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The Potential of Developing Complex and Unique Fintech Solutions in Kraków's Business Services Centres

Abstract

Objectives: The development of the concepts of the Internet of Things and the Internet of Services gave rise to changes in the financial sector, especially in the area of Fintech. The aim of this article is to assess the increase in the complexity and uniqueness of services provided by outsourcing and offshoring companies operating in Kraków, Poland.

Research Design & Methods: The paper contains an analysis of a survey conducted among the employees of Kraków's branches of business services centres (BSCs); the survey was carried out in order to determine the relationship between the technological changes that occurred in companies in the last 5 years and the complexity and uniqueness of the provided services.

Findings: The results of the analysis reveal that BSCs-related companies in Kraków have a high potential to develop services in the field of new financial technologies. Research has shown a significant relationship between the technological changes that took place in the last 5 years in the BSCs sector and the complexity and uniqueness of the services provided by this sector.

Implications/Recommendations: The research results might be important for public authorities, which should support the development and embedding of BSCs through a number of activities (e.g. support high-quality education by creating conditions and encouraging cooperation between universities and BSC companies).

Contribution/Value Added: The added value of this article is an estimate of the relationship between the technological changes that have occurred in companies in the last 5 years and the complexity and uniqueness of the services provided serviced.

Keywords: Fourth Industrial Revolution, Fintech, business services centres, Kraków, Internet of Things, Internet of Services

Article classification: research article

JEL classification: G200, G280

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Introduction

The world of finance is constantly changing. It is very often one of the pioneers in implementing new technological solutions. Particularly dynamic changes were noticeable in the last few years, when the concept of the Fourth Industrial Revolution has become a catalyst for progressive changes not only in industry, but also in the service sector. In the financial sector, innovations are very often created in the Fintech industry, which has changed the landscape of the financial sector in recent years. It has stirred up strong emotions around the world, both positive and negative ones, as Fintech solutions enter hitherto dominated markets, offering new customer-friendly solutions. Such trends manifest not only in the financial markets of highly developed countries, but also in developing countries, including those being part of Central and Eastern Europe. The aim of this article is to assess the increase in the complexity and uniqueness of services provided by outsourcing and offshoring companies operating in Kraków. It begins with a presentation of various definitions, history, and classifications of the Fourth Industrial Revolution, and goes on to Fintech definitions and typology. The paper also explores a range of factors that determine Fintech's success and its impact on the financial sector. The final part of the manuscript contains an analysis of a survey conducted among the employees of Kraków's branches of business services centres. The added value of this article is an estimate of the relationship between the technological changes that occurred in companies in the last 5 years and the complexity and uniqueness of the provided serviced.

Literature review

The logic of this part of the article is based on the assumption that dynamic technological changes that have been observed in the financial industry for at least several years have their source in the Fourth Industrial Revolution. The development of process automation in the production sector based on the integration of various systems was possible owing to the development of the concept of the Internet of Things (IoT). It also gave impetus to the creation of new solutions with regard to the Internet of Services (IoS), and in turn has driven and continues to drive change in the Fintech sector.

From the Fourth Industrial Revolution to the Internet of Services

The Fourth Industrial Revolution, also known as Industry 4.0, is a paradigm that aims to improve the productivity and efficiency of manufacturing companies by implementing advanced systems based on modern communication systems. The so-called intelligent manufacturing integrates the operation of equipment, hardware, and technology in order to optimise the production process, reduce costs and risks, and also maximise profits (Tesch da Silva et al., 2020). The concept of Industry 4.0 (Gr. *Industrie 4.0*) was formulated by a German team working under the aegis of the Ministry of Education and Research, consisting of scientists from higher education trechnical institutions and universities together with leading representatives of major companies (ThyssenKrupp AG, Deutsche Telekom AG, BMW AG, Deutsche Post DHL AG, Software AG, TRUMPF GmbH & Co. KG, Infineon Technologies AG, Hewlett-Packard GmbH, Daimler AG, Festo AG & Co. KG, ABB Ltd) (Kagermann et al., 2013).

