Industrial Project Management Supported by KM Methods: Empirical Results from Polish Enterprises

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Abstract: Organisations that customise products and services to meet individual customer needs, or offer new products to new and existing markets, implement operational processes according to project management standards. In a rapidly changing economic environment, knowledge is a key resource that provides companies with a competitive advantage. The shortening of product and service introduction cycles in many market segments means that orders are won on the basis of generic data and information. One of the symptoms in organisations is that employees perform a variety of tasks outside their area of specialisation. The research questions posed in this article are the following: Does the increased availability of data and information to support employee creativity and the increased use of knowledge management tools in this market group of companies foster an increased ability to carry out interdisciplinary projects? In this group of companies, is the increased use of tools supporting knowledge management accompanied by a positive increase in business development? These questions are part of a broader research project on Industry 4.0 and business opportunity theory, conducted at the Faculty of Engineering Management at Poznan University of Technology. The research was conducted among a group of 300 medium and large companies operating in 19 industries. It was carried out between November 2024 and February 2025 and involved 240 medium and 60 large companies. In the study sample, there is a small but clear linear correlation between an increase in the availability of data and information to support employee creativity and an increase in the ability to carry out interdisciplinary projects.

Keywords: Knowledge management, Project management, Knowledge base, Industry 4.0, Operational excellence

1. Introduction

The article presents selected results from a sample of 300 companies operating in Poland, focusing on the analysis of the impact of knowledge management tools on project management processes. Due to the increasing turbulence of the business environment, the results can be used to build effective models of operational excellence. This article focuses on the business segment of organisations that customise products and services to meet individual customer needs, or offer new products to new and existing markets. The aim of the paper is to answer the following question: Is there a correlation between the increased availability of data and information based on use of knowledge management tools and the level of increased ability to carry out interdisciplinary projects with accompanied by a positive increase in business development. These questions are a part of a wider research project on Industry 4.0 and business opportunity theory, conducted at the Faculty of Engineering Management, Poznan University of Technology. The research explored how organisations can use flexibility, intelligence and cleverness, supported by KM methods and tools, to discover and exploit market opportunities.

2. Research problem

Environment

In a rapidly changing economic environment, knowledge is a key resource that provides companies with a competitive advantage. The rapid pace of change in the business and technology area requires leaders to be agile and adapt effectively. Knowledge management is defined as the systematic process of creating, sharing, using and managing an organisation's knowledge and information (Mirai et al., 2024; Bukowitz, 2000). The modern business environment is characterised by high volatility and complexity of economic processes, among others:

- Labour shortages.
- Increasing amount of outsourced work.
- Increasing product complexity.
- Disintegration of traditional economic chains and emergence of business networks (Małkowska - Borowczyk, 2011).
- Shortening of the product life cycle and reduces profits, (Porter), (Grudzewski, Koźmiński, 1996), (Wang, 2016). Shorter product lifecycles and the growing role of customisation often means that changes in specifications, and consequently in design and technology, often occur during production phase.

- Changing operational objectives by replacing productivity with efficiency, quality and flexibility, understood as the ability of the organisation to adapt to changes in the environment (Volberda, 1998, p. 13), (Krupski, 2008, p. 6).
- Opportunities that grow in a changing environment (Trzcieliński, 2011, pp. 10-12; Trzcieliński, Kałkowska, Pawłowski, Włodarkiewicz-Klimek, 2016, pp. 9 -12; Goldman, Nagel, Preiss, 1995, pp. 8, 42-43).
- Increasing role of using Industry 4.0 methods and tools (Herman, Pentek, Otto, 2015), (Alcácer, Cruz-Machado, 2019), (Kagermann, Lukas, Wahlster, 2011; Kagermann, Wahlster, Helbig, 2013).
- Increasing customisation of products to meet individual customer needs and increasing complexity of products and services. (Salvador, De Holen, Piler, 2009; Gilmore, Pine, 1997; Duray R. 2002). The results of a study conducted on a large group of companies from eight countries (including the US and Japan) indicate that mass customisation is a very important strategic mechanism that can be applied in many manufacturing and service industries (Salvador, De Holen, Piler, 2009, pp. 71-79). Other research shows that SMEs also adapt to economic volatility and market complexity through product customization strategies (Bamiatzi, Kirchmaier, 2014), amongst others, by enabling entry into new submarkets and deterring potential competitors (Bhaskarabhatla, 2016). Organisations that customise products and services to meet individual customer needs, or offer new products to new and existing markets, implement operational processes according to project management standards.

