

## CO-OWNERSHIP OF INTELLECTUAL PROPERTY AS A SYMPTOM OF COOPERATION IN THE POLISH METAL INDUSTRY

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### Abstract

The open innovation paradigm suggests that companies should open up and cooperate with external partners. One of the manifestations of such action in the field of cooperation between science and business is co-ownership of patents. It is the result of the intellectual potential of research units linked to real needs definable by the industry. The positive results of research and development works and "monopoly" obtained through patent rights, definitively constitute a major factor in the competitiveness of enterprises. Also in the steel industry. The presence of the cross-organizational cooperation becomes a necessity to generate knowledge of a certain quality. The aim of this study was to evaluate the presence of cooperation networks for the steel industry in Poland in the field of patent rights. The network links were selected on the basis of a database for patent applications from the years 1995-2014. In order to construct a graphical structure of relationship has been applied Social Network Analysis (SNA). The second goal of the study was to evaluate the usefulness of the proposed research procedure for the purpose of identification of network participants, particularly the key players. In addition, monitoring of cooperation networks can be a useful tool in assessing intellectual property management policy in projects financed from public funds.

**Keywords:** Open innovation, intellectual property in metal industry, management of metal industry, patent analysis

### 1. INTRODUCTION

Modern business models of enterprises, in particular steel producers are much more complicated than the models before the previous decades. Today's companies must provide products corresponding to the increasingly sophisticated needs of customers and provide support at the highest level in every piece of the supply chain [1], [2], value chain [3], acting also in the global environment. Therefore, modern business models place particular emphasis on the development and innovation in action [4], [5]. The challenge is the right shape broadly understood innovation [6] which provides access to new knowledge. Literature provides many valuable tips on how to conduct these activities effectively. It is worth noting the analysis of the structural model pathways of institutional cooperation in innovative activity [7] or the attempt to identify organizational forms of cooperation in the metalworking sector [8], [9]. In order to provide the enterprise access to new knowledge, it seems obvious that the pursuit of building a lasting partnership in universities and research institutes. However, this requires thoughtful design of this process because as claimed by some researchers [10] the possibility of cooperation between science and business is determined by the complementarity of resources and the presence of a consistent strategy of commercialization.

At the beginning of the 21<sup>st</sup> century, the processes of commercialization, market connections, knowledge gathering, and collaboration between innovation-generating companies were crucial to achieving the best results in implementing new technological solutions. Open innovation has also begun to play an important role in the commercialization of processes. Open innovations are associated with the use of the work and research projects previously developed elsewhere, but abandoned as unused, too niche or difficult to develop [11]. Santarek [12] notes that, in addition to the existing division within the organization on the departments of

research and development, procurement, production, distribution and others appeared organisations providing highly specialized services for a specific kind of research, manufacturing, and service test equipment, software, computer modeling, etc. At the same time, there is a tendency to outsource research and development tasks in many companies. As a result, increasing not only the supply of widely understood services related to research and development but also the interest of companies acquiring technology from other organizations. R&D outsourcing is not a new phenomenon. The company always used, although to varying degrees, on external technology providers. The benefits of cooperation are growing in the era of open innovation. With the focus on the purely internal research and development activities, academic community has begun to emphasize that the companies should be open to external innovation [13]. Without cooperation, it is impossible to cope with the serious competition challenges. Even worse, Koschatzky [14] stated that non-cooperating companies that do not share knowledge in the long term reduce their knowledge base and lose the ability to engage with other companies and organizations. Therefore, cooperation with external actors is fundamental to increase innovation and reduce time-to-market. The work of Markman and co-workers [15] includes four categories that help understand commercialization: innovative organizations, experiences, proces of learning and dissemination of knowledge. According to these four categories, the determinants of the commercialization process are: the creators of technology and research, the specialization and unique competence of the organization, investments in venture capital and cooperation in the field of internationalization of technology. From a practical point of view, the first step towards commercialization should recognize the source of the development of new technologies, and not phases of the commercialization process. Then the process of commercialization will be based on two main knowledge sources: the opportunities of new technologies and the knowledge of the requirements of the target market. Lichtenthaler [16] points out that organizations that prepare new technology may not take into account all the uses of new technologies, seeking new solutions for their own needs, sectors where technologies could potentially be used are often overlooked. As a consequence, new technology may never reach the market or arrive late. The presence of a well-functioning eco-system of innovation is an important factor in the success of the commercialization of new technology. Szmaj [17] presented the problem of knowledge infrastructure of the ecosystem of innovation on the example of the Silesian Voivodeship. The paper highlights the aspect of knowledge diffusion conditions created using knowledge economy infrastructure. Given the main assumption of the concept of open innovation, which suggests that companies should open up and cooperate with external partners, the authors have decided to explore one of the manifestations of such cooperation. A very concrete manifestation of cross-sectoral cooperation between science and business is co-ownership of patents. This cooperation is the confrontation of the intellectual potential of research units with the real needs of the industry, which ultimately translates into the competitiveness factor of enterprises. The aim of the study was to assess the presence of cooperation networks for steel industry in Poland in the field of patent law, which gave an opportunity to evaluate incentive policies for co-operation in projects financed from public funds.

