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AN ANALYSIS OF THE CAUSES AND CONSEQUENCES OF THE INFORMATION GAP IN IT PROJECTS. THE CLIENT'S AND THE SUPPLIER'S PERSPECTIVE IN POLAND

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***Abstract**:*

The high IT project failure rate means that the stakeholders start recognizing the need to analyze the factors influencing project success, previously deemed irrelevant in the face of technology, including the agile approach, eliminating project documentation, effective prototyping, information asymmetry between project parties, while also perfecting communication and the methods of knowledge transfer between team members. Currently, IT projects are researched using a holistic approach, seeing an implementation project as a whole, subject to specific regularities, which may not be deduced based on the knowledge of their individual components. We would like to enrich the research perspective with the notion of the information gap. The article aims to evaluate and analyze the information gap in ERP and CRM project implementations. We have researched the information gap from the perspective of project managers on the supplier's and the client's sides. The study was conducted in Poland between 2014 and 2021 in a group of medium companies, using qualitative research methods: unstructured interview and direct observation. The study led to a qualitative characterization of the information gap and the identification of its causes and consequences. The presented research result can help achieve three goals, i.e. studying the information gap in the selected group of IT projects, indicating the nature of imperfection in information access by the project participants, and raising awareness amongst project managers regarding risk management issues, especially uncertainty. Reducing the information gap can be used by the transaction parties to implement a strategy of building the object's resilience to uncertainty and its consequences. These results can help develop methodologies of IT project implementation, limiting the level of risk and uncertainty.

Keywords: *information gap, IT project, ERP, CRM*

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1. Introduction

MIS projects are most frequently completed in a dynamic, changeable environment, characterized by a considerable level of risk, uncertain conditions and a high intensity of cooperation between the key parties (Bannister et al., 2000; Bannister et al., 2004). Thus characterized IT projects can be described through uncertainty models designed by (Kuhlthau, 1991; Kuhlthau 2005), where uncertainty is treated as a lack of possibility to predict and understand the issues by the stakeholders, while the information gap initiates a search for information, in order to reduce the uncertainty. Research shows that over the last twenty years, success rates in IT projects have fluctuated between 16 and 37%, hence from the qualitative point of view, the situation has not improved significantly (Johnson, 2018). This is accompanied by the increasing importance and number of ICT projects, as the use of information technologies is a key challenge for companies operating in the turbulent environment orientated towards global competition (Joshi et al., 2008). A good example of such a problematic, intensely competitive market is logistics and distribution of goods by different modes of transport, where management of processes requires using advanced ICT technologies. They are necessary to gather and analyze huge data streams related to logistics processes and planning to take appropriate decisions based on gathering data (Ambroziak et al., 2015; Jacyna-Gołda et al., 2015; Jachimowski et al., 2018).

For this reason, both practitioners and theorists conduct far-reaching research, resulting in a proliferation of studies on critical success factors and determinants influencing the effectiveness of IT projects. One of the significant reasons behind the low effectiveness of IT project completion in high-risk conditions and uncertainty is communication (Müller, 2003; Carvalho, 2008) between the members of the client's and supplier's project groups (Amoako-Gyampah et al., 2004). Experts currently believe the network communication system is the most effective method of information and knowledge transfer (Kisielnicki, 2016), where all the individual members of the client and supplier project group and the supplier's representatives are treated as nodes and their relations and information channels as graphs.

Figure 1 presents a network communication system of the client and supplier project group in the studied IT implementation projects, with nodes and graphs marked.

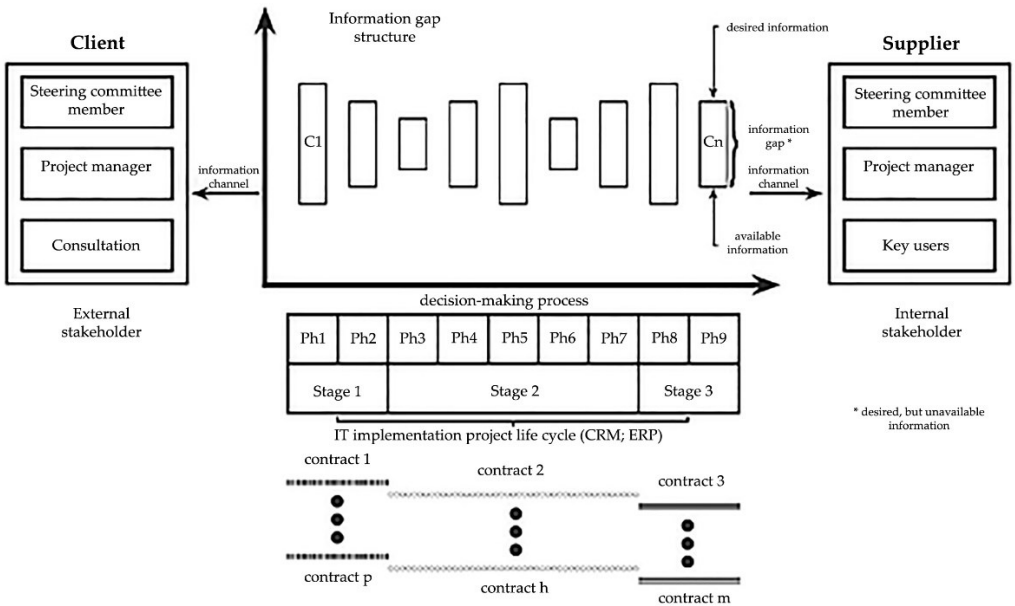

Fig. 1. The network communication system of the supplier and client project group in an IT implementation project

Network nodes represent the client and supplier project group members, with their communication channels described. Figure 1 presents the PM information channel between the CPM node – the client's project manager, and the SPM node – the supplier's project manager. In the communication process in the PM information channel, an information gap occurs during the entire IT project life cycle, which may influence the effectiveness of communication between the parties and, consequently, project success. Considering the partial conflict of the client's and supplier's goals and interests during the entire IT project life cycle, we can say that the scale and the causes of the information gap are dynamic and may result either from an information redundancy or an information deficit. The occurrence of information gaps in the individual nodes of the network, representing the members of the client's and supplier's project group in the group's network communication system, may result in risk and uncertainty and impact the effectiveness of an IT project. The main goal of this article is to identify and describe the causes and consequences of the information gap from the perspective of the client's and the supplier's group managers.

Figure 2 presents a diagram outlining the structure of information gaps in the information channel between the client's and the supplier's project managers.

The information gap is studied for individual information components belonging to the (C1 & Cn) set in IT projects implemented based on clusters of contracts in each of the three stages. In IT projects, the range, character, and dynamic of information gap occurrence amongst the decision-makers on the client's and the supplier's side strongly determine the degree of uncertainty in decision-making in each stage of the project life cycle. The information gap in an IT implementation project should be analyzed through the prism of network learning, i.e., as a multi-dimensional exchange and diffusion of knowledge, information, and any attempt to achieve equilibrium in the levels of knowledge and information in individual knowledge nodes – project group members. Comparing the potential of IT implementation project managers on the client's and the supplier's side, an evaluation of knowledge and indicating a method of accessing the missing knowledge amongst the identified components start the information search process. The transfer of knowledge as part of an information gap reduction may encourage verification of the efficiency of the existing relations and procedures within the network, as well as help discover new methods of information flow, enhancing the network with new

