DIGITAL COMMUNICATION CHANNELS IN INDUSTRY 4.0 IMPLEMENTATION: THE ROLE OF INTERNAL COMMUNICATION

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Abstract. *Industry 4.0 describes a phenomenon which augments business models and also communication channels in commercial enterprises. This paper analyses scientific publications related to the business model changes driven by Industry 4.0, and also digital internal communication channels used to reduce risks in the process. The paper is based upon a systematic review of scientific publications and evaluation by experts. The research revealed a gap between internal communication through digital channels and the change process in Industry 4.0-driven business models. Each channel has its mission and contributes to reducing risk during the change process. Since there is no universal digital channel for internal communication, different digital communication channels are efficient at different stages of change. The paper makes recommendations for enterprises, related to the effectiveness of digital communication channels during the business model transformation. It further contributes to existing knowledge by expanding the change process model and aligning the change process with features of digital communication channels. The research focused on the manufacturing sector, exploring digital communication channels used to reduce risk during the change process, which is a limitation of this study, along with assumption of a basic level of digital competences in the enterprise.*

Keywords: *Industry 4.0, internal communication, digital communication channels, digital business models, change management*

1. INTRODUCTION

The fourth industrial revolution, also known as Industry 4.0, is characterised by a combination of new technologies in which interactivity, real-time data, participation (anytime, and from anywhere), and changes in businesses have been rapid and widespread. The decentralisation of communications in modern enterprises has dispensed with the need for hierarchy, so that information is no longer subject to power games, but instead brings huge changes in internal communication. Employees appreciate this paradigm shift (Ruck, et al., 2017), as their voice is being heard, with the result that they have real power to effect change.

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Thus, employee participation and continuous learning (Madsen, 2018; Ilmudeen, et al., 2019) are vital to reduce risks, if business models are to transform and change. This can be achieved by transferring some elements of communication from traditional to digital channels (Ruck & Welch, 2012; Ewing, et al., 2019) such as social media, streaming, and conferencing, etc. These are just a few of many that Industry 4.0 technologies offer, say Ruck et al., 2017. The shift in communication effectively ends the discussion about top-down or down-top communication (Uysal, 2016), since communication is simultaneously flat and omnidirectional. Hence, no longer is communication a linear process, but rather a multi-stakeholder process, with players holding equal power (Crittenden, et al., 2019).

Whilst there has been a significant body of research into corporate communication and Industry 4.0-enabling technologies, rarely can one find an integrated approach, focusing on empirical research of digital internal communication in the context of the business model change. We note, however, that some researchers (Corniani, 2006; Yigitbasioglu, 2015; Caputo, et al., 2017; Madsen, 2018) compare the pros and cons of physical and digital communication.

The main hypothesis of this article is that enterprises face challenges such as increased risk, and resistance from staff and others when Industry 4.0 influences models for business change. Hence, enterprises should use digital internal communications channels to communicate digital transformations. Digital channels for internal communication should be used differently in each of the change phases, i.e. awareness, understanding, acceptance, action and follow up. This leads to the following *research question:*

RQ1 - Industry 4.0 drives significant changes in business models. Which digital internal communication channels are the most efficient in reducing risk during the change process?

This paper comprises seven chapters. Chapter 1 introduces the context and the problem of the research, the research questions, and the structure of the article. Chapter 2 analyses the scientific literature on Industry 4.0 driven business models and change process and internal communication and digital channels. Chapter 2 also presents the model used for empirical research. Chapter 3 presents the research methodology and design. Chapter 4 presents the results of the study. Chapter 5 introduces the conclusions and discussion. Chapter 6 presents limitation and guidelines for further research. Chapter 7 discusses recommendations for use at the industrial and enterprise levels.

2. LITERATURE REVIEW

2.1. Change towards Industry 4.0 driven business models

For the most part, the phenomenon of Industry 4.0 has been explored by German scholars (Henning, Kagermann, 2011; Johannes, 2013; Brettel et al. 2014; Burmeister & Lüttgens, 2016; Schwab, et al., 2018). Their work has been followed by other scientists, who expanded the focus from manufacturing to communication (Jasińska & Jasiński, 2019) and other social applications. According to Schwab et al. (2018), Industry 4.0 now emphasizes the diffusion between physical and virtual lives, which are driven by a wide range of Internet-based (Alcácer & Cruz-Machado, 2019; Stremousova & Buchinskaia, 2019) and other cooperative technologies (Martínez-Olvera & Mora-Vargas, 2019).

In addition, Crittenden et al. (2019) argue that digitalization is changing business models from a linear process to being more collaborative. Business models are being analysed by scholars from different perspectives. Some define a business model as a way to describe business logic. Other analyse business models according to their use of new technologies (e.g. Internet of things, artificial intelligence, virtual reality, etc.). Typically, this includes business models, such as: driven by technology (Fleisch, Weinberger, & Wortmann, 2014) - e.g. data-based business models, cloud-based business models, software-as-a-service; business models as a strategic direction (e.g. matchmaking, assembling, sharing). Turber, et al. (2014) focus on the collaboration, which leads to communication in digital business models.