## 2. METHODS

The analysis of patent databases steel industry was defined according to the proposed by PWC [18] in report *Innovation trends steel 2015 - Analysis of patent publications in steel and its implications*. The classification takes into account the 19 classes of the IPC assigned to the 4 main processes in the production chain. Respectively - metallurgy (C21B,C; C22C,D), hot and cold forming (C21D), finishing (C25C,D), processing (B21B,C,D,F,H,J,K,L; C23C,D,F,G). The basis of the analyzes was the database, which was a collection of patent applications publicized in the Polish Patent Office [19] between 01.01.1995 and 31.12.2014 for the selected codes IPC only for Polish entities. As the source of the data was used the search engine of the European Patent Office available at [www.espacenet.com](http://www.espacenet.com). The process of data collection and processing were performed using Microsoft Excel, OpenRefine and Gephi software. The process of preparing the data was consistent with the following scenario:

- 1) Data collection - Data for individual classes (19 single base IPC)

- 2) Formatting databases - the combination of individual databases in a collective base; remove duplicates; Organize and unify data using OpenRefine for filtered records.
- 3) Data Analysis - Target analysis of selected values, data visualization using software Gephi.

Formatted database contained a total of 2195 unique records being separate patent application of Polish business entities, scientific institutions and private persons. In the third key stage for network visualization and visibility of supply of knowledge, we applied ForceAtlas algorithms [20]. The ForceAtlas layout algorithms come under a category of algorithms called force-directed algorithms. They simulate a physical system in order to spatialize a network. Finally, it is expected the obtained network configuration will help interpret the data in a reliable way. In this case will be identified leading players in the supply and transfer of knowledge.

