Case study **Open Access**

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Investigating the relationship between knowledge management and organizational agility in an industrial company

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Abstract: The main objective of this research work is to examine the way knowledge management (KM) affects organisational agility in an industrial company. To this end, the staff of Bosch Car Multimedia in Braga was chosen as the study population. This study is descriptive in terms of methodology; from the perspective of the purpose, it is applied; and as for data collection, it is a survey. The required data were collected through a questionnaire validated by experts, from academia and from Bosch Car Multimedia. The research hypothesis suggests that there is a significant relationship between KM and organisational agility. Therefore, improving KM through agility variables may contribute to higher levels of competitiveness of companies. KM and agility are dependent, and therefore, the indicators of each of them and their meaning have to be recognised and managed. This study suggests that KM capabilities enable organisations to develop organisational agility, which improves performance.

Keywords: knowledge management, organisational agility, project management

1 Introduction

Knowledge management (KM), a new management method, has been a topic of discussion in the management domain and related fields since the early 1990s. Throughout the twenty first century, organisations emphasise knowledge and information as the most important asset (Khalilnezhad and Daneshvar 2017) for an high level of effectiveness. KM can be viewed as an umbrella term encompassing a variety of solutions used to manage the knowledge of an organisation's employees. The KM strategy and process is aimed at acquiring value from the invisible assets within an organisation.

Shoghi et al. (2017) state that there are two major assets that organisations possess: one is the people who work in that organisation and the other is the knowledge that resides in the minds of the employees of the organisation. Therefore, knowledge needs to be created, stored and used, which is the task of KM. In the last decade, a huge number of studies have proved the importance of knowledge in organisations (Blumenberg et al. 2009). Nevertheless, many organisations today are struggling with the problem that knowledge-sharing activities are not usually part of the official job description for their employees (Cantu et al. 2009).

It has been two decades of changes for competition, and it is clear that these changes are of such a magnitude that they present new management challenges. With new information, constraints or opportunities emerging, agile action motivates practitioners to revise and update early working versions to improve processes or services. These improvements may reduce delivery times, improve the quality of products or services or impact the operations of the programme. In contrast to traditional processes that are only about reporting on results, agile processes are designed to not only to produce detailed documentation but also solve a customer's problem while achieving the outcome (Mergel et al. 2021).

In the current era, agile has been the subject of much research. Therefore, the main objective of this research work is to examine the way KM affects organisational agility in an industrial company. A summary of the notation used in the article is presented in Table 1.

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Tab. 1: Notation used in present article

Abbreviation	Description
IT	IT Infrastructure
KA	Knowledge Application
KG	Knowledge Generation
KIC	Knowledge Management Infrastructure Capabilities
KMS	Knowledge Management Systems
KPC	Knowledge Management Process Capabilities
KR	Knowledge Sharing
KS	Knowledge Storage
OC	Organisational Culture
OS	Organisational structure

2 Background

2.1 Knowledge

2.1.1 Knowledge definition

Thierauf (1999) defines data as a set of unstructured facts and figures, which is the lowest level of information. Next, there would be 'structured data information' and finally knowledge would be 'information about information'.

As a concept, knowledge can be defined as the application, analysis and use of data or information. Knowledge is information and data that are analysed logically and interpreted as a result; it is a structure of meaning that fits within an already existing system of beliefs and knowledge. Knowledge provides several tools for analysing and understanding information, establishing causal links between events and actions and guiding the process of thinking and acting effectively (Sabharwal 2019).

Knowledge is closely related to action and indicates expertise and understanding. A person's knowledge is a product of their experience and includes the norms they use to evaluate new inputs from their environment (Davenport and Prusak 2000).

As a result, it became clear that knowledge played a key role in the business debate (Durst et al. 2012) and that knowledge was one of the most valuable strategic resources that must be managed effectively to achieve a sustainable competitive advantage (Teece 2001).