Literature review

Despite the growing interest in knowledge management (KM), the concept remains elusive due to the absence of a universally accepted definition (Ode, Ayavoo, 2020; Nonaka, 1994). The knowledge management literature often focuses on information technology (IT), where knowledge should be codified, systematised and standardised (Al-Zayyat at all, 2010; Davidson and Voss, 2002). Many organizations begin their knowledge management efforts by trying to understand what they know and where that knowledge is. This was primarily due to the emergence of knowledge-based systems, which played a significant role in this development (Barclay, R. and Murray, P., 2004). Academic research has been conducted on the impact of using knowledge management methods on operational project management and performance levels. The majority of research has sought to identify positive relationships between them. The studies described in the literature were often dealt with a single sector of industry e.g. IT (Reich, Gemino, Sauer, 2013; Al-Zayyat at all, 2010; Foote, and Halawi, 2016), or oil and gas industry (Mirai et al., 2024), or space industry (Cocchiara, Nigro, Roma, Ragusa, 2024). In the literature, we can also find work researching the inverse relationship between the use of project management tools and knowledge management (Clemente, Domingues, 2023). However, Ahern, Leavy, Byrne (2014) in their research indicated that complex project management as a form of complex problem solving is a challenge of knowledge management under uncertainty, no less, they based their research on the analysis of two cases.

Research Problem

In spite of the growing interest in the use of knowledge management in project management, few studies have provided empirical evidence on the relationship between knowledge management practices and operational project management. This article focuses on the business segment of organisations that customise customer needs, or offer new products to new and existing markets. The results can be used to build effective models of operational excellence and this paper is part of a broader research project on Industry 4.0 and business opportunity theory. Operational excellence (OpEx) model needs empirical testing with organisations from different industries and sectors. A detailed breakdown and explanation of each element in terms of the underlying logic and laws that guide it is required (Found at all, 2018). With regard to the above this paper concentrates on two issues:

- Does the increased availability of data and information to support employee creativity and the increased use of knowledge management tools in this market group of companies foster an increased ability to carry out interdisciplinary projects?
- In this group of companies, is the increased use of tools supporting knowledge management accompanied by a positive increase in business development?

3. The Proposed Methodology

3.1 Research Sample, Scope and Methods

The research sample comprised 300 medium and large companies, operating in 19 industries, and included 240 medium and 60 large companies. The research was conducted from November 2024 to February 2025. The respondents comprised individuals directly involved in the management of the production and engineering area, including the president/managing director, the technical director, and other persons with similar competencies. The scope of the research encompassed the degree of product customisation, the extent of data and information availability, the utilisation of tools facilitating knowledge management, and the efficency of achieving a positive increase in business development. In the scope of this study, a questionnaire survey was conducted among a sample of 300 medium and large industrial enterprises in Poland. The survey was conducted in the form of an interview. The respondents were invited to respond on a 1–5 (Likert) scale. In addition, the data was partially processed using the Spearman's rank correlation test (Statistica 13.3).

3.2 Data Processing Methodology

The data collected was processed using the following methodology, based on the approach used in ongoing research on the Industry 4.0 project and business opportunity theory (Pawlowski, 2024):

Step 1 – Group of companies that customise products and services to meet individual customer needs was selected from the research sample for further investigation.

Step 2 – Following a comprehensive analysis of the aforementioned group of companies, two subgroups were identified:

- Group A comprises companies with positive growth in business development.
- Group B comprises other enterprises that have not experienced a positive increase in business development.

Step 3 – In research samples A and B, the following indicators were identified:

- Availability of data and information to support employees' creativity indicator.
- Ability to carry out interdisciplinary projects indicator.
- Use of tools to support knowledge management indicator.