It is commonly agreed that changes are enormous and have a significant impact, especially when transforming or disrupting business models from the traditional, or those slightly modified by the influence of the Internet. Changes are significant in social life, workplace and communication habits. The speed and spread of changes raise their impact and possible risks, if they are a part of the enterprise processes.

Previous research (Kovaitė & Stankevičienė, 2019) identified six areas of risk, which proposed two particular risk areas, relevant for implementation of Industry 4.0 – *acceptance by staff*, and *competence,* which is closely related to the human factor. The former refers to the habits of organising work during times of uncertainty and relates to organisational culture, social skills and the human factor (Maarit Lipiäinen, et al, 2014; Reim, et al, 2016; Mensah & Gottwald, 2016). The latter refers to organisational structure, responsibilities, structure, procedures and the qualifications of personnel, as well as the knowledge base and know-how (Jacobsson, et al, 2016; Karimi & Walter, 2016). Those factors carry financial risks, related to investment or cash flow, but also risk related to staff habits (Laïfi & Josserand, 2016). Linke & Zerfass (2011) propose a change framework that can be represented by four broad phases: awareness, understanding, acceptance and action. The authors introduce the fifth stage – follow up – and in Table 1 the five-stage process in further research is proposed.

Table 1. The expanded five- stage change process model

Change phase	Description
Awareness	Function: to inform Importance: everybody receives the same information at the same time
Understanding	Function: to increase knowledge about the situation Importance: encourage people to talk and participate
Acceptance	Function: to encourage people to feel that they have been listened to and gain agreement about the future Importance: obtain moral and informal agreement
Action	Function: to organise the process Importance: ensure that everybody knows what, how, and when to take action
Follow up	Function: to maintain the momentum of change Importance: employees feel ownership and involvement

Source: Streich, Linke & Zerfass, 2011; expanded by authors.

Each stage has its place in the efficient process, in which internal communication plays a significant role. These findings show the importance of exploring the ways to prevent and reduce risks during the change processes, faced by enterprises, when transforming their business. Internal communication prevents risks in at least two of the significant risk areas described above. Many of these examples show that both outward and inward communication for the enterprise is interrelated and that employees understand the implications of inefficient change (Tiago, et al, 2016; Jiang, et al, 2016).

2.2. Internal communication

Internal communication is a part of management process, through which information is shared, collected and distributed, as to ensure employee understanding of the organization's goals and objectives (Verčič, et al, 2012; Uysal, 2016; Smaliukienė & Survilas, 2018; Lemon (2020). Internal communication plays a key role in keeping the employees informed about the organization's plans, vision and ideas, but also encourages them to participate in the decision-making processes, as well as promotes employee feedback and peer learning. Traditionally, management transmits information to employees in the top-down fashion (Uysal, 2016; Lemon, 2020). In recent decades, the role of internal communication has expanded, so that it now tends to be bottom-ip, i.e. feedback and inputs are collected from employees. It has been noted that internal communication has progressively become more horizontal, i.e. employees tend to communicate and share messages between themselves without any hierarchical consideration (Korzynski, 2015).

Other researchers (Verčič & Vokić, 2017; Lemon, 2020) note the positive consequences of internal communication, such as more effective changes and decision-making, and higher engagement of employees, all of which leads to more productive work and less risk of failure and losses during the change processes. Some scholars (Madsen and Verhoeven, 2016; Madsen, 2018) also note the possible negative consequences of internal communication, which leave people feeling insecure about hierarchical structures, poor control of information flow, or insufficient time, devoted to explaining information to participants. All of this makes internal communication an important, yet challenging area to achieve effective change in an enterprise.

2.3. Digital channels for internal communication

Over the last decade, the Internet and digitalisation have changed all areas of communication, with employees using digital channels to communicate in the workplace and their personal lives. Deloitte (2012) asserts that digitalisation brings collaboration, crowdsourcing, connectivity, mobility and ongoing communication to the workplace. Consistent with later research on digitalisation and internal communication (Cho, Furey, & Mohr, 2017; Madsen, 2018), Verčič & Vokić (2017) suggest that communication is becoming more decentralised, due to the introduction of digital communication channels. People change their communication habits and obtain information at any time, from anywhere, as a part of two-way communication, providing feedback, insights, sharing of emotions and participation in debates (Table 2.). Bringing the communication, characteristic for personal life, to internal workplace conversations was seen as a cost-effective and targeted method for reaching employees.

Table 2. Benefits and risks of the digital communication channels

Benefits/ risks	Description
Benefits/ advantages	Overall issues: almost zero-cost to maintain and use a channel; time-efficient circulation of information; create a sense of commitment towards the organization, or establish trust in management.
	The manager's role: supportive behaviour towards goal achievement among co-workers.
	Organisational culture and employees: co-workers share knowledge, experiences and learnings to improve internal processes, development of products and services; open discussions about possible improvements and influence.
Risks	Overall issues: higher investment to protect data and the flows; security and privacy risks for organizations and their employees and customers are identified as critical concerns.
	The manager's role: managers should be equal participants in a discussion to ensure openness and honest feedback from employees; empower co-workers and give them license to critique their strategies, mission statements and values; fear of losing control over information; reluctance to give co-workers real influence.
	Organisational culture and employees: competitive organisational culture lowers the efficiency of internal social media in internal communication; pretending to empower employees, yet giving them no real influence demotivates them; employees should feel safe before sharing and talking in the internal social media, or will take their concerns outside the organisation; achieving mutual trust is essential for digital internal communication; employees must learn to navigate and use large amounts of information.

