

FRUGAL INNOVATIONS IN ENTERPRISES: A COMPARISON BETWEEN SERVICE AND INDUSTRY SECTORS

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Abstract. *Frugal innovations are one of the dynamically developing models of innovative activities in enterprises. As the analysis of the international literature indicates, this type of innovation is primarily aimed at optimizing the efficiency of operations – by reducing redundant functionalities and thus reducing costs. Customers/users receive the so-called “must have”, but of the highest possible quality. The foreign authors clearly indicate that frugal innovations are designed to increase the availability of innovations in less affluent societies, and are also focused on creating high-added value for the environment. The study aims to estimate the complexity of applying the assumptions of the concept of frugal innovations in innovative enterprises in the service and industry sectors, to indicate the dominant activities/factors in this area, and to compare the two indicated sectors. Eight research hypotheses have been stated in the study. In the empirical study, quantitative research techniques were used: CAWI survey and statistical data analysis. The study constructed two basic composite indicators: ICSRC – an indicator of the complexity of shaping relationships with customers, and ICSIP – an indicator of the complexity of shaping innovative processes. The indicators were developed using the method of factor analysis. The study also used the verification of normality of variables' distribution, Friedman's rank test, cluster analysis using the k-mean method, and the U Mann-Whitney test for independent samples. The CAWI survey was conducted on a random sample (N=200) of business owners or managers. On the basis of the conducted empirical research, it can be concluded that the complexity of applying the assumptions of the concept of frugal innovations in enterprises from the service and industry sectors is at a moderately high level. In addition, there are no statistically significant differences between service and industry companies in the complexity of applying the assumptions of frugal innovations. The basic contribution of the study to the theory is the focus on the analysis of the complexity of applying the assumptions of the concept of frugal innovations in enterprises, as well as the comparison of two sectors: service and industry.*

Keywords: *complexity; customers; enterprise; frugal innovations; industry sector; innovation processes; service sector.*

Introduction

Enterprises operating on the market are looking for new ways to create value for the environment/customers nowadays. One of the "paths" to create such value is the implementation of frugal innovations, which are primarily aimed at optimizing the efficiency of operations. Frugal innovations mainly help to decrease redundant functionalities and thus bring reduced costs.

Examples of frugal innovations are: (1) low-cost Swiss Swatch watches, (2) Five App for deaf-mute people to communicate with friends, (3) Oppy Mars rover, (4) IKEA furniture,

(5) Foldscope paper microscope, (6) General Electric battery-operated ECG, (7) MittiCool clay refrigerator, as well as (8) Tata Motors' Nano car (Woźniak, 2022; Markiewicz et al., 2020; Ratten, 2019, p. 44).

Such innovations can be implemented within the enterprise in different ways and to different extents. Nevertheless, it is necessary to meet certain conditions for the companies to state that the enterprise operates in accordance with the assumptions of the concept of frugal innovations. That is why the article focuses on the complexity of applying the assumptions of the concept of frugal innovations in innovative enterprises, measured on the basis of the importance/level of application of specific factors/activities reflecting the essence of the frugal approach. In addition, since the concept of frugal innovations is relatively young (also in Poland), the study will estimate the complexity of applying its assumptions in innovative enterprises.

Literature review

Frugal innovations are one of today's "challenges" for businesses worldwide, both in highly developed and underdeveloped countries. This is a "model" of creating new value for individual customers and even entire social groups (e.g. local communities). It is worth noting here that frugal operation is economical, and diligent, and reflects sustainability in the use of resources (*Merriam Webster Dictionary*, 2022), as well as is simple, uncomplicated, and low cost (*Oxford Dictionaries*, 2020). The basic attributes of frugal innovations include low costs, high financial efficiency, and meeting users' most important needs (Makowski, & Kidyba, 2018, p. 201; Hossain, 2020, p. 2). The concept of frugal innovations assumes the creation of maximum available value for specific stakeholder groups (Dadlani et al., 2022). Moreover, enterprises must ensure that value chains are aligned (Mukerjee, 2012). The basic attributes of frugal innovations are shown in Figure 1.

