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Ewa Okoń-Horodyńska,
Jagiellonian University,
Krakow, Poland,
E-mail: ewa.okon-
horodynska@uj.edu.pl

Anna Zachorowska-
Mazurkiewicz,
Jagiellonian University,
Krakow, Poland,
E-mail: anna.zachorowska@uj.edu.pl

Rafał Wisła,
Jagiellonian University,
Krakow, Poland,
E-mail: rafal.wisla@uj.edu.pl

Tomasz Sierotowicz,
Jagiellonian University,
Krakow, Poland,
E-mail: tomasz.sierotowicz@uj.edu.pl

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GENDER, INNOVATIVE CAPACITY, AND THE PROCESS OF INNOVATION: A CASE OF POLAND

ABSTRACT. Innovation, as well as scientific research, is not a gender-neutral activity. There are few research results available concerning women's and men's contribution to the process of innovation at the national, regional and enterprise levels. Examining the current situation in this area of research, is the first and necessary step towards better understanding of women's and men's potential in the process of innovation. It is also a chance to point out a new source of synergies taking place in this process. The main objective of this article is to present the results of research addressing gender approach to the process of innovation. The first part of the article presents newly created integrated genome, dedicated to conduct the multidimensional research on women and men participation in the process of innovation, examining their traits, attitudes, behaviours and competencies. This design allows us to grasp the commonalities and differences between women and men roles in the process of innovation. The second part of article presents results of the pilot survey. Respondents of this survey were research personnel from Polish innovative enterprises. There are certain differences and similarities in what women and men perceive as important in the process of innovation. Skilful use of these attitudes in mixed research teams may become a new source of progress in the process of innovation.

Introduction

Innovation is increasingly becoming a way for enhancing economic development, and becoming a key to a prosperous future. There is a plethora of questions concerning efficiency, effectiveness, and also limitations identified in the context of growing importance of such issues as: cooperation between business and science, interdisciplinary research, commercialization of outcomes of the process of innovation, and a growing scale of public intervention directed to the stimulation of innovative attitudes and activities. These include barriers and limitations rising from gender stereotypes and prejudices, often based on a belief

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that masculinity and femininity play a determining role in shaping individuals, their behaviour, attitudes and needs (Okoń-Horodyńska *et al.*, 2015).

It is rational to increase innovative capacity of the nation by exploiting the whole society – men as well as women. It can also be stated that innovation, as well as scientific research, is not gender-neutral activity. A research project called „Innovative Gender as a New Source of Progress” is an attempt to analyse the broad and multidimensional relation between gender and the process of innovation, with a special emphases on the complexity and complementarity of women’s and men’s potential to achieve optimal effects in research and innovative activities. The complexity and complementarity of women’s and men’s potential consists of gender specific: behaviour, attitudes, roles and experiences. For this purpose, the dedicated design of integrated genome of women and men participation in the process of innovation was created.

In the first part of the paper the concept of gender is explored in the context of innovation theory and research. The following part presents the adopted research methodology. It is followed by the presentation of results of pilot survey conducted among research personnel in Polish innovative enterprises. It needs to be stressed, however, that the survey is only a part of a broader research project focused on gender as one of the new sources of economic progress.

1. Gender in the process of innovation – literature review

While discussing innovation it is worth turning to Schumpeter, who is considered one of the forerunners of innovation theory. He emphasized that innovation is virtually in the centre of all phenomena, difficulties and problems of the economic life of the capitalist community. The sense of innovation is “the formation of a new production function” (Schumpeter, 1939, p. 87). The entrepreneur is characterized by dynamism and innovativeness and thus creates new businesses, new products, introduces a new organization of production and new production technologies. The entrepreneur-innovator therefore decides on the driving force for economic development and the concept of innovation refers to broader creative human activity.