Source: Modified from: Madsen, 2018, Corniani, 2006, Ewing et al., 2019.

A survey, conducted among German companies (Sievert & Scholz, 2017) found that social media drives engagement by improving the flow of communication, accelerating internal processes, and facilitating collaboration. Numerous scholars (see Table 3) group digital channels into six areas: instant messaging, enterprise social media, electronic media, intranet-based knowledge and performance management, streaming, and online profiles, etc. Examples of instant messaging include all chat possibilities, such as Messenger, Gmail chat, Skype, etc. Social media can be public and internal, such as: Facebook, LinkedIn, Twitter vs. Salesforce.com's Chatter, Slack, etc. An enterprise collaboration network, such as Microsoft Yammer, is also emerging. Examples of electronic media can include emails, websites, listservs, while streaming includes video and audio, which can be delivered by different platforms, such as: Skype, Acrobat Connect, etc.

Internal communication offers significant opportunities to integrate digital tools for communication of employees and managers. Both theory and empirical studies (Ruck & Welch, 2012, Verčič & Vokić, 2017; Verheyden & Cardon, 2018) have suggested that employee-centric communication and digital communication channels (such as: internal or external social media, intranets, etc.) are able to meet this need.

Table 3. Comparison of digital internal communication channels

	Instant messaging	**Streaming audio or video**	**Intranet blogs**	**Online employee profiles**	**Social network**	**Electronic media**
Timing: Immediate vs. long after	Immediate	Immediate	Long after	Long after	Immediate and long after	Long after
Real-time vs. recorded	Real-time	Real-time	Recorded	Recorded	Real-time	Recorded
Private vs. public	Private	Public	Public	Public	Public	Private
Learning vs. information	Information	Information	Learning vs. information	Information	Learning vs. information	Information
One-way vs. two-way communication (level of interaction)	Two-way	One-way	Two-way	One-way	Two-way	One-way
Record vs. one time	One time	One time	Record	Record	One time	Record
Tracked vs. one time	One time	One time	Tracked	Tracked	Tracked	Tracked
Stored vs. one time	One time	One time	Stored	Stored	Stored	Stored
Between individuals vs. between individuals and organisation	Between individuals	Between individuals	Between individuals and organisation	Between individuals and organisation	Between individuals	Between individuals and organisation

Source: Modified from: Leonardi, et al, 2013; Korzynski, 2015; Weber & Shi, 2016; Uysal, 2016; Madsen, 2018; Madsen & Johansen, 2019; Ewing et al., 2019; Kramer, Lee, & Guo, 2019.

3. RESEARCH METHODOLOGY

This research examined the efficiency of digital communication channels in the business model change process, which aims to reduce risk. It was conducted in the context of Industry 4.0. The research was organised in three stages: a review of the scientific literature, validation of the model and expert judgment. It was divided into 8 steps, which are further explained in Figure 1.

3.1. Ethics

Ethical protocols and procedures were strictly observed. Face-to-face meetings were conducted with experts, who were informed of the objective and context of the

research, and issues of confidentiality. For a more complete understanding of the task, they were also informed of the main findings of the scientific literature relating to Industry 4.0, as well as the research topic. The aim was to ensure that experts started on an equal footing, before completing the evaluation forms individually. This ensured the highest degree of independence, the absence of external influence, and that results were not skewed by the undue influence of the views of the most prominent, authoritative experts. The data collected were processed anonymously to achieve reliable estimates and ensure complete confidentiality for both the enterprise and the industry. In this study, an expert was defined as a person to whom society and/or his peers attribute special knowledge and can use this knowledge, about the matters being elicited (Wilson, 2017; Garthwaite, Kadane, & O'Hagan, 2005). Expert judgment implies obtaining information, using a structured and methodologically robust approach, which is used to contribute to defining key points of the estimates and eliminate uncertainty (Werner, Bedford, Cooke, Hanea, & Morales-Nápoles, 2017; Iglesias, Thompson, Rogowski, & Payne, 2016). For studies, involving the judgements of multiple experts, it is necessary, or at least preferable, to combine results into a single coherent judgement (Wilson, 2017), and for this reason, we used mathematical aggregation, which is described in detail in the 6th and 7th stages of the research process.