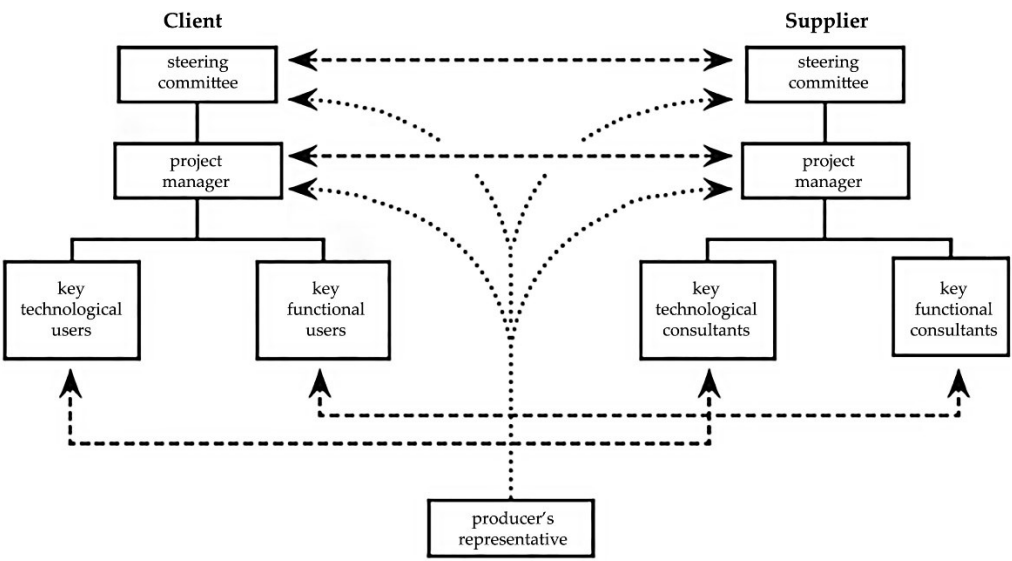

Fig. 2. The structure of the studied gap within the identified information components

structural and relational elements. A reduction of the information gap in IT projects will enrich the holistic view of their implementation effectiveness, which will help the stakeholders make more rational decisions as part of risk and uncertainty management and consequently help complete IT projects more effectively.

2. Materials and Methods

2.1. Literature review and background

2.1.1. The essence and character of an MIS project implementation

The subject of the study was the information gap between the supplier's and the client's managers in an IT project consisting in the implementation of ERP and CRM-class Management Information Systems. The aim of the MIS implementations was appropriate customization reflecting the client's business and technological requirements. The conducted analysis of the life cycle of IT implementation projects, used by the producers of Microsoft and SAP software, as well as that included in the literature (Bradley, 2004; Chang, 2004; Esteves et al., 2006; Esteves et al., 2007; Nguyen et al., 2007) and other project completion standards, such as PMI (PMI, 2021), PRINCE 2 (PRINCE 2, 2021) and best-practice models in IT service management - ITIL (ITIL, 2021), has allowed for a generalization of various approaches to the main stages, phases, and tasks. Figure 3 presents the research subject, a generalized life cycle of an IT project, consisting of 3 stages. Stage one, the preparation stage, consists of two phases.

1) Pre-implementation analysis – covers the creation of the problem domain model (e.g., organizational business process model, reporting-analytical requirements, and integration with IS), the user needs analysis and definition of the system's functional requirements, analysis of the organization's IT infrastructure, project group definition, identification of significant risk factors, ex-ante economic analysis of the investment and preliminary definition of the implementation project;
2) System and supplier selection phase – covers the preparation of a potential suppliers' list, creation of RFP forms, analysis and evaluation of offers according to established criteria, substantive and trade negotiations, and contract formulation. The end result of the first, preparatory stage is a selection of a system and a supplier. The completion of Phase 2 is a multi-dimensional task, where a number of organizational, legal, social, and technical factors have to be considered. According to (Bannister et al., 2000) the decision to start an IT implementation is dictated by an "act of faith" and intuition towards the software, as well as towards the competencies of the implementation company.

Stage two, the completion of an IT implementation project, consists of five phases.

1) Initiation phase – covers the following project tasks: implementation planning session as an initiation meeting and a technological project consisting in the installation and configuration of components in the hardware layer, system software, and application software layer;

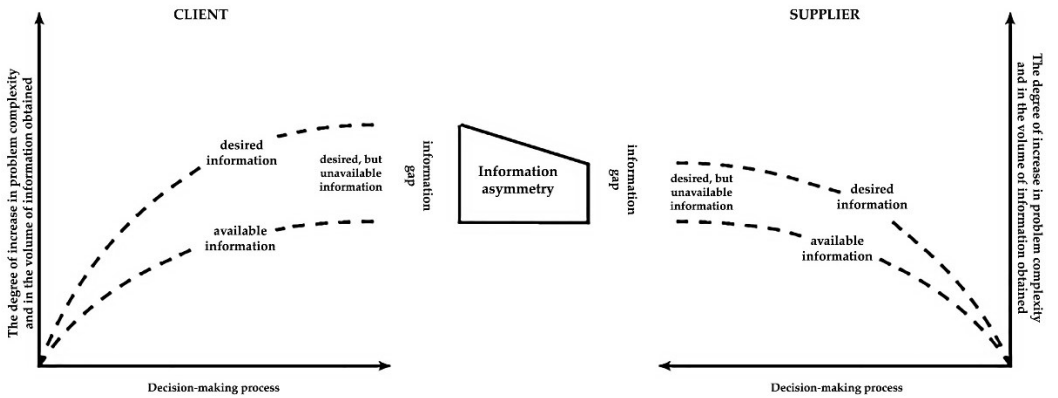

Fig. 3. IT project life cycle

2) Analysis phase – covers the following project tasks: training for key users and functional analysis including analytical workshops and designing a theoretical prototype;
3) Design phase – covers the customization project task;
4) Implementation phase – covers preliminary data migration, acceptance testing for the completed customization along with tuning, developing workplace instructions, and training for key users.
5) Launch phase – covers system launch and post-launch support during the system stabilization phase.

Stage three, IT system operation, consists of two phases.

1) Post-implementation analysis and identification of operational needs – covers tasks linked to an ex-post analysis of the completed IT project and an identification of needs linked to system operation;
2) Selection of an appropriate supplier of post-implementation services linked to system operation – covers preparing a list of potential suppliers, creation of RFP forms, analysis and evaluation of offers according to established criteria, substantive and trade negotiations, and creation of an SLA.

In the case of IT projects consisting of ERP and CRM implementations, the course of the above-mentioned phases in Stage 2 depends on the adopted project life cycle. According to (Selby, 2007), a more beneficial alignment of program products to the users' requirements, and at the same time a decrease in uncertainty in the completion of such projects and costs, are especially encouraged by incremental, iterative, incremental-iterative, and spiral models. These models can be used with an incomplete requirements specification – as opposed to the traditional waterfall model, requiring a complete specification of system requirements already in the first stage, which is impossible to complete. Professional literature (Flasiński, 2006) proposes classifying the agile, adaptive software development model, most commonly used in small or medium-size projects with high-risk levels, where the likelihood of the client's change of requirements is high, as an incremental model as well. Characterizing IT implementation projects, we need to indicate the specific conditions of successful completion. The increasing importance and relevance of issues linked to the effectiveness of IT implementations have resulted in a proliferation of studies containing a variety of approaches – different research perspectives – towards success factors in IT projects. The cognitive map of the taxonomy of critical success factor analysis axes, designed by (Shaul et al., 2013), is a unique approach, specifying the following axes of analysis:

1) Strategic-tactical axis;
2) Organization-end user axis;
3) Public institutions-companies axis;
4) Global-national axis;
5) Endogenic-exogenic axis;
6) Developing countries-developed countries axis;
7) Cultural-technological axis;
8) Project life cycle-one project phase axis;
9) Corporations-MSE axis (Auksztol, 2008).

Our research, presented more broadly by (Wachnik, 2015; Wachnik, 2017) has indicated that, in IT projects, information asymmetry manifests in the relation of two information gaps, on the supplier's and the on the client's side, is a critical success factor. The cognitive map of the taxonomy of critical success factor analysis axes designed by (Shaul et al., 2013) does not include this factor, which broadens the research perspective on IT projects to include the notion of information gap.

2.1.2. Understanding GAP Information in an MIS project

According to (Ben-Haim, 2006), information gap theory can support business decisions in the conditions of deep and dynamically changing uncertainty and indetermination. Studies regarding the information gap theory mainly concern non-probabilistic decision-making models that allow for establishing priorities or alternative choices in the conditions of deep uncertainty (Marchau et al., 2019). Decision-making models providing for an information gap can include evaluations of alternative operational scenarios (i.e. design a system, select a budget, decide to launch or not, etc.), or more abstract scenarios (select a model structure, complete a prognosis, formulate a policy), which are based on a big amount of data (big data), scientific theories, empirical knowledge and contextual understanding (Marchau et al., 2019; Ben-Haim, 2018). The theory of information gap has been used in fields such as engineering ((Marchau et al., 2019), project management (Zhang, 2011), economics (Adams et al., 2011),

security (Davidovitch et al., 2011), and medicine (Sentz et al., 2013). The development of information gap theory influences the development of operational information management in IT projects. Operational information management consists of planning, organization, completion, and control over ongoing work on information support services, including managing information and information access in a way ensuring its quality, coherence, and security. Considering the range (a set of managed resources: resources, streams, processes, and information technologies), timeline (strategic, tactical, and operational management), and information management functions (planning, organizing, and controlling) allows for defining a multi-dimensional information management space.

