Acquisition of Open Intellectual Capital: A Case Study of Innovative, Software-developing SMEs

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Abstract: The existing studies into intellectual capital (IC) focus on its utilisation and effect on selected business performance indicators, mostly achieved by large enterprises. IC is subject to single-stream analyses and understood as an internal enterprise resource. Since IC is used in the business operations of enterprises, it must also be acquired. The aim of this study is to present the results of research conducted in a field of IC acquisition that has not yet been explored. The described research focused on innovative small and medium enterprises (SMEs) that develop software in Poland (2007–2019). Empirical data were obtained in time series form through the use of dedicated statistical tools including the dynamic rate of change. The main conclusion states that IC acquisition in the SMEs covered by the research should be described as a process taking place simultaneously, systematically and continually in two streams: an internal and an external stream of acquisition. Thus, considering the IC acquisition, the concept of Open IC (OIC), which consists of two streams of acquisition: internal and external, was introduced. Future research in this field allow focus on comparative analyses of different branches, which can extend our knowledge of the importance of OIC in businesses.

1 INTRODUCTION

The evaluation of research and development (R&D) In a knowledge-intensive economy, the division into property and plant equipment on the one hand and intangible assets on the other hand is commonly used. Intangible assets are indicated with increasing frequency as the factor that is more important for sustained growth, success and increased enterprise market value (Barney and Hesterly, 2019). Intangible resources, particularly intellectual capital (IC), are perceived and treated by large enterprises as strategic for sustained growth and success (Edvinsson, 1997; Edvinsson and Malone, 1997; Stewart, 1998; Sveiby, 2001; Steenhuis et al. 2012; Rothaermel, 2016; Santis et al. 2019; Schiavone et al. 2022). Therefore, the use of various IC components and their constituent parts is dictated principally by the needs of enterprises' operating activities. The analyses and evaluations found in the existing literature on the subject address mainly large enterprises and questions relating to the transfer of knowledge both inside and outside these enterprises (Van Wijk et al. 2008; Chen et al. 2009; Matricano et al. 2020; Ahmed et al. 2022). They focus on such topics as IC value measurement (Pulic, 2004; Wiederhold, 2014), value added creation in an enterprise (Pike and Roos, 2000; Abeysekera, 2021), the share of IC in the market value of an enterprise (Dimitrios et al. 2011; Yovita et al. 2018; Mačerinskienė and Survilaitė, 2019), and other selected outputs and indicators achieved by that group of enterprises (Pulic, 2000; Nazari, 2015; Roos and Pike, 2018; Santis et al. 2019). These studies lead to the conclusion that specific IC components are used in line with the types and in-depth knowledge of the individual conditions of enterprises' business operations. Hence, the vast corpus of literature on the subject is focused on research into IC use in the business operations of large enterprises. The results of these research projects are widely used in developing IC models and in planning strategies that are implemented by the management of large enterprises. Particular attention is paid to the models that aim to describe the effect of IC use on selected indices and performance indicators of enterprises (Bontis, 2001; Bonfour, 2003; Hejase at al., 2016; Lee at al., 2019). However, management practice indicates that IC, considered a key resource for

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enterprise growth, is subject to limitations, like other types of resources. First, IC in an enterprise is not a self-renewable resource. It must be actively acquired and developed. Consequently, the utilisation and the acquisition of IC must be considered equally important and key processes in the operating activities not only of large enterprises but also of SMEs. To be used, IC must firstly be acquired to the extent that is necessary to ensure the continuity of an enterprise's operating activities. Since IC must be acquired before it is used in an enterprise's operations, it can be assumed that IC acquisition also represents a systematic and continual process related to the enterprise's operating activities. Moreover, management practice indicates that IC is acquired by enterprises both internally and externally. Also, it can be expected that the IC utilisation level and the level of acquisition of that capital will be higher in innovative SMEs that operate in the knowledge-intensive sector. This inherent characteristic distinguishes business operations of enterprises in the knowledge-intensive sector from those in other sectors and types of business. The above reasons underlie the choice of innovative SMEs that develop software in Poland. However, studies presented in the subject literature did not focus on IC acquisition and these types of SMEs. Up-to-date research took into account the utilisation of IC as a single stream of internal resource. Since IC acquisition and use are equally important, the absence of research into the field of IC acquisition represents a major gap in our knowledge. Another gap in the literature on the subject is the absence of research projects covering relatively long periods. Most analyses are limited to one year, which provides only a snapshot of the results. The research project described in this paper aimed to fill above-mentioned gaps.