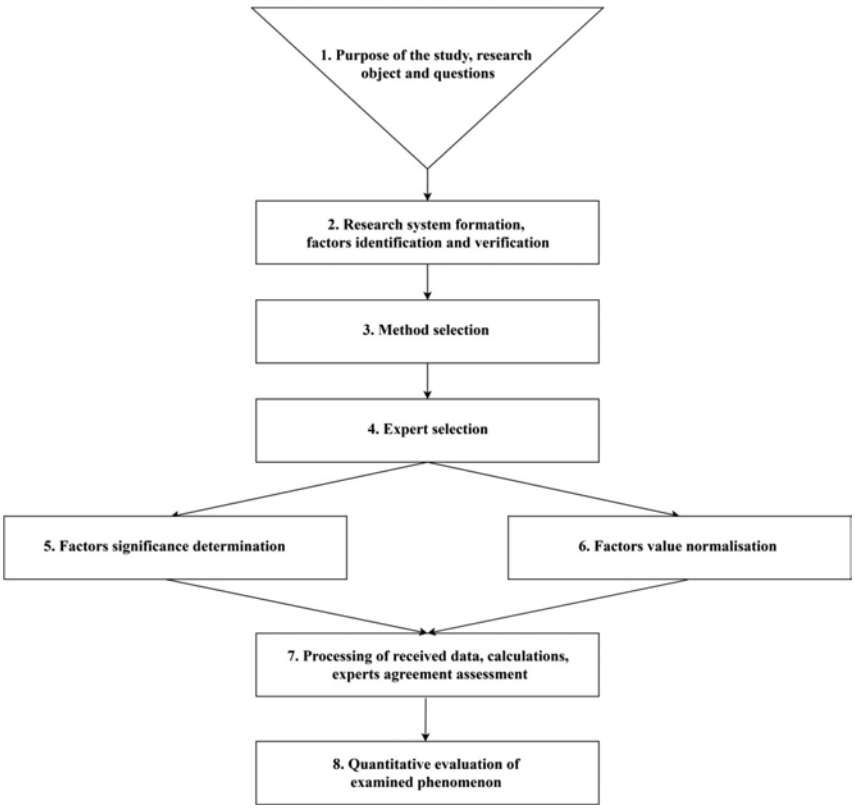

Figure 1. Research design
Source: Authors

3.2. Purpose of the study, research topic and questions

Our purpose is to identify which digital communication channels are the most efficient during each stage of the change process Industry 4.0 is driving significant changes in business models, which leads to the following research question: *Which digital internal communication channels are the most efficient in reducing risk during the change process?*

3.3. Research system formation, factors identification and verification

During the second stage, we performed research system formation, followed by factors system identification and verification. First, we analysed the scientific literature by selecting articles from Clarivate Analytics and Scopus databases from the 2014-2020 period. Next, we analysed digital communication channels for internal communication and identified stages in the change process. The following six digital communication channels for internal communication were identified:

- instant messaging;
- streaming audio/video teleconferences;
- human resources, internal blogs, intranet;
- online employee profiles;
- social networks;
- electronic media.

Five states of the change process were identified as follows:

- awareness;
- understanding;
- acceptance;
- actions;
- follow up.

This second step (factor verification) was performed, by selecting an expert group of seven people, based on their experience in the fields of change management and internal communication. This included at least five years in decision-making in manufacturing companies and at least one Industry 4.0-related project. Results proposed by the scientific literature and expert views correspond with each other.

3.4. Method selection

Based on the research and factors systems, we applied the expert judgment method (Kendall, 1970; Vainiunas, Zavadskas, Turskis, & Tamošaitiene, 2010; Dadelo, Turskis, Zavadskas, & Dadeliene, 2014) to determine criteria weights, whereby experts were asked to allocate weights across criteria of interest. The generalized opinion of the expert group and the application of knowledge, experience and intuition to the specific field of study is presented. Indeed, most of the currently known and used weights for multi-criteria evaluation criteria are based on expert judgment and allow the views of individual experts to be reconciled and the consensus reached.

3.5. Expert selection and sampling

3.5.1. Sampling procedure and expert competence

The non-probability sampling strategy was chosen for the study and experts were eligible if they: (1) have at least 5 years' experience in a management position; (2) have competencies related to internal communication in a manufacturing enterprise(s); (3) have competencies related to digital change process in

the enterprise(s); and (4) have competencies related to risk management in the enterprise(s). Expert recruitment was conducted in January 2020, through business associations and professional networks.

3.5.2. Determination of the number of experts

The number of experts was determined by reference to Libby & Blashfield, 1978, who argue that a group of at least five experts is sufficient to generate a reliability threshold of 75%. For this study, 12 experts were selected through purposive sampling, who met the stated eligibility requirements.

3.6. Determination of factor significance

Expert assessment defined the significance of each digital communication channel during each stage of the change process. They were asked to allocate weights across criteria of interest. For this study, we chose a weighting interval from 0.00 to 1.00 (where 1.00 represents the most efficient factor and 0.00 indicates the least efficient factor). The higher the weighting factor, the greater is its importance, compared to alternatives. The experts were briefed on the study methodology and asked to allocate weights, according to the research question, i.e. which digital communication channels are efficient to reduce risk in the business model change process in the context of Industry 4.0? They were also asked to complete the template and comment on it.

3.7. Normalisation of factor values

For digital communication channels, during each stage of the change process, experts allocated a weighting value, after which weights were normalised, as to enable data calculation. The rank-sum method (Ginevičius & Podvezko, 2008, Kraujalienė, 2019; Stankevičienė, Žinytė, 2011) was used for this purpose, where factors were ranked from best to worst, so that the best factor was awarded the first place (the one with the highest weight) and the worst factor was placed last (the one with the lowest weight). The next step summed the locations of the options. The one with the lowest sum received the highest value by weighing and was considered the best for this purpose. The following formula was used:

$$V_j = \sum_{i=1}^{m} m_{ij} \quad (1)$$

where: m_{ij} *– is the location of the i indicator for the j – m object (*$1 \leq m_{ij} \leq$ m).