The idea of Industry 4.0 also had important political ramifications. It was devised to a large extent in response to the ever-deepening economic crisis in Europe, and its main objective was to secure the future of German manufacturing and its leading position in the production engineering sector. In its original form, Industry 4.0 primarily involved the use of the Internet of Things and Services in the production process. The Internet of Things (IoT) includes smart energy networks, smart products and smart buildings, whereas the Internet of Services (IoS) comprises smart mobility and smart logistics. It is worth noting

that Industry 4.0 was one of the first concepts to combine the IoT with the IoS.

Industry 4.0 aroused great international interest and marked the beginning of discussions on the so-called Fourth Industrial Revolution. Thus, the number of publications dealing with this subject increased, both in the academic community and in the private sector (Beier et al., 2020). Apart from further development of the concept itself and the assessment of its impact on socio-economic development, attempts have been made to create a vision of the development of this trend in the literature (Lee, Kao, & Yang, 2014). It has also attracted a fair amount of criticism, which mainly concerned the lack of a precise definition of this phenomenon (Heng, 2014; Lasi et al., 2014). One of the attempts to define a precise framework for Industry 4.0 was made by Stock and Seliger (2016). They identified three dimensions characteristic of this paradigm:

- horizontal integration across the entire value creation network;
- end-to-end engineering across the entire product life cycle;
- vertical integration and networked manufacturing systems.

The first dimension describes the intelligent networking and digitalisation of value creation modules (VCM) (Halstenberg, Steingrímsson, & Stark, 2017) both within individual companies and among different actors. The second dimension represents a comprehensive engineering approach to a product at all stages of its life-cycle: from raw material acquisition through production and use to the end of its life-cycle (i.e. disposal). The third dimension is associated with the intelligent networking and digitisation of VCMs at different levels of production, from all the components of production lines to ancillary value chain functions such as marketing, sales, and R&D.

This vision of the production process leads to the concept of the Intelligent Factory (Gilchrist, 2016), which is an almost futuristic idea, since in its ideal form, it can produce and deliver goods that far exceed our expectations, especially if we take into account the dynamic development of Artificial Intelligence Systems, which can additionally support the basic tenets of Industry 4.0.

One of the basic tenets of Industry 4.0 is the use the Internet of Things (IoT) in the production process. The idea is that nearly every physical object can be connected to the Internet. Naturally, it does not mean that all of them will turn into computers, but for some time now, there has been a growing tendency to install in pieces of everyday equipment (but not only) small computer chips capable of communicating with other devices (Fleisch, 2007). Such things are then called smart, because they perform the purpose for which they were made in a slightly better way. Let us take as an example the simple electric kettle: all it needs is a temperature sensor and a Bluetooth module. Owing to its capacity to communicate with a smartphone, it becomes capable of boiling water at a given time and up to a specified temperature. The smart home or the smart car are being developed according to the same principles.

Apart from the IoT phenomenon, the Internet of Services (IoS) trend was being developed. Initially, it was rather an underdefined theoretical concept in telecommunications and Internet services (Soriano et al., 2013), or something that used to describe the transformation of the financial sector (Black et al., 2001), which, due to highly standardised procedures and large capital resources, has moved a significant proportion of its activity to the virtual world. The popularisation of the Industry 4.0 concept not only in the production area, as well as the development of the IoT, permitted a broader view of the IoS. New services that could not be provided before or that were provided inefficiently now began to emerge.

Thus, with properly-equipped components of the system, companies were able to offer services more efficiently and at a lower cost. Popular vehicle rental networks that charge fees by the minute are but one example. In order to launch such a service, in principle one needs only a smartphone, a car equipped with a GPS tracker, and a universal broadband access to the Internet.

This made it possible to rent cars by the minute without incurring staff costs, as is the case with traditional companies.