2.1.2 Knowledge classification

Knowledge can be classified into explicit and tacit knowledge based on its complexity and difficulty. Explicit knowledge refers to knowledge expressed in the official language and can be easily passed from person to person simultaneously and asynchronously, including instructions and computer programs (Raman et al. 2014; Pourdjam et al. 2015; Sabharwal 2019). This type of knowledge may be formalised and represented by codes and is referred to as 'know-what' (Brown and Duguid 1998), being prone to identification, storage and retrieval (Wellman 2009). Knowledge management systems (KMS) are an efficient method for managing this type of knowledge as they assist in storing, retrieving and modifying texts and documents. A database, a note, a document, etc. can include explicit knowledge (Botha et al. 2008).

Tacit knowledge, on the other hand, is the knowledge that is individual to the person within an organisation and includes intangibles such as beliefs, values and personal beliefs.

According to Burnette (2017), tacit knowledge is the individual knowledge that exists within a person's mind, behaviour and perceptions. Tacit knowledge encompasses skills, perspectives, insights, intelligence and judgement. Through conversation, narratives, analogies and interactions, tacit knowledge is generally passed from person to person. It is difficult, therefore, to capture or represent the explicit knowledge of people because their knowledge constantly expands and their perceptions and behaviours evolve. In the case of tacit knowledge, an attempt is made to make this knowledge shareable. However, tactic knowledge doesn't really exist as an exact formula; it is always changing, growing, evolving and reshaping as the knowledge holder's experiences continue to shape it. The main purpose of KM is to codify and make explicit unprocessed knowledge and to reinforce and promote knowledge sharing (KR) (Pourdjam et al. 2015).

Organisations consider knowledge to be a strategic resource and a key competence; thus, KM is on the agenda of leading organisations to make optimal use of this resource. Based on the source of knowledge it originated, knowledge is classified into three categories: individual knowledge, group knowledge and organisational knowledge. As a result, individual knowledge is the knowledge that an individual has acquired and is usually tacit, whereas group knowledge pertains to an individual's knowledge which other individuals trust, share and understand. It should be noted that group knowledge is more than the integration and multiplication of individual changes. It is also the interpretation and perception of people. Organisational knowledge is produced by various entities that work together to create new knowledge. It may be implicit or explicit.

2.1.3 KM

The aim of KM is to make sure that the right knowledge is readily available to the right people. Peter Drucker defined it as 'the coordination and effective utilization of organizational knowledge resources to achieve a competitive advantage' (Drucker 1999). Over new knowledge, disagreement sometimes arises. By definition, Wellman (2009) defines KM as the management of already known knowledge through lessons learned and techniques. In Wellman's view, knowledge creation is frequently viewed as separate from innovation and is generally managed through it.

Another definition by Davenport and Prusak (2000) states that the concept of KM is a system for gathering, organising, maintaining, applying, sharing and renewing employees' tacit and explicit knowledge to boost the performance and value of organisations.

Organisations can gain knowledge from mistakes and successes of past activities and events with good KM (Caballero-Anthony et al. 2021). In addition to that definition, KM can be defined as a process for creating value, improving productivity and maintaining a competitive advantage through the identification, improvement and effective management of intellectual resources (Carrillo et al. 2000; Israilidis et al. 2021).

Project management and KM are among the most effective management methods to improve management efficiency and sustainability in construction. It broadly means the processes of creating, classifying, processing and analysing information about production, management and business (Meneiluik and Nikiforov 2022).

Pannu (2017) identified three primary factors for KM infrastructure assessment in previous studies: organisational culture (OC), IT infrastructure (IT) and organisational structure (OS). Based on the literature, the most important indicators for KM assessment were selected, and the framework of Table 2 was used to group the KM assessment criteria.

Tab. 2: Classification of KM indicators

Component	Indicator
KI	
OC	OC is also known as a set of assumptions, rules, standards, systems and beliefs shared by employees within the organisation that affect their thinking and decision-making (Obeidat et al. 2015).
IT	IT includes various hardware and software that facilitate and help in providing technological capabilities that lead to transfer of knowledge between units (Soud Jaradat and Al Maani 2014).
OS	Definition of hierarchic relationships and sector boundaries of an organisation, and the necessary policies and procedures which create the conditions for managing the designated activities, roles and responsibilities (Gold et al., 2001).
KP	
KG	KG involves the development of new knowledge or the replacement of the existing content of the organisation's tacit and explicit knowledge (Chang and Lin 2015).
KS	This process also includes all activities that allow knowledge to be stored, updated and easily retrieved by users (Al-Shanti 2017).
KR	The process of KR helps people exchange tacit and explicit knowledge and generate new knowledge among the target people (Birasnav 2014).
KA	The purpose of KA is to transform the knowledge into practical application (Dalkir 2005).