The rank-sum method was used to normalise the values of weights, allocated by experts, as to proceed with data calculations and experts' agreement assessment.

3.8. Data analysis and experts' agreement assessment

Kendall's coefficient of concordance (*W*) (Kendall & Smith, 1939) was used to assess agreement among experts, with possible responses ranging from 0.00 (no agreement) to 1.00 (complete agreement). We used intervals to interpret the (*W*) results in the following way: W=0.000-0.500 – there is no agreement among experts; W=0.501-0.700 agreement among experts is moderate; W=0.701-0.800 agreement among experts is good; W=0.801-0.900 agreement among experts is very good; W=0.901-1.000 agreement among experts is perfect. To calculate the concordance coefficient, expert assessments were ranked, based on the above explanation, and the following formula was used:

$$W = \frac{12S}{m^2(n^3-n)}; \quad (2)$$

where:
S – the sum of squared deviations;
m – the number of experts;
n – the total number of objects being ranked.

The concordance coefficient (W) was used to determine the compatibility of the assessment. Data were processed and analysed using Microsoft Excel. Only final results after numerous steps of data processing are presented in this article.

3.9. Quantitative evaluation of the examined phenomenon

After data processing and calculations, only the final results and quantitative evaluation of the examined phenomenon are presented in the following section. Firstly, each stage of the change process and each digital communication channel are evaluated separately according to the data. Secondly, their dynamic over time and efficiency are evaluated in the whole change process.

4. RESULTS

This section presents only final results. Our research method allowed observation of each change process stage separately, as to identify which digital communication channel, according to expert assessment, is the most efficient, compared to others. Each change process stage is presented by a separate table, with expert assessment results - average weight and rating. Average weight represents the mean of weights, allocated by the experts. Digital communication channels, according to expert assessment are ranked from best to worst. The best channel is ranked first (the one with the highest weight), and other channels with lower weights, based on the formula described above, are respectively presented. The shading visualises average weight (efficiency), compared to other digital communication channels during the specific stage of the change process. Table 4 identifies internal digital communication channels during the change process in the "Awareness" stage.

Table 4 shows that the most efficient digital communication channel during the "Awareness" stage in the change process are "Electronic media" (with 0.312 avg. weight); second is "Streaming audio or video" (with 0.276 avg. weight). The least efficient digital communication channel, i.e. the one with the lowest rating are "Online employee profiles" (with 0.033 avg. weight). Kendall's coefficient of concordance (W) – 0.839 means that agreement among experts is high.

Table 4. Internal digital communication channels during the change process in the "Awareness" stage

Awareness stage		
Digital communication channels	**Avg. weight**	**Rating**
Instant messaging	0.072	5
Streaming audio or video	0.276	2
Human resources (internal) blogs	0.167	3
Online employee profiles	0.033	6
Social networks	0.141	4
Electronic media	0.312	1

W - 0.839; p<0.01*

Source: Authors

Table 5 identifies internal digital communication channels during the change process in the "Understanding" stage. Here, we can observe that the most efficient digital communication channel in the stage is "Streaming audio or video" (with 0.249

avg. weight); second is "Social networks" (with 0.228 avg. weight); third-most efficient channel is "Electronic media" (with 0.194 avg. weight). The least efficient digital communication channel and with the lowest rating is "Online employee profiles" (with 0.063 avg. weight). The Kendall's coefficient of concordance (*W*) value of 0.716 means that agreement among experts is good.

Table 5. Internal digital communication channels during the change process in the "Understanding" stage

Understanding stage		
Digital communication channels	**Avg. weight**	**Rating**
Instant messaging	0.122	5
Streaming audio or video	0.249	1
Human resources (internal) blogs	0.143	4
Online employee profiles	0.063	6
Social networks	0.228	2
Electronic media	0.194	3

W - 0716; p<0.01*

Source: Authors

Table 6 shows internal digital communication channels during the change process in the "Acceptance" stage. One can observe that the most efficient digital communication channel in this stage are "Social networks" (with 0.258 avg. weight); second are "Human resources (internal) blogs" (with 0.209 avg. weight); the third most efficient channel is "Streaming audio or video" (with 0.189 avg. weight). The least efficient digital communication channel, with the lowest rating are "Online employee profiles" (with 0.083 avg. weight). The Kendall's coefficient of concordance (*W*) value of 0.765 means that agreement among experts is good.

