The Economic Impact of Intellectual Property Management: Towards Model of Intellectual Property Management

Tomasz Sierotowicz[a]
Jagiellonian University, Faculty of Management and Social Communication,
Institute of Economics, Finance and Management, Department of Economics and Innovation,
Prof. Lojasiewicza 4, 30-348, Krakow, Poland
tsierotowicz@uj.edu.pl

Keywords: Management of Intellectual Capital, IT Management, Model of the Intellectual Property Management, Empirical Analysis.

Abstract: Subject literature indicates the International Business Machines (IBM) as the uninterrupted leader in the number of patents obtained from United States Patents and Trademarks Office (USPTO), out of all enterprises and industries for over 25 years. Since 1998, the IBM has conducted an internal business segment called Intellectual Property Management (IPM). This article presents results of two research goals of this study. The result of the first goal was to create an original design of the IPM model based on the IBM business experience. Given the interdependent environment of IBM, the complexity theory approach was used to achieve this goal. The second goal was to evaluate the economic profitability of activities included in the IPM segment, and their impact on the total income of the whole IBM enterprise, over the entire research period 1998-2018. The created design of IPM segment is a new and significant help for managers dealing with the complex issues of intellectual property, which allows to achieve economic profitability of IPM in the large enterprises. The final conclusion of results of the second goal indicated that out of all IPM activities only custom development of intellectual property was the only driver of profit increase in the IBM.

1 INTRODUCTION

The evaluation of research and development (R&D) expenditure efficiency in relation to the number of obtained patents is economically significant. This evaluation addresses how enterprises manage their spending in a profitable way; by reducing the cost of a single obtained patent while increasing the number of obtained patents in the long-term. One of the best ways to evaluate R&D expenditure efficiency is to undertake research on leading enterprises in terms of the number of obtained patents. Previous research indicates that, over the last three decades, enterprises belonging to the Information and Communication Technologies (ICT) sector obtained the highest number of patents from the USPTO compared to other industries and enterprises (USPTO, 2019). Among them, the International Business Machines (IBM) was the uninterrupted leader in the number of obtained patents from the for over 27 years (USPTO, 2019; IBM, 2017). Source documentation, made up of annual reports also confirms this statement (Sierotowicz, 2017). Previous research also indicated that during 1997-2015, IBM maintained the flattest value of R&D expenditure, while the number of patents obtained from the USPTO was the highest (Sierotowicz, 2017). In addition, the number of patents obtained per US$1 million spent on R&D was the highest and increased annually by an average of 7.92% (Sierotowicz, 2017). This indicates that every dollar spent on R&D at IBM resulted in a better outcome measured in the obtained patents, ensuing cheaper patents. However, this research dedicated to patent activity also reveals that IBM conducted an internal business segment called Intellectual Property Management (IPM), closely related to other business segments including R&D. Since 1998, this business segment has been recognised in source documentation. According to these documents, the IPM segments is dedicated to managing all types of the intellectual property in IBM, including patent activity (IBM, 2019; USSEC, 2019). The findings

[a] https://orcid.org/0000-0002-1462-8267

Sierotowicz, T.
The Economic Impact of Intellectual Property Management: Towards Model of Intellectual Property Management.
DOI: 10.5220/0009513600730081
In *Proceedings of the 17th International Joint Conference on e-Business and Telecommunications (ICETE 2020) - Volume 3: ICE-B*, pages 73-81
ISBN: 978-989-758-447-3

presented above are the most important reasons behind launching another research effort, this time dedicated to a more in-depth understanding of how this enterprise managed the intellectual property, as well as economic profitability over a long-time period. The main goals of this article are: to present the results of the research that is a conceptual design and implementation of the IPM segment in the corporate complex environment and economic achievements of this segment, generates as a part of entire income. The research period covers all years since the IPM segment was indicated in the source documentation, from 1998 to 2018. The presented case study indicates how the unquestionable leader of patent activity designed and configured the IPM segment with other segments like production, R&D, acquisitions and divestitures, and addresses whether the IPM segment generates economic profit over the entire research period.