These ratios indicate the proportion of enterprises in which respondents indicated the occurrence of a given characteristic at level 4 or 5 on the Likert scale, in relation to the total size of the given sample. In other words, these ratios demonstrate the intensity of a specific characteristic within each survey sample. The values of the individual indicators were analysed in research groups A and B.

Step 4 – Spearman’s rank correlation tests were carried out for some of the features.

3.2.1 Step 1 – Identification of a group of companies that customise products and services to meet individual customer needs

The following two questions was posed with the objective of identifying the group of companies that offer highly customised products, designed to meet the specific requirements of individual customers:

Q1. We adapt (modify) existing products:

Q 1.1. - to the markets in which we are present;

Q 1.2. - to new markets.

Responses on a scale of 4 and 5 to both questions qualified the company to the group of companies offering highly customised products, designed to meet the specific requirements of individual customers. A total of 128 companies from the entire research sample (N=300) offered highly customised products. The research indicates that 43% of the companies in the research sample are customising products, thus confirming the growing trend that has been identified in the literature research.

3.2.2 Step 2 – Identification of groups A and B in relation to the business development trend

In order to identify groups A and B in relation to the business development trend, the following question was asked:

Q 2. The trend in business development over the last 5 years is:

1 - very negative;

2 - negative;

3 - neutral;

4 - positive;

5 - very positive;

Responses on a scale of 4 and 5 classified the enterprise into group A, responses on a scale of 1 to 3 classified the enterprise into group B. Group A comprises 74 companies, while Group B consists of 54 companies.

3.2.3 Step 3 – Determination of indicators: availability of data and information indicator, ability to carry out interdisciplinary projects indicator, use of tools to support knowledge management indicator.

- Availability of data and information (Availability Indicator).

The following research question was posed to determine the lability of data and information to support employees' creativity indicator in group A and B:

Q 3. The availability of data and information to support their employees' creativity is:

1-very low,

2-small,

3-moderate,

4-large,

5-very high.

Thirty-five companies in Group A (74) have reported a high intensity of the bhad trait, which means an (Availability Indicator) value of 47%, in contrast, the value of the (Availability Indicator) in Group B was 30%.

- Ability to carry out interdisciplinary projects indicator (Interdisciplinarity Indicator).

The following research question was posed to determine ability to carry out (Interdisciplinarity Indicator) in group A I B:

Q 4. The company's ability to implement interdisciplinary projects is:

1-very low,

2-small,

3-moderate,

4-large,

5-very high.

29 companies in Group A indicated answers of 4 and 5 on a Likert scale, which means that an indicator of 31% was reached. Group B, on the other hand, had an indicator of 22%.

- Use of tools to support knowledge management indicator (Tools Indicator).

The following research questions was posed to determine (Tools Indicator). The following technologies:

Q 5. Big Data Analytics (BDA) (BDA is the process of analysing very large data sets to uncover hidden patterns, trends and information that can support better business decisions within a company) are used:

1 - not used at all,

2 - to a very small extent,

3 - to a moderate degree,

4 - to a large extent,

5 - to a very large extent.

Q 6. Big Data Analytics (BDA) They affect the working conditions in the company:

1 - Not used at all

2 - To a very small extent;

3 - To a moderate extent;

4 - To a large extent;

5 - To a very large extent.

Twenty-three companies in Group A indicated answers of 4 and 5 on a Likert scale, which means that an indicator of 31% was reached. In contrast, Group B demonstrated an indicator of 20%. However, it is interesting to note that in the entire survey sample (N=300) the indicator is at 29%, i.e. the value of the indicator in group A is slightly higher than in the entire survey sample, while in group B of companies with a low development trend it is definitely lower at 20%. Also, 43% of Group A companies said that using Big Data Analytics tools has a big or very big effect on their employees' working conditions. In Group B, 38 per cent of the companies surveyed said the same.