Table 6. Internal digital communication channels during the change process in the "Acceptance" stage

Acceptance stage		
Digital communication channels	**Avg. weight**	**Rating**
Instant messaging	0.103	5
Streaming audio or video	0.189	3
Human resources (internal) blogs	0.209	2
Online employee profiles	0.083	6
Social networks	0.258	1
Electronic media	0.158	4

W - 0.765; p<0.01*

Source: Authors

Table 7 shows internal digital communication channels during the change process in the "Actions" stage. The most efficient digital communication channel in this stage are "Social networks" (with 0.233 avg. weight); second are "Human resources (internal) blogs" (with 0.210 avg. weight); the third most efficient channel is "Streaming audio or video" (with 0.194 avg. weight) and the fourth channel are "Electronic media" (with 0.167 avg. weight). The least efficient digital communication channel, with the lowest rating are "Online employee profiles" (with 0.085 avg. weight). One

can observe almost homogenous distribution among the first four digital channels in the "Action" stage. Kendall's coefficient of concordance (*W*) value of 0.823 means that agreement among experts is very good.

Table 7. Internal digital communication channels during the change process in the "Actions" stage

Actions stage		
Digital communication channels	**Avg. weight**	**Rating**
Instant messaging	0.194	3
Streaming audio or video	0.110	5
Human resources (internal) blogs	0.210	2
Online employee profiles	0.085	6
Social networks	0.233	1
Electronic media	0.167	4
	W - 0.823; p<0.01*	

Source: Authors

Table 8 shows internal digital communication channels during the change process in the "Follow Up" stage. It can be observed that the most efficient digital communication channel in the stage are "Social networks" (with 0.260 avg. weight); second are "Electronic media" (with 0.233 avg. weight); the third most efficient channel are "Human resources (internal) blogs" (with 0.203 avg. weight). The least efficient digital communication channel, with the lowest rating are "Online employee profiles" (with 0.088 avg. weight). Kendall's coefficient of concordance (*W*) value of 0.817 means that agreement among experts is very good.

Table 8. Internal digital communication channels during the change process in the "Follow Up" stage

Follow Up stage		
Digital communication channels	**Avg. weight**	**Rating**
Instant messaging	0.113	4
Streaming audio or video	0.103	5
Human resources (internal) blogs	0.203	3
Online employee profiles	0.088	6
Social networks	0.260	1
Electronic media	0.233	2
	W - 0.817; p<0.01*	

Source: Authors

The research method allowed us to observe each specific digital communication channel separately, in all stages of the change process, and evaluate, according to expert assessment, the dynamics of each digital channel and its comparison to other channels. Only digital channels, which were awarded the first position in one, or multiple stages of the change process, will be shown in the following tables with expert assessment results (average weight and rating, compared to other channels). Table 9 evaluates the internal digital communication channel "Streaming audio or video" during all stages of the change process.

Table 9. Internal digital communication channel "Streaming audio or video" during the change process

Digital communication channel	Change process stages				
	Awareness	Understanding	Acceptance	Action	Follow up
Streaming audio or video	0.276	0.249	0.189	0.110	0.103
Rating compared to alternatives	2 out of 6	1 out of 6	3 out of 6	5 out of 6	5 out of 6

Source: Authors

This table shows that the importance of this specific channel is diminished during the process. In the first two stages "Streaming audio or video" channel occupies one of the top two positions (with avg. weight of 0.279 and 0.249), compared to other channels. In the last two stages, it falls the to second and even the last place (with avg. weights of 0.110 and 0.103).

Table 10 evaluates the digital communication channel "Social networks" during the whole change process. It can be observed that the channel importance increases during the process. In the first stage ("Awareness"), it occupies the fourth, out of six positions (with avg. weight of 0.141); in the second stage ("Understanding"), it occupies the second place, out of six (with avg. weight of 0.228). From the third stage, until the last one, the "Social networks" channel is the most efficient during the change process and is rated first among all alternatives (with avg. weights of 0.258, 0.233 and 0.260).

Table 10. Internal digital communication channel "Social networks" during the change process

Digital communication channel	Change process stages				
	Awareness	Understanding	Acceptance	Action	Follow up
Social networks	0.141	0.228	0.258	0.233	0.260
Rating compared to alternatives	4 out of 6	2 out of 6	1 out of 6	1 out of 6	1 out of 6

Source: Authors

Table 11 evaluates the digital communication channel "Electronic media" during the whole change process. It can be observed that this specific channel is the most efficient in the "Awareness" stage (with 0.312 avg. weight) and later, during the change process stages, its importance decreases, with the lowest rating being on the fourth, out of six positions (in "Acceptance" and "Action" stages).

Table 11. Internal digital communication channel "Electronic media" during the change process

Digital communication channel	Change process stages				
	Awareness	Understanding	Acceptance	Action	Follow up
Electronic media	0.312	0.194	0.158	0.167	0.233
Rating compared to alternatives	1 out of 6	3 out of 6	4 out of 6	4 out of 6	2 out of 6

Source: Authors

Table 12 summarises all examined internal digital communication channels and their efficiency during each stage of the change process.