Skillful information management is the essence of project management. In a market transaction of an IT project completion, we can identify a cluster of contracts for the purchase of licenses and information services aimed at creating a unique configuration of IT systems. An IT project consists of a number of individual information components. Pieces of information constituting an information component are not individual subjects of trade but appear on the market as an integral part of the services that are being delivered (Olesiński, 2003). From the perspective of the client and the supplier, information resources consisting of components, information, and knowledge about each of the components are necessary to achieve their goals, which are partially conflicting. Hence, possessing information about the components helps the client and the supplier better shape their mutual relations. The structure of information components changes from the perspective of the supplier and the client during individual stages and phases of an IT project's life cycle, which results from their learning curve. The scope of this study is to analyze information gaps on the supplier's and the client's side for the identified information components during the entire project life cycle.

The study will use the definition and characteristic of the information gap devised by (Oleński, 2003). In modern society, state, and economy, a human, citizen, or socio-economic entity act in the conditions of information gap between the information resources available to them and the information necessary to make rational, effective action in specific situations. In case of IT projects the range, character, and dynamic of the information gap of the client's and supplier's manager determines the level of uncertainty in decision-making at each stage of the project life cycle. Information gap is an integral part of information asymmetry between the client and the supplier. The relation between the two information gaps for each given information component on the side of the internal and external stakeholders defines information asymmetry.

The size of information gaps, their strength, and the dynamic of changes in their occurrence for each component influence the scale of information asymmetry for all individual information components. Figure 4 presents the information gap as an integral element of information asymmetry between the client and the supplier in IT projects.

In information management of IT projects, the management of the information gap between the client and the supplier is particularly noteworthy. Managing the information gap for all individual components consists in decreasing the information gap on one's own side and decreasing and/or increasing it on the side of one's partner in an economic relationship, in this case, an IT project. Decreasing or increasing the range of the information gap amongst the stakeholders may help one of the parties achieve their planned aims.

According to (Babik, 2000), information needs are shaped by two factors: the type of solved task, Q, and the experience of the human user of the system (user U). Information needs can be divided into two subsets: the subset of information necessary to solve the Q task, which is already available to the system user, and the subset of information that is necessary, but not directly available. The shaping of information needs can be illustrated using the following formula:

$$<U, Q, M> \text{ - > } I\text{- > } Iu\ UL$$

where:

U - user looking for information,
Q - task (problem) solved by U,
M - methods which U intends to use to solve Q,
I - information necessary for U to solve Q using M,
Iu - information that U already possesses,
L - information needed to solve Q, which U does not yet possess.

Set L, called the information gap, has the following characteristics:

– it is always someone's gap – hence it cannot be studied in separation from a specific user and the

problems solved by them; this means that it is the user's responsibility to establish their information needs and define the requirements regarding the substantive quality of needed information;;
– it is variable in time – the time influences the contents and determinants of the task (Q) and changes knowledge resources of the user (U), which has a direct effect on their new information needs; these needs can be subject to changes under the influence of another method or the availability of other information;
– the borders of the L set are not defined – it is only in exceptional circumstances that it is possible to clearly define the kind of information that is necessary to solve the Q problem.

Usually, the information is useful to a varied extent. The decision to add information to L or to omit it depends on U. The gap (L) is a set of necessary, but unknown information, with varied contents, linked to one another through different relations resulting from an internal information model in the user's mind on how to solve the problem (Q). This is why the complexity of the gap is a subjective one. Psychologists see a hierarchical structure of all needs in human behavior, including information needs. Consequently, the gap (L) can be divided into two subsets: the subset of the necessary information and the subset of desired (complementary) information. Obtaining information that fills the gap is linked to covering relevant costs. The bigger the gap, the higher the costs, which increase the more the user aims to fill the gap. Different styles of action in the search for information discussed in the literature (Babik, 2000) indicate various approaches of information users to problem-solving and defining their information needs. Consequently, in the processes of information support services for users, a varied approach to each of them is necessary. This is linked to the need to include the user in the dynamic model in order to effectively support their information needs. Particularly noteworthy are the models and standards linked to the Information Literacy (IL) concept, designed in the 1990s: "The Big6" (The Big6, 2021) and SCONUL (SCONUL, 2021). Such models should constitute the basic mechanism of each IT project management system, especially in supporting those users who have to make important decisions in the condition of uncertainty within a very limited timeframe.

2.2. Literature review and background

The research presented in this article is interdisciplinary, contributing to the development of the information gap theory and the research field of business informatics, linking two fields, i.e. in informatics and economics. As described in the Introduction, the article aims to identify and describe the causes and

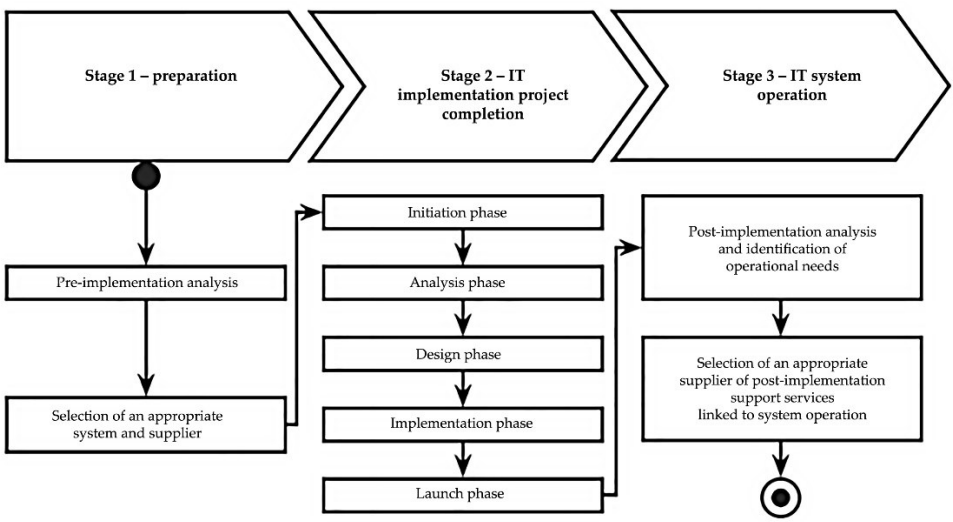

Fig. 4. Information asymmetry between the client and the supplier

consequences of the information gap from the perspective of the project manager on the client's and the supplier's side. This research problem leads to the formulation of the following research question: How can identify an information gap that affects project managers on the client's and the supplier's side influence the completion of an IT project of an ERP and CRM implementation throughout its whole life cycle?

As a result of thus formulated research goal and adopting the inductive research method, this study does not assume a specific picture of reality, but a formulated research question, and then, based on empirical experience, a formulated generalization, which, through answers to the research question, will create a concept, framework or proposal, with a transition from chaos of the observed reality to the generalization being key.

We have studied the information components using the direct observation method (Ciesielska et al., 2012). We focused on the functioning of the client's and the supplier's project teams, including the steering committee, project management, and functional and technological consultants. During the research project, authors participated in 10 IT projects on the client's side (5 CRM and 5 ERP) and 12 on the supplier's side (6 CRM and 6 ERP) completed in medium and large enterprises in Poland. The lowest value of an IT implementation project contract cluster equaled EUR 100 000, while the highest value was EUR 600 000. According to the research assumptions, direct observations were carried out between 2012 and 2020, covering the whole project life cycle. The main goal was to dentify and characterize information components throughout the entire project life cycle.