Fintech – definitions and typology

Fintech can be defined in a variety of ways. On the one hand, the term is used in an instrumental sense to cover innovative solutions in the financial sector, and on the other, it denotes a company (usually a start-up) that offers this kind of services. The latter approach is supported by Nicoletti, who describes Fintech as "reshaping the financial services industry, offering customer-centric services capable of combining speed and flexibility, backed by forward-looking strategies, and cutting-edge business models" (2017, p. 3). The sectoral approach is also present in the literature: Fintech is a "new financial industry that applies technology to improve financial activities" (Schueffel, 2017, p. 13).

Fintech is not a new phenomenon in the financial services industry. It can be described as a process that has been going on continuously for almost 200 years and is characterised by variable dynamics. Arner, Barberis and Buckley (2015) identified three key stages in the development of Fintech, which resulted from specific technological breakthroughs. The first such breakthrough was the invention of the electromagnetic telegraph in 1833, which revolutionised the system of remote information transmission and had a considerable impact on the development of the financial sector (Du Boff, 1980; Winston, 1998). An extra factor that facilitated radiotelegraphic communication (not only in the financial sector) was the laying of a telegraphic cable across the floor of the Atlantic Ocean in 1866 (Russell, 2011). Such a radical increase in the flow of information between the capital markets of New York and London led to a situation in which quotes on the then London Stock Exchange almost immediately reflected the newly available data from the New York Stock Exchange (Hoag, 2006). The dynamic development of communication via telegraph coincided with the Second Industrial Revolution (Kagermann et al., 2013), which extensively used electricity in the production process and provided the driving force for the world economy in the second half of the 19th century. Until the outbreak of World War I, that era is now known as Fintech 1.0.

The second technological breakthrough in the financial industry took place in 1967 with the introduction of 'automated teller machines' (ATMs, i.e. cash machines) by the Barclays Bank. This British innovation was quite quickly adapted by American (NCR) and German (Siemens-Wincor) manufacturers, who later came to dominate the world market. The evolution of this technology perfectly illustrates the change that took place in the organisation of financial institutions. Firstly, they started to digitalise and automate financial transactions in real time, which later made it possible to create electronic banking systems. Secondly, ATMs freed up a large proportion of the human resources (tellers) needed at bank branches to serve customers who wished to withdraw cash. These two trends, i.e. the beginnings of the process of digitalising services and the gradual transfer of employees to other areas of a company's operations, are also characteristic of the Third Industrial Revolution, which began in the late 1960s and involved the use of programmable controllers for further production automation (Kagermann et al., 2013). The period from 1967 to 2008 is now called Fintech 2.0.

Today, Fintech is in its third stage of development and, unlike with the first or the second ones, it was not a technological breakthrough that marked its beginning. It is widely acknowledged that the third era started in 2008 with the beginning of the global financial and economic crisis, which provided the trigger for a further development of this industry. Given the problems faced by large financial institutions all over the world, new start-ups and established technology companies began to provide financial products and services directly to the public, bypassing the major players in the field, mainly banks. This change was made possible by altering the way consumers think about who in the industry has the legitimacy and

resources needed to provide financial services (Arner, Barberis, & Buckley, 2015).

A number of different Fintech classifications (Gimpel, Rau, & Röglinger, 2018) can be found in the literature and industry reports. One of them (Deloitte, 2016) divides Fintech solutions into two parts:

1. **Established financial technologies**, which include banking, insurance, asset management, and capital markets; in particular, they comprise IT solutions developed directly by the employees of a given financial institution or by an external supplier in support of such primary areas of activity as CBS (Capital Budget System), CRM (Customer Relationship Management), billing, online/mobile banking, trading, compliance, etc.; other solutions concern aspects such as: improving the offer, sales and service model, capabilities or process efficiency of banking, insurance, and asset management players (e.g. API – Application Programming Interface, alternative trading schemes, foreign exchange platforms);
2. **Emerging financial technologies**, which comprise:
   - payments, i.e. IT solutions supporting payments, money transfers, and cash handling, which may include, e.g., mobile payment terminals (mPOS) or NFC payments, software and infrastructure for Internet and mobile payments, cryptographic or prepaid and non-bank debit cards;
   - capital raising and personal finance, i.e. systems designed for non-banking capital raising and financial management, e.g. peer-to-peer (P2P) lending markets, micro-loans, social finance, mobile financial advice, solutions intended to encourage saving habits;
   - cybersecurity, i.e. solutions for increasing security both at the level of the entire financial system (including data security, protection against fraud, customer verification schemes) and at the level of individual users;
   - data and analytics, i.e. solutions enabling financial analyses based on large datasets, (e.g. analytical software, credit scores, and data-based market analyses for financial institutions);
   - other software – software not otherwise classified, including distributed ledger technologies (databases that can securely record financial, physical, and electronic assets for sharing across a network through entirely transparent updates of information) as well as systems and applications supporting the financial functions of companies (such as accounting, controlling, and debt collection).