Table 12. Comparison of all internal digital communication channels during the change process

Digital communication channels		Change process stages				
		Awareness	Understanding	Acceptance	Action	Follow up
Instant messaging	Avg. weight	0.072	0.122	0.103	0.194	0.113
	Rating	5 out of 6	5 out of 6	5 out of 6	3 out of 6	4 out of 6
Streaming audio or video	Avg. weight	0.276	0.249	0.189	0.110	0.103
	Rating	2 out of 6	1 out of 6	3 out of 6	5 out of 6	5 out of 6
Human resources (internal) blogs	Avg. weight	0.167	0.143	0.209	0.210	0.203
	Rating	3 out of 6	4 out of 6	2 out of 6	2 out of 6	3 out of 6
Online employee profiles	Avg. weight	0.033	0.063	0.083	0.085	0.088
	Rating	6 out of 6	6 out of 6	6 out of 6	6 out of 6	6 out of 6
Social networks	Avg. weight	0.141	0.228	0.258	0.233	0.260
	Rating	4 out of 6	2 out of 6	1 out of 6	1 out of 6	1 out of 6
Electronic media	Avg. weight	0.312	0.194	0.158	0.167	0.233
	Rating	1 out of 6	3 out of 6	4 out of 6	4 out of 6	2 out of 6
Kendall's coefficient of concordance of each stage		*W - 0.839; p<0.01**	*W - 0716; p<0.01**	*W - 0.765; p<0.01**	*W - 0.823; p<0.01**	*W - 0.817; p<0.01**

Source: Authors

Based on the obtained results, one can observe the dynamics of digital communication channel individually (see Figure 2).

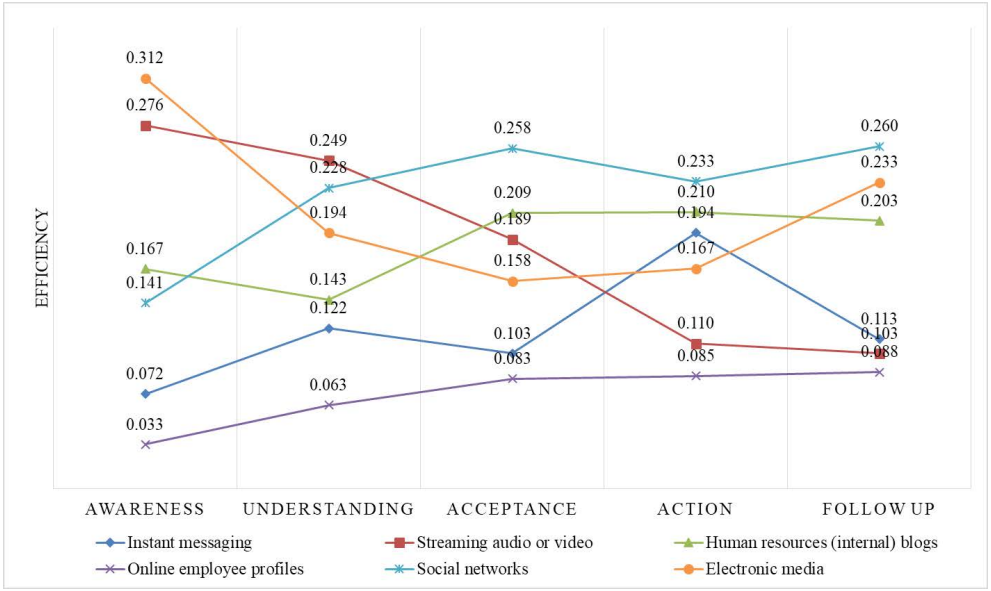

Figure 2. Dynamics of the digital internal communication channels
Source: Authors

From Figure 2, one can observe the dynamics and efficiency of each channel separately, for all stages of the change process. Each data point in the figure represents the average weight, allocated by the xperts. The "Electronic media" digital channel was ranked first in the "Awareness" stage and its efficiency decreases rapidly during the process, and rises in the last ("Follow up") stage, where it was placed at the second position. The "Streaming audio or video" digital channel is ranked as second in the "Awareness" stage. However, in the second stage ("Understanding") it is ranked as the first by experts, but, later in the process it falls dramatically to the second and, ultimately, to the last place in the final stage. The "Human resource (internal) blogs"

channel is ranked as the third in the first stage and its efficiency is maintained in the middle, or slightly above the middle, during the whole change process. The "Social networks" digital channel ranked only as the fourth in the first stage and second in the second ("Understanding") stage, but later in the process, the channel maintained the first ranking during all stages. The "Instant messaging" digital channel is ranked as the fifth in the "Awareness" stage and kept that rank, until the fourth ("Action") stage, when it is ranked as the third, out of six positions. In the last stage of change process, it is ranked as the fourth, out of six positions. The "Online employee profiles" digital channel maintained the last position, compared to other digital channels during all stages of the change process.

5. CONCLUSIONS AND DISCUSSION

Our research explores digital channels used for internal communication during all stages of change, as to reduce risks, when Industry 4.0 solutions are implemented. The authors used the four-stage model, proposed by Linke & Zerfass (2011), which was expanded and tested, with a follow-up, fifth stage.

The findings show that different digital communication channels are efficient at different stages of the change process, as the enterprise seeks to reduce risk in the business model change process. Each channel has its rationale and achieves different results in reducing risk. Results show that one-way channels, such as emails, are efficient when employees need to be informed about final decisions, e.g. in the awareness stage. Two-way channels are especially powerful, when the change situation requires input from different stakeholders, collective knowledge and participation of employees, e.g. in acceptance, understanding, and follow-up stages.

