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The Change of Communication Process in Manufacturing Companies Implementing New Technologies: Empirical Evidence

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Abstract:

Purpose: *The purpose of the study is to diagnose how the implementation of cloud computing on daily organisational usage affected the perceived communication process.*
Design/Methodology/Approach: *Quantitative research in the form of computer assisted telephone interviewing (CATI) and computer assisted web interviewing (CAWI) was applied in Polish language. the questionnaire was addressed towards managers in charge of IT solutions or company owners – in the case of small enterprises. The preparation of a survey questionnaire was preceded by a literature analysis.*
Findings: *Implementing the cloud-computing solutions into the everyday routine of manufacturing companies improved the communication in 2018 by 56,3% and in 2020 by 46,9%. Since the declared impediment was at the level of statistical error - which is 2.3% in 2018 and 1,5% in 2020, there is no doubt that communication impediment during the implementation of cloud solution can occur, but according to this research it is extremely low. The scope of the organisation has a significant influence on communication change in the process of implementing cloud-computing solutions into the daily routine in manufacturing companies.*
Practical Implications: *Since the regional companies did not report any impediment at all in 2020, further research on its CMCs absorbance is recommended to verify if they coped well in the Covid reality and in the e-business model.*
Originality/Value: *When planning the research in 2018 with the second phase delayed in 2020, the authors did not predict the pandemic and its impact on CMC absorption and did not predict the effects of accelerated 'ITC-tization'. The research – by chance – confirms this.*

Keywords: *Cloud computing, communication processes, manufacturing.*

JEL classification: *C80, C88.*

Paper Type: *Research article.*

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1. Introduction

Communication connects people and is the basis of the functioning of any organisation. Methods and tools of mediated communication in organisations are becoming more accessible or more convenient – often the newer forms are adapted from organisations outside e.g. firstly informally predestined, adapted because they are convenient for users. The emergence of cloud computing (CC) solutions offers various possibilities in this context. The uptake of CC solutions was natural in IT organisations, but questions arose if it could be done in manufacturing companies as well. Indications could be the rise, development and the spread of the internet of things (IoT).

The companies where IT activities are the core of their business are familiar with cloud solutions. The level of cloud solution acquaintance and absorption is unknown in the branch of production companies. It is interesting as a research sample because it is believed that manufacturing companies tend to concentrate on upgrading mainly their products to meet their clients' requirements, which is their main concern; the other purposes of technology usage are of lower priority (The Definitive…, 2017).

Simultaneously the question arose whether the introduction of CC for everyday use by companies had an impact on the improvement of interorganisational communication. The first attempt to tackle the issue was in 2017 when desk research was conducted and a questionnaire was constructed. The research was planned for two phases but when the first study was conducted in 2018, no one could have predicted the pandemic and its long-term course. The first part of the results was compiled in 2019 when the pandemic started and disturbed the course of the second phase. This situation presented a fait accompli and gave the possibility to compare the situation before the pandemic with the situation during the pandemic on interorganisational communication change. The purpose of the study is therefore to diagnose how the implementation of cloud computing on daily organisational usage affected the perceived communication process.

2. Literature Review

Three main issues have the impact on fulfilling the purpose of this paper – cloud computing as the accelerator of organisational change, information and communication technology (ICT) and computer mediated communication (CMC) as tools and methods of conducting indirect/mediated communication processes via technology and finally the chosen communication features, adjusted to the research purpose.

Effective communication is the essence of the organisation's operation, its bloodstream, the efficient functioning of the organisation and its success depend on it. Obviously, the tools of intra-organisational communication have changed since the beginning of the pandemic. All tools for electronic communication of any kind

have gained in importance and the ways and methods of communicating messages have also been modified. Among these forms of electronic communication support, the CC, ICT and CMC may be enumerated as the most frequently invoked by researchers.

