, November, 179-189.
- Szopik-Depczyńska, K. 2018. Koncepcja innowacji kreowanej przez użytkownika w działalności badawczo-rozwojowej przedsiębiorstw. Wydawnictwo Uniwersytetu Szczecińskiego, Szczecin.
- Tapscott, D., Williams, A. 2006. *Wikinomics*. Penguin, New York.
- Tkaczyk, J. 2007. Kampanie marketingu szeptanego. *Marketing w praktyce*, 11, 46-49.
- Tkaczyk, J. 2009. Uwarunkowania skuteczności działań wykorzystujących komunikację nieformalną. *Handel Wewnętrzny*, 6, 166-172.
- Tkaczyk, J. 2015. Poziom zaangażowania konsumenta w zakup produktu a skłonność dogenerowania przekazów w komunikacji nieformalnej. *Studia Ekonomiczne. Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach*, 236, 153-163.
- Toral, S.L., Roci'o Martinez-Torres, M., Barrero, F., Corte's, F. 2009. An empirical study of the driving forces behind online communities. *Internet Research*, 19(4), 378-392.
- Vrontis, D., Thrassou, A., Chebbi, H., Yahiaoui, D. 2012. Transcending innovativeness towards strategic reflexivity. *Qualitative Market Research: An International Journal*, 15(4), 420-437.
- Włodarczyk, R. 2016. Determinanty skutecznej komunikacji w modelu biznesowym B2C. *Zeszyty Naukowe Politechniki Częstochowskiej. Zarządzanie*, 22.
- Wortmann, F., Flüchter, K. 2015. Internet of Things. *Bus Inf Syst Eng.*, 57, 221-224.