The efficiency of digital communication channels is changing during the entire change process, with no channel being more important than the others. A combination of digital communication channels should be, therefore, used.

We suggest that the use of digital communication channels can differ in different enterprises, according to their organisational culture and digital maturity. In any case, the context of the article – reducing risk as an enterprise changes their business model toward more digital ones – presumes that there is a basic level of digital competences internally and that different digital channels can be used, without professional IT competence required. Whilst we believe that the obtained research findings are widely applicable, further research is needed to identify additional opportunities for usage of digital communication channels in internal communication.

Authors believe that physical communication channels, such as face-to-face conversations and meetings, should be maintained, although there needs to be a greater focus on digital communication channels. Some researchers (Cho et al., 2017), investigating the differences between physical and digital communication, analyse employee engagement, i.e. the emotional side, associated with usage of different communication methods. Other scholars (Walden, et al, 2017), raise questions about the employee age, arguing that digital communicative is native to a younger generation.

We also note that digital channels play a significant part in our daily lives. Technologies introduced by Industry 4.0 allow people to connect; they also change the

way we communicate, including giving and receiving feedback, increasing participation in decision-making, and being willing to participate in a working community, anytime and from anywhere. Changes merge our physical lives with digital channels, and employees appear not to discriminate among them, as long as they remain part of the information flow.

6. LIMITATIONS AND FURTHER RESEARCH

Our analysis of the existing literature and research findings reveals several gaps. We performed research of internal communication channels, as to explore how those can help reduce risk, when the enterprise changes its business model toward a more digital one, in response to Industry 4.0 technologies. The changes are significant and require that employee engagement. Yet, this assumes basic digital competence of enterprise employees and management, which may not exist. The second limitation are related to organisations, included into research, as the digital communication channels in manufacturing sector can differ from service, financial and other sectors.

Further research directions are noted, as a comparison of different sectors would be useful. Another avenue for research could include digital communication channels and tools, such as storytelling, photos, and stories about the enterprise or its action plans. Future research might, also, explore different perspectives, such as how to use digital internal communication channels to recruit new employees (inside or outside the organisation), with specific competencies or to identify potential crises in the enterprise. In addition, Industry 4.0 brings about the Internet of things, big data and artificial intelligence into business processes. Hence, exploring their technological application approach would help integrate various disciplines. The enterprise collaboration network, as an independent digital internal communication channel, emerges as worthy of further enquiry. Finally, mobile technologies are rapidly emerging in internal communication and offer greater efficiency, flexibility and real-time communication.

7. RECOMMENDATIONS

This study contributes to communication and management science by analysing digital communication channels, through the change management process, consisting of five stages. It also contributes to a better understanding of communication in risk management. At the practical level, this paper presents a model of using the digital communication channels in the change process. Research results guide internal communication plans, which can be used to plan and implement internal communication, as the enterprise seeks to manage digitalisation of their business model, influenced by Industry 4.0.

Finally, this study could contribute to national objectives, especially as an aid to policy decision-making methodologies, e.g. in business support programmes. Policy-makers can use the proposed model to assess the potential of the successful implementation of digitisation in enterprises, especially if it receives support through targeted public programmes.

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DIGITALNI KOMUNIKACIJSKI KANALI U IMPLEMENTACIJI INDUSTRIJE 4.0: ULOGA INTERNE KOMUNIKACIJE

Sažetak. *Industrija 4.0 opisuje fenomen, koji proširuje poslovne modele, ali i komunikacijske kanale u poduzećima. U ovom se radu analiziraju znanstvena saznanja, koja se odnose na promjene poslovnih modela, uslijed uvođenja Industrije 4.0, kao i uporabe digitalnih komunikacijskih kanala, s ciljem smanjivanja rizika ovog procesa. Rad se zasniva na sistematskom pregledu znanstvenih publikacija i ekspertnoj evaluaciji. Istraživanje je otkrilo jaz između interne komunikacije u digitalnim kanalima i procesa promjena poslovnih modela, vođenih načelima Industrije 4.0. Svaki kanal ima svoje usmjerenje i doprinosi smanjenju rizika tijekom procesa promjena. S obzirom da nema univerzalnog digitalnog kanala za internu komunikaciju, različiti su komunikacijski kanali učinkoviti tijekom procesa provedbe promjena. U ovom se radu iskazuju preporuke poduzećima, vezane uz efikasnost digitalnih komunikacijskih kanala tijekom procesa promjene poslovnog modela. Rad, nadalje, doprinosi povećanju postojećeg znanja proširenjem modela promjena te usklađivanjem modela promjena s karakteristikama digitalnih komunikacijskih kanala. Istraživanje se fokusiralo na proizvodni sektor, analizirajući digitalne komunikacijske kanale, korištene za smanjivanje rizika tijekom procesa promjena, a što predstavlja ograničenje istraživanja, uz pretpostavku o postojanju temeljne razine digitalnih kompetencija u poduzeću.*

Ključne riječi: *Industrija 4.0, interna komunikacija, digitalni komunikacijski kanali, digitalni poslovni modeli, upravljanje promjenama*