The aim of this study is to present and discuss the results of research on the acquisition of OIC, which occurs as a continuous process in two mutually symmetric, internal and external streams, as observed over the long term in innovative, software-development Polish SMEs.

2 CHARACTERISTICS OF SOFTWARE-DEVELOPMENT POLISH SMES

The existing models and concepts of IC lead, among other ideas, to the conclusion that IC utilisation is related to the operating activities of an enterprise. Since the operating activities of an enterprise are carried out continually and systematically, IC utilisation and thus IC acquisition also represent a continual and systematic process that is related to the operating activities of the enterprise. The knowledge-intensive sector includes innovative, software-development SMEs. Business operations of these enterprises consist of developing and improving software, based on two business models. The first is implemented when an enterprise carries out IT projects individually commissioned by enterprises that conduct business in other economic sectors. The second is used when an enterprise that develops software introduces into the market its IT products that are systematically extended, improved and distributed. The range of products developed by enterprises that are engaged in developing and improving their own computer programs is frequently designed for enterprises that conduct business in other economic sectors. In both cases described, SMEs keep and continually expand their catalogues of regular business customers, including foreign ones, whose opinions and suggestions are used in subsequent projects and program versions. The relations with regular customers form one of the streams of acquiring IC. Generally, it can be concluded that the business operations of innovative, software-development SMEs consist of the developments and improvements of their own computer programs as part of their IT projects, and of carrying out IT projects individually commissioned by enterprises that conduct business operations in other economic sectors, not only in domestic but also in foreign markets. Thus, the operating activities of the enterprises covered by the research project described in this study consist of carrying out IT projects. These operating activities are undertaken in the enterprises continually and systematically and include the development and improvement of software, wherein the writing of source code is accompanied by a number of repeated tests of the program under development, performed using dedicated electronic (computer) equipment. When managing the development and improvement processes, usually dedicated techniques based on the Agile Manifesto are employed (Schwaber, 2005; Brencher, 2015). Two distinctive characteristics are evident in the IT project implementation process: iteration and the teamwork of programmers (software developers). This teamwork of program developers is repeated many times as part of the software development and improvement processes (sprints) (Highsmith, 2009; Brencher, 2015). Each sprint aims to implement specific parts of the functionalities to be offered by the developed or improved software.

Sprints are systematically repeated during each IT project. This means that each sprint aims to achieve specific and varied values that are added to the developed or improved software. Sprint repetitions are accompanied by other regularly recurring events included in the software development and improvement process, such as (Schwaber and Sutherland, 2012; McConnell, 2019): Product backlog; Sprint planning; Sprint backlog; Sprint interaction; Daily scrum; Sprint review; Sprint retrospective and Software tests.

Sprints and other events are repeated a number of times in each individual IT project, and each time they refer to different content related to software development and improvement. Hence, the above events form an iterative mechanism of cooperation in a programmer team that creates added value. The iterative work of the programmer team is based on the systematic and continual use of IC that is transformed, by way of the written source code, into added value, represented by functionalities offered by the developed software. Since the value that is added in innovative SMEs that develop software is created systematically and continually as part of the IT projects that constitute their principal operating activity, these enterprises are characterised by the highest level of iterative and systematic use of IC. These operating characteristics of the innovative SMEs that develop software provided the reasons this group of enterprises was chosen as the subject of this research.

3 MATERIALS AND METHOD

This study into open IC (OIC) acquisition by innovative, software-development Polish SMEs aimed to answer the following research questions:

1. Is OIC acquired in two entire streams (internal and external) simultaneously over the entire research period?
2. Does OIC acquisition in both streams form a systematic and continual process?
3. Which OIC acquisition stream is more important for the surveyed enterprises, considering the level of acquisition of that capital?
4. Which OIC acquisition stream is more important for the surveyed enterprises, considering the dynamic rate of change in the OIC acquisition level?
5. Which acquired OIC component is more important for the surveyed enterprises, considering the dynamic rate of change in the levels of component acquisition?