Another convenient and up-to-date overview of Fintech's classification was presented by Chen, Wu and Yang (2019). Here, the Fintech industry was broken down into 7 areas: cybersecurity, mobile transactions, data analytics, blockchain, peer-to-peer (P2P), robo-advising, and the Internet of Things (IoT).

The development of Fintech in Central and Eastern Europe

The societies of Central and Eastern European countries quite readily accept various innovations in the area of finance. This provides a fertile ground for the development of assorted Fintech solutions, which is a trend supported by industry reports. For example, more than 90% of Slovenian companies issue and receive invoices in electronic format through their electronic banking systems (Deloitte, 2016). Data from MasterCard reveals that 50% of Slovak cardholders pay using contactless technology and 75% are willing to use (or will continue to use) it in the future. According to the ING International Survey 2015 (ING, 2015), 60% of smartphone users in Poland have already used or expect to use mobile banking apps, which is the third best result in Europe, just behind the Netherlands (67%), the United Kingdom (63%), and on a par with Spain. Another example of consumers' readiness to use financial innovations in the Polish banking sector is the use of contactless debit cards. Almost 80% of all the cards issued

in Poland have dedicated chips, compared to 54% in the UK.

According to Deloitte's calculations (2016), the value of the Fintech sector in 9 Central and Eastern European countries totals 2.2 billion euros. Poland emerges as a clear leader in the region, ahead of Austria and the Czech Republic.

In recent years, Fintech companies have shown a particular interest in payments, since in the era of numerous breakthrough solutions and the growing popularity of e-commerce, this area has become remarkably profitable. Poland and the Czech Republic have emerged as regional leaders owing to the development of sophisticated payment solutions where transactions are processed by robots, which enables rapid order execution.

The main barriers to further development of the CEE markets are posed by regulatory issues. Public institutions quite often introduce special requirements or restrictions which hinder the implementation of innovative financial solutions. Countries with less-developed economies and limited internal demand are usually less attractive for the Fintech industry. The favourable features of business environments, such as low tax rates and competitive labour costs, attract young start-ups intention to succeed in CEE countries (Deloitte, 2016).

Table 1. Fintech market in CEE countries

Country	Fintech market size (in million euros)
Poland	856
Austria	588
Czech Republic	190
Slovenia	121
Romania	119
Croatia	92
Hungary	83
Slovakia	73
Bulgaria	39

Source: Own elaboration based on Deloitte (2016, p. 75).

Development-related factors and impacts on the financial sector

Puschmann (2017) identifies a range of factors conducive to the development of Fintech in the traditional banking and insurance industry over the past several years. Firstly, it was the internal digitalisation of financial institutions. The first attempts to use the IT potential focused on internal processes, such as payment transactions or portfolio management. In the initial stages, banks and insurers embarked on the automation of financial services processes mainly with a view to increasing their efficiency. Firms offered only one or two customer service channels (branch/consultant or insurance agent + ATM) and focused on support, mostly through back-office services. The integration of IT systems at that time did not exist or was only partial. It emerged and developed at the third stage, where the first multi-channel approaches were adopted.