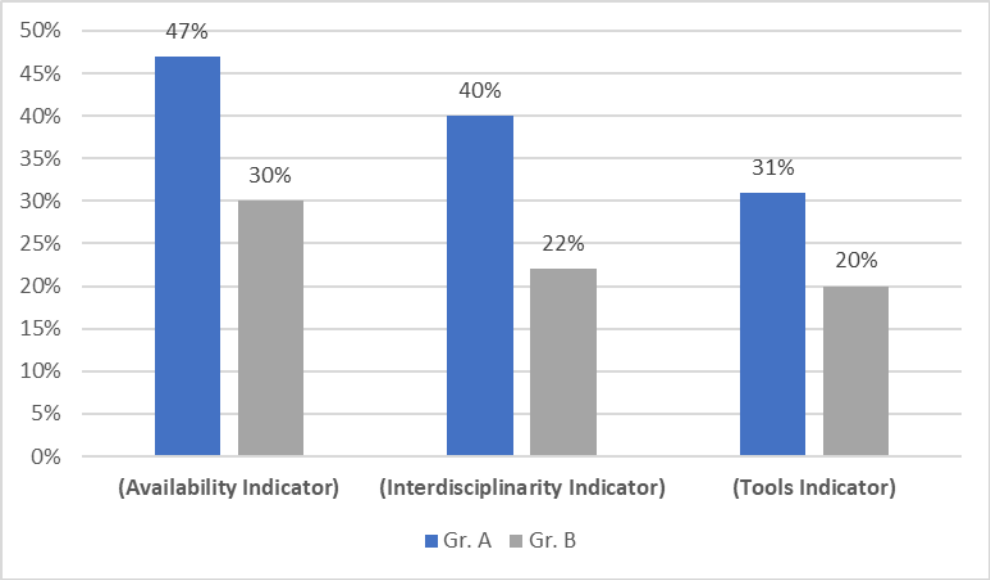

Figure 1: Determination of indicators: availability of data and information to support employees' creativity indicator, ability to carry out interdisciplinary projects indicator, use of tools to support knowledge management indicator

As illustrated in Figure 1, the data provides a comparative summary of the three indicators examined for enterprise groups A and B. The results support the assumption that companies in Group A, which offer highly customised products designed to meet the specific requirements of individual customers and demonstrate a positive or very positive business development trend, achieve significantly higher results for the indicators studied. The increased use of Big Data Analytics tools is combined with greater accessibility to information and an increased ability to carry out interdisciplinary projects.

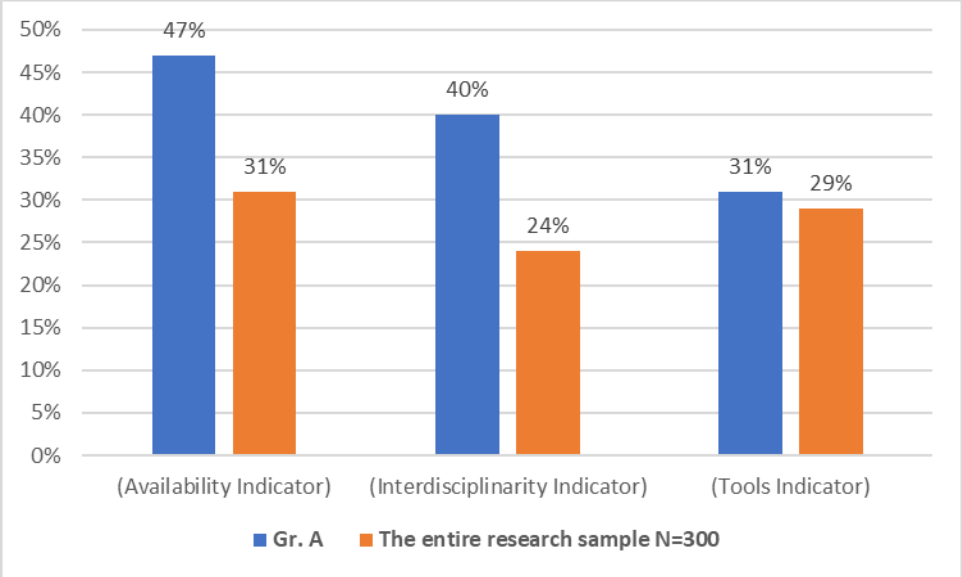

Figure 2: Determination of indicators: availability of data and information to support employees' creativity indicator, ability to carry out interdisciplinary projects indicator, use of tools to support knowledge management indicator in group A and entire research sample N = 300