Cloud computing was a development in information and communication technology – in 2012 and considered as probably the newest (Xu, 2012). It changed the way industries and enterprises do their business and offered new opportunities for enterprises. The name cloud computing was inspired by the cloud symbol that is often used to represent the Internet in flow charts and diagrams (Zissis, 2012). National Institute of Standards and Technology (NIST) formed the most popular definition: "A model for enabling ubiquitous, convenient, on-demand network access to a shared pool of services (for example, networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." (Mell and Grance, 2011, p. 2)

The reason organisations implement cloud computing is the necessity of constant change to adjust to their environment. The level of CC absorbance rapidly grew when the pandemic started. Before 2019 it was obvious that CC solutions were helpful, important and developing dynamically. Companies were adopting this solution carefully and with a proper introductory phase but after the pandemic, the appearance of the CC implementation become a method for survival on the market. The proof of such a statement may be found in the literature published at that time.

In 2014, research reports indicated that 60% of small and medium enterprises had purchased at least one cloud service, and 30% had purchased five or more cloud services (Avrane-Chopard *et al.*, 2014). After 2019 the forecasts for CC adoption level were dramatically bolder. In 2020 there were the estimations, by which the transition from spending money on traditional IT to cloud services, the so-called 'cloud shift', grew to more than $216 billion in 2020 (Gartner Says by 2020). The pandemic altered the judgement of the CC advantages, since conducting 'ordinary' business as practiced before the pandemic was no longer possible. Most companies instantly became cyberspace dependent in their daily activities, and the absorption of cloud computing rose dramatically. Cloud computing, therefore, was thought to foster productivity and economic growth (Haug, Kretschmer, and Strobel, 2016).

"Most people recognize cloud computing as a fairly recent development in information and communication technology (ICT)." (Haug, Kretschmer, and Strobel, 2016). Bearing that in mind a thought should be devoted to communication tools and methods in the form of information and communication technology (ICT) and computer mediated communication (CMC) – as their importance in communication processes was high before the pandemic started, but afterwards it rapidly rose.

Again, as with cloud computing, various ICT and CMC definition may be quoted here. A vast number of ICT definitions was gathered by Aggarwal, Gaur, and Nayak

(2016), together with a catalogue of ICT benefits. For the purpose of this article the definition by Ritchie and Brindley (2005) will be suitable. ICT is defined as "the array of primarily digital technologies designed to collect, organize, store, process and communicate information within and external to an organization" (Ritchie and Brindley, 2005, p. 206). Among ICT tools electronic mail, bulletin boards, audio/video/data conferencing, automated workflow, electronic voting and collaborative writing (Coleman, 1997) are enumerated.

On the other hand, computer mediated communication (CMC) will be understood here as "the process by which people create, exchange, and perceive information using networked telecommunications systems (or non-networked computers) that facilitate encoding, transmitting, and decoding messages" (December, 2011). Originally, most CMC was text based – messages were typed on a computer keyboard and read from a computer screen (Herring and Androutsopoulos, 2015). Among text-based CMC modes email, discussion forums, newsgroups, chat, also blogs, microblogs, and wikis were enumerated. However, textual CMC has been supplemented by graphical, audio, and/or video channels of communication, and multiple modes of CMC are available on Web 2.0 platforms and smartphones, that provides contexts in which to observe verbal interaction and the relationship between communicational parties.

Both ICT and CMC cross time and distance barriers, meaning they are free from space-time markers, which allow parties to communicate with geographically dispersed team members. Both use synchronous and asynchronous communication channels, therefore it was difficult for the author of this article to find the criteria of difference in used tools in both concepts. Although it is not the purpose of this paper, for the clarity of the argumentation it would be useful to name the difference. Moreover, in the context of the research conducted, such a question arose. Unfortunately, according to the best of the author's knowledge and search, it was not found – but examples of interchangeable usage of ITC and CMC were found (Sayago, Sloan, and Blat, 2011)

The reviews concerning CMC can be found that it is not just a tool but it is technology, a medium, and the core of social relations at the same time. It structures social relations, it gives the space for relations to occur and it is also the tool for individuals to enter that space (Jones, 1995). It is also said to be a type of interpersonal communication that works through computer devices (Herring, 1996). Therefore, in this paper the CMC abbreviation is chosen to be use, the abovementioned argument speaks for it.