An analysis, including description of the OIC concept, were conducted in the three stages described below to answer the above-mentioned research questions.

3.1 Description of OIC Concepts: The First Stage of Empirical Analysis

Since there is no universal concept of IC in the literature, an IC concept including as many components as possible had to be developed for the purposes of this study. Various IC concepts proposed in the literature on the subject contain various sets of components. The IC concept proposed here is as broad as possible and includes numerous components, facilitating a more detailed analysis and evaluation of the OIC acquisition process. It was also useful because only the selected components and their constituent parts, which create the structure of IC, are utilised in enterprises' operations. Moreover, enterprises differ in their utilisation of IC. It depends on such factors as the conditions of the social and economic environment, the economic sector, the industry and individual enterprise conditions, e.g. its size and the employees' educational background and occupational experience.

The above concept was formulated in line with the rule of uniqueness of IC components. Considering the most comprehensive IC concepts in terms of their components and constituent parts, concepts that 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 project:

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

A survey was conducted with the division of simultaneous IC acquisition into two streams: internal and external. The internal stream describes IC generation internally within the surveyed enterprises, based on their own resources. The external stream describes the IC acquisition process from the external environment of the surveyed enterprises. For methodological reasons, comparative analyses required the same IC component structure in both (symmetric) streams. Hence, the formulated concept is termed Open IC (OIC).

The second stage of this research project was aimed at analysing and evaluating the dynamics of

OIC acquisition in two symmetric and internal and external streams in the SMEs covered by the research. The third stage of this research project was aimed at analysing and evaluating the dynamics of OIC acquisition at the component level independently for the internal and external streams in the SMEs covered by the research.

Seeking answers to the research questions, comparative analyses of the streams were made, at the level of the streams, and at the level of the individual OIC components that constitute the internal and external streams of IC acquisition.

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

The catalogue of variables describing individual OIC components, symmetric in the internal and external streams, was compiled based on a form used in a regular survey for innovative entities, i.e. SMEs that develop software in Poland and belong to the knowledge-intensive sector. The original empirical data set, in the form of a time series, was obtained from a regular survey conducted by Statistics Poland. The time series contained 13 annual observations, covering the adopted research period of 2007–2019 and describing each component constituting OIC separately in the internal and external streams (Table 1).

Table 1: Time series of the variables obtained during the research project for all of the OIC components used in the performed analysis.

OIC component of stream	Description of variables characterising the acquiring of OIC
Streams of components forming the internal stream of acquired OIC	
V_1	Stream of Human Capital component
V_2	Stream of Organisational Capital component
V_3	Stream of Relational Capital component
V_4	Stream of Technological Capital component
V_5	Stream of Information Capital component
V_6	Stream of Project Capital component
V_7	Stream of Innovation Capital component
Streams of components forming the external stream of acquired OIC	
V_8	Stream of Human Capital component
V_9	Stream of Organisational Capital component
V_{10}	Stream of Relational Capital component
V_{11}	Stream of Technological Capital component
V_{12}	Stream of Information Capital component
V_{13}	Stream of Project Capital component
V_{14}	Stream of Innovation Capital component

The different variables characterise topics that are directly related to the acquisition of OIC and that are indispensable to the iterative process of software development and improvement.

The survey included a group of innovative SMEs that develop software in Poland over the entire research period. The enterprises were characterised by a headcount varying from 10 to 249 employees, and their businesses were included in NACE classes 62.01 and 62.02 (European Communities, 2008). The population of the surveyed group is given in Table 2.

Table 2: Number of SMEs covered by the research project.

Year	Number of SMEs
2007	192
2008	246
2009	261
2010	293
2011	247
2012	282
2013	305
2014	349
2015	363
2016	345
2017	357
2018	372
2019	391

The comparative analysis and evaluation of OIC acquisition conducted as part of this research project required purposefully selected computational tools and the division into internal and external streams of capital acquisition, both at the component level and at the level of the stream.