IT, IT infrastructure; KA, knowledge application; KG, knowledge generation; KI, knowledge management infrastructure; KM, knowledge management; KP, knowledge management process; KS, knowledge storage; OC, organisational culture; OS, organisational structure; KR, knowledge sharing.

2.2 Agility

2.2.1 Agility definition

In today's competitive environment, agility has emerged as a key organisational asset (Shams et al. 2021; Ferraris et al. 2022) for innovating and gaining competitive advantage (Bresciani et al. 2022). Agility is considered an appropriate means of ensuring speed and effectiveness in adapting business models for companies (Giacosa et al. 2022). This requires the design and implementation of various value-adding activities in this competitive environment (Shams et al. 2021).

McKenzie and Aitken (2012) define agility as the capability of an organisation to rapidly adapt to changing work demands as a key to competitive advantage. Such an organisation ensures that its employees' goals align with its goals, and both respond actively to changing customer needs, working together to improve the organisation.

The key traits of an agile organisation include its ability to respond quickly to market opportunities, unforeseen developments and customer needs. It is evident in such a company that some processes and structures facilitate speed, adaptability and robustness. It has coordinated, simple and orderly processes that provide

competitive performance in an entirely dynamic business environment (Ajdari and Amirnejad 2017).

In these definitions of agility, the organisation is portrayed as being dynamic, positional, variable and growth-oriented. An organisation has a tendency to be dynamic due to the fact that the conditions under which it is agile today may not apply tomorrow. Positioning is important because the market environment determines the level of agility required. The reason for this variability is the way an organisation adapts. As for the latter, it refers to a growth-oriented agility achieved by organisations that are able to articulate a vision, adjust strategies and innovate techniques. Specifically, agility is the ability of an organisation to sense, perceive, consider, analyse and predict changes in the business environment, and according to this definition, the agile producer has a well-organised organisation with a broad vision with its limited capabilities, as well as dealing with constant disruption and turbulence while grasping the positive aspects (Ajdari and Amirnejad 2017).

To survive in a changing business environment, agile organisations require a variety of capabilities (Shahai and Rajabzadeh 2005):

(1) **Responsiveness:** the ability to recognise change and react quickly to resolve it.
(2) **Competence:** the ability to effectively and efficiently accomplish the goals and objectives of the organisation.
(3) **Flexibility/Acceptance:** the ability to handle different processes and achieve different goals using the same skills.
(4) **Speed/Agility/Sharpness:** the ability to perform activities in the shortest possible time.

Based on these principles, a system called strategic competitive capabilities has been developed to integrate them into a cohesive and integrated whole. Thus, to be agile, an organisation should take these four principles into account (Mollahosseini and Mostafavi 2007).

In the future, companies and organisations that compete in a competitive and dynamic market environment should think about developing agile capabilities and use agility as a competitive advantage. One of the problems in focussing on improving agility is the dynamic nature as well as the contingency of a capability already defined by the organisation. Agility is viewed here as a never-ending path of continuous improvement, and since no plan for measuring agility is mentioned in the literature on this theory, it is difficult to determine the specific level of agility required.

2.2.2 Organisational agility

Nowadays, the organisation faces high degrees of uncertainty, complexity and dynamism. It is crucial that organisations develop capabilities to anticipate, respond to and exploit changes in the competitive environment to survive in such an unstable environment and gain competitive advantage. In this context, the concept of organisational agility emerges as an important part of management research (Harraf et al. 2015; Felipe et al. 2017). To be agile, a company must be able to detect and react quickly and fearlessly to opportunities and threats in the environment (Ashrafi et al. 2005; Tallon and Pinsonneault 2011; Aburub 2015; Al-Nsour 2021).