Figure 2 shows the levels of the indicators studied in enterprise group A relative to the entire research sample N=300. The availability of data and information to support employees' creativity indicator, and the ability to carry out interdisciplinary projects indicator, are significantly higher in research sample A compared to the entire research sample N=300. As indicated earlier, the rate of use of tools to support knowledge management (BDA) is slightly higher in group A enterprises compared to the entire research sample. Analysing Figures 1 and 2, we can therefore assume that in the group of companies adapting products to customer requirements, the increased ability to carry out interdisciplinary projects and the increased availability of information and use of tools (BDA) is conducive to a positive business development trend.

3Step 4 – Spearman's rank correlation tests

Statistical analyses were performed using Statistica 13.1 software. Spearman's rank analysis was performed with a significance level of $p<0.05000$. The strength of the correlations was assessed according to the classification shown below in Table 1. The interpretation of the correlation coefficient does not provide a clear answer on the causal relationship, but it indicates the existence of a certain statistical relationship between the variables studied, which is one of the conditions for the existence of a causal relationship (Małkowska-Borowczyk, 2011).

Table 1: The strength of the correlations

Correlation coefficient value	**Interpretation**
r ≤0.2	Virtually no relationship
0.2< r ≤0.4	Low but clear linear correlation
0.4< r ≤ 0.7	Moderate correlation
0.7< r ≤0.9	Significant correlation
0.9< r ≤1	Very strong correlation

Elaboration based on Ostasiewicz, Rusnak, Siedlecka, (2000) .

Table 2 presents the results of Spearman's Rang correlation between the ability to carry out interdisciplinary projects, availability of data and information to support employees' creativity, use of tools to support knowledge management Big Data Analytics (BDA) and business development trend.

Table 2: Spearman's Rang correlation.

		[1]	[2]	[3]	[4]
[1]	Ability to carry out interdisciplinary projects	x	0,215519	0,067373	0,240773
[2]	Availability of data and information to support employees' creativity	0,215519	x	-0,070026	0,215519
[3]	Use of tools to support knowledge management Big Data Analytics (BDA)	0,067373	-0,070026	x	0,067373
[4]	Business development trend	0,240773	0,215519	0,067373	x

The following conclusions can be drawn from the analysis of Table 2:

- Correlation coefficients marked in red are significant with p <.05000.
- In addition, coefficients circled in yellow indicate low but clear linear correlation (0.2< r ≤0.4). These results were analysed in detail. All of the above statistically significant results are positive, indicating that an increase in one factor is accompanied by an increase in the other.
- An increase in the availability of data and information to support employee creativity is fostered by an increase in the ability to carry out interdisciplinary projects and an increase in the business development trend.

4. Conclusions

In a turbulent environment, the role of product and service customisation is growing. On the operational side, it means implementing processes according to project management methods. One of the symptoms that can be observed in organisations is that employees are required to perform a variety of tasks outside their designated area of specialisation. The aim of the paper was to answer the following question: Is there a correlation between the increased availability of data and information, use of knowledge management tools and the level of increased ability to carry out interdisciplinary projects with accompanied by a positive increase in business development. In a rapidly changing economic environment, knowledge is a key resource that provides companies with a competitive advantage. An analysis of the indicators and Sperman rank correlations indicates a that increase in the availability of data and information is fostered by an increase in the ability to carry out interdisciplinary projects and an increase in the business development trend. In view of the increasing turbulence in the business environment, the results can be used to build effective models of operational excellence.

The analysis of the above results indicates that such a model, in the variant for companies offering customised products or services, should include in its pillars methods supporting project management supported by tools increasing access to information such as Big Data Analytics (BDA).

Of course, the issue of knowledge management in the context of building (OpEx) systems in different business contexts is a broad field for further detailed research.

Ethics Declaration: N/A

AI declaration: AI tool - Elicit.com has been used to search databases for available literature on knowledge management and project management issues. Thanks to the tool, several literature items were identified.

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