

Diversity of Open Intellectual Capital Acquisition by SMEs of Different Branches

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Abstract: Research studies on intellectual capital (IC) focus on its utilisation by mainly large enterprises and its effect on selected indicators. IC is subject to single-stream analyses as an internal enterprise resource. Because IC is used in the business operations of enterprises, it must be acquired. This paper presents the results of research conducted in an unexplored field of IC acquisition. This research focused on innovative small- and medium-sized enterprises (SMEs) belonging to the two branches of software and hardware development in Poland (2008–2019). Empirical data were obtained in time series form using dedicated statistical tools, including the dynamic rate. The main conclusion of a comparative analysis revealed that IC acquisition in the SMEs in this research should be described as a simultaneous dual-stream (internal and external) process, and IC acquisition differs significantly between compared branches. Thus, the open IC (OIC) concept should be used in IC acquisition research. Future research can focus on comparative analyses of enterprises belonged to different branches, thereby extending our knowledge of the importance of OIC in business.

1 INTRODUCTION

Intangible assets are indicated with increasing frequency as an important factor in the knowledge economy for sustained growth, success and increased enterprise market value (Barney and Hesterly, 2019). Intangible resources, particularly intellectual capital (IC), are perceived by large enterprises as strategic for sustained growth and success (Edvinsson and Malone, 1997; Santis et al., 2019; Stewart, 1998; Sveiby, 2001). The use of many different IC components and their constituent parts is dictated principally by the needs of enterprises' business activities.

The research presented in the literature mainly addresses large enterprises and questions relating to the transfer of knowledge inside and outside of these enterprises (Alimov and Officer, 2017; Matricano et al., 2020). They focus on topics such as IC value measurement (Pulic, 2004; Wiederhold, 2014), the share of IC in the market value of an enterprise (Mačerinskienė and Survilaitė, 2019; Yovita et al., 2018), value-added creation in an enterprise

(Abeyssekera, 2021; Pike and Roos, 2000) and other selected outputs and indicators achieved by that group of enterprises (Nazari, 2015; Roos and Pike, 2018; Santis et al., 2019). These studies conclude that specific IC components are used in line with the types and in-depth knowledge of the individual conditions of large enterprises' business activities. The results of these studies are widely used in developing IC models. Particular attention is paid to the models that aim to describe the effect of IC use on selected indices and performance indicators (Hejase et al., 2016; Lee and Wong, 2019).

However, management practice indicates that IC is not a self-renewable resource; it must be actively acquired and developed by enterprises. Thus, the utilisation and the acquisition of IC must be considered equally important key processes in the business activities of any enterprise regardless of their size and branch. Intellectual capital must first be acquired to the extent necessary to ensure the continuity of an enterprise's business activities. Since IC must be acquired before it is used, it can be assumed that IC acquisition also represents a

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systematic and continual process related to an enterprise's business activities. The above reasons underlie the choice of innovative small- and medium-sized enterprises (SMEs) belonging to different branches conducting their business activities in Poland. Since IC acquisition and use are equally important, the absence of research on IC acquisition represents a major gap in our knowledge.

Another gap in the literature on this subject is the absence of studies covering relatively long periods. Most analyses are limited to one year, which provides only a snapshot of the results. The presented reasons are important barriers to conducting comparative research on IC. Therefore, the research presented in this paper aims to fill the above-mentioned gaps.

This study aims to present and discuss the results of research on the comparative analysis and evaluation of open IC (OIC) acquisition performed by SMEs belonging to different branches and conducting business activities in Poland as observed over 12 years of time period.

2 MATERIALS AND METHOD

It is important to note that SMEs in the two branches covered by the research conduct different business activities. The first branch consisted of SMEs that develop software in Poland (and belong to the branch of knowledge-intensive services). Their business is described in *Nomenclature statistique des Activités économiques dans la Communauté Européenne* (NACE) classes 62.01 and 62.02 (European Communities, 2008). For simplicity of description, it is termed in this paper as branch 62. The second branch consisted of SMEs that manufacture computer, electronic and optical products (and belong to the high-tech manufacturing [hardware] branch). Their business is described in NACE classes 26.11, 26.12, 26.20, 26.30, 26.40, 26.51, 26.52, 26.70 and 26.80 (European Communities, 2008). For simplicity of description, it is termed in this paper as branch 26. Nowadays, information and communication technology (ICT) equipment is composed of hardware and software products. Although these branches represent significantly different business activities, their products are unavoidable parts of today's ICT tools. The above-mentioned branches conduct different business activities, and at the same time, their products are integrated in nowadays communication equipment. The above-mentioned issues were arguments why these two branches were selected for inclusion in the research. Because the business activities of these two branches differ

significantly, an important main research question was raised: Does the acquisition of OIC indicate differentiation between the branches covered by the research? To answer the main research question, the following detailed questions were formulated:

1. Was OIC acquired simultaneously and continuously in two entire streams (internal and external) in both branches over the entire research period?

2. Which OIC acquisition stream was more important for the surveyed SMEs in both branches considering the level of acquisition of that capital?

3. Which OIC acquisition stream was more important for the surveyed SMEs in both branches considering the dynamic rate of change in the OIC acquisition level?

4. Which acquired OIC components were most important for the surveyed SMEs in both branches considering the share and dynamic rate of change in the levels of each component acquisition?

An analysis was conducted over the three stages described below to answer the above-mentioned questions.