In contemporary world innovation is increasingly seen as one of the main ways to enhance economic growth, it is a key to a future prosperity, and it creates prosperous nations, and is considered crucial for development (Alsos *et al.*, 2013; Hunt *et al.*, 2013). Growth will be highest if the innovative capacity of the whole workforce is exploited. So the failure to integrate women into science, research and the development of innovation could be perceived as unacceptable waste of human resources (Abels, 2012, p. 188). As Abels (2012, p. 187) writes, scientific research, and innovations are not gender-neutral activities. The gender dimension is deeply embedded in the way we do science and develop innovations, influencing the entire process from the laboratories to the market. Yet the focus of efforts so far were not concentrated on particular groups in terms of their involvement in the process of innovation, such as women and men. In order to fill in this gap, the gender dimension should be applied to the consideration of innovation. This means that to be able to involve women and men in the process of innovation¹, it is necessary to understand what derives creativity and innovativeness of women and men. The main driver to undertake gender research in the area

¹ One way to investigate innovation is through the process of innovation. Descriptions of the process of innovation take into account various aspects and elements, such as: the creativity stimulation techniques, methods of searching for innovative solutions, evaluation and selection of optimal variations of solutions, organization and management of the process of innovation (Tidd, Bessant, Pavitt, 2005), research and development and development of new technologies and their transfer (Rothwell, 1994). The current proposals for the process of innovation take into account the cultural, sociological and psychological issues, influencing the development of innovation (Degraff, Quinn, 2007).

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of creativity and innovation is the diversified contribution of women and men in these areas. The involvement of women and men in the process of innovation is not related only to the quantitative but, first of all, to qualitative terms, and they need to be considered in different stages of this process.

Among studies that have been undertaken in the area of innovation and gender there are few of a rather interdisciplinary nature. In social sciences they include business, management and economics literature, there are studies and reports that have stressed the problem of women's under-representation in science, and in the business sector. The results of international empirical comparative studies indicate that, in general, there is a clear statistical pattern that women are less involved than men in the creation of scientific and industrial knowledge (Larivière *et al.*, 2013; Whittington & Smith-Doerr, 2005; Frietsch *et al.*, 2008; Frietsch *et al.*, 2009; Okoń-Horodyńska *et al.*, 2015). Whilst women represent over 35% of all researchers in the higher education and government sectors of most European countries, this is not the case for the corporate sector. The percentage of female researchers in the business sector is less than 25% in most countries (European Commission, 2010). Hunt *et al.* (2013) investigated women's underrepresentation among the holders of commercial patents. They concluded that the magnitude of the gender gap in patenting raises the concern that, rather than reflecting comparative advantage or different tastes by gender, the gap reflects gender inequality and an inefficient use of female innovative capacity (p. 831). There is also limited research with a gender perspective on innovation policy, innovation systems and innovation support schemes (Alsos *et al.*, 2013, p. 240).

Ewa Okoń-Horodyńska *et al.* (2015) conducted study concerning a statistical picture of innovative activity taking into account the criterion of gender and identifying the directions and dynamics of change in the number of patent inventors in the selected EU member states. An interesting regularity has been discovered after the analysis of the results achieved. The patent activity of women in the leading EU countries in terms of obtaining patents included in the study increased significantly while the patent activity of men decreased in all these countries throughout the same period. It means that the role of women as inventors of patents, that make an important component of the innovative potential of the leading EU countries included in the study, was systematically growing². This phenomenon, which was observed in the field of patent activity, has a significant impact on the innovative development of the economies. In the paper by Sierotowicz and Zachorowska-Mazurkiewicz (2016) the similar dynamics was considered for transition economies. The same data set was used, and the results show that in Poland the dynamics of growth in the number of men inventors of industrial property is higher than in the case of women inventors in the same period under study. In Poland there was actually a drop in the ratio of the number of women to the number of men inventors of industrial property in business sector. It is a situation opposite to the one describing EU leading countries, where the ratio was increasing throughout the analysed period. It could be concluded that the role of women in the process of innovation is limited in business sector in Poland. This limitation leads to the decreasing role of women inventors of industrial property in business sector. That could also be a factor explaining poor performance of Poland in terms of patent obtained.

According to Alsos *et al.* (2013, p. 237) one of the reasons for the lack of studies taking a gender perspective to innovation is the apparent invisibility of people in innovation. When people are not visible in the discourse, gender easily becomes invisible. Gender in innovation has remained invisible due to the fact that most studies on innovation are about products, processes or organizations, and not about people. It is not to say that gender is irrelevant to studies of innovation. As Thorslund and Göransson (2006) highlighted,

² The study conducted used data from European Patent Office (EPO) for years 1999-2013 concerning creative activities by women and men in business sector.

individuals – men and women – are smallest parts of innovation systems, and all the systems are results of their parts (cited in Alsos *et al.*, 2013, p. 238). The invisibility of actors does not mean there are no actors in innovation. Processes, organizations and systems consist of actors. Identifying these actors is one way of examining gender in innovation as a new sources of hidden potential.