2 THEORETICAL BACKGROUND

The measurement of patent activities as economic indicators, particularly the relationship between the number of patents and expenditure on R&D activities, is not a new concept (Schmookler, 1951; Stoneman, 1987; Meliciani, 2000; Lanjouw and Schankerman, 2004; Arora et al. 2010). Analyses and evaluations presented in existing literature covers the inventive activities of countries, sectors and industries, such as the ICT sector (Thornhill, 2006; Sierotowicz, 2015). The conclusions of these studies indicate that there is a strong relationship between expenditure on R&D and inventive activities represented by the number of obtained patents. Hence, patent activity as a suitable measure of R&D spending is also widely discussed in existing literature. There are mainly a few streams of discussion related to the patent activity, where specific arguments are presented, for example: usage of specific statistical tools, significance of patent applications and granted patents (Baraldi et al. 2014), or the lag between input and output variables of R&D activities (Bjelland and Chaptman, 2008; Ness, 2012). Although these arguments are important, none of them discredit patent activity as an adequate measure of R&D. However, patent activity is a component of intangible assets that belongs to the intellectual property of an enterprise (Henkel et al. 2013; Hagedoorn and Zobel, 2015). Although patent activity is not the only result of R&D, it is important to recognise that it has many sources inside and outside the enterprise environment beyond R&D, including employees, acquisitions or custom developed projects (Sagasti, 2004; Afauf, 2009; Palfrey, 2011; IBM, 2013; Alimov and Officer, 2017). Existing literature presents research results in relation to the sophisticated role of intellectual property in business management (Junghans et al. 2006; Kianto et al. 2017). Other discussions are related to the usage of intangible assets in business strategy (Kaplan and Norton, 2004; Manzini and Lazzarotti, 2016; Sessions and Hamaty, 2016) and the evolution of the intellectual property role in the enterprise (Holgersson et al. 2017). But widely discussed in the literate problem related to successful implementation of the IPM in the enterprise, is not only sophisticated and it is impossible to describe it through common components. Instead of the sophisticated and reductionist approach that is applied in many existing literature examples, the complexity theory approach should be used (Richardson, 2008; Espinosa and Walker, 2017). Large enterprises representing unique and complex environments. In the case of IBM, there are about 90 international wholly owned subsidiaries. In such environment, design the IPM efficiently aligned with all sources and products and services in order to achieve advantage of opportunity to support the generated income is the most important and complex managerial issue. This article presents an example of such a successful solution, based on the complexity theory approach that combines the abovementioned examples.

3 MATERIALS AND METHOD

This research consists of two stages. The first stage was to provide a more in-depth understanding of how IBM managed its intellectual property and intangible assets. The intellectual property and intangible assets are used in this research according to the rules presented in the General Accepted Accounting Principles (GAAP) and Statement of Financial Accounting Standard (SFAS). As Hargadon and Douglas (2001, p. 480) pointed out, “historical case studies provide a perspective that covers the decades often necessary to observe an innovation's emergence and stabilization”, to achieve the main goal of this article, a longitudinal case study approach was used. The IPM evolved over time. Adopting a long-term perspective helps to correctly specify the complex role of IPM in business activities. This research covers the period of 1998-2018, as the IPM segment of IBM was included in source documentation from

1998. As stated in the introductory section of this article, there are four reasons why IBM was chosen for this study. Firstly, IBM is the uninterrupted leader in the number of obtained patents from the USPTO, among all enterprises, sectors and industries for over 27 years. Secondly, the results in patent activity was achieved based on the increased efficiency of R&D spending, not the amount of spending. Thirdly, the patents obtained by IBM became cheaper. Finally, IBM introduced its new IPM segment where patent activity is one of many other activities related to intellectual property and intangible assets. Given the complex and interdependent environment of IBM, to achieve the research goals of this study, it was necessary to abandon the sophisticated and reductionists approach, as presented in many existing literature examples, and apply the complexity theory approach (Espinosa and Walker, 2017; Richardson, 2008). The design of IPM, efficiently aligned with all sources of intangible assets (inputs) and products and services of enterprise (outputs), to successfully support the generated profit, become the most complex managerial issue.