2.1 Description of Open Intellectual Capital Concepts

The first stage was to propose the broadest IC concept used in this research. It was an important stage since there is no universal concept of IC in the literature. Many IC concepts proposed in the literature on the subject vary in component sets. Thus, an IC concept including as many components as possible was used as a basis to develop the IC for this research. The concept of IC proposed here is as broad as possible. It includes numerous components, facilitating a more detailed analysis and evaluation of the IC acquisition process. Also, it was useful because only the selected components and their constituent parts, which create the structure of IC, are utilised in the SME operations covered by this research. Based on managerial practice, it can be assumed that enterprises differ in their utilisation of IC. It depends on many enterprises' external factors, such as the social and economic environments, the industry and internal factors related to individual conditions of enterprises, e.g. their size and employees' educational backgrounds and occupational experience.

The concept used in this research was formulated according to the rule of the uniqueness of IC components. Considering the most comprehensive IC concepts in terms of their components and constituent parts, which are also popular in the literature, and following the above rule, an IC concept consisting of

the following components was developed and used in this research:

- Human capital;
- Organisational capital;
- Relational capital;
- Project capital;
- Innovation capital;
- Information capital;
- Technological capital.

A survey was conducted with an identical component structure but divided into separate internal and external IC acquisition streams. These OIC components were acquired by SMEs covered by the research. The internal stream describes IC generation internally within the surveyed SMEs based on their own resources. The external stream describes the IC acquisition process from the external environment of the surveyed SMEs. For methodological reasons, comparative analyses required the same IC component structure in both (symmetric) streams. Thus, the formulated concept was termed OIC.

The second stage of this research was to analyse and evaluate the dynamics of OIC acquisition at the level of two symmetric, simultaneous and independent (internal and external) streams in the SMEs covered by the research.

The third stage of this research was to independently analyse and evaluate the dynamics of OIC acquisition at the component level for the internal and external streams in the SMEs covered by the research.

To answer the research questions, comparative analyses were made at the level of the streams and the individual OIC components that constitute the internal and external streams of capital acquisition.

2.2 Empirical Data, Research Period and SMEs Covered by the Research Project

The set of variables describing individual OIC components, which were symmetric in the internal and external streams for both branches covered by the research, was obtained and compiled based on a form used in a regular survey for innovative entities. In the form of a time series, the original empirical data set was obtained from a regular survey conducted by Statistics Poland.

The survey covered two groups of innovative SMEs belonging to different branches described above in chapter 2. Branch 62 consisted of SMEs that develop software in Poland and branch 26 consisted of SMEs that manufacture computer, electronic and

optical products. Both branches were covered by the entire research period of 12 years, from 2008 to 2019. The SMEs covered by the research in both branches were characterised by the number of employees, which varied from 10 to 249. The population of the surveyed group is given in Table 1.

Table 1: Number of SMEs covered by the research.

Year / Number of SMEs	Branch 62	Branch 26
2008	278	186
2009	291	185
2010	269	181
2011	306	193
2012	314	177
2013	347	168
2014	338	198
2015	345	211
2016	352	224
2017	367	222
2018	382	205
2019	403	196

The time series contained 12 annual observations; these covered the research period of 2008–2019 and described each acquired by SMEs covered by the research component constituting OIC separately in the internal and external streams and branches studied (Table 2).

Table 2: Time series of the variables used in the performed comparative analysis.

Streams of OIC acquired components		Description of variables characterising the acquiring of OIC
Branch 62	Branch 26	
<i>Streams of components forming the internal stream of acquired OIC</i>		
i62_1	i26_1	Human Capital
i62_2	i26_2	Organisational Capital
i62_3	i26_3	Relational Capital
i62_4	i26_4	Technological Capital
i62_5	i26_5	Information Capital
i62_6	i26_6	Project Capital
i62_7	i26_7	Innovation Capital
<i>Streams of components forming the external stream of acquired OIC</i>		
e62_8	e26_8	Human Capital
e62_9	e26_9	Organisational Capital
e62_10	e26_10	Relational Capital
e62_11	e26_11	Technological Capital
e62_12	e26_12	Information Capital
e62_13	e26_13	Project Capital
e62_14	e26_14	Innovation Capital

The different variables characterise topics directly related to the acquisition of OIC and are

indispensable to the business conducted by the SMEs studied in both branches. Thus, this research conducted a comparative analysis and evaluation of OIC acquisition in both branches to answer the research questions. Such analysis and evaluation required purposefully selected computational tools and the division of OIC acquisition into internal and external streams (both at the component level and the stream level) separately for the SMEs in the two branches covered by this research.

2.3 Empirical Analysis in the Internal and External Streams Level of Open Intellectual Capital Acquisition

The calculations in the second stage of analysis and evaluation consider the level of OIC acquisition in the internal and external streams over the entire research period. They were performed based on variables forming a time series of annual empirical observations of the acquired constituent parts comprising each of the structural components of OIC. The level of OIC acquisition in the internal stream was calculated using the variables marked in Table 2 as $i_{62_1} - i_{62_7}$ for the SMEs belonging to branch 62 and $i_{26_1} - i_{26_7}$ for those belonging to branch 26 of the enterprises covered by this research. Similarly, the level of OIC acquisition in the external stream was calculated using the variables marked in Table 2 as $i_{62_8} - i_{62_14}$ for the SMEs belonging to branch 62 and $i_{26_8} - i_{26_14}$ for SMEs belonging to branch 26 of the enterprises covered by this research. Consequently, both streams in both branches consist of similar groups of seven components and their constituent parts, which form the OIC structure in each year of the research period. Thus, unit streams of individual OIC component acquisition levels could be used to build an index of the overall level of OIC acquisition for each branch covered by this research, which was calculated according to Equation 1:

$$ind_{sbt} = \frac{\sum_{i_b=1}^7 v_{ibt}}{\sum_{j_b=8}^{14} v_{jbt}} = \frac{v_{inbt}}{v_{exbt}}, \quad (\forall t = 2008, \dots, 2019), \quad (1)$$

where:

t – the subsequent year in the time series;
 b – the index (from 1 to 2) denoting branches covered by the research: $b = 1$ for SMEs belonging to branch 62 and $b = 2$ for SMEs belonging to branch 26 (Table 2);

i_b – the index of each variable $i_{62_1} - i_{62_7}$ for $b = 1$ and $i_{26_1} - i_{26_7}$ for $b = 2$, representing the subsequent component of OIC in the internal stream of both branches covered by the research;

v_{ibt} – the level of the acquired subsequent component i , of OIC in the internal stream (calculated in subsequent branch b and year t);

v_{inbt} – the level of the acquired internal stream of OIC (calculated in subsequent branch b and year t);

j_b – the index of each variable $i_{62_8} - i_{62_14}$ for $b = 1$ and $i_{26_8} - i_{26_14}$ for $b = 2$ representing the subsequent component of OIC in the external stream of both branches covered by the research;

v_{jbt} – the level of the acquired subsequent component j of OIC in the external stream in subsequent branch b and year t ;

v_{exbt} – the level of the acquired external stream of OIC (calculated in subsequent branch b and year t), and

ind_{sbt} – indices of the overall OIC acquisition by the SMEs covered by this research (calculated in subsequent branch b and year t).

The calculated value of the indices of the overall OIC acquisition ind_{sbt} provides information for each branch covered by this research as to whether OIC is acquired in both streams simultaneously, continually and systematically. It also indicates which stream of OIC acquisition reached a higher level in the surveyed SMEs in each branch in each year of the research period. The calculated indices provide answers to the first and second research questions.

The values of obtained variables i_{inbt} , i_{exbt} and ind_{sbt} , which take the form of time series, were used to analyse the dynamic rate of change in OIC acquisition in the surveyed SMEs in both branches over the entire research period (Hatcher, 2013; Sharpe et al., 2014). The dynamic rate of change in the above-described time series was calculated according to Equation 2:

$$\bar{T}_{nb} = \left(\left(\sqrt[N]{\prod_{t=2}^N \frac{n_{bt(t)}}{n_{b(t-1)}}} \right) - 1 \right) \times 100\%, \quad (\forall t = 2008, \dots, 2019), \quad (2)$$

where:

t – the subsequent year in the time series;
 N – the number of annual observations in a time series of the subsequent variable calculated in that stage of research in the adopted research period;

b – the index ranging from 1 to 2 and denoting branches covered by the research: $b = 1$ for SMEs belonging to branch 62 and $b = 2$ for SMEs belonging to branch 26 (Table 2);

$n_{b(t)}$ – the three calculated variables denoted in each internal and external stream, branch b and year t : $n_1 -$

$i_{int1(t)}, n_2 - i_{ext1(t)}, n_3 - ind_{s1(t)}, n_4 - i_{in2(t)}, n_5 - i_{ex2(t)}, n_6 - ind_{s2(t)}$;

$\frac{n_{b(t)}}{n_{b(t-1)}}$ – the next chain index value of the three

calculated variables denoted in the internal and external stream and branch b , and year t ;

\bar{T}_{nb} – the value of the dynamic rate of change in each of the three calculated variables denoted in each branch b , respectively: $\bar{T}_1 - \bar{T}_{i_{in1}}, \bar{T}_2 - \bar{T}_{i_{ext1}}, \bar{T}_3 - \bar{T}_{ind_{s1}},$

$\bar{T}_4 - \bar{T}_{i_{in2}}, \bar{T}_5 - \bar{T}_{i_{ext2}}, \bar{T}_6 - \bar{T}_{ind_{s2}}.$

An interpretation of the dynamic rate of change \bar{T}_{nb} answers the third research question. As the dynamic rate of change exceeds 1, the level of OIC acquisition rises; this means that IC becomes increasingly important for the business activities that take place in the surveyed SMEs in both branches since OIC is acquired in line with the demand created by these activities. This tool is also useful in determining the dynamic rate of change in the acquisition level separately for the internal and external streams of OIC in the SMEs of both branches over the entire research period.

2.4 Empirical Analysis in the Internal and External Component Level of Open Intellectual Capital Acquisition

The third stage of analysis and evaluation is aimed at analysing the dynamic rates of change in OIC acquisition by the SMEs of both branches at the component level constituting the internal and external streams. This stage consists of the two phases described below, which address different aspects of the analysis and evaluation of the diversified acquisition of OIC at the component level. Phase 1 of Stage 3 was dedicated to analysing and evaluating the share of individual OIC component acquisition levels in the internal and external streams separately for both branches over the entire research period. The share of individual OIC component acquisition levels in the internal stream in both branches over the entire research period was calculated according to Equation 3:

$$Inc_{ib} = \frac{\sum_{t=2008}^{2019} in_{ib(t)}}{\sum_{t=2008}^{2019} (in_{ib(t)} + ex_{jb(t)})} \times 100\%, \quad \left(\forall t = 2008, \dots, 2019; i = 1, \dots, 7; j = 8, \dots, 14 \right), \quad (3)$$

where:

t – the subsequent year in the time series;
 b – the index ranging from 1 to 2 and denoting branches covered by the research: $b = 1$ for SMEs

belonging to branch 62, and $b = 2$ for SMEs belonging to branch 26 (Table 2);

i_b – the index of each variable $i_{62_1} - i_{62_7}$ for $b = 1$ and $i_{26_1} - i_{26_7}$ for $b = 2$, representing the subsequent component of OIC in the internal stream of both branches covered by the research;

j_b – the index of each variable $i_{62_8} - i_{62_14}$ for $b = 1$ and $i_{26_8} - i_{26_14}$ for $b = 2$ representing the subsequent component of OIC in the external stream of both branches covered by the research;