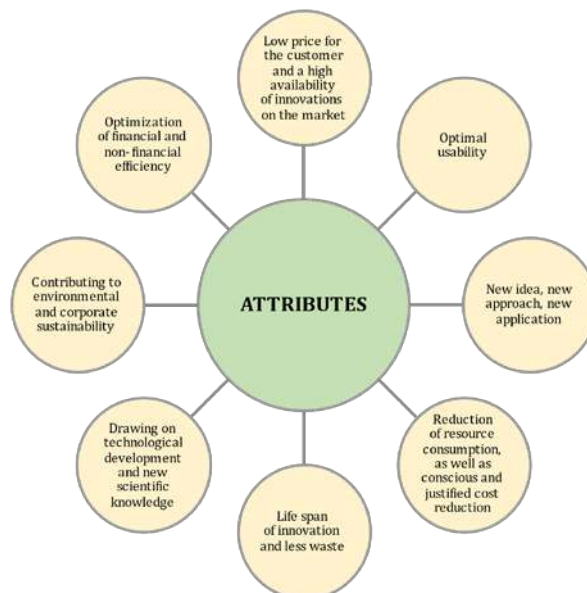


Figure 1. The basic attributes of frugal innovations
(own elaboration based on: Weyrauch, & Herstatt, 2017; Markiewicz et al., 2020; Dadlani et al., 2022)

Frugal innovations are a specific approach to serving consumers with limited resources in emerging and developing markets, as well as in low-growth Western markets (Hyvärinen, et al., 2016). Thus, frugal solutions/projects must be designed, manufactured, delivered, and maintained to meet the needs of underserved consumers in poor environments (market segments) (Bhatti, 2012). In other words, innovations of this class refer to the launch of affordable products and services that meet the needs of consumers with a modest lifestyle (see: Zeschky et al., 2011; Basu et al., 2013).

It is interesting that J.M Janiszewski (2020, p. 76) associates frugal innovations with "lean thinking", which reduces waste resources and time in innovative processes. In turn, D. Beaulin (2019, s. 8) notes that frugal innovations are a kind of "overarching philosophy that enables a true »blank sheet of paper« approach to product development". At this point, it is also worth noting that the model of frugal innovations "assumes a revision of existing solutions in order to provide social value by minimizing the consumption of resources" (Markiewicz et al., 2020, p. 24). In other words, it is a transition from the "doing more with less" model to the "doing better with less" model (Radjou & Prabhu, 2016).

At this point, it should be clearly noted that the international literature is primarily focused on the indication and description of the attributes of frugal innovations implemented in specific classes of organizations. The issue of estimating and comparing the complexity of the application of the assumptions of the concept of frugal innovations in innovative enterprises has not been explored so far which points to a significant research gap. Therefore, the obtained empirical results will be difficult to compare to the results of other Authors and to conduct discussions.

Methodology

Research objective and hypotheses

The study's objective is to estimate the complexity of applying the assumptions of frugal innovations in innovative enterprises in the service and industry sectors, to indicate the dominant activities/factors in this area, and to compare the two sectors.

The research problem is as follows: *What is the level of complexity of applying the assumptions of frugal innovations in innovative enterprises and what factors are dominant in this area in the service and industry sectors, as well as are there statistically significant differences between enterprises from the service and industry sectors in terms of the complexity of applying the assumptions of the concept of frugal innovations (in the areas of shaping relationships with customers and shaping innovative processes)?*

Eight hypotheses have been stated in the study:

- H.1. The complexity of applying the assumptions of the concept of frugal innovations in shaping relationships with customers in companies from the service and industry sectors is at a high level.
- H.2. The complexity of applying the assumptions of the concept of frugal innovations in shaping innovative processes in companies from the service and industry sectors is at a high level.

- H.3. Comparing companies from the service and industry sectors, there are statistically significant differences in the complexity of applying the assumptions of the concept of frugal innovations (shaping relationships with customers).
- H.4. Comparing companies from the service and industry sectors, there are statistically significant differences in the complexity of applying the assumptions of frugal innovations (the area of shaping innovative processes).
- H.5. The dominant factors in applying the assumptions of the concept of frugal innovations in the area of shaping relationships with customers in enterprises from the service and industry sectors related to optimizing the functionality of innovation.
- H.6. The dominant factors in applying the assumptions of the concept of frugal innovations in shaping innovative processes in enterprises from the service and industry sectors related to managing financial resources.
- H.7. In both the service and industry sectors, companies characterized by the high complexity of applying the assumptions of the concept of frugal innovations in shaping customer relationships dominate.
- H.8. Both in the service and industry sectors, companies characterized by the high complexity of applying the assumptions of the concept of frugal innovations in shaping innovative processes dominate.