An organisation's agility is becoming more effective as a key competitive advantage in a rapidly changing environment (Žitkiene and Deksnys 2018). Moreover, it is important for companies/organisations to use it to generate the information needed to inform management decision-making (Zain et al. 2005), improve organisational performance (Chatfield and Reddick 2018) and competitive advantage (Cheng et al. 2020) in hypercompetitive environments (Roberts and Grover 2012b). For example, organisational agility is required to search for and retrieve relevant knowledge from the business ecosystem to develop improved products and services (Cegarra-Navarro et al. 2016), establish market channels and segment trade outlets (Sambamurthy et al. 2003). Organisational agility is also important to successfully respond to new competitors in a given market (Cegarra-Navarro et al. 2016). To recognise and adapt quickly to changing customer needs and behaviours (Chatfield and Reddick 2018), any organisation should demonstrate agility in a competitive environment. This also applies to the corporate ambition to quickly and easily identify and capture innovation threats and opportunities, then pooling all required assets, knowledge and business connections (Richardson et al. 2014).

By defining agile business as a profitable organisation accepting constant change and capable of adapting to unpredictable consumer habits, Goldman et al. (1995) introduced the concept of agile business strategy and vision. Organisational agility is dependent on ensuring a balance among cost, time, quality and scope. According to Dove (1996), cost is an essential component to determining organisational agility. In terms of handling market changes, as well as detecting and adapting to them, organisational agility generates benefits for organisations. Particularly, agile organisations are knowledgeable about the current market and actively monitor it (Roberts and Grover 2012a).

Organisational agility enables managers to shape technical processes, time management, quality assessments, productivity assessments and outsourcing initiatives. A classification model was derived from studying these cases and many similar ones until finally a classification model was developed (Table 3).

Tab. 3: Classification of organisational agility assessment indicators (Swafford et al. 2006)

Indicator	Components
Flexibility	Production model flexibility, production system flexibility, flexible workforce, flexibility structure and methods, flexible workplace and flexible business strategy
Responsiveness	Responding to changes in demand, responding to changes in the business and market environment, responding to changes in social environmental achievements and the degree of adaptation of business goals to changes
Culture of change	Continuous improvement, product-related change capability, reconfiguration capability, supporting the learning environment, change management, changing organisational responsibilities and continuous monitoring of internal and external environment to identify opportunities and threats
Speed	Learning to perform tasks and operations in the shortest possible time, operation time, production change time, time of the delivery of products and services, learning time and adaptation time to change
Low integrity and complexity	Integration inside and outside the organisation, integration of individuals, technology and organisation, combination of technology, conflicting skills and competencies, flow of materials, products and suppliers, and facilitating change
High quality and custom production	Goods and services with high volume of information and added value, quality throughout the life of the product, correct and timely decision and short development cycle time
Central competence	Multi-risk capability, difficulty in copying developed business methods, skills and knowledge of increasing technologies, close communication with customers and suppliers, customer enrichment, customer incentive innovation, customer satisfaction, and cooperation and collaboration for increased competitiveness
Human resources	Employee empowerment, job rotation, decision-making independence, access to knowledge and information, teamwork, multitasking teams, manpower training and development, and individual initiative

2.3 Relation between KM, organisational agility and performance

KM, organisational agility and performance are closely interconnected and influence each other in various ways:

2.3.1 KM and organisational agility

As the business environment continues to change, organisations require specialised knowledge to build capacity, which enables them to capture more market share while providing high-quality products and services (Haider and Kayani 2021). Knowledge-based culture and structure are provided by knowledge management infrastructure capabilities (KIC), which sets norms and provides structural assistance from management (Gyemang and Emeagwali 2020). With KIC, organisations are able to match agility to market changes and utilise those (market changes) through a knowledge-based structure.

KM is the collection, organisation and use of both explicit and tacit knowledge within an organisation. This knowledge can be a valuable resource to help improve organisational agility (Gyemang and Emeagwali 2020).