As discussed earlier, we studied the causes and consequences of the information gap using the unstructured interview method with a standardized list of desired information and direct observation. The interviews were conducted with a target group of 25 experts between 2012 and 2021. Each interview was completed in five stages, each between two and three hours long, and took the form of an unstructured, moderated monologue. The meetings consisted of one meeting discussing Stage 1, three meetings discussing Stage 2 and one meeting discussing Stage 3, which took place between one and two years after the launch of the IT system. Before each meeting, the participants were presented with a list of desired information that was going to be discussed. Each meeting focused on the causes and consequences of information gaps in the identified components in each phase of the project life cycle. The respondents had at least 10 years of experience in the management of IT implementation projects, including ERP and CRM system implementations, in medium and large enterprises in Poland and abroad. All the experts had previously represented both the client's and the supplier's side. Table 1 presents a characteristic of the research sample from the perspective of project management experience.

The list of desired information used to study the causes and consequences of the information gap can be found in Appendices A and B.

Table 1. Characteristic of research sample from the perspective of the respondents' experience[1]

Experience in project management according to project size, considering the purchase of implementation services and software licenses. The numeric value of projects that the experts participated in.		**Experience in project management according to the MIS class. The numeric value of projects that the experts participated in.**		**Experience in project management according to the type of IT implementation project. The numeric value of projects that the experts participated in.**	
Small (below PLN 500,000)	15	CRM	21	Standard	20
Medium (PLN 500,000 – 1,500,000)	28	ERP	36	Roll-out	15
Large (PLN 1,500,000 – 2,500,000)	13	CRM and ERP	4	Reimplementation	5
Very large (over PLN 2,500,000)	5			Vertical	11
				Upgrade	10

[1]Each participant could simultaneously choose many qualities of the studied characteristics.

3. Results

3.1. Information components

Table 2 presents a catalog of information components in the entire life cycle of the studied IT projects from the perspective of the supplier's project manager (Wachnik, 2020). Table 3 presents a catalog of information components in the entire life cycle of the studied IT projects from the perspective of the client's project manager (Wachnik, 2020). The numeric value of the information components (Table 2 and 3) indicates their similarity during individual stages and phases of an IT implementation project, which also facilitates a comparison between the two perspectives – of the supplier and the client.

Table 2. The structure of information components on the supplier's side during the entire life cycle of the studied IT implementation projects

Stage 1		**Stage 2**					**Stage 3**	
Phase 1	**Phase 2**	**Phase 3**	**Phase 4**	**Phase 5**	**Phase 6**	**Phase 7**	**Phase 8**	**Phase 9**
Supplier's competence in the area of IT project completion (1)	Competence in the use of the methodology in IT project completion (4)	Detailed project completion methodology (14)	Methods of functional and technological knowledge transfer from the supplier to the client in the area of functional analysis (21)	Customization (parameterization) methods (25)	Methods of acceptance testing and system tuning completion (30)	Methods of final data migration completion (33)	Competence in identifying the client's needs in the area of support services (36)	Competence in client support services in the area of system development (37)
	Information regarding process and organizational maturity of the client (5)	Risk and uncertainty management (15)	Methods of collecting functional and technological requirements by the supplier as part of the functional analysis (22)	Customization (programming) methods (26)	Final data migration methods (31)	Methods of system launch (34)	Competence in client support services in the area of system development (37)	Competence in client support services in the area of system operation (38)
Supplier's competence in IT project implementation management (2)	Client's functional requirements for the system (business process maintenance, report, and analysis maintenance) (6)	Detailed project schedule (16)	Methods of functional analysis documentation (23)	Methods of managing the quality of customization (27)	Methods of supplier-client knowledge transfer (workplace instructions, training) (32)	Methods of test completion in extreme conditions, e.g. large volume of data (35)	Competence in client support services in the area of system operation (38)	Competence in the area of risk and uncertainty management (15)

Competence in budget and time-scale estimation for an IT implementation project (3)	Producer's information regarding the structure of software license (7)	Information regarding the design of a communication support system for the implementation of an IT project (17)	Competence in task workload management (20)	Methods of internal acceptance testing and system tuning completion by the supplier (28)	Competence in the area of communication in a project based on remote working (24)	Competence in the area of risk and uncertainty management (15)	Competence in the area of risk and uncertainty management (15)	Competence in task workload management (20)
	Competence regarding estimation and presentation of the TCO for the entire life cycle of the IT implementation (8)	Defining the client's and the supplier's project group (18)	Competence in the area of communication in a project based on remote working (24)	Methods of documenting the completed customization (29)	Competence in task workload management (20)	Competence in task workload management (20)	Competence in task workload management (20)	
	Information regarding the decision-making process in supplier selection by the client (9)	Information regarding designing a knowledge transfer system between the supplier and the client in the area of project management (19)	Risk and uncertainty management methods (15)	Competence in task workload management (20)	Risk and uncertainty management methods (15)	Competence in the area of communication in a project based on remote working (24)		
	Information regarding the reasons behind the decision to invest in an MIS (10)	Competence in task workload management (20)		Competence in risk and uncertainty management (15)				
	Information allowing to define the schedule (11)			Competence in the area of communication in a project based on remote working (24)				
	Information allowing to define the financial credibility of the client (12)							

Competence and information allowing to define the workload of the given IT implementation project (13)	

Table 3. The structure of information components on the client's side during the entire life cycle of the studied IT implementation projects. Source: (Wachnik, 2020)

Stage 1		**Stage 2**					**Stage 3**	
Phase 1	**Phase 2**	**Phase 3**	**Phase 4**	**Phase 5**	**Phase 6**	**Phase 7**	**Phase 8**	**Phase 9**
Competence in estimating the total cost of system ownership during the entire life cycle of an IT implementation project (1)	Supplier's culture and organization (7)	Methods of documenting the IT project completion (14)	Knowledge and experience of the supplier that can improve the client's organization, resulting from analogous IT projects on the client's side (18)	Methods of performing internal testing of the customization completed by the supplier (23)	Data migration method (28)	System launch method (34)	Identification of needs linked to the functional development of the system (34)	Completion of post-implementation services by the supplier (36)
	Methods of charging the system user the license fee(8)	Methods of risk and project uncertainty management (15)	Methods of maintaining the implementation cost on the planned level (19)	Customization documentation methods (24)	End-user training methods (29)	Methods of risk and project uncertainty management (15)	Economic evaluation (*ex-post*) of the IT project completion (35)	Supplier's competence and experience (37)
The client's project group competence in IT project implementation	The right to modify the completed customization, inc. the right to source code modification (9)	Project schedule (12)	Functional analysis documentation methods (20)	The influence of customization method on the total cost of system ownership (25)	Methods of workplace instructions design (30)	Project schedule (12)	Methods of risk and project uncertainty management (15)	Methods of risk and project uncertainty management (15)
The structure of the project group and the roles and responsibilities of its members during the project completion (3)	Estimated system maintenance budget in Stage 3, i.e. system operation (10)	The roles and responsibilities of the client's project group members during the implementation project (16)	Methods of collecting functional requirements by the supplier during the functional analysis (21)	Customization (programming) methods (26)	Methods of system tuning completion after receiving the results of acceptance testing (31)		Project schedule (12)	Project schedule (12)

Technological system requirements (4)	Stable completion budget in stage 2 of the project (11)	Detailed project implementation methodology (17)	Methods of functional and technological knowledge transfer from the supplier to the client as part of key user training and functional analysis (22)	Customization (parameterization) methods (27)	Cooperation of the consultants and users during the completion of acceptance testing (32)		
Project completion method (5)	Project schedule (12)		Methods of risk and project uncertainty management (15)	Methods of risk and project uncertainty management (15)	Methods of acceptance testing completion by the supplier (33)		
Functional system requirements (6)	Project completion method (5)		Project schedule (12)	Project schedule (12)	Methods of risk and project uncertainty management (15)		
	The competence of the supplier's consultants and project manager (12)				Project schedule (12)	Competence in task workload management (20)	Competence in task workload management (20)
	Project implementation methods (13)			Competence in task workload management (20)		Competence in the area of communication in a project based on remote working (24)	
	Future development and license price policy of the IS producer (14)			Competence in the area of risk and uncertainty management (15)			
	Meeting functional requirements (15)			Competence in the area of communication in a project based on remote working (24)			
	Customization copyright (16)						

A theoretical and empirical analysis conducted during the study has indicated that information gaps for the identified components are independent from the class of MIS, i.e. ERP and/or CRM. Our research has shown that the occurrence of information gaps for the identified components depends upon:

1) The functional-technological character of the customization, which relies on the technical possibilities of parameterization and programming;
2) The type of IT project in an ERP or CRM system implementation, i.e.
   a. Standard
   b. Roll-out
   c. Reimplementation
   d. Implementation of a vertical solution
   e. Upgrade
3) The impact of trust between project managers on the client's and the supplier's side.