Research methods

Quantitative methods and research techniques were used in the empirical study (Lisiński, & Szarucki, 2020). An inductive approach was used (see: Sułkowski, 2012; Wojciechowska, 2016). The study also used elements of a deductive approach, mainly at the stage of critical analysis of national and foreign literature sources. The study also used the analysis and synthesis methods (Hajduk, 2012). As part of the inductive approach, the following quantitative empirical research methods and techniques were used (based on: Sudoł, 2012; Apanowicz, 2005; Zaborek, 2009; Wojciechowska, 2011): CAWI survey technique, and statistical analysis of quantitative data. The basic research tools were: CAWI survey questionnaire, PS IMAGO PRO 7.0 software, and Microsoft Excel (Woźniak, 2022).

In the scope of the CAWI study, two basic composite indicators were identified, which were used for quantitative verification of research hypotheses (indicators reflect the level of complexity of enterprises' activities¹): (1) ICSRC – an indicator of the complexity of shaping relationships with customers, (2) ICSIP – an indicator of the complexity of shaping innovative processes (Woźniak, 2022).

The indicators were developed using the factor analysis method (the PCA method, the rotation method – Varimax with Kaiser's normalization), and based on detailed measures (see Figures 2 and 3) (Woźniak, 2022). Detailed measures have been identified on the basis of the literature analysis (see: Radjou et al., 2012; Radjou, & Prabhu, 2016; Beaulin, 2019; Ratten, 2019; Markiewicz et al., 2020; Bhatti et al., 2022).

In order to obtain detailed analyses for the ICSRC and ICSIP indicators, companies were divided into three basic clusters taking into account three standard levels of these

¹The higher value of the indicator, the higher complexity of actions. All factors (i.e. detailed measures) were assessed by respondents on a 5-point scale (score "1" means a very low level/importance, and score "5" means a very high level/importance).

indicators: low, moderate, and high – to identify the dominant clusters in the research sample. The cluster analysis using the *k*-mean method (including standardization of variables) was used. When analyzing the results of the CAWI study, basic descriptive statistics (e.g. median, dominant, mean, standard deviation, and skewness) for individual indicators/variables were also considered. The study also used the verification of the normality of variables' distribution, the Frieman's rank test, and the U Mann-Whitney test for independent samples (Woźniak, 2022).

Research scope and research sample

For the study, the objective, subjective, temporal, and spatial scope was established. The subject of the study was the application of the assumptions of the concept of frugal innovations in Polish enterprises implementing innovative activities in two sectors: services and industry. Companies belonging to the most innovative sectors in Poland² were qualified for the research through the CAWI survey. The study included companies in which innovative activity is dominant. The CAWI survey was conducted on a random sample (N=200) of business owners or managers responsible for risk management, innovative processes, or project management, employed in enterprises operating in Poland (one respondent from each surveyed enterprise). The study covered entities operating throughout the whole of Poland (16 voivodships). The population consisted of large enterprises. The specification of the research sample – regarding the division into service and industry sectors – is presented in Table 1 (Woźniak, 2022).

**Table 1. Specification of the research sample
(Source: Author's own research results)**

Enterprises' attributes	SERVICES		INDUSTRY	
	Number of entities	% (in the sector)	Number of entities	% (in the sector)
N	80	100	120	100
Activity profile				
Food & Beverage Manufacturing	-	-	20	16,6(6)
Manufacture of textile products and manufacture of clothing	-	-	20	16,6(6)
Manufacture of chemicals and chemical products	-	-	20	16,6(6)
Manufacture of basic pharmaceutical substances, as well as medicines and other pharmaceutical products	-	-	20	16,6(6)
Manufacture of computers, electronic and optical products, as well as manufacture of electrical equipment	-	-	20	16,6(6)
Manufacture of motor vehicles, trailers and semi-trailers, excluding motorcycles	-	-	20	16,6(6)
Warehousing and service activities supporting transport	20	25	-	-
Activities related to the production of films, video recordings, television programmes, sound and music recordings	20	25	-	-
Software, IT consultancy and related activities	20	25	-	-
Insurance, reinsurance and pension funds, excluding compulsory social security	20	25	-	-
Age				

² The list of the most innovative sectors in the Polish economy was developed on the basis of the following studies: (Innowacyjność Polski. Chartbook, 2020, p. 21; Innowacyjność Polski. Chartbook, 2021, p. 27).