The second stage of this research was to analyse and evaluate the dynamics of the economic profitability of the IPM segment, its impact on the total income of the whole IBM enterprise, over the specified research period. This stage consists of two steps. Firstly, to analyse and evaluate the IPM segment separately to identify whether it generates profit or loss. In this case, the costs and revenues can be used as an input and output variables, or at least total IPM income before tax. Hence, the income before tax does not include the analysis of cash flow; however, it evaluates the economically important issue of whether profits or losses are generated by the IPM segment. Secondly, to analyse and evaluate the IPM segment impact on the total income of the entire IBM, before tax. This evaluation identifies the extent and dynamic rate of the IPM segment impact on the total income of the IBM, over the specified research period. As the IPM segment operates continuously over the research period, empirical analysis is used to indicate the continuous impact of the IPM segment (profits or losses, as well as dynamics) on the total income of IBM, before tax, in both steps of the second stage, over the research period. This approach ensures that single episodic and short-term events with both positive and negative impacts are not treated as standalone impact indicators, and this is important for eliminating lag influence generated by commercialisation process. To achieve the abovementioned evaluation goals and to correctly indicate the dynamics of the IPM segment impact on the income generated by IBM, the dedicated Average Change Rate tool was selected. This tool is used to analyse changes in results, and evaluate impact over long periods of time. The method of calculation is presented in equations 1 and 2 (Sharpe et al. 2014; Triola, 2014).

$$\log \overline{y}_{Vi} = \frac{1}{n-1} \times \sum_{i=2}^{n} \log \frac{v_{i(t)}}{v_{i(t-1)}} \quad (1)$$

where:

$\overline{y}_{Vi}$ – is the geometric mean of chain indices of the analysed variable v_i, during the entire period of analysis,

v_i – is the next, annual value in the time series of the analysed variable v_i,

$\frac{v_{i(t)}}{v_{i(t-1)}}$ – is the annual value of the chain index of the analysed variable v_i,

i – is the next value in the chain index,

n – – expresses the number of elements in the time series of the analysed variable v_i.

$$\overline{T}_{Vi} = \left(\overline{y}_{Vi} - 1\right) \times 100 \quad (2)$$

where:

$\overline{T}_{Vi}$ – is the average rate of change of the analysed variable v_i, during the entire period of the study,

$\overline{y}_{Vi}$ – is the geometric mean of the chain indices of the analysed variable v_i, during the entire period of analysis.

4 RESULTS

4.1 Empirical Data

The source documentation describes financial results of the IPM segment over the research period. Table 1 and table 2 illustrates the input data in time series, allowed to identity in the source documentation. The four columns of the data series presented in Table 1 illustrates the IPM segment.

Table 1: The input data identified over the entire research period – description of the IPM segment.

Year/ Variable	Sales and other transfers of intellectual property income before tax [USD millions]	Licensing/royalty-based income before tax [USD millions]	Custom development income before tax [USD millions]	Total IPM Income before tax [USD millions]
1998	363	302	436	1 100
1999	628	646	232	1 506
2000	915	590	223	1 728
2001	736	515	284	1 535
2002	511	351	238	1 100
2003	562	338	268	1 168
2004	466	393	310	1 169
2005	236	367	345	948
2006	167	352	381	900
2007	138	368	452	958
2008	138	514	501	1 153
2009	228	370	579	1 177
2010	203	312	639	1 154
2011	309	211	588	1 108
2012	323	251	500	1 074
2013	352	150	320	822
2014	283	129	330	742
2015	303	117	262	682
2016	27	214	1 390	1 631
2017	21	252	1 193	1 466
2018	28	275	723	1 026

(Source: IBM, Annual Report, 1998, p. 64; 1999, p. 64; 2000, p. 64; 2001, p. 70; 2002, p. 81; 2003, p. 94; 2004, p. 63; 2005, p. 68; 2006, p. 80; 2007, p. 84; 2008, p. 60; 2009, p. 89; 2010, p. 62; 2011, p. 70; 2012, p. 70; 2013, p. 78; 2014, p. 33; 2015, p. 76; 2016, p. 84; 2017, p. 78; 2018, p. 70).

The first column in Table 2 contains the total income of IBM, before tax.

Table 2: The input data identified over the entire research period – description of the entire IBM.

Year/ Variable	IBM – total income before taxes [USD millions]	Expenditure on R&D activities [USD millions]	Number of acquired companies	Total Expenses on acquisitions [millions USD]
1998	9 040	5 046	9	828
1999	11 757	5 273	17	1 551
2000	11 534	5 151	9	511
2001	10 953	5 290	2	1 082
2002	7 524	4 750	12	3 958
2003	10 874	5 077	9	2 536
2004	12 028	5 673	14	2 111
2005	12 226	5 842	16	2 022
2006	13 317	6 107	13	4 817
2007	14 489	6 153	12	1 144
2008	16 715	6 337	15	6 796
2009	18 138	5 820	6	1 471
2010	19 723	6 026	17	6 538
2011	21 003	6 258	5	1 849
2012	21 902	6 302	11	3 964
2013	19 524	6 226	10	3 219
2014	19 986	5 595	6	608
2015	15 945	5 247	14	3 555
2016	12 330	5 751	15	5 899
2017	11 400	5 787	5	134
2018	11 342	5 397	2	49