$in_{ib(t)}$ – the acquisition level of subsequent component i included in the internal stream of OIC acquisition by the surveyed SMEs in branch b and subsequent year t of the research period;

$ex_{jb(t)}$ – the acquisition level of subsequent component j included in the external stream of OIC acquisition by the surveyed SMEs in branch b and subsequent year t of the research period, and

Inc_{ib} – the share of the acquisition level of subsequent component i included in the internal stream of OIC acquired by the surveyed SMEs in branch b over the entire research period.

The share of individual OIC component acquisition levels in the external stream in both branches over the entire research period was calculated according to Equation 4:

$$Exc_{jb} = \frac{\sum_{t=2008}^{2019} ex_{jb(t)}}{\sum_{t=2008}^{2019} (in_{ib(t)} + ex_{jb(t)})} \times 100\%, \quad \left(\forall t = 2008, \dots, 2019; i = 1, \dots, 7; j = 8, \dots, 14 \right), \quad (4)$$

where:

t – the subsequent year in the time series;
 b – the index ranging from 1 to 2 and denoting branches covered by the research: $b = 1$ for SMEs belonging to branch 62 and $b = 2$ for SMEs belonging to branch 26 (Table 2);

i_b – the index of each variable $i_{62_1} - i_{62_7}$ for $b = 1$ and $i_{26_1} - i_{26_7}$ for $b = 2$, representing the subsequent component of OIC in the internal stream of both branches covered by the research;

j_b – the index of each variable $i_{62_8} - i_{62_14}$ for $b = 1$ and $i_{26_8} - i_{26_14}$ for $b = 2$ representing the subsequent component of OIC in the external stream of both branches covered by the research;

$in_{ib(t)}$ – the acquisition level of subsequent component i included in the internal stream of OIC acquisition by the surveyed SMEs in branch b and subsequent year t of the research period;

$ex_{jb(t)}$ – the acquisition level of subsequent component j included in the external stream of OIC acquisition by the surveyed SMEs in branch b and subsequent year t of the research period, and

Exc_{jb} – the share of the acquisition level of subsequent component j included in the external stream of OIC acquired by the surveyed SMEs in branch b over the entire research period.

Phase 2 of Stage 3 was dedicated to analysing and evaluating the dynamic rate of change in each component of the acquired OIC in both branches covered by this research (Hatcher, 2013; Sharpe et al., 2014). The dynamic rate of change in this section was calculated according to Equation 5:

$$\bar{T}_{bc_s} = \left(\left(\sqrt[N]{\prod_{t=2}^N \frac{v_{bc_s(t)}}{v_{bc_s(t-1)}}} \right) - 1 \right) \times 100\%, \quad (\forall c = 1, \dots, 7; s = 1, 2), \quad (5)$$

where:

t – the subsequent year in the time series;

N – the number of annual observations in the time series of the subsequent components included in the OIC acquired by the surveyed SMEs over the adopted research period;

b – the index ranging from 1 to 2 and denoting branches covered by the research: $b = 1$ for SMEs belonging to branch 62 and $b = 2$ for SMEs belonging to branch 26 (Table 2);

c – an index ranging from 1 to 7, denoting subsequent components included in the OIC acquired by the surveyed SMEs over the adopted research period;

s – index 1 or 2 indicating, respectively, the internal or external stream of OIC acquisition by the SMEs covered by the research;

$\frac{v_{bc_s(t)}}{v_{bc_s(t-1)}}$ – another value of a chain index in the time series of the acquisition level of subsequent component c included in the OIC acquired by the surveyed SMEs in branch b and subsequent year t of the research period; and

\bar{T}_{bc_s} – the dynamic rate of change in the acquisition level of component c (included in the OIC acquired by the surveyed SMEs in branch b) over the entire research period in the internal and external stream (s) separately.

The share of individual OIC component acquisition levels in the internal and external streams of the SMEs belonging to both branches and the dynamic rate of change \bar{T}_{bc_s} calculated in this phase allowed to answer the fourth research question. As the dynamic rate of change exceeds 1, the level of acquisition of an OIC component rises, which means that IC becomes increasingly important for the business activities of the surveyed SMEs since OIC is acquired in line with the demand created by these activities.

The share of individual OIC component acquisition levels in the internal and external streams of the SMEs belonging to both branches and the dynamic rate of change \bar{T}_{bc_s} calculated in this phase allowed to answer the fourth research question. As the dynamic rate of change exceeds 1, the level of acquisition of an OIC component rises, which means that IC becomes increasingly important for the business activities of the surveyed SMEs since OIC is acquired in line with the demand created by these activities.

3 RESEARCH RESULTS

The results of the calculated annual indices of the overall OIC acquisition level ind_{s1t} and ind_{s2t} of the SMEs covered by the research and belonging to branches 62 and 26, respectively, are shown in Table 3. They were obtained from Equation 1.

Table 3: Calculated results of the OIC acquisition level by the SMEs of branches 62 and 26.