Chronologically speaking, the next development factor involved provider-oriented digitalisation. At this stage, financial institutions began to integrate their suppliers. To that end, they introduced uniform rules for the standardisation of processes and software functions. The outsourcing of business processes began with support areas such as IT, and only later did it involve the back-office areas such as payments, investments, and credit service. Currently, the degree of utilisation of own resources in business processes is relatively high in German-speaking countries, such as Germany (73.8% in-house production), Austria (77.5%), and Switzerland (90%). Other European countries usually display lower rates, e.g. Luxembourg 50.7% or Sweden 53.8% (Alt, 2016).

The latest Fintech development factor involved customer-oriented digitalisation processes. This area focuses on the needs and expectations of clients and it redefines the existing product-oriented logic towards creating new solutions. Early examples of this approach comprised electronic wallets, including not only payments, but also the ability to collect, store, and issue loyalty points and

other personal data. These new services also take advantage of the development of peer-to-peer (P2P) business models. In Poland, this development is perhaps best exemplified by the Internet exchange offices, which entered the market quite quickly and continue to operate successfully largely due to the demand for this kind of services on the part of people who pay off foreign currency loans. Owing to the automation of currency exchange processes, the scale of operations of these entities makes the currency spreads much more competitive than those offered by traditional exchange offices. In this case, Fintech's solution has, on the one hand, reduced the required human resources and, on the other, solved the problem of building expensive infrastructure needed to secure the premises of an exchange office.

The development of Fintech provoked a discussion on its potential threats to the traditional financial sector. In the literature and industry reports, opinions are divided. Although the innovations created by Fintech are considered to have a destructive impact on the financial services sector (Waupsh, 2017; Zalan & Toufaily, 2017; PwC, 2017), some analysts assert that both sectors will find their market niches and their services will prove to be complementary (Vives, 2017). Fintech solutions providers undoubtedly increase competition in financial markets, provide services that traditional financial institutions do less efficiently or not at all, and expand the pool of users of such services. Yet, they cannot replace banks in most of their key functions. Fintech solutions devise ever more efficient ways of delivering traditional financial services, but banks are also well-prepared to accept technological innovations and provide these traditional services themselves (Vives, 2017).

Fintech is an industry that commonly uses new technologies, which are inherently associated with high innovation, but also with the complexity and uniqueness of products and services (Gozman, Liebenau, & Mangan, 2018; Schueffel, 2017; Wonglimpiyarat, 2019). The literature even uses the term "technological complexity" (or "technology complexity") (Cagliano et al., 2019; Cheah, Bellavitis, & Muscio, 2021; Hoffecker & Hoffecker, 2017). "Complexity" is often used nowadays (in economy, in engineering, and in other disciplines), but different approaches to – and aspects of – complexity are often mixed up. Hausmann, Hwang and Rodrik (2007) suggested two simple empirical measures of product complexity. It is represented by the income level associated with that product, and it is calculated as a weighted average of the income per capita of the countries that export the said product. Products become more complex in terms of the capabilities they require; they become less accessible from the point of view of local production (Hausmann & Hidalgo, 2011). The operationalisation of the concept of uniqueness in literature is poorer than that of complexity. For the purposes of the research, it was assumed that uniqueness is the quality of being the only one of its kind, which is the opposite of ubiquiti.

Material and methods

For many years, the level of the embeddedness of Kraków's business services centres (BSCs) has been discussed by the industry's representatives and local government. In 2005, when a regular inflow of such companies to Kraków began and employment in the sector grew very dynamically (20–30% per annum on average (Aspire, 2019)), more and more concerns were raised about the stability of employment for a large proportion of the city's population in the event of a further increase in labour costs and potential relocation to other parts of the world (e.g. India). Nevertheless, the Kraków's BSCs environment believes that recent years have seen a steady increase in the complexity of services provided by them. In this light, the aim of the discussion below is, firstly, to verify this opinion, and, secondly, to identify the links between the change in the nature of services and the technological changes in the area of finance. The following are the findings of research conducted in 2018 and 2019 among the CEOs (15) in branch managers of companies operating in Kraków,

and their employees (316). In the part covering technological change, the survey contained questions about the complexity and uniqueness of the services provided. The respondents rated the current characteristics of the processes (on a 1–5 scale, where 1 meant "not complex/unique at all," and 5 meant "highly complex"), and the change in complexity/uniqueness that took place over the last 5 years (1 – "significantly decreased," 3 – "no change," 5 – "significantly increased").