Inheriting information gaps for the identified components means that they become more widespread and ingrained, which increases uncertainty. In the early phases of the project life cycle, inheriting information gaps has a significant impact on the resilience of project managers on the supplier's and the client's side to information uncertainty, which directly affects decision-making methods. The resilience of the client's and the supplier's project group to uncertainty decreases with the increasing level of complication in the functional, technological and organizational requirements of an IT project. Functionally and technologically complex IT projects, with the added partial conflict of interests between the supplier and the client, characterized by opportunistic behavior, will be more susceptible to more frequent information gaps, which will strongly influence the effectiveness of the projects. Considering the technological advancement of MIS, we can presume that the phenomenon of information gaps will become an imminent part of IT projects, and will increase. Considering the character of the information gap in IT projects, I would like to propose the introduction of the "information gap management" concept as an integral part of information management, which would cover the entirety of processes allowing us to identify, analyze and reduce information gaps. Managing information gaps would also cover the process of creating information gaps on the opposite side of the contract in order to achieve the planned goal.

3.2. The causes of the information gap

Following a detailed research process, the causes of the information gap in an IT project have been studied employing the unstructured interview method with a standardized list of desired information and direct observation. During the research, the causes of the information gap of the client's and supplier's project managers were identified using two interdisciplinary research perspectives:

1) **Risk and uncertainty management perspective** in an IT project constitutes an integral part of project management. In the conditions of risk and uncertainty, it is important to analyze the causes of information gaps in IT projects considering four categories of risk and uncertainty presented in Table 4;
2) **Information science perspective** - with a particular focus on information ecology, it is treated as an area of knowledge studying the laws and discovering the regularities governing information in the so-called information ecosystems, especially the flow of knowledge between people (Babik, 2014). The research results on the selected issues in the info-sphere and information niches, information redundancy and deficit, information behaviors, information barriers, information stress, and information competence can be used to understand better the information gap on the project manager's side.

Table 4. Grouping the categories of risk and uncertainty in the context of information gap causes

Risk and uncertainty categories	Information gap causes - groups
executive	– causes linked to technological development
project	– causes linked directly to the competence of the project manager – causes linked to the character and implementation methods of the IT project completion
organizational	– causes linked to the organization of the client's and the supplier's enterprises – causes linked to opportunistic information management
external	– causes linked to the enterprise environment – causes linked to opportunistic information management

Below is a characteristic of information gap causes from the perspective of risk and uncertainty management in an IT project.

Causes linked to the competence of project managers:

1) The ability to make managerial decisions. Managerial competence covers problem-solving skills, change, innovation and resource management, leadership, and constant perfecting of the organization;
2) Specialist skills of the project manager in completing analogous IT projects. Significant knowledge regarding issues linked to the implemented IT system and the organizational environment of the client;
3) Limited rationality of decision-making. Noting many deficiencies and an overly formulaic character of rational decision-making models, researchers have tried to propose alternative decision-making methods that would reflect decision-making processes in managerial practice, also in IT projects (Malewska, 2014; Moorhead et al., 2008). The results of our research are behavioral models, which have been divided into limited rationality models and heuristic models (March et al., 1993);
4) Behavioral determinants linked to the inflow of information. Literature indicates numerous behavioral determinants linked to the analysis of information that allows for decision-making. Our research has identified the following significant behavioral determinants of managerial decisions (Kahneman, 1979; Edwards, 1982):
   a. Anchoring effect – a simplified conclusion-making method, consisting in relying (or anchoring one's mind) on a chosen piece of information, and then interpreting other data in reference to it;
   b. Professional bias effect – tendency to evaluate things from the point of view of one's profession, ignoring a wider perspective;
   c. Cognitive conservatism effect – manifesting through mistrust of unexpected information and an intention to maintain the status quo in one's thinking;
   d. Tendency to maintain and solidify one's beliefs; tendency to favor information that reaffirms one's expectations and hypotheses, no matter whether that information is correct (Akerlof et al., 2010).

Causes linked to the organization of the client's enterprise:

1) Project management information systems, including in the area of communication between project groups. Due to the constant transformation of IT project organization, orientated towards the network model, IT tools supporting communication between project groups become increasingly more important. In the case of an IT project completion in an organization with a distributed structure, there is a trend to move away from direct communication based on project group meetings and user training towards communication-based on IT tools. Research has shown that using MIS in communication is the source of information gap on the side of client's and supplier's project manager as it may lead to disruptions in the transfer of information;
2) Trust in the client's enterprise, the client, and between the parties. In management, trust is an element of social capital, and organizational value referring to all the functions of management, the foundation of relations and mutual expectations between people and groups within an organization;
3) Organizational culture of the IT project participants. It is a set of social norms and value systems characterizing a given project team (West, 1997). The organizational culture characterizing a given entity result from its strategy, structure, and management (Asquin et al., 2010). The organizational culture of a team constitutes a collective base of knowledge or experiences, reflecting the history of a given team and simultaneously undergoing constant transformations through learning processes. Organizational culture in enterprises specializing in high-tech products such as MIS, or using them to a significant extent, is incredibly important and may determine their further development. Our research has shown the team's organizational culture characterized by the following features to be the cause of an information gap of the project manager: a lack of focus on organizational goals and interests, a lack of willingness amongst project group members to share knowledge and information, a predominantly short-term perspective, a greater focus on power and hierarchy and a high level of bureaucracy;

4) The maturity of the participants. The selected companies implemented process maturity models such as ITIL and COBIT, which represent – quantitatively or qualitatively – the stages of increasing capacity of model elements to perform tasks in order to evaluate them in reference to the defined areas (Kohlegger et al., 2009). The basic idea of maturity models is the possibility to evaluate processes taking place in the organization or its chosen area on one of the five maturity levels (Harmon et al., 2010). In the selected organizations, implementing an ITIL or COBIT model limited the information gap. Despite the implemented models, the organizations aimed to reduce their costs significantly, which meant that the implemented model was not as effective in reducing the information gap as it could have been.

Causes linked to the environment:

1) Limited job market resources. A significant characteristic of the European job market of IT and implementation specialists is a deficiency of highly qualified employees needed to implement ERP and CRM projects;
2) Changeability of law and its ambiguity. New legal requirements defining the functioning of ERP and CRM systems as part of their integration with other systems, especially in the area of reporting accounting data to tax authorities (e.g. SAF-T) from ERP and CRM systems may cause an information gap;
3) The actions of global software producers. The concentration of generation and management of information resources in the hands of global software producers, who are the holders of world information resources, means that they have control over making these resources available to other countries, organizations, and socio-economic entities. The actions of these enterprises may result in the client being unable to predict the range of product development and the costs linked to the completion of IT projects, thus increasing the information gap of the client and the supplier;
4) Not applying quality norms and standards supporting IT projects in practice. In spite of norms and directives regarding the creation of software requirements, i.e. ISO and IED, being available on the market, qualitative research has proven that they are not used in practice, which may result in an information gap, as reference norms that software characteristics or services delivered by the software, could be compared with, are unknown;
5) Inheriting information gaps by the participants of the environment. Research shows that the suppliers are mainly small and medium local enterprises rather than large global ones. Their relationship with the main global software producers is characterized by a strong asymmetry consisting of a limited ability to influence the license price policy of the implemented software, the direction of software development, and the organization of software distribution by the software producers. Information asymmetry may result in inheriting information gaps by the supplier of IT project services.