Enterprises' attributes	SERVICES		INDUSTRY	
	Number of entities	% (in the sector)	Number of entities	% (in the sector)
1-5 years ("young")	7	8,7	19	15,9
6-10 years ("quite young")	35	43,8	40	33,3
11-15 years ("mature")	15	18,8	25	20,8
Over 15 years ("old")	23	28,7	36	30,0
Scale of operation				
Local (1 city/municipality/district)	3	3,7	1	0,8
Regional (1-8 voivodships in Poland)	7	8,8	15	12,5
National (9-16 voivodships in Poland)	47	58,8	53	44,2
European (min. 1 country in Europe outside Poland)	15	18,7	31	25,8
International (min. 1 country in the world outside Europe - including Poland)	8	10,0	20	16,7
Average annual turnovers				
PLN 0-3 million	19	23,8	35	29,2
PLN 3-6 million	40	50,0	54	45,0
PLN 6 million and more	21	26,2	31	25,8

The research concerned the activities of enterprises (in the field of innovative processes) in the period from January 2017 to December 2021, i.e. five full years of their operation on the market. Overall, the study was conducted in the period April-July 2022. The CAWI study was carried out (at the level of data collection) by the IPC Research Institute (Wroclaw, Poland) (Woźniak, 2022).

Results

Complexity of applying the assumptions of the concept of frugal innovations, and dominant factors in enterprises

The first problem considered in the study is to estimate the level of complexity of applying the assumptions of the concept of frugal innovations in the area of shaping relationships with customers and in the area of shaping innovative processes in enterprises from the service and industry sectors. For this purpose, the average values of the ICSRC and ICSIP indicators (Table 2) were used. The study adopted a simplification of four levels of the complexity - the same for both indicators: (1) low - values in range <1;2>, (2) moderate low - values in range <2;3>, (3) moderate high - values in range <3;4>, as well as (4) high - values in range <4;5> (Woźniak, 2022).

Table 2. Descriptive statistics for indicators
(Source: Author's own research results)

Sector	SERVICES		INDUSTRY	
	ICSRC	ICSIP	ICSRC	ICSIP
N	80		120	
Mean	3,7307	3,7089	3,5106	3,5060
Median	3,7273	3,8875	3,5455	3,5597
Dominance	5,00	5,00	3,36 ^a	5,00

Sector	SERVICES		INDUSTRY	
	ICSRC	ICSIP	ICSRC	ICSIP
Standard deviation	0,79469	0,78265	0,83770	0,75141
Variance	0,632	0,613	0,702	0,565
Skewness	-0,322	-0,071	-0,542	-0,512
Kurtosis	0,433	-1,013	0,534	0,995
Minimum	1,18	2,15	1,00	1,00
Maximum	5,00	5,00	5,00	5,00
Gap mark	3,82	2,85	4,00	4,00

a. There are many modal values. The lowest value is given.

The above division is conventional and is a kind of simplification of the complex socio-economic reality in which innovative enterprises operate. In order to precisely determine the level of the complexity of the application of the assumptions of the concept of frugal innovation, each enterprise must be considered individually, taking into account its potential, as well as specific development limitations. On the basis of the data contained in Table 2, partial confirmation of the H.1 and H.2 hypotheses can be made.

In order to identify the dominant factors in the application of the assumptions of the concept of frugal innovations in the areas of shaping relationships with customers and shaping innovative processes in companies from the service and industry sectors, Friedman's rank test (Figures 2 and 3) was used. Analyzing the obtained results, it can be noted that in the area of shaping relationships with customers in companies from the service sector, the following factors dominate: scaling up the distribution of innovations (greater availability), ensuring the universal and comprehensive nature of innovation for customers (applicable in different situations), ensuring the life span of innovation (long service life of innovation), as well as developing alternatives, improvisation, and practical methods to overcome a lack of resources or solve seemingly unsolvable financial, social and technological problems of customers. Concerning the enterprises from the industry sector the factors: achieving the level of the minimum expected functionality of innovation in the opinion of customers (providing only the so-called must-have for the customer), ensuring low costs for customers to acquire innovations (low price), creating innovations for the poorest social groups, as well as training of customers in the field of self-contained creation of solutions and development of acquired innovations (Figure 2). At this point, it is worth noting that the factors relating to the functionality of innovation are slightly more visible in the service sector.