Year / Designation	Branch 62			Branch 26		
	v_{in1t} [number]	v_{ex1t} [number]	ind_{s1t}	v_{in2t} [number]	v_{ex2t} [number]	ind_{s2t}
2008	698	494	1.412	335	492	0.681
2009	836	576	1.451	408	576	0.701
2010	707	486	1.454	439	580	0.756
2011	643	518	1.241	476	642	0.741
2012	739	496	1.489	464	584	0.794
2013	945	534	1.769	462	555	0.832
2014	743	554	1.341	549	604	0.908
2015	980	571	1.761	602	632	0.952
2016	787	592	1.329	656	698	0.939
2017	895	652	1.372	643	719	0.894
2018	1151	785	1.466	545	811	0.672
2019	1162	879	1.321	490	717	0.683

The obtained calculation results indicate that the values of index ind_{s1t} , which represents those covered by the research SMEs of branch 62, are greater than 1. In comparison, index ind_{s2t} , which represents the SMEs belonging to branch 26, is lower than 1 in each year of the research period. Thus, the comparative analysis reveals that IC was acquired by the surveyed SMEs in both branches simultaneously, continually and systematically during the entire research period in the two internal and external streams because the variables in v_{in1t} and v_{ex1t} describe branch 62, and v_{in2t} , v_{ex2t} describe branch 26, assuming positive values (Table 3).

The values of index ind_{s1t} , which represents the SMEs belonging to branch 62, are greater than 1 (Figure 1). Thus, considering the level of OIC acquisition, the internal stream is more important for the software-developing SMEs of branch 62 since its OIC acquisition level is greater than the acquisition level of OIC in the external stream (i.e. the variable v_{in1t} is greater than v_{ex1t}).

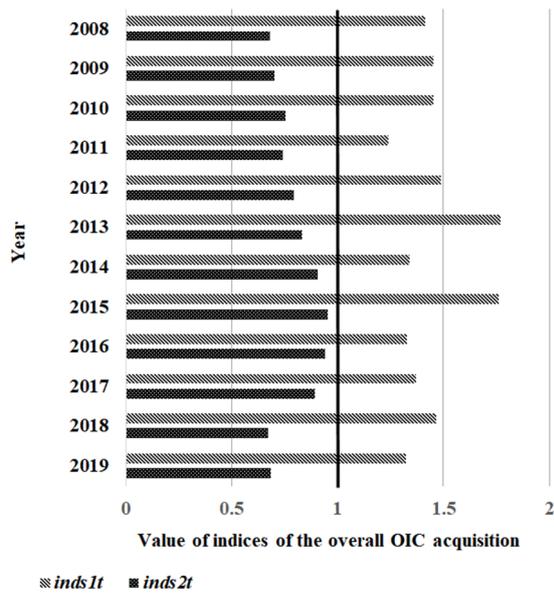


Figure 1: Diversified level of OIC acquisition in branches 62 and 26.

The opposite situation reveals the values of index $inds_{2t}$, which represents the SMEs belonging to branch 26, which are lower than 1 (Figure 1) in each year of the research period. It signifies that the external stream is more important for the hardware-producing SMEs of branch 26 since its OIC acquisition level is greater than the acquisition level of OIC in the internal stream (i.e. the variable v_{ext2t} is greater than v_{int2t}). The conclusions presented above answer the first and second research questions. Table 4 shows the results obtained using Equation 2 to determine the dynamic rate of change in OIC acquisition in the internal and external streams and the overall OIC acquisition of the SMEs representing branches 62 and 26 covered by the research.

Table 4: Calculated dynamic rates of change in the level of OIC acquisition in branches 62 and 26.

Branch 62			Branch 26		
\bar{T}_{int1}	\bar{T}_{ext1}	\bar{T}_{ind1}	\bar{T}_{int2}	\bar{T}_{ext2}	\bar{T}_{ind2}
4.74%	5.38%	-0.60%	3.52%	3.48%	0.03%

The calculation results indicate that the level of OIC acquisition in the internal and external streams rose year on year by 4.74% and 5.38%, respectively, on average, over the entire research period for the SMEs belonging to branch 62. A similar situation reveals the results for SMEs belonging to branch 26, for which OIC acquisition in the internal and external streams rose year on year by 3.52% and 3.48%, respectively, on average, over the entire research period. The indices of the overall OIC level decreased

year on year by 0.60%, on average, over the entire research period for branch 62, while they rose year on year by 0.03% for branch 26. The results of the comparative analysis allowed to conclude that in both branches, the internal and external levels of OIC acquisition rose year on year over the entire research period. However, in conjunction with the results presented in Figure 1, the comparative analysis led to the conclusion that there is opposite importance of streams of the OIC acquisition in both branches. In branch 62, the internal stream is more important, while in branch 26, the external stream is more important. This situation can be interpreted via the direct relation of acquired IC to business activities. The SMEs in branch 62 generated more added value to the software-developing products in their internal environment than those producing hardware and belonging to branch 26. The main conclusion is that although the SMEs in both branches are innovative, those in branch 62 are more creative, while those in branch 26 are more reproductive.

Table 5 shows the calculation results of the individual components of the OIC acquisition level separately in the internal and external streams as a share of overall OIC acquisition for both compared branches over the entire research period. The calculations were performed according to Equations 3 and 4. The results obtained indicate that the surveyed SMEs belonging to branch 62 acquired the highest share of acquisition over the entire research period, indicating both innovation and project capital. These results answer the fourth research question.

Table 5: Calculated values of component share in OIC acquisition over the entire research period.