Causes linked to the character and completion methods of an IT implementation project:

1) **Functional analysis completion methods**. In the second stage of an IT implementation project life cycle, the supplier and the client complete functional analysis, applying methods from the field of requirements engineering and design engineering in that specific IT system. The selection of methods and their use in requirements engineering and design engineering have an impact on the information resources of the client's project manager and on their information gap. The participants of my qualitative research have confirmed that a requirements specification designed correctly during the functional analysis influences, i.e. minimizes, the information gap in the chosen group of information components, especially in the second stage of an IT project;
2) **Knowledge transfer methods**. Knowledge transfer has a significant impact on the effectiveness of an IT project completion throughout the entire project life cycle, especially during the functional analysis and training. The cause of the information gap in the selected group of components is a lack of an effective knowledge transfer between the members of the client's and the supplier's project groups, which may result from, succinctly, three factors (Wachnik, 2013):
   – the client makes an attempt to irrationally minimize the costs linked to the organization

of knowledge transfer during the project completion;
- knowledge transfer has been incorrectly planned and completed due to a lack of necessary knowledge and skills, both amongst the supplier's consultants and the system users on the client's side;
- the supplier consciously limits the transfer of knowledge to the client's system users in order to make them dependent upon him/herself during system operation, counting on a larger income during the third stage;

3) **Customization methods.** The customization of an MIS may be conducted using two methods, i.e. parameterization and programming. The selection of customization methods depends upon the system architecture and the specification of functional and technological requirements. Information gaps may be caused by a lack of knowledge regarding the functional-technological architecture of an IT system and an incomplete specification of functional and technological requirements designed during the functional analysis;
4) **Project management methodologies.** Currently, we can distinguish the following methodologies of managing IT implementation projects:
   - heavy (classic, traditional): waterfall (linear), incremental, evolutionary, prototype and spiral;
   - light (modern, agile): XP (extreme programming), Scrum, Feature Driven Development (FDD), Dynamic System Development Method (DSDM), and Adaptive Software Development (ASD). Light methodologies, as opposed to heavy methodologies, pay more attention to change management, more effective communication based on a higher dynamic of activities, as well as adaptability and flexibility.

According to our research, the causes of the information gap of the IT project manager influence the choice of project management methodology, i.e. the way of using the following methods:
- project group communication methods,
- methods of knowledge accumulation through training and project documentation,
- methods allowing to achieve higher adaptability by the client's organization to the challenges occurring during an IT implementation project,
- methods allowing for a more dynamic reaction to changes of functional and technological requirements of the client towards the implemented system during the project completion.

Causes linked to the technological development

In the information society, social, technical, and organizational progress has an informational character in the sense that it is achieved thanks to information and introduced through information processes (Olesiński, 2003). Technical progress in information society impacts information in the following way: it generates more and more new information; it requires the creation of increasingly more information; implementing the effects of technical progress requires increasingly bigger information resources and streams, and using the results and effects of technical progress requires increasingly bigger information resources from the entities. Main suppliers of MIS and ICT equipment try to maintain a fast technological development of IT hardware and software. In the case of IT systems and computer hardware, the activities linked to technological progress require the consultants, designers, producers, companies specializing in implementing applications and clients to access the latest and increasingly larger information resources necessary to understand and effectively use new IT systems. The producers of software, implementation companies, and clients face a significantly higher level of resource and IT system redundancy than ever before. Users and economic entities have difficulties operating in an information environment "littered" with such a high volume of irrelevant, non-pertinent data, which is conducive to an increase in the information gap between the supplier and the client.

Causes linked to opportunistic information management:

1) **Disinformation**. In the Polish Language Dictionary (Doroszewski, 2012), misinformation is described as false, deceitful, or alleged information, so one that does not display the traits of typical information that increases the level of the recipient's knowledge. Misinformation is relaying false information that misleads the recipient. It is usually done deliberately in order to achieve specific effects resulting from a lack of knowledge of the targeted person or institution. Currently, intentional misinformation is often

used in the form of fake news, both in the area of politics and business. This information is spread with the objective of misleading or increasing the information gap, thus obtaining financial or political benefits;

2) **Manipulating information**. In the Polish Language Dictionary (Doroszewski, 2012), manipulation has two meanings: first referring to a physical act of moving an object held in one's hand, second to activities aimed at influencing people's behavior by altering reality (facts) in order to achieve one's goals. Manipulation can be observed in the supplier's behavior, mainly in stage 1 of an IT implementation project. The goal of manipulation is to position the offer in a way that will stir the recipient's emotions and push them to act. Hence, the main manifestation of manipulation is underlining unimportant elements of the message and omitting facts that matter to people (Hernik, 2013). As a result of manipulation, we do not possess knowledge or information about the real phenomenon, and the information we receive is false. Such an approach of the message creator is aimed at achieving their goal and benefits.

Identifying and analyzing the information gap of the client's and supplier's project manager, from the perspective of information science with a particular focus on including information ecology, my research indicates the following causes:

1) **A redundancy and deficit of information resources**. A redundancy and deficit of information resources of the client's and the supplier's project manager can be considered on three levels: physical, technological (IT), and social. Information redundancy and an overly changeable supply of the available information may result in the project manager getting lost in the world of information, not being able to find real and beneficial values or distinguish the truth from falsehood, experiencing a distortion of their hierarchy of values, emotional instability and even information apathy (fatigue) (Babik, 2014). Redundancy of information and a desire to quickly gain knowledge means that the project manager finds it hard to choose relevant information that would fully meet their information needs and narrow their information gap. A constant increase of not always current, full or credible information means that a process of its rational evaluation and selection becomes indispensable. Information deficit of the supplier's and the client's project manager consists in a lower supply of information than necessary. Information deficit causes confusion and negatively impacts the thought process. Additional qualitative research shows that the project manager is not only affected by an information deficit, but also by a deficit of quality information. The quality of information is defined as the total of the object's qualities linked to its ability to satisfy expected needs. In this case, the quality of information counts as an information characteristic dependent upon the will and intentions of its user, which influence the level of the practical usefulness of the information and contribute to increasing its value. We use the information to manipulate the behavior of people and socio-economic entities in a way that helps us achieve our planned goals and interests. Qualitative research has shown that the recipient of information aims to minimize the information gap. It also indicates that the information originator manipulates information in order to create an information gap on the side of the recipient in order to achieve their goals, also through opportunistic information management. Qualitative research indicates that manipulating the information gap by the originators sometimes takes place through information behaviors aimed at creating an information redundancy or deficiency in the individual information components of the project manager or their network. Information deficit and redundancy constitute two extremities between which the whole range of information behaviors reveals itself. Obtained or intuitive skills of the project manager in managing an information deficit or redundancy allow them to choose correct information behaviors aimed at minimizing information gaps.

2) **Information barriers**. One of the causes of information gaps are information barriers, factors that make it difficult and sometimes even impossible to receive information, use it, and spread it. Our research has found the following types of information barriers:
   – informational – linked to a lack of information, imperfections in the process of obtaining it, and a low information value (usefulness);

– psychological – limitations of the client's project manager in the process of generating and interpreting information; information overload; lack of information skills;
– sociological – linked to the communication with other members of project group and people's own interpretation of it;
– organizational – bad organization and technical resources, and bad use of information channels;
– economic – lack of resources.

Information barriers in the conducted research impede, delay or even block access to information for project managers. They are negative, changeable factors which influence information needs, motivation, information attitudes and behaviors. Interestingly, research shows that thanks to the IT development, space and time barriers to IT implementation projects have completely disappeared. Currently, it is standard to complete an IT project through remote working. Experts in the field have proven that an increasing number of IT implementation projects are completed without any direct contact between the members of the client's and the supplier's project groups as part of network structures.

3) **Information behavior.** According to (Materska, 2007), information behaviors are various behaviors performed by an individual in order to define (identify) their needs, search for, use and pass on information. I understand information behavior as the reactions of the project manager to information reaching them, hence the human-information relationship. Information behavior of the project manager depends on the attitude that the user assumes towards the information. Qualitative research has shown the following determinants in information behaviors that affect the information gap of the project manager:
   – Passive behavior in collecting and analyzing information.
   – Technological skills and possibilities of the client's organization linked to information search, which are not always precisely directed and purposeful.
   – Lack of support in collecting and analyzing information by other project group members.
   – Filtering information regarding functional and technological requirements of the system.
   – Cognitive maturity and appropriate skills to critically analyze information.

To sum up, the causes of the information gap of the supplier's and the client's project manager are dynamic throughout the entire cycle of an IT project. One of the significant determinants of the information gap is the character of each individual phase in the life cycle of an IT project completion, which has a direct influence on the scale of knowledge accumulation in the nodes of the client's and the supplier's knowledge resulting from the learning curve of the project group members. An interdisciplinary analysis of the causes, using the risk and uncertainty management perspective, as well as the information science perspective, allows for a better understanding of the information gap of the client's and the supplier's project managers.