3.3 Statistical Tools Used in the Second Stage of Empirical Analysis

The calculations in the second stage of analysis and evaluation, which considers the level of OIC acquisition in the internal and external streams over the entire research period, are based on variables forming time series of annual numbers of the acquired constituent parts that form each of the structural components of OIC. The level of OIC acquisition in the internal stream was calculated using the variables marked in Table 1 as $V_1 – V_7$. Similarly, the level of OIC acquisition in the external stream was calculated using the variables marked in Table 1 as $V_8 – V_{14}$. Consequently, both streams 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, calculated according to Equation 1.

$$Cs_{at} = \frac{\sum_{i=1}^{7} V_{it}}{\sum_{j=8}^{14} V_{jt}} = \frac{V_{int}}{V_{ext}}, \quad (\forall t = 2007,...,2019) \tag{1}$$

where:
t – the subsequent year in the time series;

i – the index of each variable from V_1 to V_7 (Table 1), describing the subsequent component of OIC in the internal stream;

V_{it} – the level of the acquired subsequent component i, of OIC in the internal stream in subsequent year t;

V_{int} – the level of the OIC acquired in internal stream, calculated in subsequent year t;

j – the variable from V_8 to V_{14} (Table 1), describing the subsequent component of OIC in the external stream;

V_{jt} – the level of the acquired subsequent component j, of OIC in the external stream in subsequent year t;

V_{ext} – the level of the OIC acquired in external stream, calculated in subsequent year t;

Cs_{at} – indices of the overall OIC acquisition by the SMEs covered by the research project, calculated in subsequent year t.

The calculated value of indices of the overall OIC acquisition Cs_{at} provides information as to whether OIC is acquired in both streams simultaneously, continually and systematically, and indicates which stream of OIC acquisition reached a higher level in the surveyed SMEs in each year of the research period. The calculated indices provide answers to the first, second and third research questions.
The obtained values of variables V_{int}, V_{ext} and Cs_{at}, which take the form of time series, were used to analyse the dynamic rate of change in OIC acquisition in the surveyed SMEs over the entire research period (Sharpe et al. 2014; Hatcher, 2013). Equation 2 was used to calculate the dynamic rate of change in the described time series.

$$\overline{T}_Z = \left(\left(\sqrt[N-1]{\prod_{t=2}^{N} \frac{n_{z(t)}}{n_{z(t-1)}}} \right) - 1 \right) \times 100\%, \quad (\forall z = 1,...,3) \tag{2}$$

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;
z – an index ranging from one to three and denoting a subsequent variable;
n_z – another of the three calculated variables denoting, respectively, $n_1 – V_{int}$, $n_2 – V_{ext}$, $n_3 – Cs_{at}$;
$\frac{n_{z(t)}}{n_{z(t-1)}}$ – next chain index value of another variable n_z;
$\overline{T}_Z$ – the value of the dynamic rate of change in each variable: $\overline{T}_1 – \overline{T}_{Vint}$, $\overline{T}_2 – \overline{T}_{Vext}$, $\overline{T}_3 – \overline{T}_{Csat}$.

An interpretation of the dynamic rate of change $\overline{T}_Z$ provides an answer to the fourth research question. As the dynamic rate of change exceeds one, the level of OIC acquisition in particular stream rises, which means that OIC acquired in this stream becomes increasingly important for the processes of software development and improvement that take place in the surveyed SMEs, because OIC is acquired in line with the demand created by these processes. 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 over the entire research period.

3.4 Statistical Tools Used in the Third Stage of Empirical Analysis

The third stage of analysis and evaluation is aimed at analysing dynamic rates of change in the level of OIC acquisition, considering the components constituting the internal and external streams. Stage 3 consists of the two sections described below that address different aspects of the analysis and evaluation of the diversified acquisition of OIC components. Section 1 of Stage 3 of the research project was aimed at analysing and evaluating the share of the levels of individual OIC component acquisition in the internal and external streams over the entire research period. Equation 3 was used to calculate the share of levels of the individual OIC component acquisition in the internal stream over the entire research period.