2. Methodology

The above discussion shows that the relationship between gender and the process of innovation is not well recognized yet, and further research has to be undertaken. In order to further investigate the significance of gender in the process of innovation, the concept of innovative genome (DeGraff, Quinn, 2007) was adopted. The uniqueness of the original genome lies in its strengthening of the criterion of creativity, its multi-dimensionality, the need for cooperation and balance, as well as capturing the transition from closed to open innovation, which decided on its usefulness in the sense that it can provide a map of areas of research on the importance of gender in the innovation process. Although the multi-dimensional character and wide scope of the areas encompassed by the innovation genome shows that the process of innovation involves all members of an organisation and selected specialists from cooperating organisations, the issue of gender is not accounted for, yet. To research gender relations in the process of innovation, the original model had to be transformed. After the changes it is possible from this model to extrapolate and connect the two main economic categories that form the subject of the studies undertaken, namely the *process of innovation*, based on creativity and its determinants, and *gender* from the perspective of the diverse and complex relationship between men and women and the importance of their participation in the different phases of the innovation process.

The starting point of the preparation of conducted research has been the construction of dedicated matrices, containing information (variables) describing a given area through a gender perspective. For the time being, a pathway to innovation has been presented, made up of six stages:

- stage 1 – creativity – the generation of ideas,
- stage 2 – accumulation – the gathering, application and protection of ideas,
- stage 3 – prioritization – selection of ideas to be implemented in the formal process of innovation,
- stage 4 – development – testing, preliminary assessment of possibilities to commercialize ideas,
- stage 5 – potential innovation – ready solution, preparation of commercialization strategy, market research and pricing,
- stage 6 – Innovation – implementation of a new / improved solution and diffusion of innovation, first financial rewards.

At every stage of the innovation process, although to varying degrees, men and women are involved. They perform different work, represent different levels of creativity, have different inspirations, drawing both from their own skills and experience, as well as acquiring other bundles of new knowledge and information from the environment. In the next step groups of characteristics that might be of importance in different stages of the process of innovation have been distinguished. The metrix used in the pilot research is presented underneath.

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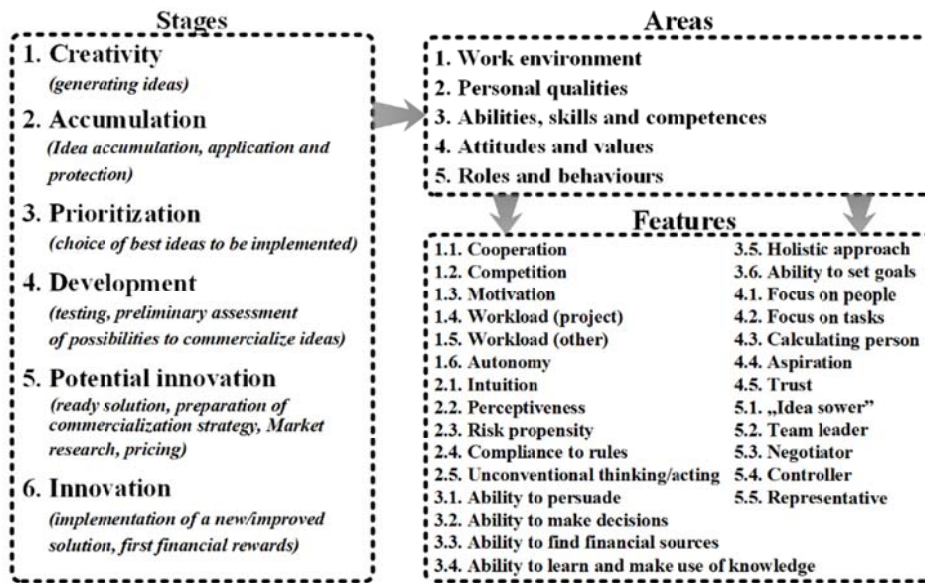


Figure 1. Stages, areas and features of the design for the research on women and men participation in the innovation process
 Source: Own elaboration.

The above stages, areas and features could be presented in a different form, creating a radar diagram. The data necessary to fill in the figure had to be collected. The gender aspect is a cross-cutting issue, since the data collected are disaggregated by gender.