In the area of organisation and management it is recognised that efficient internal communication is the basis for management, decision-making processes in task teams, team building, the distribution of competence, motivation to act and the evaluation of effects of joint work (Bolman and Deal, 2017). Furthermore, it may

improve the level of satisfaction with work and beneficially affect the workplace atmosphere (Ten Brummelhuis *et al.*, 2012).

Even the very best communication competence of recipients cannot help in the situation of aggravating communication overload (information overload) (Stephens *et al.*, 2017) or incorrect flow of communications inside an organisation (White, Vanc, and Stafford, 2010). According to Heidi Bartoo and Patricia M. Sias (2004), receipt of a 'significant volume of information' is not necessary, given that the 'proper amount of information' is sufficient, provided it includes 'adequate information.' Nevertheless, adequate quantity is hard to determine.

According to the studies of Haas (2007), even if the volume of internal communication in an organisation grows, employees still desire more of it. Therefore focusing on the amount of information sent and received may be misleading. Converted into CMCs features – since communication by cloud computing usage requires computer mediators – the following were recognised. Speed "refers to how rapid the production, sending, and receiving of a message" (Bubaš, 2001) or to the speed of message transmission.

Disruption caused by interruptions to users by computer technologies as the result of a request for synchronous or asynchronous communication (Arroyo and Selker, 2011, p. 455). Also disruption by intervening, irrelevant messages (Herring, 1999). An interruption can be defined "as an unanticipated request for task switching from a person, an object, or an event while multitasking." Disruption caused by interruptions presented to users by computer technologies as the result of a request for synchronous or asynchronous communication. Interruptions "typically request immediate attention and insist on action, and reduce productive focus" (Arroyo and Selker, 2011, p. 455). It should be noted that the aim is to eliminate disruptions to raise the effectiveness of the communication. Some authors say that interruptions and distractions are highly disruptive and can cause fatal errors in important jobs – distracted driving or piloting (Russell, Jackson, and Banks, 2021).

Distortion is "the interference with or alteration of a message–is a way of describing undesirable disruptions to a message as it moves from organizational member to organizational member" (Bisel, 2017). There is an interesting piece of research on feedback of hearing one's own voice with different types of distortion (Fu *et al.*, 2006). The distorted feedback then may lead receivers to be uncertain of its origin or misidentify (Johns *et al.*, 2001) or use of the devices aided in smooth communication of feedback as intended, as meaning and intention often became distorted through only written feedback (van der Kleij, Adie, and Cumming, 2019).

Fulk and Mani (1986) identified factors of upward communication distortion by subordinates including supervisor's power, supervisor's upward influence and subordinate's aspirations for upward mobility. They argue that upward distortion is connected to the subordinate's role stress and perceptions of supervisory

communication behaviours. Therefore, according to the research some of the distortion may be neglected – like in the case of a video camera, that initially distorts the normal interactions but it is soon forgotten even in the short space of a 10-15 minute feedback session (Rowe, 2009). Some may not be neglected when the message is distorted by way of noise, then the intention of the sender is not carried out (Anya and Ekezie, 2019).

The communication process changes not only because the process itself is moved to the cloud, but also because the core process of the organisation is moved to the cloud. No matter the cause, it is extremely difficult to establish the source of communication change, but the state of change itself or the lack of the change in the communication process can be noticed during a move to the cloud solution.

The state of *worsening* the time dimension of the communication process can be seen in two aspects – the time of conducting the process itself and the time of searching for information needed. The former covers simply the longer time of passing the message. The latter is the time spent on finding the proper information that may be of open access but finding the proper source (human or paper one) or place where to find it takes much more time than before the introduction of the cloud. The message simply does not arrive on time.