3.3. The consequences of the information gap in an IT project

During the conducted research on the causes of the information gap in the entire IT project life cycle, we have distinguished two research perspectives:

1) As part of the first research perspective, project completion effectiveness is a consequence of an information gap in an IT project. Project effectiveness was understood as meeting four criteria, i.e. completing the project within the planned budget, within the planned schedule, within the planned functional and technological range, and achieving the planned business requirements. Qualitative research results show that the consequences of the information gap apply to these criteria equally. The most important information gap consequence for the identified components during the entire project life cycle is the impact on the changes of uncertainty and risks occurring throughout the entire life cycle of an IT project. As part of research results, Table 5 presents the consequences of information gaps throughout the entire IT project life cycle resulting from accumulating and inheriting uncertainties and a lack of the possibility of transferring these uncertainties into risks;

Research has indicated that from the perspective of effectiveness, the consequences of information gaps for the identified components are independent from the class of the studied MIS, i.e. ERP or CRM, and the types of IT systems, while they are dependent on the size of the function set within the system that is meant to be subject to customization through parameterization and completion of programming changes.

Table 5. The consequences of information gaps on the client's and the supplier's side throughout the entire project life cycle

Stage	Client's perspective	Supplier's perspective
1 (preparation)	Incorrect selection of an IT system	Insufficient definition of the client's system requirements
	Incorrect selection of a supplier	Insufficient definition of the client's requirements regarding the functional and business range
	Incorrect selection of Stage 2 completion methods	Signing agreements does not sufficiently secure the interests of the supplier
	Signing agreements does not sufficiently secure the interests of the client	
2 (completion)	High total cost of ownership	Low profitability of Stage 2 completion
	Not achieving all business goals	Not achieving all business goals
	Ineffective knowledge transfer	Exceeding the timescale
	Exceeding the timescale	Not obtaining a reference as a confirmation of project completion
3 (operation)	High total cost of ownership	High total cost of ownership
	Not achieving all business goals	Not achieving all business goals

2) As part of the second research perspective, our study has indicated that one of the significant consequences of information gaps is the transaction cost occurring during the entire life cycle of an IT project.

According to (North. 1993), transaction costs are both the costs of obtaining information and the costs of implementing contracts and ensuring trust in obligations in time and space. Both in the neoclassical economy focused on production costs, and in the economy of transaction costs focused on management costs, savings constitute the main point of analysis of a business organization. Leaving out or marginalizing transaction costs in effectiveness analyses of an organization, which was still common practice a decade ago, led to false conclusions. Research indicates that an increase in transaction costs in the private sector is linked to an increasingly greater complication of economic life and changes to the model of the modern economy (Łobejko, 2011). Our research has identified a network approach in the organization of the analyzed IT projects, which is reflected by the changes of organizational structures and the management methods used in project completion between the network nodes both in the client's and the supplier's project group.

The studied IT projects are seen here as a network of highly qualified employees (knowledge nodes), both on the client's and the supplier's side. Thanks to the use of modern IT communication tools and the character of IT projects, the client is supported by external (network) non-material resources of the supplier that they can obtain and engage on a global scale, not only internally (locally). Throughout the entire life cycle of an IT project, the client and the supplier, completing a cluster of contracts, can use knowledge and intellectual resources of numerous professionals, e.g. employees, freelancers, or global experts, for instance via the LinkedIn network. This contemporary approach to economic activity is based on the purchase logic in opposition to the traditional approach mainly based on the internal production of an enterprise (Dioguardi, 2010). Our research has shown that one of the consequences of information gaps in IT implementation projects are transaction costs, which depend upon three parameters (Wachnik, 2017):

$$CT = f(U, F, AS)$$

U – Uncertainty, resulting from the internal and external technological-organizational determinants of IT projects and the causes of information gaps. Research shows that uncertainty is an integral part of IT projects, making it significantly harder to achieve planned goals.

F – Frequency, resulting from the accumulated information, knowledge, experiences, and opportunistic behaviors of the main knowledge nodes of the

client's project group, first of all, the project manager. The higher the frequency of a certain type of transaction [e.g., project completion] on the client's side, the lower the transaction costs. The character of IT projects is determined by a low frequency of this type of transaction on the client's side.
AS – Asset specificity is the basis of choice between alternative management structures and then understanding and efficient management of their internal connections. Asset specificity should also be understood as the specificity of a purchase resulting from technological-organizational determinants of IT projects. Currently, it is increasingly more common to favor network structures in the management of IT projects, which requires a significant input of information technology.

An important result of information gaps in the studied group of suppliers and clients is an increase in transaction costs, resulting in an increasingly greater complication of this type of IT project and changes to the modern economic model. Currently, the costs of contracts increase on a macroeconomic scale, as reality undergoes constant and unpredictable changes, which are much more dynamic than in the past. Hence, knowledge of transaction costs resulting from information gaps in IT projects is important, as the costs increase the price of products and services, consequently making it hard to achieve optimal efficiency. Table 6 presents the types of transaction costs of the client and the supplier in three stages.
Our studies indicate that many researchers do not include transaction costs in evaluating whether the project has been completed within the planned budget, which may lead to incorrect conclusions. This may result from the fact that the measurement of transaction costs is a complicated and complex

Table 6. The types of transaction costs of the client and the supplier in three stages

Stage	Client's perspective	Supplier's perspective
1 (preparation)	Tender organization	Sales process as part of the tender
	Obtaining information in order to verify the supplier and to verify alternatives	Obtaining information in order to prepare an offer regarding services and the IT system
	Legal support	Legal support
	Negotiations and securing an agreement with external entities	Negotiations and securing an agreement with external entities
2 (implementation)	Project management	Project management
	Knowledge transfer	Knowledge transfer
	Verification and measurement of project results	Explanation and discussion of transfer of partial project results
	Accounts settlement	Accounts settlement
3 (operation)	Tender organization	Sales process as part of the tender
	Obtaining information in order to verify the supplier and to verify alternatives	Obtaining information in order to prepare an offer regarding services and the IT system
	Legal support	Legal support
	Negotiations and securing an agreement with external entities	Negotiations and securing an agreement with external entities
	Project management	Project management
	Knowledge transfer	Knowledge transfer
	Verification and measurement of project results	Explanation and discussion of transfer of partial project results
	Accounts settlement	Accounts settlement

issue that requires a large volume of work. In a simple, bilateral transaction, they are usually easy to measure. However, in a situation where IT implementation agreements are complex and account for the specificity of such projects, referring to exchanges between many different parties within a network structure, an accurate measurement of transaction costs may prove impossible. For this reason, I have based my study on defining only the qualitative characteristics of information gap impact on transaction costs. Authors believe that another interesting conclusion of the qualitative research is the indication that transaction costs of an IT implementation project, resulting from information gaps, may differ in developed and developing countries, due to the character of such projects described before. To sum up the impact of the information gap on transaction costs, we need to underline that including transaction costs renders the total cost of an IT project completion more realistic. Transaction cost economy accounts for opportunism and limited rationality of the parties, so if we assume that the members of the client's and the supplier's project groups are opportunistic to an extent, then during an IT project completion they will struggle to think long-term, build alliances, care to achieve their company's value or to create inter-organizational networks, while managers at every level will predominantly think in the "here and now" terms. The problem of risk and uncertainty in transaction costs proves incredibly important in the completion of an IT project throughout its entire life cycle, not only from the perspective of the stability of such projects but most of all from the perspective of enterprise development and its functioning on the market. An important challenge that project managers face is attempting to balance short-term transaction costs resulting from issues such as information gaps and the consequences of risks and project uncertainties. Transaction cost economy assumes that aiming to save costs is at the basis of organizational diversification, an example of which may be the use of network structures.