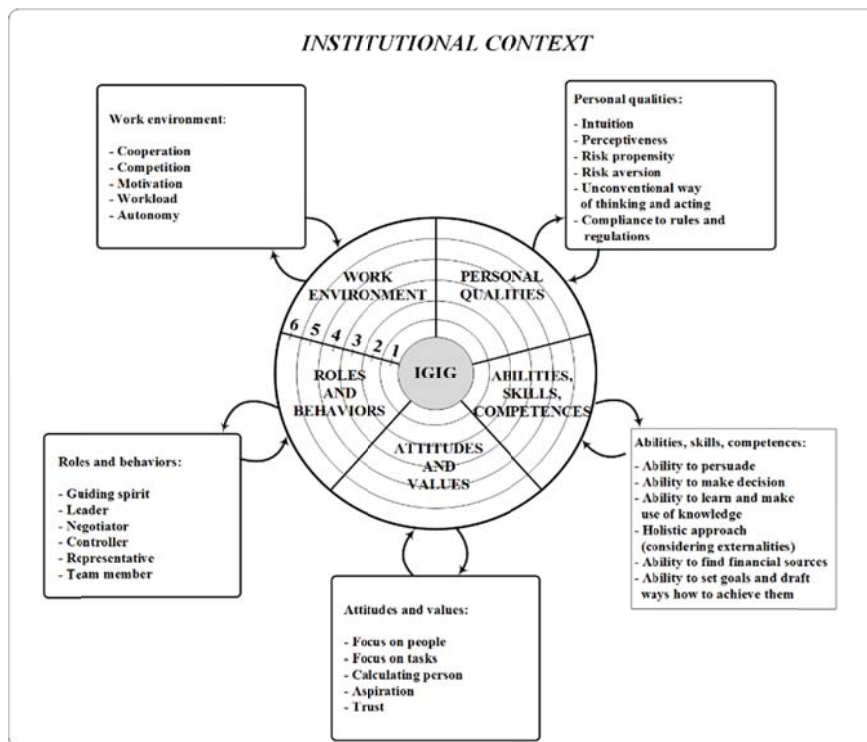


Figure 2. Design of integrated genome for women and men participation in the innovation development process
 Source: Own elaboration.

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The starting point is the analysis of the matrix of relationships between the characteristics of the participation of women and men in the innovation process. Individual matrices contain a description of the characteristics of the participation of women and men in all stages of the innovation process, depending on the gender pattern of innovative activities (e.g. gender pattern of creativity, gender pattern of competition). The individual characteristics of the participation of women and men in the innovation process taking into account all the paths of innovation activity make up the matrix of the integrated genome of women and men role in the innovation process. In order to fill in individual matrices, there was a questionnaire used that covered all areas of interest. The results of the pilot survey are presented in the following section of the paper.

3. Results of the pilot survey

The pilot research material was obtained in a first half of 2015 using the method of questionnaire, and in-depth interviews. The respondents were men and women employed in Polish enterprises sector involved in different ways in the process of innovation. In the survey there were 104 questionnaires collected, 83% of which came from enterprises and the rest from research institutions. Among respondents there were 56% of men and 44% of women. They served different roles in these organizations. *Figure 3* presents the roles played by respondents in the company.