Branch	62	
OIC component	Internal stream	External stream
Innovation Capital	84.99%	15.01%
Project Capital	81.00%	19.00%
Information Capital	70.28%	29.72%
Human Capital	52.82%	47.18%
Organisational Capital	39.68%	60.32%
Relational Capital	30.02%	69.98%
Technological Capital	0.00%	100.00%
Branch	26	
OIC component	Internal stream	External stream
Innovation Capital	34.93%	65.07%
Project Capital	26.54%	73.46%
Information Capital	43.69%	56.31%
Human Capital	55.77%	44.23%
Organisational Capital	60.61%	39.39%
Relational Capital	37.58%	62.42%
Technological Capital	72.30%	27.70%

Innovative solutions and knowledge of IT project management techniques principally through the internal stream. The managerial techniques are adapted to the individual conditions in each enterprise so that the processes of software development and improvement are managed to create the maximum added value represented by an innovative product. Technological and relational capital were mostly acquired in the external stream. The technological capital component includes computer technologies and equipment, which proves that in the software-developing SMEs of branch 62, the computer programming environment (which consists of suitable software, IT technologies and computer equipment) does not result from their operational activities but is acquired from external parties. The relational capital component consists of a list of regular customers and the SMEs' partners, image, trust, reputation and external relations. This component was also obtained mostly by the SMEs representing branch 26. Thus, the result confirms that these constituent parts are strictly related to the external social and economic environment of SMEs belonging to both compared branches.

In addition, the SMEs belonging to branch 26 acquired mostly project and innovation capital in the external stream, while in the internal stream, these SMEs acquired mostly technological and organisational capital. Conversely, human capital was acquired in both streams at a similar level in both compared branches. This result answers the fourth research question.

The calculation results above demonstrate that OIC acquisition at the component level clearly varied in both streams and compared branches. This conclusion is confirmed by the graphical representation of the internal and external streams of OIC acquisition at the component level. Figure 2 shows the spectrum of OIC acquisition by the SMEs belonging to branch 62. Figure 2 indicates that the intersection of acquisition is insignificant, and the larger areas are clearly different. These results lead to the conclusion that the SMEs belonging to branch 62 acquired components mostly in the internal and external OIC streams, and these acquisitions were complementary. Figure 3 presents the spectrum of OIC acquisition by the SMEs belonging to branch 26. Conversely, Figure 3 shows that the intersection of acquisition is significant, and the smaller areas are clearly different. These results lead to the conclusion that SMEs belonging to branch 26 components acquired in the internal and external OIC streams, but they are less complementary than in branch 62.

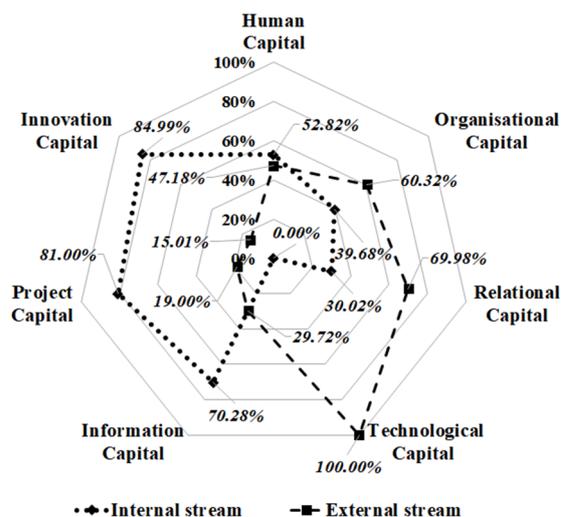


Figure 2: Diversified acquisition of OIC components in branch 62.

Furthermore, a close examination of the locations of the internal and external streams in Figures 2 and 3 reveal that they are located in opposing areas. The external boundary of the internal stream of OIC acquisition in branch 62 is designated by the following components: human capital, innovation capital, project capital and information capital (Figure 2). Three of these (innovation capital, project capital and relational capital) designate the boundary of the external stream of OIC acquisition in branch 26 (Figure 3).

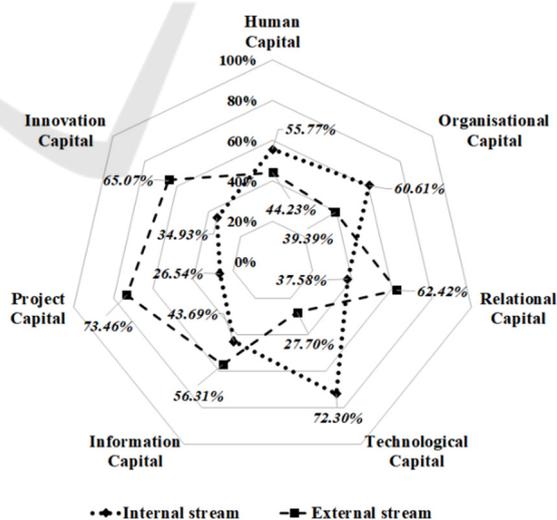


Figure 3: Diversified acquisition of OIC components in branch 26.

This situation indicates that the component acquisition of OIC reveals significant differentiation between the compared branches.

Table 6 presents the results of the dynamic rate of change calculation in the level of the acquisition of individual OIC components separately in the internal and external streams for branches 62 and 26 over the entire research period. The calculations were performed according to Equation 5.

Table 6: Calculated dynamic rates of change in acquisition of the OIC components for branches 62 and 26.