(Source: IBM, Annual Report, 1998, p. 64; 1999, p. 64; 2000, p. 64; 2001, p. 70; 2002, p. 81; 2003, p. 94; 2004, p. 63; 2005, p. 68; 2006, p. 80; 2007, p. 84; 2008, p. 60; 2009, p. 89; 2010, p. 62; 2011, p. 70; 2012, p. 70; 2013, p. 78; 2014, p. 33; 2015, p. 76; 2016, p. 84; 2017, p. 78; 2018, p. 70).

Column two in Table 2 contains some additional time series, such as the expenditure on R&D activities, and columns three and four presents the number of acquired companies and expenses on acquisitions, respectively. Table 3 presents the variables used in the analysis and evaluation.

$\bar{T}_{Vi}$ – symbol of the calculated average rate of change,

v_i – symbol of the time series input data.

Table 3: Time series of variables obtained during the research for all components of the IPM segment and the IBM total income, over the period of 1998-2018.

$\bar{T}_{Vi}$	v_i	Name of the analysed input data variable over the period of 1998–2018
Ast_{ipm}	st_{ipm}	Time series of the IPM sales and other transfers of intellectual property income before tax.
Alr_{ipm}	lr_{ipm}	Time series of the IPM licensing/royalty-based income before tax.
Acd_{ipm}	cd_{ipm}	Time series of the IPM custom development income before tax.
Ati_{ipm}	ti_{ipm}	Time series of the total IPM income before tax.
At_{ibm}	t_{ibm} – Time series of the total IBM income before tax.	
Ard_{sp}	rd_{sp} – Time series of research and development spending	
Aac_{nq}	ac_{nq} – Time series of the number of acquired businesses	
Aac_{q}	ac_{q} – Times series of the total acquisition expenses	

The first four variables presented in Table 3 are used to achieve the first step of the second stage of the analysis and evaluation. To accomplish the other step of the second stage of the analysis and evaluation, Equation 3 was applied to indicate the share of the IPM segment in relation to the total income before tax of the IBM.

$$vtz_{ipm} = \frac{v_{i(t)}}{t_{ibm(t)}} \quad (3)$$

where:
vtz_{ipm} – annual value of IPM subsequent variable data series from Table 1 and 2, to annual value of the total income of IBM, before tax, over the research period;
$v_{i(t)}$ – annual value of IPM subsequent variable data series from Table 1 and 2;
$tibm_{(t)}$ – annual value of the total income of IBM, before tax;
z – the subsequent IPM source variable presented in Table 1 and 2;
t – following year in the time series.
Equation 3 introduces time series variables representing the ratio of each IPM segment source variable (as presented in Table 3) income before tax of the entire IBM over the research period. The ratio variables are presented in Table 4, and were used to calculate the average change rate (according to Equations 1 and 2). Using the same methodology allowed a direct comparison of the calculated results to be performed.
$\bar{T}_{Vi}$ – symbol of the calculated average rate of change,
vtz_{ipm} – symbol of the time series input data.

Table 4: The variables representing the ratio of each IPM segment.

$\bar{T}_{Vi}$	vtz_{ipm}	Name of the analysed input data variable over the period of 1998–2018
$Avt1_{ipm}$	$vt1_{ipm}$	Time series of the IPM sales and other transfers of intellectual property income before tax to total IBM income before tax ratio.
$Avt2_{ipm}$	$vt2_{ipm}$	Time series of the IPM licensing/royalty-based income before tax to total IBM income before tax ratio.
$Avt3_{ipm}$	$vt3_{ipm}$	Time series of the IPM custom development income before tax to total IBM income before tax ratio.
$Avt4_{ipm}$	$vt4_{ipm}$	Time series of the total IPM income before tax to total IBM income before tax ratio.

Income before tax was used as financial results of the IPM segment over the research period, obtained from the source documentation. There was an identified limitation in the performed evaluation as cash flow could not be analysed for the IPM segment. The results of the two stages of this study are presented in the following sections.