By facilitating knowledge management process capabilities (KPC), organisations can leverage knowledge resources to bring operational efficiency by deploying them in conjunction with other organisational resources and competencies. Agile organisations are noted to be proficient at identifying, accumulating and deploying the right knowledge at the right place by the right people at the right time, as Pereira et al. (2019) pointed out. As organisations become aware of the external environment's needs, they respond with robust solutions, by tailoring their processes and strategies and by adjusting their operational capabilities to be more agile by changing business operations in new ways, which is indicative of agility. Hence, the KPC strategy fosters the use of innovations, higher risk-taking and increased risk-taking by firms to stay competitive (Revilla et al. 2010). Therefore, KPC is an important capability that promotes organisational agility.

According to Mehdibeigi et al. (2016) research, customer KM positively impacts organisational agility. According to the results, customer KM contributes positively to organisational performance, and its influence on performance through organisational agility is greater than its direct effect on performance. Thus, organisational agility plays an important role as a mediator.

Effective KM enables companies to respond and adapt quickly to changing market conditions, customer demands and technological advances. KR, collaboration

and learning contribute to increased organisational agility (Gyemang and Emeagwali 2020).

2.3.2 KM and performance

Knowledge is seen as a vital asset for business. Every organisation needs a way to manage, use and apply knowledge (Kogut and Zander 1996). KM helps you reconfigure your activities and perform better than before. Various studies such as Hamel (1990) proposed that the organisations can be more competitive by generating knowledge in all sectors. The competitiveness of any firm depends on KM (Zack 1999). 'Knowledge has long been recognised as a strategic resource, knowledge creation and use is ambiguous, but knowledge enables companies to build a sustainable competitive advantage' (Teece 1989).

Effective KM practices have a positive impact on business performance. When organisations capture and share knowledge effectively, it leads to more innovation, better decision-making, less duplication of efforts and greater efficiency. Sharing best practices and lessons learned across departments and teams helps improve performance by preventing mistakes, encouraging continuous learning and fostering a culture of KR (Haider and Kayani 2021).

2.3.3 Organisational agility and performance

Organisational agility is the ability of an organisation to quickly and effectively respond to internal and external changes. Agile organisations are better able to adapt, innovate and seize opportunities. This agility translates into better overall performance by enabling organisations to increase customer satisfaction, improve operational efficiency, meet business objectives and gain a competitive edge in the marketplace.

Overall, KM plays a crucial role in driving organisational agility, while both KM and organisational agility contribute to improved performance. Through effective KM, companies can become more agile, which has a positive impact on overall performance (Hackman and Wageman 1995).

3 Methodology

3.1 Research hypothesis

This research aims to determine whether or not there is a significant relationship between dimensions of KM and organisational agility in Bosch Car Multimedia in Braga, Portugal.

3.2 Materials and methods

In terms of data collection method, this study is objective, descriptive and cross-sectional. It was developed with a questionnaire divided into three parts. In the first part of the questionnaire, respondents are asked about their demographic characteristics (e.g. gender, age, education level, work experience and position). In the second section, organisational agility is examined, and in the third section, KM is discussed. In this study, variables were measured using a five-point Likert scale, from 'strongly disagree' (1) to 'strongly agree' (5).

The questionnaire includes 51 questions adopted from previous studies (Guru Dev et al. 2015; Etehadi et al. 2019). The dimensions of organisational agility were flexibility, responsiveness, culture of change, speed, integrity, quality, competence and human resources. In addition, KM includes two dimensions, namely KM infrastructure and KM process. The questionnaire is included in the Appendix.

3.3 Data collection and sample characteristics

The study population included the employees of Bosch Car Multimedia in Braga, Portugal. A random sample of 50 individuals from all levels (including managers, employees and researchers) was selected based on the availability of employees. During the data collection process, questionnaires were sent via email, and respondents were given a few days to record their responses. Two of these questionnaires were considered unacceptable due to inconsistencies in the answers. Consequently, 48 completed questionnaires were used for data analysis.

3.4 Validity of the research

To check the validity of the questionnaires, the ideas of experts, an academic and some professionals from Bosch Car Multimedia, were used.

3.5 Data analysis

The findings are examined in two parts: descriptive and inferential. In the descriptive analysis section, statistics such as mean, standard deviation and frequency tables have been used, and in the inferential analysis section,

appropriate statistical tests have been used to reject or accept the research hypothesis.