### 3. RESULTS

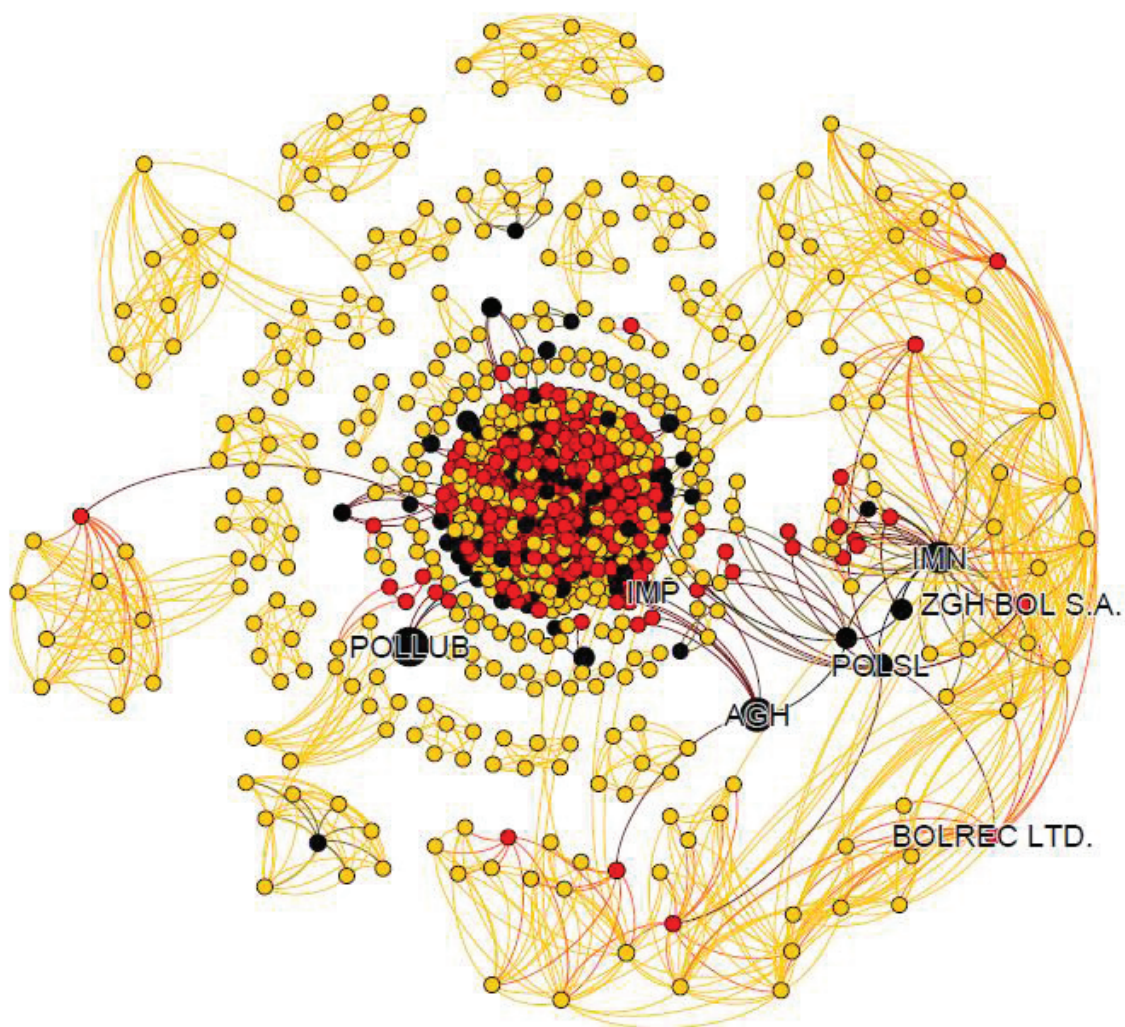
The intention of the authors was to investigate the presence of co-ownership model of industrial property rights in the Polish steel industry using Social Network Analysis. However, the analysis is not limited to the identified patent applications in the ownership but to all records. This approach allowed us to identify the key players not only in terms of the number of patents but also links with the network. Therefore, the database contained 1,037 unique entities in the category of applicant. Which resulted in the presence of 304 patent applications in co-ownership. Visualization of all participants in the network shown in **Figure 1**. For a better interpretation of the resulting network visualization private persons were marked in yellow, research units in black while the entrepreneurs red. Furthermore, distinction was drawn due to the number of patent applications (proportionally larger marks). The thickness of the edge connecting the individual nodes of the network is directly proportional to the number of relationships between them (the number of different patent applications, to which a pair of entities have co-ownership). Relationships in the network (edges) was defined as equivalent to all claiming ownership of the patent application (network undirected).

**Table 1** Key players in network cooperation

Name	Frequency	Degree (number of connections)
Lublin University of Technology	196	3
AGH University of Science and Technology	151	8
Institute of Non-Ferrous Metals	132	33
Silesian University of Technology	72	11
Institute of Precision Mechanics (IMP)	55	4
ZGH Bolesław S.A.	15	17
KGHM Polska Miedz S.A.	9	1
ArcelorMittal Poland S.A.	7	0

The ForceAtlas algorithm allowed to clustering all network participants in individual and co-owned clusters. On the basis of the preliminary analysis of the **Figure 1**, can be noted the homogeneity of the presented structure. In the center there is a grouping of patent applications with one owner, which constitutes the vast majority of the analyzed base. It is worth noting that a significant part of these applications are owned by entrepreneurs (red dots), which seems natural because of the competitive advantage sought in the industry and the monopoly on the technology. The opposite of this action is the Capital Group Bolesław (ZGH BOL S.A., BOLREC LTD.), which seeks new business opportunities through extensive co-operation with other entities. In particular with scientific units. As the center of knowledge and technology transfer, should be considered research institutions and enterprises from the South Poland steel industry focuses its activities. The network includes research institutions and enterprises: Silesian University of Technology (POLSL), AGH University of Science and Technology (AGH), Foundry Research Institute, Orzeł Biały Ltd., Capital Group

Boleslaw and Institute of Non Ferrous Metals (IMN), which should be indicated as the Leader of the network connecting all entities (see **Table 1**). On this occasion, the authors attempted to identify the impact of EU funds for research and development in the increase of protection rights in joint ownership with scientific units by reducing network to the records before 2008 and compared it with the years 2008 to 2014. For such a comparison there were no significant differences that could indicate the stimulating effect of the EU funds seen as a co-ownership of industrial property rights (due to editorial restrictions, the visualization for the years 1995-2008 was not published). In the interpretation of the network, it is impossible to ignore the significant participation of private persons who are more likely to decide on the joint ownership of patent rights than the other groups. At the same time, they are also an important factor in maintaining relations within the network of institutional connections.