<i>Branch</i>	<i>62</i>	
OIC components	Internal stream	External stream
Human Capital	8.48%	10.13%
Organisational Capital	1.74%	3.11%
Relational Capital	4.13%	1.58%
Technological Capital	-	2.65%
Information Capital	4.34%	8.03%
Project Capital	3.82%	7.01%
Innovation Capital	4.54%	5.63%
<i>Branch</i>	<i>26</i>	
OIC components	Internal stream	External stream
Human Capital	6.88%	6.93%
Organisational Capital	6.01%	0.30%
Relational Capital	5.74%	-1.32%
Technological Capital	8.81%	-7.61%
Information Capital	1.82%	7.78%
Project Capital	-1.70%	5.67%
Innovation Capital	-2.65%	4.73%

The obtained calculation results indicated that for the SMEs belonging to branch 62, human capital grew in importance more than other components in both streams of this branch (Table 6). Furthermore, the dynamics level of acquisition of the OIC components increased only in branch 62. Conversely, the results obtained from the SMEs belonging to branch 26 indicate a more diversified situation. The level of acquisition of information capital, organisational capital and human capital components increased in both the internal and external streams. The highest increase in the OIC acquisition level was for human capital, which was an average of 6.88% and 6.93%, respectively, year on year over the entire research period.

Compared with other components, these results allowed the conclusion that human capital is also one of the most important components in branch 26. A very interesting situation indicates the technological component, where the level of OIC acquisition increased in the internal stream year on year by 8.81% and decreased in the external stream year on year by 7.78%. Such results could lead to the conclusion that a significant part of the business activities of the SMEs belonging to branch 26 contains not only

hardware production but also services and technical support for hardware products introduced to the market.

4 DISCUSSION AND CONCLUSIONS

The literature review indicated that research has focused on the use of IC in business. Those studies concentrated on the effects of IC use on selected business indices and enterprise performance indicators and considered single-stream IC models, which were understood as an internal enterprise resource (Dimitrios et al., 2011; McConnell, 2019). The acquisition of OIC was not often covered by past research. Thus, IC acquisition seems to be a relatively new field of study.

Although, the software-developing and hardware producing businesses significantly evolved in the last 12 years, the management practice suggest that IC is acquired both internally and externally (Ahmed et al., 2022). What's more, SMEs belonged to both branches could be considered as knowledge-intensive enterprises. There is almost impossible in nowadays to create a new ICT equipment produced by SMEs in both compared branches without acquisition of new knowledge and technologies in their business activities (Schivone et al., 2022). The spread of a new knowledge and technologies seems to be unavoidable and play incremental role in business activities. These issues triggered research into a new field of IC acquisition that has not been explored previously. This paper discussed research results obtained in that field by comparing OIC acquisition in two separate branches. The research covered innovative SMEs conducting business activities in Poland that belonged to two branches: branch 62, represented by software-developing SMEs, and branch 26, represented by hardware producing SMEs.

The research results discussed above clearly demonstrate that the surveyed SMEs in both compared branches acquire IC continually, systematically and simultaneously from both external and internal sources; this answers the first and second research questions. Consequently, the analysis and evaluation of IC acquisition, including comparisons between any branches and groups of selected enterprises, should be performed using OIC acquisition concepts which, after being empirically proven, can be considered an OIC model.

The calculated values of the indices of overall OIC acquisition indicate that the internal stream is

more important for the software-developing SMEs belonging to branch 62. In contrast, the external stream is more important for the hardware producing SMEs belonging to branch 26. This is the answer to the third research question.

Considering the dynamic rate of change in OIC acquisition at the component level, the results obtained reveal the significant differentiation between the compared branches. The OIC acquisition of each component increased for the SMEs belonging to branch 62 over the entire research period, while for those belonging to branch 26, only the level of acquisition of information capital, organisational capital and human capital components increased in both internal and external streams. The results reveal significant differentiation in the level of OIC acquisition in terms of project capital, innovation capital, relational capital and technological capital. The differences in acquiring OIC components are related to the different business activities of the SMEs belonging to the compared branches. Considering the dynamic rate of change, human capital, project capital and information capital were most important for the SMEs belonging to branch 62, while human capital, information capital and organisation capital were most important for those belonging to branch 26. This answers the fourth research question.

Considering the share in the level of acquired OIC components, for the SMEs belonging to branch 62, innovation capital and project capital were the most acquired components in the internal stream. Relational capital and organisational capital (except technological capital) were most important in the external stream. For those SMEs belonging to branch 26, technological capital and organisational capital were most important in the internal stream. In contrast, project capital and innovation capital were most important in the external stream. These results answer the fourth research question.

In addition, the results of the comparative analysis of the graphic representation of OIC component acquisition for branch 62 indicated that the intersection of acquisition is insignificant, and larger areas are clearly different since they are located outside the intersection. This led to the conclusion that the acquisition of OIC components by the SMEs belonging to branch 62 is mostly complementary. However, there is a different situation in branch 26, where the intersection of acquisition is significant, and smaller areas are clearly different because they are located outside the intersection. This led to the conclusion that the acquisition of OIC components by the SMEs belonging to branch 26 is significantly less complementary than for the SMEs of branch 62. A

close comparison of the areas of the internal and external streams in Figs. 2 and 3 reveals that they are located in opposing areas. The external boundary of the internal stream of OIC acquisition in branch 62 is designated by human capital, innovation capital, project capital and information capital (Figure 2), while innovation capital, project capital and relational capital designate the boundary of the external stream of OIC acquisition in branch 26 (Figure 3). Accordingly, the component acquisition of OIC reveals significant differentiation between the compared branches.