3.6 Descriptive statistics

The results of the study are related to the demographic variables. The scattering parameters and the associated graphs show that 19 respondents (39.6%) of the 48 were male and 29 (60.4%) of the respondents were female. The number of females is relatively higher than that of males (Table 4).

Most of the respondents were in the 31- to 40-year age group (68.8%), and the fewest number in the age group was in 41–50 years (6.3%) (Table 5).

The highest number of education of staff in Bosch Car Multimedia with a master's degree was 40 (83.3%), and the lowest was two respondents (4.2%) with a bachelor's degree (Table 6).

It was observed that eight respondents (16.7%) had <1 year of work experience. Nine respondents (18.8%) of employees had 2–3 years of work experience, four respondents (8.4%) of employees had 3 years of work experience or more, and subsequently, the higher number of work experience is related to groups of 1–2 years (27 respondents) (Table 7).

Tab. 4: Frequency distribution of statistical samples by gender

Gender	Frequency	%
Male	19	39.6
Female	29	60.4
Total	48	100.0

Tab. 5: Frequency distribution of statistical samples by age

Age (Years)	Frequency	%
21–30	8	16.7
31–40	33	68.8
41–50	3	6.3
>50	4	8.3
Total	48	100.0

Tab. 6: Frequency distribution of statistical samples by education

Education	Frequency	%
Bachelor	2	4.2
Master	40	83.3
Ph.D.	6	12.5
Total	48	100.0

The highest number of respondents was from employees in the group (64.6%), and the fewest number in the age group was from managers (10.4%) (Table 8).

3.7 Descriptive indicators of the main research variables

Table 9 shows the general information of the statistical indicators of the research variables (obtained through the average scores of the questions of each variable), which include the indicators of central tendency and the indicators of dispersion tendency.

According to Table 9 and the mean values, all variables have mean values above three and lower than four, near the central value of the scale. It can also be said that the highest mean belongs to quality, and the lowest mean belongs to speed. The standard deviation also shows the amount of data scatter from the mean point, and according to the table, the largest standard deviation belongs to quality, and the lowest standard deviation belongs to agility.

3.8 Inferential analysis

In this section, we examine the research questions and test the hypothesis. In the first step to select the appropriate statistical test to answer the questions, the normality of the research variables should be tested. The Kolmogorov–Smirnov test was used for normality test, the results of which are shown in Table 10.

According to the results of the Kolmogorov–Smirnov test, for all major variables, at the confidence level of 0.95, the claim that the desired distribution is normal

Tab. 7: Frequency distribution of statistical samples by work experience

Work experience (years)	Frequency	%
<1	8	16.7
1–2	27	56.3
2–3	9	18.8
>3	4	8.4
Total	48	100

Tab. 8: Frequency distribution of statistical samples by position

Position	Frequency	%
Manager	5	10.4
Employee	31	64.6
Researcher	12	25.0
Total	48	100.0

Tab. 9: Descriptive statistical indicators of the main research variables

Variable	Central orientation indicators		Dispersion tendency indicators		
	Mean	Median	Variation range	Variance	Standard deviation
Agility	3.26	3	2.06	0.322	0.57
Flexibility	3.19	3	2.8	0.442	0.66
Responsiveness	3.14	3	2.33	0.396	0.63
Culture	3.12	3	2.4	0.43	0.66
Speed	3.03	3	2.33	0.516	0.72
Integrity	3.21	3	2.75	0.535	0.73
Quality	3.48	3.67	3	0.557	0.75
Competence	3.44	3.33	2.33	0.355	0.60
Human resources	3.46	3.4	2.2	0.366	0.61
KM	3.24	3	2.32	0.425	0.65
Infrastructure	3.27	3	2	0.336	0.58
Process	3.21	3	2.82	0.528	0.73

KM, knowledge management.