The *distorted message* means that the message has changed its content during the multiplication of the sending and receiving process.

The *accelerated process* means that a communiqué reaches the destination quicker than before the introduction of the cloud computing solutions. This is the positively understood time dimension, opposite to the category 'worsened' communication process.

The *eliminated disruptions* are of all kinds (mostly technological ones, apart from psychological) – too many 'go-betweeners', physical interruption during the communication process and the improper understanding of the sent messages.

On the basis of those elements *two indicators were made* – the improvement and impediment indicator. The first is composed from acceleration and disruption elimination whereas the second – communication distortion and worsening.

3. Research Method and Sample

Quantitative research in the form of computer assisted telephone interviewing (CATI) and computer assisted web interviewing (CAWI) was applied in Polish language. the questionnaire was addressed towards managers in charge of IT solutions or company owners – in the case of small enterprises. The preparation of a survey questionnaire was preceded by a literature analysis. The literature review formed the base of the study by framing the following research questions:

RQ1: Does communication improve in the process of implementing cloud-computing solutions into the everyday routine in manufacturing companies?
RQ2: Does communication impede the process of implementing cloud-computing solutions into the everyday routine in manufacturing companies?
RQ3: Which of the companies' features have a significant impact on the change in communication (size, scope, CMC used, or set-up time) in the process of implementing cloud-computing solutions into the everyday routine in manufacturing companies?

The research was conducted twice – repetition after two years was to determine the process dynamics over time. The first research therefore was conducted in December 2017 and January 2018. The repeated research was planned to be conducted in January 2020. Unfortunately, the CoV-2 situation influenced plans in a few aspects. The second phase of research lasted from January until September 2020. All researched organisations were Polish and manufacturing companies.

In the first phase (the year 2018), only the CATI survey was used as the research method and in the second phase (the year 2020), CAWI and CATI surveys were conducted because of the difficulties caused by Covid with gathering answers to research questions. To ensure the quality of data, the survey was conducted by professional agencies – the Market Research and Analysis Centre (ASM) and by Zielinet Company respectively. The samples of the two studies are not the same sets of companies, although both groups fulfil the same requirements of targeted choice.

There were enterprises that have their offices registered in the territory of the Republic of Poland and/or have a production plant located there – only production companies were included in the research group. Moreover, there was the condition of the regular usage of clouds in their daily work, which covered the organisation that used cloud-based mailing and office package or that used clouds in a wider range of applications (for example for designing or selling processes). These two conditions are '0-1' – in case the criterion was not met, the company was excluded from the research, and another company was randomly chosen for the research. The third condition – the size of the company – imposed a sample of altogether 400 companies but at least 50 organisations from each group size: micro (employing up to 9 people), small (from 10 to 49 people), medium (50 to 249 employees) and large (employment above 250).

Table 1. *The sample characteristics*

	2018	2020		2018	2020
size			**scope**		
micro-companies	50/ 12.50 %	56s 14.00 %	local	4.8%	0
small companies	81 20.25 %	93 23.20 %	regional	3.3%	4.7%
medium	146	179	national	28.2%	39.4%

companies	36.50 %	44.60 %			
large enterprises	123 30.75 %	73 18.20 %	international	63.7%	55.9%
CMC used			**Set up time**		
postal and office purposes	181	1	The youngest	2017	2019
regional	219	399	The oldest	1875	1872
return rate to achieve answers from 400 units				0.7966%.	2.0475%.