4.2 Complex Design of IPM Model based on the IBM Environment

The first stage of this research was dedicated to identifying and describing the complex design of the IPM segment. Many changes in the IPM were tracked over the research period of this study. The conceptual design of the configuration and cooperation of the IPM segment in the complex IBM enterprise is illustrated in Figure 1. The links presented in the diagram occur throughout the entire research period, but with different levels of intensity and scope. Intensity can be measured by the number of recognised intangible assets, while scope represents the number of intangible asset types of IPM sources and outputs. For example, and in relation to outputs, at the beginning of the research period, IPM mostly powered systems and technology and software business segments, but later in the period, it powered other additional business segments such as global technology services and global business services.

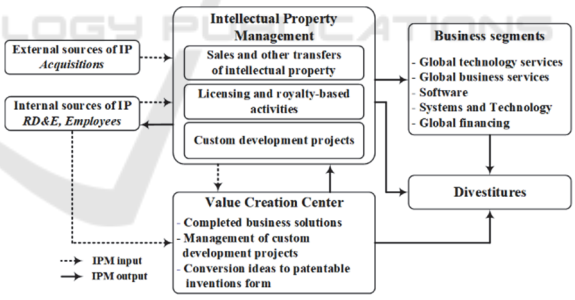

Figure 1: Conceptual design of the IPM model based on the IBM environment.

Over the research period, IBM was involved in the divestiture of selected business operations, such as Hitachi's hard disk drive technology in 2002 for USD 2.05 billion and ThinkPad to Lenovo in China for USD 2.3 billion in 2005 (IBM, 2019). The acquired intellectual property and other intangible assets constituted a direct supply of some of the business operations selected as strategic priorities for divestiture. In these transactions, IPM had its share in the field of technical and technological solutions. However, divestitures were also supported directly from the Value Creation Centre (VCC). This centre is

responsible for completing business solutions obtained from the R&D segment, managing custom development projects where some results from IPM were systematically used, and converting ideas gathered from employees' information patentable forms and sending them to the IPM segment for the finalising patenting process in USPTO. The custom projects create necessary solutions through initialising dedicated projects in the R&D segment, as well as put as priority to acquire from outside the specific intangible values though the IPM. Hence, the link between the VCC and the IPM, and the IPM and R&D was bidirectional, intensive and wide scoped, with close cooperation. Such a close cooperation was necessary to transform the various intangible assets obtained through acquisitions, along with those required by dedicated custom projects, R&D segments, business segments or businesses selected for divestiture. Acquisitions bring many assets, and among them, intangible assets were indicated according to GAAP and SFAS, such as goodwill, completed technology, in-process R&D, patents and trademarks, client lists and relationships, but excluding contracts, clients with contracts/backlog and other intangible assets. Acquisitions were performed regularly and during the research period; IBM acquired 219 businesses. Using Equations 1 and 2, the number of acquired businesses (Aac_{nq}) decreased over the research period, year to year, by an average of 7.24%. At the same time, the acquisition expenses (Aac_q) also decreased year to year, by an average of 13.18%. However, the R&D spending was managed through the entire research period at a flat level, and the average R&D spending (Ard_{sp}) increased year to year, by an average of only 0.34%. Acquired businesses are mostly from the Information Technology sector. A selection of acquisitions is a part of the multidimensional innovation development strategy. One of the dependent strategies is dedicated to IPM segment and plying own role in the entire system of orchestrated strategies. Intangible assets obtained through acquisitions are partially directly included in current business solutions. Some of them are transformed (through R&D) to form required by other segments, and finally, some intellectual properties are patented and/or commercialised. Hence, the IPM consists of the following subsegments of business activities:

- sales and other transfers of intellectual property,
- licensing and royalty-based activities,
- custom development projects.

These activities manage all intangible assets obtained through acquisitions and ideas coming from employees. The distinctive characteristic of the IPM complexity is to maximise the use of various intangible assets in many diversified business fields. The presented concepts imply wide usage of intangible assets. The presented design concept, works as a form of template for large enterprises, which is able to manage many intangible assets in a profitable way. Its outputs are wide in provided business types; from custom development projects, to five business segments and divestitures of unwanted businesses, from services in financing of business ventures, through the most advanced technological solutions in nanoelectronics and bionanoelectronics to wide offer of computer software (often acquired) and comprehensive business services including outsourcing, reengineering or business transformation outsourcing (IBM, 2019). Such a multi-business environment allows IPM to make profit through precisely and carefully selected acquisitions and the collection of any intangible assets from R&D and employees. This raises the question of whether the IPM segment is profitable. This question is explored and addressed in the next subsection.