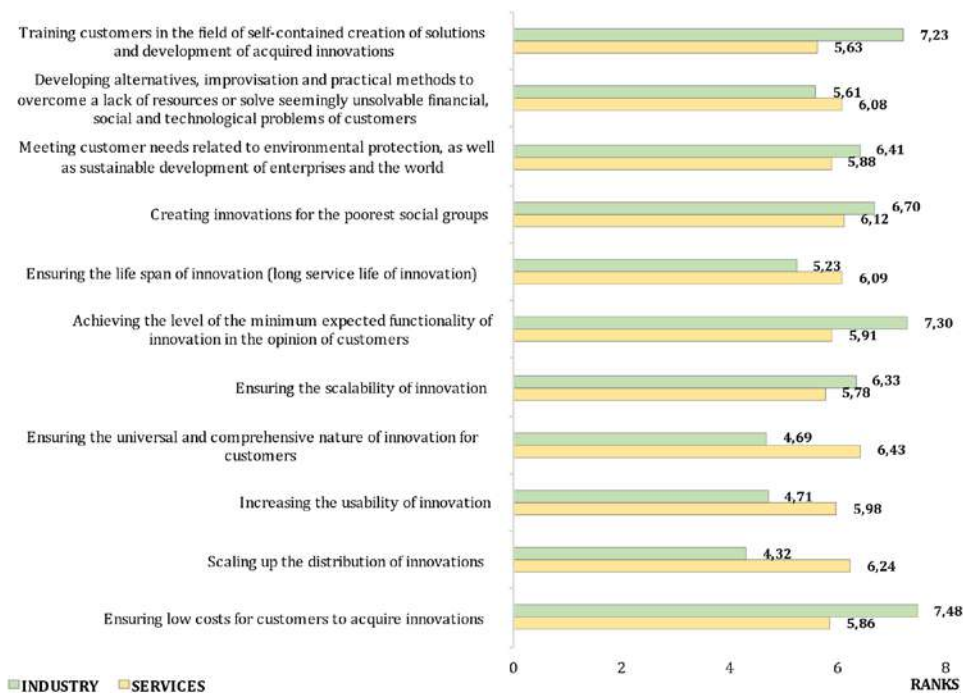


Figure 2. Dominant factors in enterprises for ICSRC indicator – Friedman's ranks (Author's own research results)

On the other hand, in the area of shaping innovative processes in enterprises from the service sector, the following factors dominate: increasing the efficiency of financing innovative processes, increasing the efficiency of knowledge management in innovative processes, recognizing basic customer needs while complexly penetrating the market, as well as social acceptance of innovative activities of enterprises, and in enterprises from the industry sector, the factors such as: reducing the costs of conceptualizing innovations, reducing the costs of imitation activities, the use of outsourcing (external business services), changes in the value system of society and in the mood of citizens, as well as the emergence of inconsistencies between market reality and the needs of customers/society (Figure 3). Interestingly, factors relating to financial resource management are more visible in enterprises representing the industry sector.

On this basis, partial confirmation of the H.5 and H.6 hypotheses can be made.