5 FUTURE RESEARCH

This research was conducted in a new field and undoubtedly extends the knowledge of OIC acquisition by enterprises. The presented results provide the opportunity and indicate the need to continue research into more detailed topics in the field of OIC acquisition in other branches. The continued development of research will allow comparative analyses of different groups of enterprises and branches in terms of OIC acquisition. This can contribute to the development of knowledge on diversified OIC acquisition by enterprises characterised by various sizes and who conduct business in various industries. Continued research will also improve the methods of comparative analysis and evaluation of OIC acquisition with the aim of building an OIC acquisition model.

REFERENCES

- Abeysekera, I., 2021. Intellectual Capital and Knowledge Management Research towards Value Creation. From the Past to the Future. *Journal of Risk Financial Management*. 14(6), DOI: <https://doi.org/10.3390/jr14060238>.
- Ahmed, A., Bhatti, S. H., Gölgeci, I., Arslan, A., 2022. Digital platform capability and organizational agility of emerging market manufacturing SMEs: The mediating role of intellectual capital and the moderating role of environmental dynamism. *Technological Forecasting and Social Change*. 177, 121513.
- Alimov, A., Officer, M. 2017. Intellectual property rights and cross-border mergers and acquisitions. *Journal of Corporate Finance*, 45, 360-377.
- Barney, J.B., Hesterly, W.S., 2019. *Strategic Management and Competitive Advantage*. Pearson. Harlow. UK.
- Dimitrios, M., Dimitrios, Ch., Charalampos, T., Theriou, G., 2011. The impact of intellectual capital on firms' market value and financial performance. *Journal of*

- Intellectual Capital. 12, 132-151, DOI: 10.1108/14691931111097944.
- Edvinsson, L., Malone, M.S., 1997. *Intellectual Capital: Realizing Your Company's True Value by Finding Its Hidden Brainpower*. Harper Business. New York.
- European Communities, 2008. *Statistical Classification of Economic Activities in the European Community*. Office for Official Publications of the European Communities. Luxembourg.
- Hatcher, L., 2013. *Advanced Statistics in Research*. Shadow Finch Media. Saginaw.
- Hejase, H.J., Hejase, A., Assi, H.T., Chalak, H.C., 2016. Intellectual Capital: An Exploratory Study from Lebanon. *Open Journal of Business and Management*. 4, 571-605.
- Lee, C., Wong, K., 2019. Advances in Intellectual Capital Performance Measurement: A State-of-the-art Review. *The Bottom Line*. 32(2), 118-134, DOI: <https://doi.org/10.1108/BL-12-2018-0051>.
- Mačerinskienė, I., Survilaitė, S., 2019. Company's Intellectual Capital Impact on Market Value of Baltic Countries Listed Enterprises. *Oeconomia Copernicana*. 10(2), 309-339, DOI: <https://doi.org/10.24136/oc.2019.016>.
- Matricano, D., Candelo, E., Sorrentino, M., Cappiello, G., 2020. Investigating the Link Between Intellectual Capital and Open Innovation Processes: a Longitudinal Case Study. *Journal of Intellectual Capital*. 3rd December, DOI:10.1108/jic-02-2020-0020.
- McConnell, S., 2019. *More Effective Agile: A Roadmap for Software Leaders*. Construx Press. Bellevue.
- Nazari, J., 2015. Intellectual Capital Measurement and Reporting Models. [In:] *Knowledge Management for Competitive Advantage During Economic Crisis*, Ordoñez de Pablos, P., Turró, L.J., Tennyson, R.D., Zhao, J. (eds.). IGI Global. Hershey, 117-139, DOI: 10.4018/978-1-4666-6457-9.ch008.
- Pike, S., Roos, G., 2000. Intellectual Capital Measurement and Holistic Value Approach. *Works Institute Journal*. 42 (October/November), 1-15.
- Pulic, A., 2004, Intellectual Capital-Does it Create or Destroy Value. *Measuring Business Excellence*. 8(1), 62-68, DOI: <https://doi.org/10.1108/13683040410524757>.
- Roos, G., Pike, S., 2018. *The Strategic Management of Intellectual Capital: Essentials for Leaders and Managers*. Routledge. New York.
- Santis, S., Binachi, M., Incollingo, A., Bisogno, M., 2019. Disclosure of Intellectual Capital Components in Integrated Reporting: An Empirical Analysis. *Sustainability*. 11(62), 1-15, DOI: 10.3390/su11010062.
- Schiavone, F., Leone, D., Caporuscio, A., Kumar, A., 2022. Revealing the role of intellectual capital in digitalized health networks. A meso-level analysis for building and monitoring a KPI dashboard. *Technological Forecasting and Social Change*. 175, 121325.
- Sharpe, N., Veaux, R., Velleman, P., 2014. *Business statistics*. Pearson Publisher. Boston.
- Stewart, T.A., 1998. *Intellectual Capital: The New Wealth of Organizations*. Nicholas Brealey Publishing. London.
- Sveiby, K., 2001. *Methods of Measuring Intangible Assets*. Sveiby Knowledge Associates Publisher, available at: https://www.sveiby.com/files/pdf/1537275071_methods-intangibleassets.pdf (accessed: Dec, 08, 2021).
- Wiederhold, G., 2014. *The Value of Intellectual Capital*. Springer. New York, DOI: https://doi.org/10.1007/978-1-4614-6611-6_3.
- Yovita, M., Kardina, G., Amrania, P., 2018. The Influence of Intellectual Capital to Market Value with Return on Assets as Intervening Variable. *Journal of Accounting Auditing and Business*. 1(2), 9-16, DOI: <http://dx.doi.org/10.24198/jaab.v1i2.18267>.