4.3 Economic Impact of the IPM

Profitability is the most important economic measure. One of the most common profitability measures is income before tax, where the value of which directly indicates the profit or loss. Table 1 presents the source of the time series variables. The first four columns contain four variable values, taken over the research period that describe the IPM segment income before tax. These variables were used to analyse and evaluate the IPM as a standalone segment. The fifth column contains values of the total IBM income, before tax. There are only positive values that indicate that each year of the research period, the IPM segment and the IBM corporation generated profit. This raises the question about dynamic change of these variables over the research period. The results of the calculation performed in the first step of the second stage covered the first five variables as presented in Table 3, and are presented in Table 5.

$\overline{T}_{Vi}$ – symbol of the calculated average rate of change,

$Av_{[\%]}$ – the calculated value of the average rate of change.

Table 5: The average change rate of income before tax describing IPM segment.

$\bar{T}_{Vi}$	$Av_{[\%]}$	Name of the analysed input data variable over the period of 1998–2018
Ast_{ipm}	-12.02%	IPM sales and other transfers of intellectual property income before tax.
Alr_{ipm}	-0.47%	IPM licensing/royalty-based income before tax.
Acd_{ipm}	2.56%	IPM custom development income before tax.
Ati_{ipm}	-0.35%	IPM total income before tax.
At_{ibm}	1.14%	Total IBM income before tax

The first three variables represent the main activities carried out in the IPM segment over the research period (Table 5). The fourth variable is the IPM segment total income before tax. Although all values of variables indicated profit, the calculated dynamics showed that for sales and other transfers of intellectual property income before tax, the profit decreased over the research period, year on year, by an average of 12.02%. Similarly, for licensing/royalty-based income before tax, the profit decreased over the research period, year on year, by an average of 0.47%. It can be concluded that commercialisation of intellectual property achieved by sales and other transfers and licensing became less profitable over the research period. The custom development income before tax, representing participation in the management of custom development projects (organised and managed in VCC, see Figure 1), indicated that profit increased over the research period, year on year, by an average of 2.56%. Similarly, for the entire IPM segment income before tax, profit decreased over the research period, year on year, by an average of 0.35%. The calculation reveals that the total IBM income before tax increased over the research period, year on year, by average 1.14%. It can be concluded that the profit generated by custom development income increased faster than profit generated by the entire IBM, while the profit generated by the entire IPM segment income before tax decreased in the research period. In conclusion, not all commercialisation activities of intellectual property generated increased dynamics in profit. Two intellectual property commercialisation activities brought an alarming decrease in profit: the sales and another transfer of intellectual property and licensing/royalty-based. In the IBM case, the IPM segment decrease profit, while the entire IBM income before tax increases.

The second step of the second stage of research analysis and evaluation consisted of the measure of dynamic share variables of the IPM segment to total income of IBM, before tax. The results from this step showed a dynamic change in the generated profit of the IPM segment activities compared to the dynamic change of the total profit of IBM. The calculation results are presented in Table 6.

$\bar{T}_{Vi}$ – symbol of the calculated average rate of change,

$Av_{[\%]}$ – the calculated value of the average rate of change.

Table 6: The average change rate of the IPM segment income before tax to the IBM income before tax ratio.

$\bar{T}_{Vi}$	$Av_{[\%]}$	Name of the analysed input data variable over the period of 1998–2018
$Avt1_{ipm}$	-13.17%	The ratio of the IPM sales and other transfers of intellectual property income before tax to total IBM income before tax.
$Avt2_{ipm}$	-1.76%	The ratio of the IPM licensing/royalty-based income before tax to total IBM income before tax.
$Avt3_{ipm}$	1.23%	The ratio of the IPM custom development income before tax to total IBM income before tax.
$Avt4_{ipm}$	-1.64%	The ratio of the total IPM income before tax to total IBM income before tax.

The calculated results illustrate that the profit generated from sales and other transfers of intellectual property decreased at the highest level over the research period, year on year, by an average of 13.17% when compared to the profit generated by IBM. Similarly, the dynamics of profit generated by licensing/royalty-based activities also decreased over the research period, year on year, by an average of 1.76% when compared to the profit generated by IBM. These results not only confirm the previous conclusions for the IPM segment standalone, but also show deeper divergence of dynamic profit generation in the IBM. The dynamics of profit generated by IPM custom development of intellectual properties increased over the research period, year on year, by an average of 1.23% when compared to the profit generated by IBM. Furthermore, the dynamics of profit generated by the IPM segment decreased over the research period, year on year, by an average of 1.64% when compared to the profit generated by IBM. Based on this result, it can be concluded that intellectual property custom development increased

significantly faster than the dynamics of the total IBM profit. However, the entire IPM segment brought decrease profit, while the dynamics of the total IBM profit increases.