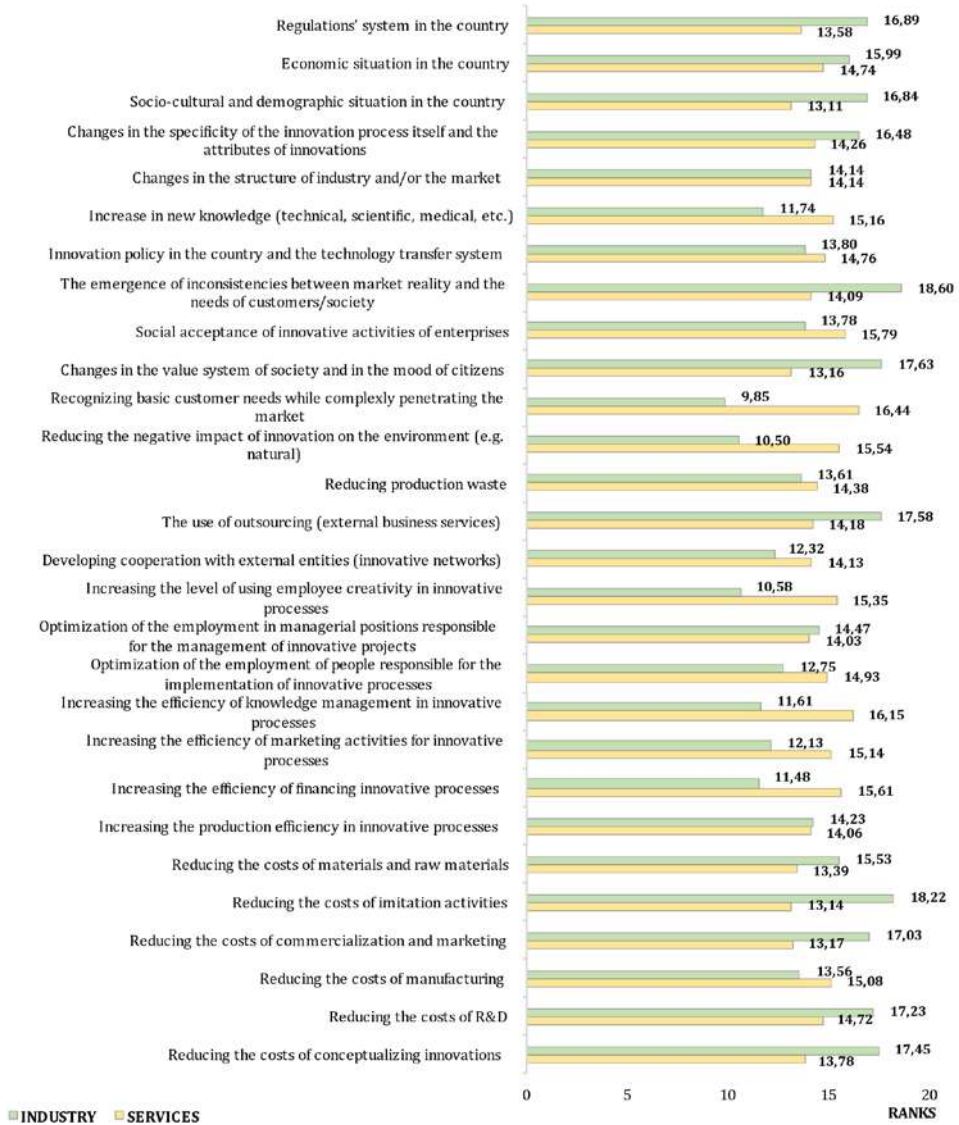


Figure 3. Dominant factors in enterprises for ICSIP indicator – Friedman's ranks (Author's own research results)

Clusters of enterprises applying the frugal innovations

Another analyzed problem is the clusters' size of enterprises characterized by low, moderate, and high values of the complexity of applying the assumptions of the concept of frugal innovations in the area of shaping relationships with customers and shaping innovative processes. For this purpose, cluster analysis using the *k*-mean method (considering the standardization of variables) was used (Tables 3 and 4).

Table 3. Clusters of enterprises – service sector
(Source: Author's own research results)

	Clusters		
	Enterprises with low values of indicators	Enterprises with moderate values of indicators	Enterprises with high values of indicators
N	9	46	25
Stand: ICSRC	-1,54435	-0,08833	1,23014
N	29	30	21
Stand: ICSIP	-0,97289	0,37824	1,40631

Table 4. Clusters of enterprises – industry sector
(Source: Author's own research results)

	Clusters		
	Enterprises with low values of indicators	Enterprises with moderate values of indicators	Enterprises with high values of indicators
N	18	56	46
Stand: ICSRC	-1,87459	-0,32190	0,84735
N	10	66	44
Stand: ICSIP	-2,13655	-0,42993	0,84261

On the basis of data contained in Tables 3 and 4, falsification of the H.7 and H.8 hypotheses can be made.

Statistical differences in the complexity of applying the assumptions of the concept of frugal innovations in chosen sectors

In order to verify whether there are statistically significant differences between service and industry companies in the complexity of applying the assumptions of the concept of frugal innovations, the normality of the distribution of variables (i.e. ICSRC and CSIP indicators) was tested first.

Table 5. Verification of the normality of variables' distribution
(Source: Author's own research results)

Sector		SERVICES		INDUSTRY	
		ICSRC	ICSIP	ICSRC	ICSIP
N		80		120	
Normal distribution parameters ^a	Mean	3,7307	3,7089	3,5106	3,5060
	Standard deviation	0,79469	0,78265	0,83770	0,75141
Test statistics		0,082	0,103	0,088	0,063
Asymptotic significance (bilateral) ^b		0,200^c	0,034	0,024	0,200^c
Skewness		-0,322	-0,071	-0,542	-0,512
Kurtosis		0,433	-1,013	0,534	0,995
Decision on the normality of decomposition		YES	NO	NO	YES

a. Compliance with the normal distribution is tested (Kolmogorov-Smirnov test). Calculated from data.

b. Lilliefors' correction.

c. This is the lower limit of actual significance.