$$Ic_i = \frac{\sum_{t=2007}^{2019} in_{it}}{\sum_{t=2007}^{2019} \left(in_{it} + ex_{jt} \right)} \times 100\%, \quad \left(\forall t = 2007,...,2019; \;\; i = 1,...,7; \;\; j = 8,...,14 \right) \tag{3}$$

where:
t – the subsequent year in the time series;
i – the index of each variable from V_1 to V_7 (Table 1), describing the subsequent component of OIC in the internal stream;
j – the index of each variable from V_8 to V_{14} (Table 1), describing the subsequent components of OIC in the external stream;

in_{it} – the acquisition level of subsequent component *i*, included in the internal stream of OCI acquisition by the surveyed SMEs in subsequent year *t* of the research period;
ex_{jt} – the acquisition level of subsequent component *j*, included in the external stream of OCI acquisition by the surveyed SMEs in subsequent year *t* of the research period;
Ic_i – the share of the acquisition level of subsequent component *i*, included in the internal stream of OIC acquired by the surveyed SMEs over the entire research period.

Equation 4 was used to calculate the share of the levels of individual OIC component acquisition in the external stream over the entire research period.

$$Ex_j = \frac{\sum_{t=2007}^{2019} ex_{jt}}{\sum_{t=2007}^{2019} \left(in_{it} + ex_{jt}\right)} \times 100, \quad \left(\forall t = 2007,...,2019;\ \ i = 1,...,7;\ \ j = 8,...,14\right) \quad (4)$$

where:
t – the subsequent year in the time series;
i – the index of each variable from V_1 to V_7 (Table 1), describing the subsequent component of OIC in the internal stream;
j – the index of each variable from V_8 to V_{14} (Table 1), describing the subsequent components of OIC in the external stream;
in_{it} – the acquisition level of subsequent component *i*, included in the internal stream of OCI acquisition by the surveyed SMEs in subsequent year *t* of the research period;
ex_{jt} – the acquisition level of subsequent component *j*, included in the external stream of OCI acquisition by the surveyed SMEs in subsequent year *t* of the research period;
Ex_j – the share of the acquisition level of subsequent component *j*, included in the external stream of OIC acquired by the surveyed SMEs over the entire research period.

Section 2 of Stage 3 is aimed at analysing the dynamic rate of change in each component of the acquired OIC (Sharpe et al. 2014; Hatcher, 2013). Equation 5 was used for the calculations.

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

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;
k – an index ranging from one to seven, denoting subsequent components included in the OIC acquired by the surveyed SMEs over the adopted research period;
s – index one or two, indicating respectively the internal or external stream of OIC acquisition by SMEs covered by the research;
$\frac{v_{ks(t)}}{v_{ks(t-1)}}$ – another value of a chain index in the time series of the acquisition level of subsequent component *k,* included in the OIC acquired by the surveyed SMEs in subsequent year *t* of the research period;
$\overline{T}_{ks}$ – the dynamic rate of change in the acquisition level of component *k,* included in the OIC acquired by the surveyed SMEs over the entire research period, separately in the internal and external stream *s*.

An interpretation of the dynamic rate of change $\overline{T}_{ks}$ at the level of OIC components provides an answer to the fifth research question. As the dynamic rate of change exceeds one, the level of acquisition of an OIC component rises, which means that OIC of this component becomes increasingly important for the processes of software development and improvement that take place in the surveyed SMEs, because OIC is acquired in line with the demand created by these processes.

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4 RESEARCH RESULTS

The results shown in Table 3 were obtained from Equation 1. In particular, annual indices of the overall OIC acquisition level Cs_{at} were calculated.

Table 3: Calculated results of the annual indices of overall OCI acquisition level by the surveyed SMEs.