5 DISCUSSION AND CONCLUSIONS

The complexity theory encourages a different managerial approach than the sophisticated and reductionist method (Espinosa and Walker, 2017). Instead of selecting strict and precisely defined courses of action in complex systems, the managerial role is to provide correctly defined goals, necessary resources and verify trajectory of development. Hence, in the case of IPM, it does not appear to be enough. The presented complex design maximises the spectrum of use of various types of intangible assets in a diversified business field and in the business-to-business project cooperation. Only in such conditions does the IPM segment appear to bring the full benefit, but it also requires orchestration with the entire multidimensional innovation development strategy. Dealing with intellectual property alone, without business context, control and correction of strategic alignment according to changes in socio-economic environment, can cause serious difficulties in achieving success. Hence, not all commercialisation activities managed in the IPM segment generated profit. The IBM is the unquestionable leader in the number of patents obtained from the USPTO. Thus, the obtained results indicate that the IPM segment and custom development of intellectual property, managed in custom development projects, can be mentioned as drivers of profit generated by the entire company, because their dynamic of increasing profit is higher than the dynamic of increasing profit of IBM. The profit generated by the entire IBM enterprise increased over the research period, year on year, by an average of 1.14%. While the profit of the custom development of intellectual property, representing participation in the management of custom development projects, increased over the research period, year on year, by an average of 2.56%; approximately 2.5 times faster than IBM. The profit generated by the IPM segment, measured by income before tax, slightly decreased over the research period, year on year, by an average of 0.35%. The dynamics of generated profit show that the custom developed intellectual property associated with projects implemented on individual orders of business clients is the most profitable, and brought the most significant positive economic impact. The last two activities; the sales and other transfers and licensing/royalty-based of intellectual property generated profit over the research period. But the dynamic of income before tax indicates a significant reduction in the evaluation of the IPM segment standalone over the research period, year on year, by an average of 12.02% and 0.47% respectively. Similarly, the dynamics of the profit of these two activities in relation to the dynamics of the profit generated by entire IBM, also decreased over the research period, year on year, by an average of 13.17% and 1.76% respectively. It means that these two activities become less profitable. Thus, the acquisitions strategy should be corrected and shifted to obtain properties, which support custom development of the internal IP.

In conclusion, not all commercialisation activities of intellectual property generated increasing dynamics in profit. From a strategic point of view, the situation of losing profit and addressing this issue should have been recognised faster than after twenty-one years. Specifically, for sales and other transfers of intellectual property decreasing at that magnitude, this should have been a warning. In such a case, it is imperative to act to reverse this dynamic. This is an area where the new complexity approach still requires specifically designed and tested tools for analysing and evaluating achieved results, and comparing them to a dedicated strategic subject and target. Achieving success in IPM requires an orchestration of both the classic and complex managerial approach.

In existing literature, there is a wide discussion about the use of intellectual property, including incentives from the law to obtain patent protection (Alimov and Officer, 2017; Holgersson et al. 2017). Both proponents and sceptics present coherent arguments related to the management of intellectual property within businesses. As expected, there is no universal application for success in intellectual property management. Hence, the presented research results show that large IPM corporations have a better chance to achieve profit due to a wider spectrum of commercialisation activities, and using intellectual properties in dedicated custom development projects is a commonly used approach in micro and small IT companies. On the contrary, the presented results illustrate that not all IPM-related activities are drivers of profit in modern business. These activities are subject to the same rules as the individually developed and implemented enterprise strategies. IPM does not guarantee success and a source of competitive advantage. Poorly managed intellectual property can bring even a large business to its

downfall. The results show that IPM does not guarantee better profit and success, even if the enterprise is innovative. The final conclusion is that not all activities of IPM generated increasing dynamics in profit which must be taken into account while design own IPM model.

REFERENCES

Afauh, A. 2009. Strategic Innovation: New Game Strategies for Competitive Advantage. Routledge. New York.

Alimov, A., Officer, M. 2017. Intellectual property rights and cross-border mergers and acquisitions. Journal of Corporate Finance, 45, 360-377.