The employees were also asked to evaluate the technological changes in the last 5 years (on a 1–5 scale, where 1 meant "no change," 5 – "very big change," whereas 0 – "don't know") that took place in the main areas of their companies' activity: finance, human resources, IT, research & development, supply chain management, help desk, information security, technology tools, cloud platforms, and others.

The research verified the following hypotheses:

1. The last 5 years saw profound changes in the complexity and uniqueness of services provided by BSCs in Kraków.
2. Changes in the complexity and uniqueness of the provided services are associated with the process of technological change.

Results and discussion

In order to verify the first hypothesis, a simple frequency analysis was used (see Table 3), which shows that more than 70% of the employees believe that the complexity of their services is high or very high; only less than 8% responded that the services are "not complex at all" or are "complex to a very small extent." As far as uniqueness is concerned, the distribution of responses almost perfectly follows normal distribution. This means that according to the employees of Kraków's BSCs, the services that they provide are characterised by an average level of uniqueness.

When analysing the changes in complexity and uniqueness that occurred in the last 5 years, one can see a clear upward trend in complexity (almost 73% of the respondents believe that the positive change in this respect was large or very large, whereas only 6.5% say that the change was negative) as well as a slight increase in uniqueness (almost 45% of the respondents believe that the positive change was large or very large in this respect, whereas less than 9% think that it was negative). However, it is worth noting that a large group of the respondents (46.5%) reported no change in uniqueness.

Table 2. The current complexity and uniqueness of processes performed by BSCs operating in Kraków in the opinion of their employees (N = 316)

Complexity				Uniqueness			
Rating	**No. of responses**		**Percentage**	**Rating**	**No. of responses**		**Percentage**
1	2		0.65	1	43		13.92
2	22		7.12	2	67		21.68
3	65		21.04	3	98		31.72
4	130		42.07	4	70		22.65
5	90		29.13	5	31		10.03
Mean	**Median**	**Mode**	**Standard deviation**	**Mean**	**Median**	**Mode**	**Standard deviation**
3.9191	4	4	0.91697	2.932	3	3	1.1837

Source: Own elaboration.

Table 3. Changes in the complexity and uniqueness of processes performed by BSCs operating in Kraków in the last 5 years in the opinion of their employees (N = 316)

Change in complexity in the last 5 years				Change in uniqueness in the last 5 years			
Rating	**No. of responses**		**Percentage**	**Rating**	**No. of responses**		**Percentage**
1	4		1.30	1	9		2.93
2	16		5.19	2	18		5.86
3	64		20.78	3	143		46.58
4	147		47.73	4	96		31.27
5	77		25.00	5	41		13.36
Mean	**Median**	**Mode**	**Standard deviation**	**Mean**	**Median**	**Mode**	**Standard deviation**
3.8994	4	4	0.88026	3.4625	3	3	0.90083

Source: Own elaboration.

Surveys conducted among the CEOs support the conclusions drawn from the employee-oriented survey. The distribution of answers concerning complexity is very similar. In terms of uniqueness, the answers of the surveyed CEOs suggest that it is indeed above average in comparison with other branches of their companies.

As to the change in complexity over the last 5 years, the CEOs considered it to be large or very large. No one reported a downward trend in this parameter in recent years. The CEOs also considered the change in uniqueness to be rather positive (71%), and the extent of this change does not differ much from the extent of change in complexity.

During the research, employees and the CEOs were asked about the impact of technological changes in the last 5 years on the area of finance. The results among employees show that over 40% of the respondents are not able to assess such an impact. This is probably due to a lack of knowledge in this regard. However, if we do not take these responses into account, there is a clear advantage of high ratings for such an impact. These conclusions are additionally reinforced by the results obtained from the CEOs' answers,

Table 4. The current relative complexity and uniqueness of processes performed by BSCs operating in Kraków in the opinion of their CEOs (N = 15)

Complexity				Uniqueness			
Rating	**No. of responses**		**Percentage**	**Rating**	**No. of responses**		**Percentage**
1	0		0.00	1	0		0.00
2	2		15.38	2	0		0.00
3	1		7.69	3	3		21.43
4	5		38.46	4	6		42.86
5	5		38.46	5	5		35.71
Mean	**Median**	**Standard deviation**		**Mean**	**Median**	**Standard deviation**	
4.1429	4	0.7703		4.0000	4	1.0801	

Source: Own elaboration.