**Table 6. U Mann-Whitney test for independent samples
(Source: Author's own research results)**

No.	H ₀	Significance ^a	Decision
1.	The distribution of ICSRC is the same for both categories: services and industry.	0,100	Confirm H ₀
2.	The distribution of ICSIP is the same for both categories: services and industry.	0,114	Confirm H ₀

a. The significance level is 0,050. Asymptotic significance is presented.

For companies from the service sector, the normal distribution has only the ICSRC indicator, and for companies from the industry sector – only the ICSIP indicator (Table 5). Therefore, the decision was made to conduct a non-parametric analysis using the U Mann-Whitney test for independent samples. The results of this test (Table 6) offered proof of the falsification of the H.3 and H.4 hypotheses.

Conclusions

The concept of frugal innovations is a "tool" for solving current business and social problems. It is a "new" mode of operation, that permits to increase in the efficiency of innovative processes in specific environmental circumstances. However, not every company is recommended to implement the assumptions of frugal innovations. This is due to the properties of the created innovations, the goals of the company, the peculiarity of the market/recipients of innovations, etc.

On the basis of the conducted empirical research, it can be concluded that the complexity of applying the assumptions of the concept of frugal innovations in the area of shaping relationships with customers and in the area of shaping innovative processes in enterprises from the service and industry sectors is at a moderately high level (but not very high). In addition, between enterprises from the service and industry sectors, there are no statistically significant differences in the complexity of applying the assumptions of the concept of frugal innovations in shaping relationships with customers and shaping innovative processes. The dominant factors in the application of the assumptions of the concept of frugal innovations in the area of shaping relationships with customers in enterprises from the service and industry sectors only partially relate to the optimization of the functionality of innovations. What's more, the dominant factors in applying the assumptions of the concept of frugal innovations in shaping innovative processes in enterprises from the service and industry sectors only partially relate to the management of financial resources. It is also important that the service and industry sectors are dominated by companies characterized by the moderate complexity of applying the assumptions of the concept of frugal innovations in shaping relationships with customers and in the area of shaping innovative processes.

The recommendations for companies that are willing to implement a process of developing frugal innovations are as follows: (1) frugal innovations can become the basis for shaping the security of enterprises, so their development and implementation should be integrated with the risk/hazard management system used in the enterprise; (2) the development of frugal innovations should take into account factors and activities relating both to the maintenance of customer relationships and the implementation of innovative processes; (3) shaping frugal innovations should reflect the specificity of the company's information needs and the broadly understood environment – because

frugal innovations should become a "tool" for ensuring the long-term development of the company by corresponding to the needs, capabilities, and limitations of the main classes of stakeholders (Woźniak, 2022).

In interpreting the obtained results, it is necessary to consider research limitations, which are mainly related to the fact that the subjective opinions of respondents were analyzed. It was also based on a limited list of factors constituting the basic assumptions of the concept of frugal innovations – the study detailed a total of thirty-nine factors. It is also worth noting that on the basis of the study, it is difficult to clearly indicate whether companies consciously implement the assumptions of the concept of frugal innovations, or whether this is an intuitive action. What's more, in assessing the complexity of applying the assumptions of the concept of frugal innovations, specially developed composite indicators (ICSRC and ICSIP) were used, simplifying the analyzed situation and respondents' assessments. In addition, only Polish companies were examined, so it is difficult to make an inference for innovative activities carried out in other countries (Woźniak, 2022).

Further research should focus on identifying the attributes of enterprises classified in given clusters of enterprises according to the level of the complexity of the application of the assumptions of the concept of frugal innovations, as well as the relationship between this complexity and attributes.