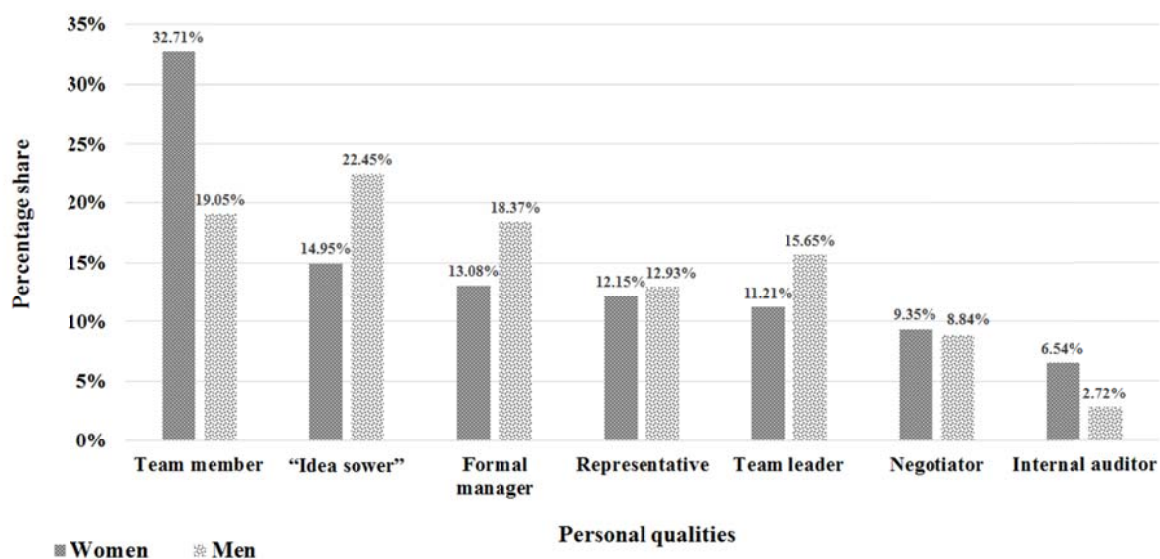


Figure 3. The role played by respondents in the company

Source: Own elaboration.

The majority of respondents were people with higher education, both in the case of women and men. Reviewing the characteristics of the respondents, we focussed on how respondents identified themselves. In the study seven types of roles played in the company were distinguished. The biggest group of women played a role of a team member, while the biggest group of men were "idea sowers". The least number of both men and women considered themselves internal auditors.

In the group of all enterprises, the structure of the teams involved in the development of innovation consisted of 40% women and 60% men. This structure correlates well with the structure of respondents. The same is true in the case of the structure of management. In researched organizations the number of female managers oscillates around 34%, while male

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respondents around 66%. The *Figure 4* presents types of innovations developed by surveyed enterprises.

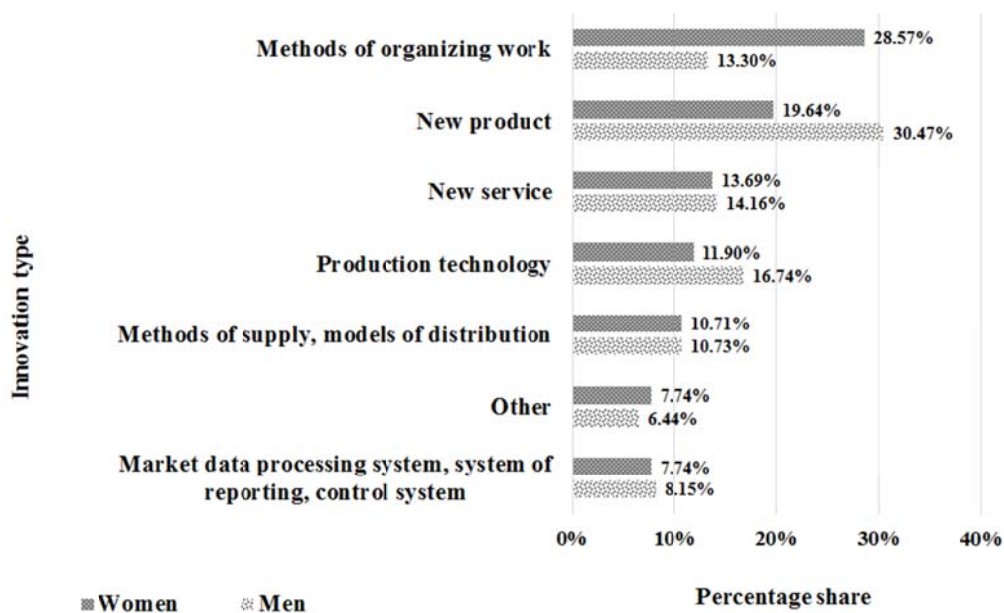


Figure 4. Women and men as managers of the sections or teams involved in development of specific type of innovations in all enterprises

Source: Own elaboration.

The biggest group of female respondents was involved in the development of innovation in organizing work, while the biggest group of men in the development of new products. The least number of women was involved in market data processing systems, systems of reporting and control, and least number of men in other types of innovation.