Table 5. Change in the relative complexity and uniqueness of processes performed by BSCs operating in Kraków in the last 5 years in the opinion of their CEOs (N = 15)

Change in complexity in the last 5 years			Change in uniqueness in the last 5 years		
Rating	**No. of responses**	**Percentage**	**Rating**	**No. of responses**	**Percentage**
1	0	0.00	1	0	0.00
2	0	0.00	2	0	0.00
3	2	15.38	3	4	28.57
4	9	69.23	4	7	50.00
5	2	15.38	5	3	21.43
Mean	**Median**	**Standard deviation**	**Mean**	**Median**	**Standard deviation**
4.0000	4	0.5774	3.9286	4	0.7300

Source: Own elaboration.

Table 6. The impact of technological changes on finance

Rating	**Assessment of the impact of technological changes on finance**			
	Employees (N = 299)		**CEO (N=13)**	
	No. of responses	**Percentage**	**No. of responses**	**Percentage**
0 (I do not know)	126	42,1	0	0,0
1 (no change)	9	3,0	0	0,0
2	22	7,4	1	7,7
3	39	13,0	1	7,7
4	55	18,4	4	30,8
5 (very high change)	48	16,1	7	53,8

Source: Own elaboration.

Table 7. Correlations between the complexity/uniqueness of processes performed by BSCs operating in Kraków and technological changes (in the opinion of their employees)

		Change in complexity in the last 5 years	**Change in uniqueness in the last 5 years**
Technological changes in the last 5 years in…	finance	**0.2250**	**0.2182**
	human resources	0.1429	0.0677
	IT	0.1159	–0.0037
	research & development	0.1150	0.0555
	supply chain management	0.1225	0.0305
	help desk	0.0629	0.0823
	information security	**0.2503**	0.0877
	technology tools	0.1394	0.0944
	cloud platforms	0.1483	0.0568
	other	0.0656	0.0118

Source: Own elaboration.

as they almost unanimously indicated the high or very high impact of technological changes on the functioning of the financial industry.

The process of verifying the second hypothesis consisted in calculating the correlation between changes that occurred in complexity and uniqueness of the provided services, and technological changes in specific areas of operation. The analysis reveals that even though the correlations are positive, they are mostly very small. However, it is worth noting that finance (in comparison with both complexity and uniqueness) is characterised by a much higher level of correlation than other areas of operation. Moreover, a slightly higher correlation is noticeable between technological changes and complexity.

Based on the results (Table 7), it can be concluded that the information security (IS) area (0.2503) shows the highest value of the correlation coefficient with technological changes. It is quite obvious due to the specificity of this area and the increasing requirements for information security in recent years. It should be noted that in this area there was also a fairly low correlation between IS and uniqueness change, which may suggest that technological changes have influenced complexity change positively, but this is a change that is quite common. Finance is the only area of analysis that shows a clearly higher positive correlation of changes in both areas. This means that technological changes influenced complexity and uniqueness more than in other areas of the functioning of BSCs.