Source: *Own study.*

4. Results

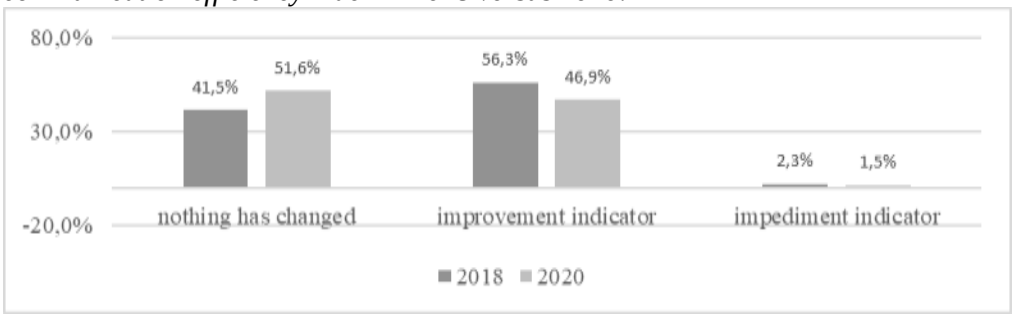
In this study, not all dependencies emerged to be statistically significant, which indicates that the implementation of cloud computing into the companies' daily routine and the change in communication related to it does not in this case depend on the size of the company, the CMCs used and the year of company set-up, but it depends on the scope of the company. Detailed data and their statistical analysis are shown below.

There is a strong statistical relationship between the change index (improvement, impediment, or status quo) and the year of the study. Therefore in 2020 more respondents declared no change than in 2018 – a rise of 10,01%, and at the same time fewer of them noticed an improvement in communication – it was 9,4%. Only 0,8% of respondents declared a drop of communication index within two years. The detailed figures are shown below in Figure 1.

The types of changes do not depend on the size of the companies. In 2018 the smallest – micro companies declared a status quo at most, improvement was close to the status quo on the second position, they – as the only one group – did not notice an impediment at all. Small and medium companies appreciated the improvement the most, the status quo the second. They both also felt the impediment equally frequently, more than the large companies. The large companies also declared more of an improvement than the status quo.

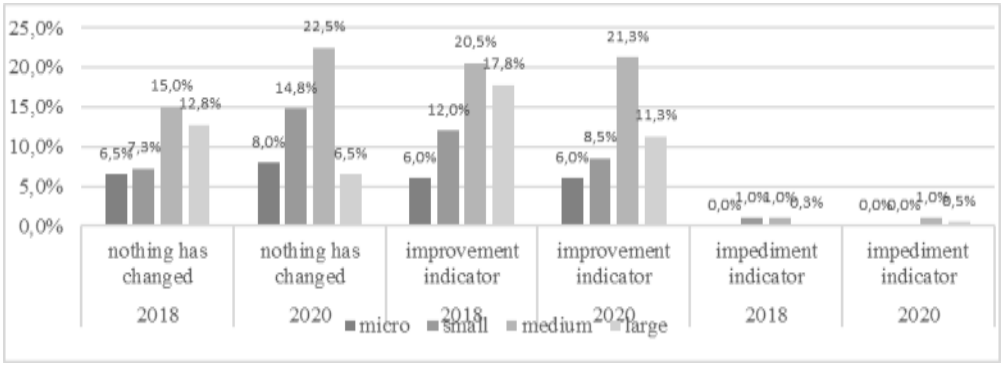
In 2020 small and medium companies noticed more of a status quo than the improvement (opposite to 2018), the same as the micro companies, but large ones preserved their situation from 2018 where the improvement outperformed the status quo. In 2020 both micro and small companies did not observe the impediment at all (Figure 2). There is a strong statistical relationship between the communication change index and the companies' scope.

Figure 1. *The impact of introducing the cloud on the change of the level of the communication efficiency index in 2018 versus 2020.*



Note: *Person chi square = 0,015; v-Cramer = 0,015; η = 0,99*
Source: *Own study.*

Figure 2. *The communication indicators versus the company's size in 2018 and 2020*



Note: *Person chi square = 0,091; v-Cramer = 0,091; η = 0,100*
Source: *Own research.*

In 2018 the international companies noticed the positive changes the most, the second answer was status quo (around 1/3 less). However, the local companies first choice was status quo, the second choice was improvement. The status quo was also noticed by local companies twice as much as by regional ones, whereas the improvement was noticed equally. Although the impediment was not a frequent answer in 2018 the most dissatisfied were international companies, more than twice as much as national and five times more than local and regional ones.