The pilot survey results enables us to investigate specificities of men's and women's behaviour in the context of different stages of the process of innovation. In *Appendix 1* a detailed picture is presented of the significance of listed features, roles and behaviours according to female and male personnel from enterprises and research institutions in Poland. In the first stage of the process of innovation – creativity – women pointed at motivation as the most important feature, and men at the role of “idea sower”. As least important in this particular stage women found compliance to roles and regulations, and men competition. Competition was considered to be least important in four following stages by both women and men, with an exception of prioritization, in which women pointed at compliance to rules and regulations as least important, and men at workload (other types of content). In the second stage women found ability to learn and make use of knowledge, as well as the rule of a leader as the most important features, men, on the other hand, underlined the importance of focus on tasks. They found this particular feature as the most important in the following three stages – prioritization, potential innovation and innovation, while women in last two. In the third stage – prioritization – women found ability to make decisions the most important feature. Same feature was pointed by them in the following stage, while men pointed at the ability to make decisions and make use of knowledge. In the two following stages both women and men underlined the importance of the focus on tasks. In the last stage women pointed at the role of an idea sower and risk propensity as least important, besides competition. *Figure 5* presents aggregated results from all the stages of the process of innovation for men and women.

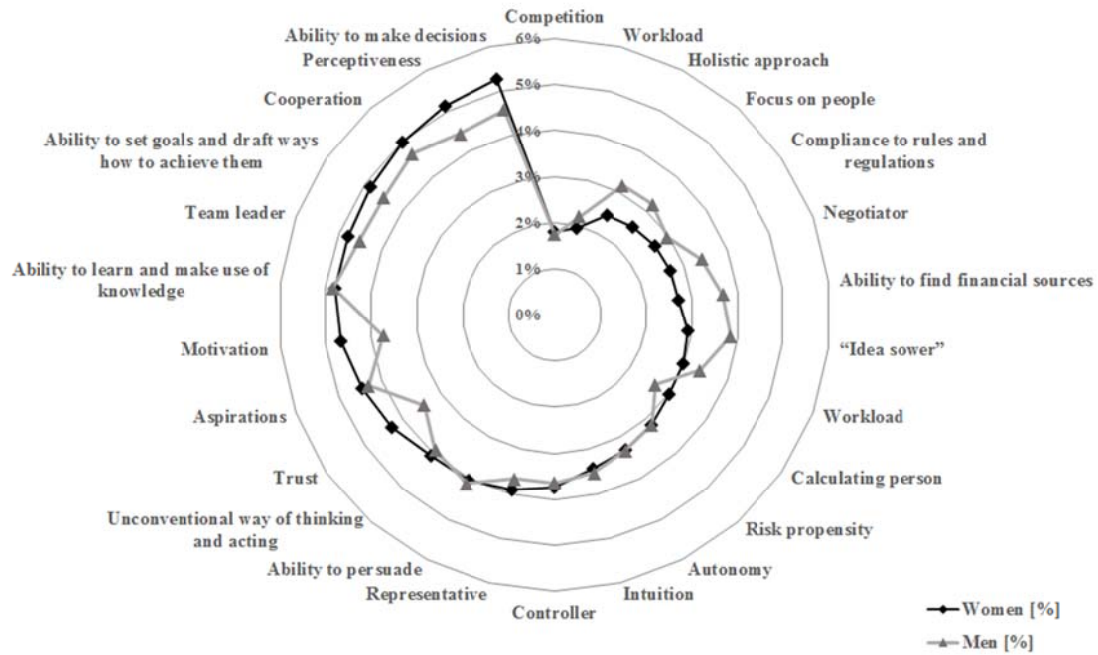


Figure 5. The importance of features roles and behavior in the process of innovation by gender (all stages)
 Source: Own elaboration.

As it can be easily observed in the *Figure 5* above there are some differences as well as similarities in the way women and men perceive the characteristics needed in the process of innovation. There are only few differences in terms of the hierarchy, however, the share of women and men who find a particular feature, role or behaviour significant differs more. In general, in the case of all enterprises and all stages, the most important personal qualities according to women are: ability to make decisions and focus on tasks, while for men they are: ability to learn and make use of knowledge and focus on tasks. In the case of least important qualities, both women and men agree to what they are: competition and workload (other types of content). There is a more detailed presentation of aggregated results from all the stages of the process of innovation in the *Appendix 2*.