Tab. 10: Kolmogorov–Smirnov test results

Variable	Test statistics	Significance level	Test result
Organisational agility	0.109	0.200	Normal
Flexibility	0.123	0.200	Normal
Responsiveness	0.120	0.066	Normal
Culture	0.063	0.095	Normal
Speed	0.114	0.185	Normal
Integrity	0.147	0.521	Normal
Quality	0.096	0.092	Normal
Competence	0.138	0.172	Normal
Human resources	0.106	0.068	Normal
KM	0.191	0.796	Normal
Infrastructure	0.120	0.200	Normal
Process	0.110	0.200	Normal

KM, knowledge management.

was accepted (because the significance level of the test is greater than the error level of 0.05 [$p < 0.05$]) and related hypothesis was tested. Thus, with these variables, we had to use parametric tests.

After determining the significance and direction of the relationship, the Pearson correlation coefficient should be evaluated.

The correlation coefficient is always a number between 1 and –1. A correlation coefficient between 0 and 1 means having a positive correlation, and the closer this coefficient is to 1, the stronger the correlation. A positive correlation means that by increasing the score of one variable, the score of another variable also increases.

The correlation coefficient between 0 and –1 means having a negative correlation between two variables, and the closer the number is to –1, the stronger the negative correlation. Negative correlation means that when the score of one variable decreases, the score of another variable decreases.

To interpret the correlation coefficient, the following guide is used (Miller et al. 2002):

- A coefficient between 0 and 0.2 indicates lack of correlation or too weak correlation
- The coefficient between 0.2 and 0.4 indicates a weak correlation
- The coefficient between 0.4 and 0.6 indicates moderate correlation
- The coefficient between 0.6 and 0.8 indicates a strong correlation
- A coefficient between 0.8 and 1 indicates a very strong correlation

The Pearson correlation coefficient test was used to examine the relationship between KM and organisational agility. The results are shown in Table 11.

As can be seen in Table 11, for example, in the displayed output, in the first row, the correlation coefficient between KM and organisational agility is 0.875. This correlation coefficient shows that there is a positive correlation between these two variables, that is, as the level of organisational agility increases, the amount of KM also increases. Also, according to the amount of Sig or significance, it can be seen that the relationship between these two variables is significant.

Tab. 11: Pearson correlation coefficient test results between KM and organisational agility

Variable	KM	
	Pearson correlation coefficient	Significance level
Organisational agility	0.875	0.000
Flexibility	0.767	0.000
Responsiveness	0.705	0.000
Culture	0.853	0.000
Speed	0.856	0.000
Integrity	0.810	0.000
Quality	0.535	0.000
Competence	0.714	0.000
Human resources	0.672	0.000

KM, knowledge management.

Tab. 12: Regression model summary

Model	Correlation coefficient	Coefficient of determination	Durbin–Watson
Regression	0.875	0.766	1.867

As a result, the correlation coefficient between all variables is significant at the level of 0.05. It can be said that the relationship between organisational agility and each of its dimensions, flexibility, responsiveness, culture, speed, integrity, quality, competence and human resources with the variable KM is significant and in a positive direction.

In Table 12, regression was used to investigate the effect of KM on organisational agility. Therefore, agility was considered a dependent variable, and KM was as a predictor. The results can be seen in Table 12.

The third column is called the coefficient of determination, which is the same as the square of the correlation coefficient. Values close to one indicate a better fit as well as a greater contribution to the expression of changes in the dependent variable by the 'ordinary least squares' (OLS) model. This value in Table 12 is equal to approximately 0.77, which indicates the contribution of 77% of the model in expressing the dispersion of the dependent variable (agility).

According to Table 12, because the value of the Durbin–Watson is between 1.5 and 2.5 (Forghani and Tavasoli 2017), it can be said that the hypothesis of error independence is confirmed. The value of the coefficient of determination is equal to 0.766. Therefore, it can be said that about 77% of changes in dependent variables (organisational agility) are expressed by KM.

The next part of the interpretation of the regression is related to the analysis of the variance table. In this table, the changes' sources are separated and presented in three sections.

- The variation or dispersion described by the regression model. In the table, this source is identified with the term **regression**.
- The changes that are determined based on the residuals (error) obtained from the regression model. The term **residual** can be seen in the table to determine this source of changes.
- Changes or total dispersion, which is made based on the sum of the squares of the distance of the dependent variable values from their mean. The row corresponding to the **total** statement displays the total changes.