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References

- Apanowicz, J. (2005). *Metodologiczne uwarunkowania pracy naukowej*. Difin.
- Basu, R. R., Banerjee, P. M., & Sweeny, E. G. (2013). Frugal Innovation: Core Competencies to address Global Sustainability. *Journal of Management for Global Sustainability*, 1. <https://dx.doi.org/10.13185/JM2013.01204>
- Beaulin, D. (2019). *Frugal Innovation & Western SMEs*. LAP LAMBERT Academic Publishing.
- Bhatti, Y. A. (2012). *What is Frugal, What is Innovation? Towards a Theory of Frugal Innovation*. <http://dx.doi.org/10.2139/ssrn.2005910>
- Bhatti, Y., Basu, R. R., Barron, D., & Ventresca M. J. (2022). *Frugal Innovation: Models, Means, Methods*. Cambridge University Press.
- Dadlani, M., Wali, A., & Mukerjee, K. (2022). *The Art and Science of Frugal Innovation*. Ebury Press.
- Hajduk, Z. (2012). *Ogólna metodologia nauk*. KUL.

Hossain, M. (2020). Frugal innovation: Conception, development, diffusion, and outcome. *Journal of Cleaner Production*, 262, 121456. <https://doi.org/10.1016/j.jclepro.2020.121456>

Hyvärinen, A., Keskinen, M., & Varis, O. (2016). Potential and Pitfalls of Frugal Innovation in the Water Sector: Insights from Tanzania to Global Value Chains. *Sustainability*, 8(9), 888. <https://doi.org/10.3390/su8090888>

Innowacyjność Polski. Chartbook (2020). https://pfr.pl/dam/jcr:9895616c-f6bb-4e4f-a053-5e27355288c4/PFR_Innowacje_202003.pdf

Innowacyjność Polski. Chartbook (2021). https://pfr.pl/dam/jcr:e5033692-ad46-45fb-89b9-df90a04744b1/PFR_Innowacje_202103.pdf

Janiszewski, J. M. (2020). Frugal Innovation i Lean Innovation – odpowiedź na ograniczone zasoby i marnotrawstwo w procesie powstawania innowacji. In K. Poznańska (Ed.), *Modele i formy innowacji* (pp. 73-88). Warsaw School of Economics.

Lisiński, M., & Szarucki, M. (2020). *Metody badawcze w naukach o zarządzaniu i jakości*. PWE.

Makowski, Ł., & Kidyba, M. (2018). Potencjał innowacji ubogich w zarządzaniu oraz rozwoju gospodarczym rynków rozwijających się. *Przedsiębiorczość i Zarządzanie*, 19(4), 197-208.

Markiewicz, J., Bielawa, A., & Tylżanowski, R. (2020). Oszczędne innowacje we współczesnym przedsiębiorstwie. Uniwersytet Szczeciński. *Merriam Webster Dictionary*. <http://www.merriam-webster.com/dictionary/frugal>

Mukerjee, K. (2012). Frugal Innovation: The Key to Penetrating Emerging Markets. *Innovation, Oxford Dictionaries*. <http://oxforddictionaries.com/definition/frugal>

Radjou, N., & Prabhu, J. (2016). *Frugal Innovation: How to do better with less*. Profile Books Ltd.

Radjou, N., Prabhu, J., & Ahuja, S. (2012). *Jugaad Innovation: Think Frugal, Be Flexible, Generate Breakthrough Growth*. Jossey-Bass.

Ratten, V. (2019). *Frugal Innovation*. Taylor & Francis Ltd.

Sudoł, S. (2012). *Nauki o zarządzaniu. Podstawowe problemy i kontrowersje*. PWE.

Sułkowski, Ł. (2012). *Epistemologia i metodologia zarządzania*. PWE.

Weyrauch, T., & Herstatt, C. (2017). What is frugal innovation? Three defining criteria. *Journal of Frugal Innovation*, 2(1). <https://doi.org/10.1186/s40669-016-0005-y>

Wojciechowska, R. (2011). *Proces badawczy w naukach ekonomicznych*. Warsaw School of Economics.

Wojciechowska, R. (2016). *Logika procesu badawczego w ekonomii*. Warsaw School of Economics.

Woźniak, J. (2022). *Innowacje oszczędne. Dojrzałość koncepcji w Polsce a bezpieczeństwo przedsiębiorstw*. C.H. Beck.

Zaborek, P. (2009). Qualitative and quantitative research methods in management science. In M. Strzyżewska (Ed.), *Selected methodological issues for doctoral students* (pp. 41-50). Warsaw School of Economics.

Zeschky, M., Widenmayer, B., & Gassmann, O. (2011). Frugal innovation in emerging markets: the case of Mettler Toledo. *Research Technology Management*, 54, 38-45.
<https://doi.org/10.5437/08956308X5404007>