Year/ Designation [unit]	V_{int} [number]	V_{ext} [number]	Cs_{at}
2007	451	304	1.485
2008	626	435	1.439
2009	700	512	1.368
2010	749	526	1.424
2011	610	415	1.470
2012	671	442	1.517
2013	708	467	1.515
2014	808	567	1.424
2015	847	598	1.417
2016	812	577	1.408
2017	847	631	1.341
2018	993	761	1.305
2019	1067	849	1.258

The obtained calculation results indicate that the values of indices C_{sat} are greater than one in each year of the research period, and thus the surveyed SMEs acquire OIC simultaneously, continually and systematically in the two internal and external streams because both variables V_{int} and V_{ext} assume positive values (Table 1). The value of the indices of the overall OIC acquisition level exceeding one indicates that:

- an analysis and evaluation of OIC acquisition should be done by dividing it into two streams of OIC acquisition: an internal stream and an external stream;
- considering the level of OIC acquisition, the internal stream is more important for the processes of software development and improvement taking place in the surveyed SMEs because its OIC acquisition level is greater than the acquisition level of OIC in the external stream (variable V_{int} is greater than V_{ext}).

Table 4 contains the results obtained using Equation 2 to determine the dynamic rate of change in OIC acquisition in the internal stream, external stream and in the indices of overall OIC acquisition.

Table 4: Calculated dynamic rates of change in OIC acquisition over the entire research period.

Designation	$\overline{T}_{Vint}$	$\overline{T}_{Vext}$	$\overline{T}_{Csat}$
Calculated value	7.44%	8.93%	-1.37%

The obtained calculation results indicate that the level of OIC acquisition in the internal and external streams rose year over year by 7.44% and 8.93%, respectively, on average over the entire research period. Thus, the levels of OIC acquisition rose in both of the analysed and evaluated streams, with the level of OIC acquisition rising faster in the external stream. The indices of the overall OIC level decreased year over year by 1.37% on average over the entire research period. Thus, the level of OIC acquisition expressed as the ratio of the internal stream to the external stream decreased in the entire research period. The calculated dynamic rate of change in the indices of the overall level of OIC acquisition T_{Csat} (showed in table 3), in conjunction with its calculated value, shown in Table 3, indicates that although the level of OIC in the internal stream is greater than in the external stream, the difference decreases over the entire research period. It may be concluded that the importance of the OIC acquired in the external stream rose over the entire research period.

Table 5 contains the calculation results of the share of the individual OIC component acquisition levels in the internal stream and external stream separately, and it also contains the values of the share of component-level OIC acquisition over the entire research period. Calculations were done using Equations 3 and 4.

Table 5: Calculated values of component share in OIC acquisition, in the internal and external streams, over the entire research period.

OIC component/ Share in stream	Share in whole internal stream	Share in whole external stream
Innovation Capital	83.5%	16.5%
Project Capital	82.4%	17.6%
Information Capital	74.0%	26.0%
Human Capital	44.6%	55.4%
Organisational Capital	33.8%	66.2%
Relational Capital	26.6%	73.4%
Technological Capital	0.0%	100.0%

The results obtained indicate that the surveyed SMEs acquire project capital principally through the internal stream. The project capital consists of knowledge about IT projects management techniques. The basic knowledge about these techniques is acquired in external stream. After that, they are adapted to the individual conditions in each enterprise so that the processes of software development and improvement are managed with the aim of creating the maximum added value represented by an innovative product. As described in chapter 2, added value is generated in the processes of software development and improvement that take place inside the surveyed enterprises by the direct involvement of programmers in iterative teamwork. Due to the direct, iterative involvement of programmers in the process of creating added value, the share of human capital in OIC acquisition was similar in both streams: 44.6% in the internal stream and 55.4% in the external stream. The human capital component includes such constituents as knowledge, competences, learning abilities and cooperation. The obtained calculation results indicate that human capital, like other components (except for technological capital), are acquired simultaneously in both streams: internal and external. This again confirms the need to conduct analyses and evaluations of OIC acquisition in these two (internal and external) streams.

The calculation results given above demonstrate that OIC acquisition on the component level clearly varies in both streams. This conclusion is confirmed by the graphic representation of the internal and

external streams of OIC acquisition at the component level, seen in Figure 1, where the intersection of acquisition is insignificant, and larger areas are clearly different. Thus, the components acquired in the internal and external OIC streams are complementary.