In 2020 there were no local firms in the research group. Again international companies noticed an improvement in communication first and the status quo as the second, and the difference percentage is similar. Most national companies noticed the status quo almost twice as much as they noticed the improvement. In comparison, in 2020 national companies noticed more of an improvement than the status quo, whereas in 2020 this order changed to the opposite. In international companies the tendency in noticing the improvement of communication over the

status quo remained. In 2018 more international companies than national companies observed the status quo whereas in 2020 the tendency reversed, while the improvement was noticed by international companies at most in both periods. As far as the impediment communication indicator is concerned, in 2018 international companies declared the most, the second was national companies, in 2020 this tendency reversed. Moreover in 2018 local and regional companies declared some impediment (together 0,5%) but it did not occur at all in 2020 in this scope (Figure 3).

Figure 3. *The communication indicators versus the company's scope in 2018 and 2020*

Note: *Person chi square < 0,001; v-Cramer < 0,001; η = 0,192*
Source: *Own study.*

Although there is no statistical dependence between the communication index and the CMCs used in organisations both in 2018 and 2020, the situation of companies using a range of CMCs was observed. Observing the situation in the world related to the pandemic and lockdowns in a series of countries, an increase in interest in remote forms of communication (CMCs and ITCs) could be expected, so at this point the research data confirms such assumptions.

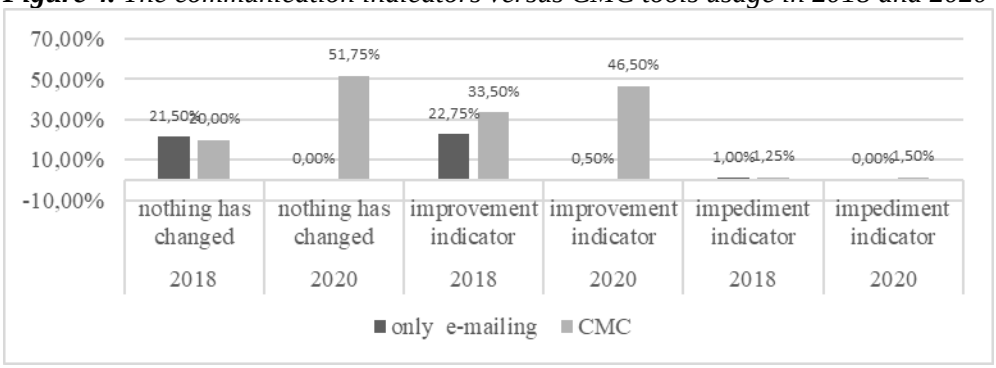
In 2018 only e-mail users noticed the improvement and the status quo with almost the same frequency, whereas CMC-users noticed more frequently the improvement than the status quo, while in 2020 this tendency for CMCs reversed (Figure 4).

There is no statistical dependence between the communication index and the set-up time. In 2018 the most improvement in communication was declared by companies that were set-up between 1990 and 1999 (the first wave of freedom), they also declared impediment the most. All of the set-up groups declared improvement the most frequent answer and the status quo as the second.