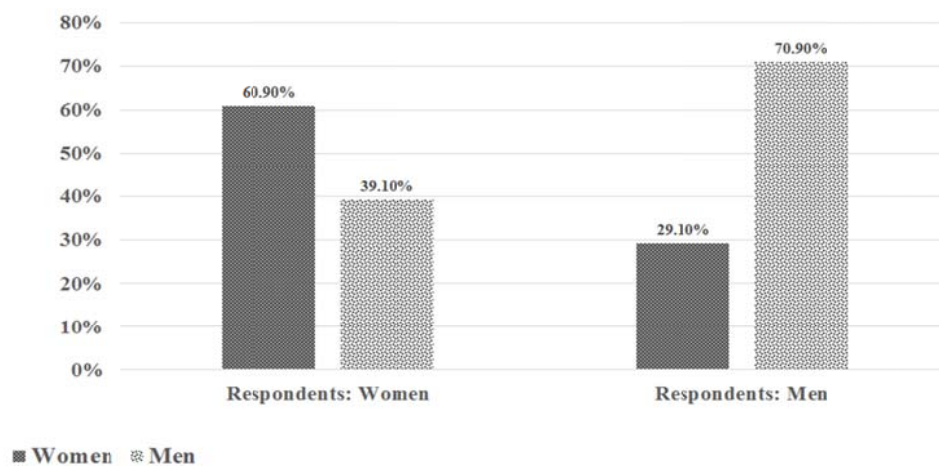


Figure 6. To what extent women contributed to the success of your organization
 Source: Own elaboration.

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Women and men participation in the process of innovation also differ, when it comes to the overall assessment of the extent in which women and men contributed to the success of their organization. As it can be noticed in the *Figure 6* both women and men believe that they contributed more to the success of their enterprises or research institutions. More than 60% of women stated that women contributed to this success, and more than 70% of men answered that these were men that contributed to the success. The least contribution was assigned by men to women (29.10%). It needs to be mentioned, however, that these results are only the opinions of participants of the process of innovation.

Discussion and Conclusion

The study of the relation between the process of innovation and gender is complex. Nevertheless both literature review and conducted research show that it needs to be investigated due to its potential to serve as a new source of economic progress. Previously conducted research shows that the process of innovation is not gender neutral. The role of gender in this process is not recognized well yet. Examination of the current situation in the women and men contribution to the process of innovation development, is the first and necessary stage towards better understanding and use of women and men potential in the innovation development process. It is also a chance to point out a new source of synergies in the development of innovations. Presented results of the pilot survey show that there are certain differences in the way women and men perceive the process of innovation, and this leads to differences in their participation in it. Women tend to value the ability to make decisions in various stages of innovation process, and men pay attention to the focus on tasks more often. In general women believe that the ability to make decisions was important in the process of innovation, while men thought it was the ability to learn and make use of knowledge that played a determining role. There also were similarities in women's and men's opinions as well. They both pointed at competition as not important in majority of stages of the process of innovation and at the importance of the focus on tasks in the aggregated approach. Presented results come from the pilot survey, but they show validity of further research in this topic.

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Appendix 1. The importance of features roles and behaviour in different stages of the process of innovation by gender