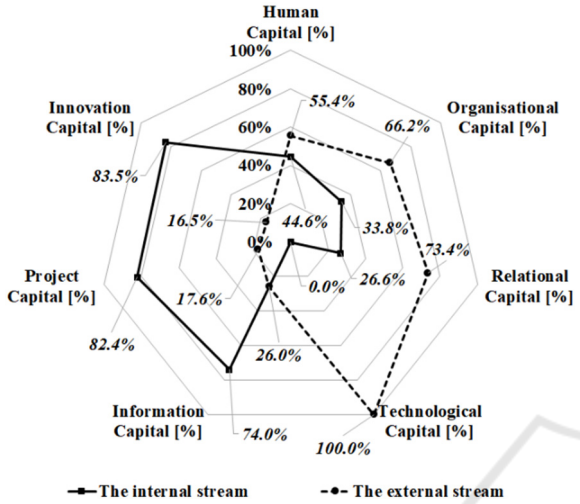

Figure 1: Diversified acquisition of OIC components over the entire research period.

Attention should be drawn to the technological capital component (indicated above) that is entirely acquired in the external stream. This component includes computer technologies and equipment. This result leads to the conclusion that in the surveyed SMEs, the computer programming environment, consisting of suitable software, IT technologies and computer equipment, does not result from the software development and improvement processes, but is acquired from external sources. The constituent parts of the technological component are used in the software development and improvement process rather than produced in that process. This result confirms the fact that the surveyed SMEs develop and improve software as ordered by individual external entities or as their own product designed for market distribution. Relational capital provides another example of diversified OIC acquisition. This component consists of a list of regular customers, the partners, image, trust, reputation and external relations. The results confirms that these constituent parts are strictly related to the external socio-economic environment of the surveyed SMEs. Individual orders for computer programs are conditional on great trust and the reputation and capability of establishing and maintaining stable relations with customers.

Table 6 shows calculation results of the dynamic rate of change in the level of acquiring individual OIC components separately in the internal and external streams over the entire research period. The calculations were done using Equation 5.

Table 6: Calculated dynamic rates of change in the level of OIC component acquisition over the entire research period.

OIC components	Dynamic rate of change in the acquisition level in the whole internal stream	Dynamic rate of change in the acquisition level in the whole external stream
Human Capital	10.78%	15.47%
Relational Capital	8.83%	4.38%
Innovation Capital	7.34%	7.93%
Information Capital	7.22%	12.82%
Project Capital	6.93%	10.36%
Organisational Capital	3.16%	6.37%
Technological Capital	0.00%	6.22%

The obtained calculation results lead to the conclusion that human capital grew in importance more than other components in the software development and improvement processes in the surveyed SMEs. This importance results particularly from the added value that was created in the processes completed by iteration and teamwork with the daily participation of the program developers who exemplify human capital. In other words, added value is created in the surveyed SMEs due to the implementation by programmers of new solutions in the source code of developed or improved software. On average, year over year, in the internal stream of OIC acquisition, the smallest increase was observed (excluding technological capital) in organisational capital (3.16%), while in the external stream, the smallest increase was observed in technological capital (6.22%). Thus, technological capital, including computer equipment, is acquired from external sources only if the IT project environment used to develop source code requires updating. For similar reasons, organisational capital, including computer networks and management methods, is provided by the internal environment to the smallest extent, as it is a capital resource acquired principally from external sources. That capital resource is acquired principally when computer equipment requires maintenance, the configuration of computer networks must be modified or knowledge of new IT project management techniques must be obtained.

5 DISCUSSION AND CONCLUSIONS

A review of the literature indicated that the studies therein have focused on IC use in businesses. Research was also conducted into the effects of IC use on selected business indices and enterprise performance indicators. Research additionally focused on large enterprises, considering one-stream models of IC, understood as an internal enterprise resource. Acquisition of OIC was not covered by past research. Thus, IC acquisition seems to be a new field of research that has not been explored to date. Business operations of today's enterprises suggest that IC is acquired not only internally, but also from the external business environment. That hypothesis triggered research into a new field of IC acquisition that has not previously been explored. This study discusses research results obtained in that field. This research covered the group of innovative, software-development SMEs in Poland. The research results discussed above clearly demonstrate that the surveyed enterprises acquire IC continually and systematically from their external environment and simultaneously from internal sources: this answers the first and second research questions. Consequently, considering IC acquisition, this type of capital should be understood as OIC and analysed and evaluated in two simultaneous acquisition streams: internal and external, relative to the surveyed enterprises. Additionally, the calculated values of indices of overall OIC acquisition indicate that the internal stream is more important for the processes of software development and acquisition taking place in the surveyed SMEs: this is the answer to the third research question.