**Figure 1** Visualization of cooperation network in polish steel industry in the field of patent rights between 1995 - 2014. Visualization in Gephi 0.91. Algorithm ForceAtlas. (red - entrepreneurs, black - research units, yellow - private persons)

**Table 1** summarizes the most important members of the network in terms of number of applications. The leader in this respect is the Lublin University of Technology (N=196), which does not guarantee a significant role in shaping the networks in terms of industrial property rights (only three connections - degree). The first company in terms of number of applications is ZGH Bolesław S.A. with 15 applications. Other companies not included in **Table 1** have no more than 10 applications. The absence of significant amount of patent applications from business entities may point to other strategies to secure technological processes, such as

know-how, non-technological innovations. However, it can not be overlooked that the Polish steel industry has been subject to deep technological and proprietary restructuring in the last two decades. Ownership changes and the entry of global steel industry players could affect the introduction of external technological processes in correlation with abandoning the generation of its own patent rights.

#### 4. CONCLUSION

The data obtained by the proposed methodology allowed for graphical visualization of inter-organizational relationships of co-ownership of patent for the Polish steel industry units. Furthermore, the proposed approach to the analysis of patent bases limited to a particular industry, allows to identify Leaders in terms of business entities and scientific units. However, it should be noted that the picture presented in this paper does not cover the full scope of information, because the cooperation of entities can take different forms (know-how, expertise). Possession of this knowledge can be translated into the construction of valuable partnerships for joint research and implementation projects. The implementation of new projects with partners with organizational and technological experience but also in the division of results of R&D works can be a success factor in these projects. In addition, the exploitation of industrial property rights is a competitive advantage of the company, which does not conflict with the ownership of these rights with third parties. In such a case, the economic exploitation of the monopoly of the protection rights is regulated by separate agreements. The experience of more developed countries shows that innovation and technology, rather than low labor costs in the long run give competitive advantage. The permanent mechanism of economic development is directly correlated with technological progress but also the presence of fruitful business, scientific and industrial partnerships. Looking at the problem in the context of the owner of the intellectual property must be emphasized that at some stage of the commercialization process it is necessary give up creativity and start working with the company. Otherwise, commercialization is ineffective both economically and technically. Economically, because there is no return of capital for reinvestment in research, due to the lack of industrial use. Today, the key is the pace of development of technologies or new products in the process of commercialization. In the global economy, which quickly spread new technologies, efficiency and above all the effectiveness of the commercialization process depends on the rate of absorption of new technologies in new sectors. Accelerate the development of technologies and new products through technology or adapt products to new sectors or the same market sectors, but within the new segments of buyers and users of technology can increase the probability of success of new technologies or products protected by law. Studies have shown that patent applications with one owner represent the vast majority of the analyzed database. It is worth noting that a significant part of these applications are owned by entrepreneurs (red dots), which seems natural because of the competitive advantage sought in the industry and present of the monopoly on the technology. Taken by the authors attempt to identify the impact of EU funds for research and development in the increase of protection rights in co-ownership with scientific institutions showed no stimulating effect. The activity of Polish entities in the field of co-operation networks described by the co-ownership of intellectual property rights is insufficient. The reason should be seen in the low budget for R&D activities and the constantly developing science-business relationship. In June 2016 started the INNOSTAL program, for which the steel industry has high expectations. The aim of the program is to support the Polish steel industry in the production of innovative, high quality products adapted to the market demand in Poland and abroad. Cross-sectoral cooperation creates the need to generate knowledge of a certain level of uniqueness. The investigated network shows that co-ownership of rights is not a dominant manifestation of co-operation. Although the era of open innovation is increasingly affecting many sectors of the economy in many companies, there is still a lack of full understanding of the mechanisms inside and outside the organization when and how to fully benefit from this concept.

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