Arora, A., Athreye, S., Huang, C. 2010. Returns to Patenting: A Literature Review, Report Prepared for the Project of Intellectual Property Rights and Returns to Technology Investment. The UK Intellectual Property Office. London.

Baraldi, A. Cantabene, C. Perani, G. 2014. Reverse causality in the R&D – patents relationship: an interpretation of the innovation persistence. Economics of innovation and New Technology, 23(3), 304-326.

Bjelland, O. Chaptman Wood, R. 2008. An inside view of IBM's 'innovation Jam'. MIT Sloan Management Review, 50(1) 32-40.

Espinosa, A., Walker, J. 2017. A complexity approach to sustainability. Theory and practice. World Scientific Publishing Europe Ltd. London.

Hagedoorn, J., Zobel, A. 2015. The role of contracts and intellectual property rights in open innovation. Technological Analysis Strategic Management, 27(9) 1050-1067.

Hardagon, A., Douglas, Y. 2001. When Innovations Meet Institutions: Edison and the Design of the Electric Light. Administrative Science Quarterly, 46(3) 476-501.

Henkel, J., Baldwin, C.Y., Shih, W. 2013. IP modularity: profiting from innovation by aligning product architecture with intellectual property. California Management Review, 55(4) 65-82.

Holgersson, M., Granstrand, O., Bogers, M. 2017. The evolution of intellectual property strategy in innovation ecosystems: Uncovering complementary and substitute appropriability regimes. Long Range Planning, 50(6) 617-634.

IBM, 2013. Made in IBL Labs: 10 Chip Breakthroughs in 10 Years. IBM Publisher. Armonk.

IBM, 2019. Annual Reports. From the Period 1997-2018. IBM Publisher. Armonk.

Junghans, C., Levy, A., Sander, R., Boeckh, T., Heerma, J., Regierer, Ch. 2006. Intellectual Property Management. Willey & Sons. New York.

Kaplan, R., Norton, D. 2004. Strategy Maps: Converting Intangible Assets into Tangible Outcomes. Harvard Business School Press. Boston.

Kianto, A., Sáenz, J., Aramburu, N. 2017. Knowledge-based human resource management practices, intellectual capital and innovation. Journal of Business Research, 81, 11-20.

Lanjouw, J. O., Schankerman, M. 2004. Patent quality and research productivity: measuring innovation with multiple indicators. The Economic Journal, 114, 441-465.

Manzini, R., Lazzarotti, V. 2016. Intellectual property protection mechanisms in collaborative new product development. R&D Managmenet, 46(2) 579-595.

Meliciani, V. 2000. The relationship between R&D, investment and patents: a panel data analysis. Applied Economics, 32(11), 1429-1437.

Ness, R. B. 2012. Innovation Generation: How to Produce Creative and Useful Scientific Ideas. Oxford University Press. Oxford.

Palfrey, J. 2011. Intellectual Property Strategy, MIT Press. Boston.

Richardson, K., 2008. Managing Complex Organizations: Complexity Thinking and the Science and Art of Management. Emergence & Complexity Organization. 10(2), 13-26.

Sagasti, F. 2004. Knowledge and Innovation Development. Edward Elgar Publisher. New York.

Schmookler, J. 1951. Invention and Economic Development, University of Pennsylvania Press. Philadelphia.

Sessions, B., Hamaty, Ch. 2016. Corporate Perspectives on IP Strategy. CreateSpace Independent Publishing Platform. New York.

Sharpe, N., Veaux, R., Velleman, P. 2014. Business statistics, Pearson Publisher. Boston.

Sierotowicz, T. 2015. Patent activity as an effect of the research and development of the business enterprise sectors in the countries of the European Union. Journal of International Studies, 8(2), 31-43.

Sierotowicz, T. 2017. The economic aspect of the efficiency of patent activities based on case studies of leading ICT enterprises. Queen Mary Journal of Intellectual Property, 7(3), 343-355.

Stoneman, P. 1987. The Economic Analysis of Technological Change. Oxford University Press. Oxford.

Thornhill, S. 2006. Knowledge. innovation and firm performance in high- and low-technology regimes. Journal of Business Venturing, 21(5), 687-703.

Triola, M. 2014. Essentials of Statistics. Pearson Publisher. London.

USPTO, 2019. The United States Patent and Trademark Office. Available at: http://www.uspto.gov/ (accessed: December 8, 2019).

USSEC, 2019. U.S. Securities and Exchange Commission. Available at: https://www.sec.gov/? (accessed: December 8, 2019).