Considering the dynamic rate of change in the OIC acquisition level, the results obtained indicate that in the processes of software development and improvement in the surveyed SMEs over the entire research period, the importance of OIC acquisition in the internal stream decreased, while the importance of OIC acquisition in the external stream increased: this is the answer to the fourth research question.

A significant differentiation in OIC acquisition is observed at the component level both in the internal and the external streams. The results indicate (Figure 1) that OIC acquisition in the internal and external streams is diversified and complementary, considering the components of that capital in the surveyed SMEs. This shift between OIC areas acquired in both streams, with a small intersection, demonstrates the high efficiency of capital acquisition in the surveyed SMEs. No OIC is acquired that is not needed to conduct business and to develop the enterprise. The intersection of both streams of OIC acquisition indicates that certain aspects of business operations and of innovative product development have common content that requires OIC acquisition in both streams. In answer to the fifth research question: human capital was the most important component for the surveyed enterprises over the research period because this component had the greatest dynamic rate of increase in acquisition.

6 FUTURE RESEARCH

This research conducted in a new field of study undoubtedly extends the knowledge of OIC acquisition by enterprises. The research project and its results provide the opportunity and indicate the need to continue research into more detailed topics in the field of OIC acquisition in enterprises from other industries. The continued development of research will allow comparative analyses of enterprise groups from various industries in terms of OIC acquisition. This can contribute to the development of knowledge of diversified OIC acquisition by enterprises that are characterised by various sizes and that conduct business in various industries. Continued research will also improve the methods of 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/jrfm 14060238.

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.

Allweyer, T., 2008. Business Process Modeling Notation-Einführung in den Standard für die Geschäftsprozess-modellierung. Books on Demand GmbH. Norderstedt.

Barney, J.B., Hesterly W.S., 2019. Strategic Management and Competitive Advantage. Pearson. Harlow. UK.

Bollen, P., 2016. Business Process Model Semantics in BPMN. Springer-Verlag. Berlin.

Bonfour, A., 2003. The IC-dVAL Approach. Journal of Intellectual Capital. 4(3), 396-413.

Bontis, N., 2001. Assessing Knowledge Assets: A Review of the Models Used to Measure Intellectual Capital.

International Journal of Management Reviews. 3(1), 41-58.

Brechner, E., 2015. Agile Project Management with Kanban. Microsoft Press. Redmond.

Chen, C.J., Shih, H.A., Yang, S.Y., 2009. The Role of Intellectual Capital in Knowledge Transfer. IEEE Transactions on Engineering Management. 56(3), 402-411.

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., 1997. Developing Intellectual Capital at Skandia. Long Range Planning. 30(3), 366-373.

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.

Highsmith, J.H., 2009. Agile Project Management: Creating Innovative Products (Agile Software Development). Addison-Wesley. Boston.

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 Cuntries 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., 2000. VAIC™ An Accounting Tool for IC Management. International Journal of Technology Management. 20(5), DOI: 10.1504/IJTM.2000.002891.

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.

Rothaermel, F.T., 2016. Strategic Management: Concepts and Cases. McGraw-Hill. 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.

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.

Schwaber, K., 2004. Agile Project Management with Scrum. Microsoft Press. Redmond.

Schwaber, K., Sutherland, J., 2012. Software in 30 Days: How Agile Managers Beat the Odds, Delight Their Customers, and Leave Competitors in the Dust. John Wiley & Sons. Hoboken.

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

Steenhuis, H.J., 2012. Joost de Bruijn, E., Technology and Economic Development: A Literature Review. International Journal of Innovation and Technology Management. 9(5), 1-11, DOI: 10.1142/S0219877012500332.

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).

Van Wijk, R., Jansen, J.P., Lyles, MA., 2008. Inter and Intra Organizational Knowledge Transfer: A Meta-Analytic Review and Assessment of its Antecedents and Consequences. Journal of Management Studies. 45(4), May, 830-853.

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.