In 2020 the so-called 'Millennial companies', set-up between 2000 and 2009 declared improvement the most of other companies, however their first choice was

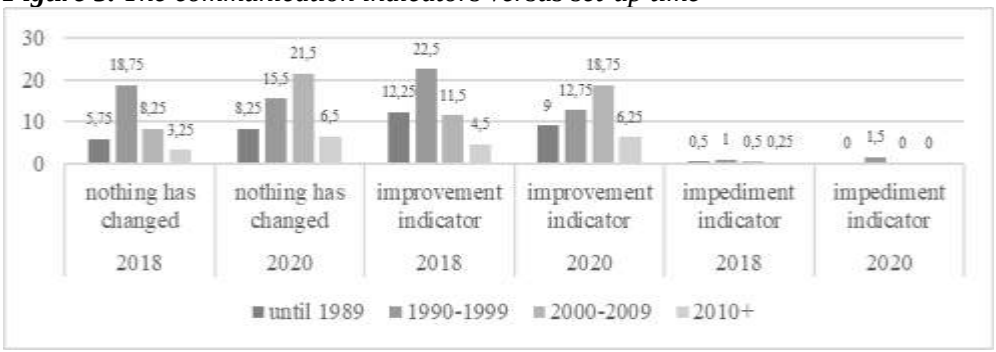
the status quo this time. In 2020 only 'the oldest companies' declared more improvement than the status quo, the rest of the companies declared otherwise – more status quo than improvement. The impediment index was declared by all age groups in 2018, but in extremely small percentages (one percent and below) whereas in 2020 only 'the first wave of freedom' declared impediment (Figure 5).

Figure 4. *The communication indicators versus CMC tools usage in 2018 and 2020*



Note: *Person chi square = 0,924; v-Cramer = 0,924; η = 0,006*
Source: *Own study.*

Figure 5. *The communication indicators versus set-up time*



Note: *Person chi square = 0,697; v-Cramer = 0,697; η = 0,103*
Source: *Own study.*

5. Conclusions and Recommendations

The answers to the research questions are as follows:

RQ1: Does communication improve in the process of implementing cloud-computing solutions into everyday routine in manufacturing companies?
Yes, implementing the cloud-computing solutions into the everyday routine of manufacturing companies improved the communication in 2018 by 56,3% and in 2020 by 46,9%. Therefore it may be stated that overall the pace of improvement has become slower, the reason for this should be further researched, author put forward

the thesis about the emergence of communication saturation with cloud solutions since in 2020, 99% of companies used a wide range of CMC tools in the company's daily routine. After the cloud's saturation, other communication means and tools might influence the improvement in the interorganisational communication. This thesis requires further research.

RQ2: Does communication impede the process of implementing cloud-computing solutions into everyday routine in manufacturing companies?
Rather no, since the declared impediment was at the level of statistical error - which is 2.3% in 2018 and 1,5% in 2020, there is no doubt that communication impediment during the implementation of cloud solution can occur, but according to this research it is extremely low.

RQ3: Which of the companies' features have a significant impact on the change in communication (size, scope, CMC used, or set-up time) in the process of implementing cloud-computing solutions into the everyday routine in manufacturing companies?
Only the scope of the organisation has a significant influence on communication change in the process of implementing cloud-computing solutions into the daily routine in manufacturing companies.

Additional conclusions derived from the research in summary are as follows:

- In 2020, communication for small businesses showed no impediment at all.
- In 2020, none of the companies defined the scope of their activities as local.
- In 2020, the regional companies did not report any impediment at all.
- In 2020, only 1 organisation used CMC in the narrow form, compared to 181 in 2018. The Covid pandemic tended to accelerate the absorption of CMCs.
- Observing the situation in the world related to the pandemic and lockdowns in a series of countries, an increase in interest in remote forms of communication (CMCs and ITCs) could be expected, so on this point the research data confirms such assumptions.
- In 2020, the oldest organisations recorded an improvement in communication whereas the youngest more often declared the status quo rather than improvement. Such results are more interesting and arouse curiosity in determining the reasons for this

Since the regional companies did not report any impediment at all in 2020, further research on its CMCs absorbance is recommended to verify if they coped well in the Covid reality and in the e-business model. When planning the research in 2018 with the second phase delayed in 2020, the authors did not predict the pandemic and its

impact on CMC absorption and did not predict the effects of accelerated 'ITC-tization'. The research – by chance – confirms this.

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