So far, not many in-depth studies have emerged that attempted to estimate the relationship between the Fintech sector and BSCs. Research on the activities of the BSCs sector in Kraków was conducted by Micek, Działek and Górecki (2010). Various forms of the impact of these companies on the environment have been distinguished. The first form is employment of service centres emerging at suppliers. The second form of influence is the income of local and regional budgets from taxes. The third type is the impact on the development of human capital in the city (the centres provide employment opportunities similar to the field of study and the use of knowledge and skills from studies). The last form of influence is shaping positive relations with local communities. An interesting result of these studies was also the statement that the degree of entrenchment of service centres is related to their size and the period of operation in Kraków. Larger and older centres are characterised by a greater network of local connections than smaller ones. Kliber et al. (2021) present the stage of the development of the Polish Fintech sector and identify the main opportunities and challenges to the formation of new companies. They observe positive trends in education, such as the constantly rising interest in IT, economics, and finance. On the other hand, the study demonstrates that regulations are the main obstacle for the development of Fintech. The companies consider them ambiguous, imprecise, and requiring too much bureaucracy. There have been several attempts to measure the average complexity of products. The proposed measures build on methods that infer the complexity of economies by iteratively weighing the variety of products produced in a country and the ubiquity of these products in other countries. Such indirect measures of complexity have been used to explain income differences across countries and their growth rates over time (Cristelli, Tacchella, & Pietronero, 2015; Hidalgo & Hausmann, 2009; Tacchella et al., 2012).

Concluding remarks

Automation and robotisation – two processes primarily associated with the manufacturing sector – began to expand into the services sector with the advent of the Fourth Industrial Revolution. It manifests in phenomena such as the Internet of Things, sharing economy, and robotic process automation. All of these have had a considerable impact on the outsourcing and offshoring sector. Fintech is one of the main beneficiaries of the Fourth Industrial Revolution in the services sector. Its success is primarily due to the specific features

of the offered products, which mostly involve data collection and processing with no physical element necessary in the process of service provision. Consequently, the vast majority of processes can be automated using algorithms, which offers a huge potential to the IT industry, especially if this is done by strong established financial institutions such as banks and insurance companies. However, the picture of the industry is diverse, since alongside the traditional financial institutions, small start-ups appeared immediately after the 2008 crisis and tried to take over part of the profitable market from banks.

The analysis of employee-oriented surveys shows that in recent years, the complexity of services provided by the BSCs in Kraków has increased appreciably, whereas their uniqueness remains average and has changed only slightly. This can translate into the employees' opinion that Kraków's BSCs have recorded a major change in complexity, but the global financial industry has also significantly changed and has benefited from automation and robotisation of the simplest processes, with human labour being needed to carry out increasingly sophisticated tasks. These conclusions are supported by the findings of a survey conducted among the CEOs, who opine that both the complexity and the uniqueness of services are high or very high in Kraków; moreover, the change in both parameters in the last 5 years has been identified as positive. Assuming that CEOs usually have more experience and have a broader view of the context of outsourcing and offshoring activities, their responses can be considered as mirroring the facts somewhat better. The results of the analysis show that BSCs companies in Kraków have a high potential to develop services in the field of new financial technologies. Research has shown a significant relationship between the technological changes that occurred in the last 5 years in the BSCs sector and the complexity and uniqueness of the services provided by this sector.

In many cities of CEE, the BSCs sector is one of the most important employers. For example, in Kraków, this sector employs approx. 10% of the city's population (Aspire, 2019), which is higher than the total employment in Kraków's Lenin Steelworks[1] in the 1970s. The research results can be important for public authorities, which should support the development and embedding of BSCs through a number of activities. One of the possibilities is to support high-quality education by creating conditions and encouraging cooperation between universities and BSCs-related companies. Such a cooperation could be carried out both in the area of staff education (e.g. participation of BSCs' employees in the training process) and by means of jointly carrying out scientific research. Considering that the Fintech industry is developing quite well in CEE countries, it can also be an important element of creating added value (Geodecki, 2020; van Dam & Frenken, 2020).

The limitations of the research mainly concern the local nature of the analysis. The results are based on a survey conducted in companies operating in Kraków. Therefore, in further research, it is worth examining in detail the analogous relationships in other BSCs, especially in other parts of Central and Eastern Europe (e.g. Prague, Budapest). Such research would provide a broader view of the issues of technological development in the financial industry as well as it would be a valuable reference point for more detailed analyses.

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[1] The Lenin Steelworks in Kraków was one of the largest production plants in Poland during the communist period. In the 1970s, about 40,000 people worked there.

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