Stage of the innovation process Personalities/gender	Creativity		Accumulation		Prioritization		Development		Potential Innovation		Innovation	
	Women [%]	Men [%]	Women [%]	Men [%]	Women [%]	Men [%]	Women [%]	Men [%]	Women [%]	Men [%]	Women [%]	Men [%]
“Idea sower”	5.03	5.70	3.90	4.16	2.41	3.58	2.53	3.17	1.99	3.31	1.56	3.27
Ability to find financial sources	1.62	2.98	2.04	3.01	2.58	3.58	2.92	3.78	3.98	4.71	3.31	3.93
Ability to learn and make use of knowledge	4.67	5.44	5.20	4.88	4.30	4.32	4.87	5.24	5.57	4.71	4.28	4.45
Ability to make decisions	4.67	4.15	5.02	4.59	5.67	4.93	5.85	4.39	5.37	4.84	5.06	4.58
Ability to persuade	4.31	4.40	4.83	4.02	4.98	4.81	2.92	3.78	3.58	3.57	3.50	4.19
Ability to set goals and draft ways how to achieve them	4.31	3.89	4.83	4.45	4.47	4.69	5.26	4.63	4.77	4.33	5.64	4.97
Aspirations	5.39	5.05	3.72	4.59	4.47	4.32	3.70	4.02	4.57	4.08	4.86	3.93
Autonomy (freedom, tolerance)	4.49	4.92	4.09	3.01	2.41	2.84	3.70	3.17	2.19	3.06	2.92	2.88
Calculating person	2.69	1.81	2.97	2.73	3.26	2.59	2.73	2.68	2.98	3.06	3.50	3.14
Competition	2.87	1.42	1.49	1.43	2.41	2.22	1.75	2.20	0.60	1.53	1.56	1.57
Compliance to rules and regulations	1.44	2.20	2.42	3.16	1.37	2.71	3.51	3.05	3.58	3.31	3.89	3.40
Controller	1.62	1.68	3.35	3.59	3.61	3.95	5.46	4.39	4.37	3.95	4.28	4.19
Cooperation	4.67	4.53	5.02	4.45	4.98	4.93	4.68	4.51	5.17	4.59	5.45	4.97
Focus on people	2.51	3.11	2.97	3.87	2.23	2.96	2.34	2.93	2.39	3.06	2.92	3.40
Focus on tasks	4.67	5.18	4.65	5.88	5.15	5.67	5.65	4.88	6.16	5.22	5.84	5.24
Holistic approach (considering externalities)	2.33	2.46	2.42	2.73	2.75	3.58	1.75	3.17	2.78	3.69	2.53	3.27
Intuition	5.03	4.40	3.72	3.59	4.64	4.32	2.73	3.29	2.19	2.80	1.95	2.75
Motivation	5.75	3.89	4.09	3.73	4.30	3.21	4.09	4.15	4.57	3.95	5.25	3.53
Negotiator	2.51	2.59	2.97	3.30	3.44	3.70	2.92	3.29	2.58	3.69	1.56	3.93
Perceptiveness	5.57	4.79	5.02	4.30	5.33	4.32	5.07	4.76	4.57	4.33	5.06	4.06
Representative	2.87	3.50	2.23	3.16	3.44	3.45	4.09	3.66	4.97	3.95	6.03	4.19
Risk propensity	4.67	4.15	3.53	3.16	3.09	2.96	3.70	2.68	2.39	2.93	1.56	3.27
Team leader	3.23	3.11	5.20	5.16	5.50	4.93	5.07	4.76	4.97	4.33	4.86	4.84
Trust	3.95	3.37	5.02	4.16	4.47	3.21	4.29	3.29	4.37	3.44	3.70	3.27
Unconventional way of thinking and acting	5.57	5.44	4.83	3.30	4.47	3.58	3.51	4.02	2.98	3.57	2.72	3.53
Workload (other types of content)	1.80	2.72	1.67	2.15	2.06	1.48	1.95	2.32	2.19	2.42	1.95	2.09
Workload (work based on content)	1.80	3.11	2.79	3.44	2.23	3.21	2.92	3.78	4.17	3.57	4.28	3.14
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: Own elaboration.

Appendix 2. The importance of features roles and behavior in the process of innovation by gender (all stages)

All stages		
Personalities/gender	Women [%]	Men [%]
Competition	1.81	1.74
Workload (other types of content)	1.93	2.19
Holistic approach (considering externalities)	2.43	3.16
Focus on people	2.56	3.20
Compliance to rules and regulations	2.65	2.97
Negotiator	2.68	3.42
Ability to find financial sources	2.71	3.68
“Idea sower”	2.93	3.85
Workload (work based on content)	2.99	3.38
Calculating person	3.02	2.67
Risk propensity	3.18	3.18
Autonomy (freedom, tolerance)	3.31	3.31
Intuition	3.43	3.53
Controller	3.74	3.64
Representative	3.90	3.66
Unconventional way of thinking and acting	4.05	3.91
Ability to persuade	4.05	4.13
Trust	4.30	3.44
Aspirations	4.46	4.32
Motivation	4.68	3.74
Ability to learn and make use of knowledge	4.80	4.84
Team leader	4.80	4.52
Ability to set goals and draft ways how to achieve them	4.86	4.50
Cooperation	4.99	4.67
Perceptiveness	5.11	4.43
Ability to make decisions	5.27	4.58
Focus on tasks	5.33	5.33
Total	100.00%	100.00%

Source: Own elaboration.