4. Discussion

To sum up the research, the authors would like to propose the following conclusions:

1) The research has allowed defining in the studied respondent group, i.e. the clients and the suppliers, a set of information components in the entire life cycle of MIS project implementations of ERP and CRM systems. The respondents have indicated the existence of information gaps for the presented components;
2) Research has shown that the character of information gaps for the identified components is independent from the class of the implemented MIS system, i.e. ERP or CRM. It is, however, dependent upon the functional and technological range of the project, the size of the function set in the IT project that may be subject to customization. Two important features of information gaps in the supplier's and the client's components have been identified, i.e. inheritance and inclusivity. The occurrence of information gaps causes a domino effect, which means that the resilience of the stakeholders to information uncertainty in the individual project phases decreases, which has a direct and indirect effect on the IT project effectiveness;
3) The causes of information gaps on the client's and the supplier's side have been identified and grouped:
   a) from the perspective of the organization of an IT implementation project
   b) from the perspective of information science, particularly information ecology
4) The identified causes of information gaps are dynamic throughout the entire life cycle of an IT project and are determined by the factors identified.
5) The results indicate that during an IT project implementation with the use of external entities (client-supplier), the goals and interests of the transaction parties are partially conflicting. Both sides attempt to achieve their goals, including information management, which also includes information gap management. During our research on the information gap, we have established that one of the important causes of information gaps is opportunistic information management by the external stakeholder, i.e. the supplier. This type of behavior encourages manipulation of other people in order to fulfill one's goals and interests.
6) The results indicate that information gaps result in:
   a) lower effectiveness of IT project implementations
   b) higher transaction costs that accompany the identification and reduction of the

information gap in an IT implementation project.

To sum up the research results, we need to stress that currently, ERP and CRM implementation IT projects are completed in conditions of uncertainty or deep uncertainty throughout their entire life cycle (Walker et al., 2010). The theory of information gap can support decision-making in IT projects with regards to prioritizing potential scenarios used in project management. The cause and effect analysis of information gaps on the supplier's and the client's side allows us to build a cognitive map of the studied phenomenon, which will limit the level of uncertainty both for the existing parameters characterizing the object, in this case, an ERP or CRM implementation project and for decision-making models in project management. Reducing the information gap can be used by the transaction parties to implement a strategy of building the object's resilience to uncertainty and its consequences. Reducing the information gap consists in identifying information components, defining information gaps within these components, defining the causes of information gaps, and linking them to their potential consequences. These actions allow increasing the resilience of project parties to the consequences of events that are both unpredictable and have unpredictable consequences. The essence of resilience-building strategy for an object that, in this case, is an ERP or CRM implementation project, lies in the adaptability of both contract parties, resulting in both from the resources and the adaptive project management methods, which include project portfolio management by both sides. The level of resilience to unpredictable events by the IT project parties shows a compromise between mistakenly taken decisions resulting from uncertainty and increased transaction costs and/or deviations from the planned effectiveness parameters of the project. Building a resilience strategy may result in the changes to the currently predominant paradigm, from the optimization of economic activity in an enterprise aimed at maximizing short-term profits towards sustainable development. However, for one party, the consequence of uncertainty may be a chance, while for the other party – a risk.

The undertaken research indicates that the correct approach would be to include risk management methods in project implementation management methodologies, as has been the case with risk management. One of the examples is an attempt to include the Robust Decision Making, RDM (Marchau et al., 2019) concept, which may support the decision-making process in large and advanced IT projects of ERP and CRM system implementations. The RDM concept combines an analysis of decision-making based on assumptions and scenarios, which may be designed using the knowledge on information gaps, with explorative modeling using a stress-test in extremely difficult conditions caused by uncertain events resulting from the research objects or its environment. Another example is the possibility of including the assumptions of Dynamics Adaptive Planning, DAP, which supports activities linked to designing a plan of adaptive possibilities adjusted to the changes in conditions and gained knowledge resulting from uncertain events. DAP covers the specification of a process-monitoring system in the project along with a definition of actions that need to be taken in order to reach trigger values for the parameters. High-quality and consistent data is required to make decisions. IT systems can therefore be a source of data for decision support systems in many areas, including logistics where they are the basis of decision models and key decisions are based on them (Jacyna-Gołda et al., 2016; Rudyk et al., 2019; Szczpański et al., 2017).

The presented research result can help achieve three goals, i.e. studying the information gap in the selected group of IT projects, indicating the nature of imperfection in information access by the project participants, and raising awareness amongst project managers regarding risk management issues, especially uncertainty.

The conducted research paves the way for further exploration in the area of the information gap in modern IT projects and its influence on project management in enterprises. It also underlines the need to focus research efforts on the following problems:

1) The information gap in technologically advanced projects of Industry 4.0 and 5.0 completed in virtual enterprises with a robust network structure;
2) Reduction of the information gap in an IT implementation project in the process of knowledge creation as a consequence of the new role of managers in a knowledge-based economy

as part of Robust Decision Making and Dynamic Adaptive Planning ;
3) Evaluation of the influence of behavioral determinants on the character and attributes of the information gap in an IT implementation project, both amongst the external and internal stakeholders;
4) Analysis of the influence of network learning that takes places in the knowledge nodes on the reduction of information gaps, the knowledge and the skills of the internal and external stakeholders;
5) Development of methods that will reduce the information gap, with a particular focus on methods using the A.I. within the network structure of the client's and the supplier's project group;
6) Development of methods that will reduce the information gap resulting from opportunistic behaviors of knowledge nodes of the internal and external stakeholders;
7) Implementation of the information gap component in modern IT project implementation methodologies, using Robust Decision Making (RDM) and Dynamic Adaptive Planning (DAP);

The authors believe that further research on the information gap may increase the effectiveness of IT project implementations, mainly through identification, analysis, and reduction of uncertainty and risk.

Appendix A

The list of the desired information is used to study the causes of the information gap. Source: own study.

1. Understanding the information gap by the project manager.
2. The impact of technological development in MIS on the information gap on the project manager's side.
3. The impact of the project manager's competencies on their information gap.
4. The impact of behavioral aspects of the project manager on the information gap.
5. The impact of limited rationality in decision-making by the project manager on the information gap.
6. The impact of the level of motivation of the project manager to complete the IT project on the information gap.
7. The impact of the character of the studied project group on the information gap.
8. The impact of the IT implementation project completion method on the information gap.
9. The effectiveness of knowledge transfer from the supplier's project group to the client's project group.
10. The impact of opportunistic information management on the project manager's information gap.
11. The impact of the organization of the client's and the supplier's project group's work on the respective project managers' information gaps.
12. The impact of the organization of the supplier's project group's work on the client's project manager's information gap.
13. How does organizational culture influence the project manager's information gap?
14. The impact of trust in the client's project group on the project manager's information gap.
15. What norms and quality management standards are used in the studied IT projects?
16. How does the job market influence the information gap of the client's project manager?
17. What behavior encourages information redundancy or deficit?
18. The impact of information redundancy or deficit on the information gap of the client's project manager:

a. the causes of information redundancy,
b. the issue of MIS technology information supply,
c. the behavior of the project manager that helps the management of information redundancy,
d. the characteristics of information shock of the project manager.

19. The speed of information exchange between the stakeholders.
20. The impact of the network structure in a project group characterized by a strong geographic dispersal on information redundancy or deficit.
21. The impact of information barriers on the project manager's information gap.
22. The determinants of information barriers in the context of the information gap:

e. psychological determinants in the process of generating and interpreting information,
f. sociological determinants linked to communication,
g. economic determinants linked to obtaining information,

h. organizational determinants linked to communication.
23. Identifying the behaviors of the project manager that may impact the information gap.

Appendix B

The list of desired information used to study the consequences of the information gap from the perspective of completion effectiveness in an IT implementation project. Source: own study.

1. Understanding the concept of effectiveness of IT project completion from the client's point of view.
2. Designing the budget of IT project completion in Stage 1 considering the information gap.
3. Defining the timescale of the IT project completion in Stage 1 considering the information gap.
4. Defining the functional and technological range of the IT project in Stage 1 considering the client's project manager's information gap.
5. Defining the functional and technological requirements of the IT project in Stage 1 considering the client's project manager's information gap.
6. Defining the general impact of the information gap in the IT project on the budget, timescale, range of requirements, etc.
7. Defining and understanding in detail the impact of individual information gaps in the components on the budget, timescale, range and requirements in the IT project.
8. Understanding transaction costs from the client's perspective.
9. Understanding how information gaps impact transaction costs.

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