The second column specifies the Sum of Squares, for each source of change.

The third column is dedicated to 'degree of freedom'. The degree of freedom is related to the sources of dispersion. Total dispersion has N-1 degree of freedom because an estimate (overall average) has been made; as a result, one unit is reduced from the degree of freedom. This means that from N observation, one cannot changed freely and N-1 observations can change freely because the total average is predetermined. In this case and in our example, N = 48 individuals, so the degrees of freedom for the total variance are 47.

In the fourth column, the average of the sum of squared dispersions (or variance) for two sources of regression model changes (MSR) and residuals (MSE) is obtained. Averaging is done by dividing each of the sum of squares values by the degree of freedom.

Therefore, in the fifth column, F ratio, the calculation is obtained by dividing MSR by MSE. The larger this value is, the more appropriate the regression model will be.

The last column (significance value) also specifies the magnitude. The larger the value of F, the closer the significance value is to zero. A value <0.05 for significance value indicates a suitable regression model. A value of 0.05 is considered the same type I error.

In Table 13, the value of F is large and the significance value is equal to zero and is <0.05. Therefore, regression is significant.

In Table 14, the column β is the mean and the column standard error is the standard deviation of the estimators of each of the regression coefficients.

Tab. 13: Analysis of variance

	Sum of squares	Degrees of freedom	Mean square	F statistic	Significance value
Regression	11.604	1	11.604	150.343	0.000
Residues	3.551	46	0.0770		
Total	15.155	47			

Tab. 14: Coefficients of regression model variables

Variables	Unstandardised coefficients		Standardised coefficients	T statistic	Significance value
	β	Standard error	β		
Constant coefficient	0.787	0.205		3.830	0.000
KM	0.763	0.062	0.875	12.261	0.000

KM, knowledge management.

To specify the importance of each of the variables and their role in the regression model, the standardised coefficients column should be considered.

Columns T statistic and significance value have also tested the assumption of coefficients. The larger the value of T, the weaker the assumption of zero coefficient and the greater the role of that variable in modelling. This magnitude is also determined by the significance value. If the significance value is <0.05, the null hypothesis, which indicates that the variable is ineffective in the model, is rejected.

In Table 14, it is observed that significant values for KM are <0.05. Therefore, with 95% confidence, we can say that the coefficient of effect of this variable is significant in the regression model. As a result, it can be said that KM is a significant predictor of organisational agility.

4 Conclusions, limitations and future research

The goal of this study was to examine the relationship between KM and organisational agility at Bosch Car Multimedia in Braga, Portugal. The correlation coefficient of Pearson is used to investigate the relationship between the variables based on the Kolmogorov–Smirnov analysis considering the normality of the data. According to the results presented in the previous section, results of the hypothesis test, specifically regression analysis, were presented to examine the relationship between KM and organisational agility. The hypothesis was rejected. Therefore, our results indicate that there is a significant relationship between KM variables and organisational agility.

As a result, the findings show that KM enables the organisation to learn from its mistakes and successes and that it allows the organisation to protect and leverage its knowledge more effectively. This increases the organisation's ability to innovate. Thus, managers should effectively use the knowledge they have today to predict what knowledge they will need in the future. Managing the organisation's communication and decision-making processes can also encourage more employees to collaborate. Using technology to strengthen the knowledge base is another suggestion.

In general, agility refers to an organisation's ability to adapt quickly and efficiently to change in the environment. In an effort to be agile, an organisation must cultivate and strengthen various competencies and skills to remain competitive. In a turbulent environment, agile organisations take advantage of opportunities and gain a competitive advantage through their innovations.

Finally, this research results reinforced some of the suggestions made by previous researchers (Meredith and Francis 2000) to achieve agility in organisations:

(1) The structure of the organisation should be flexible. This capability can be achieved by introducing flexible structures and promoting a culture of unforeseen changes.
(2) The organisation should be able to take the most of the intelligence and agility of human resources and have strategies for effective development of various skills.
(3) Given the implementation of KM plans, future research may consider the cost and efficiency of KM practices in solving various problems within the organisation.

Several limitations of this study suggest directions for future research. First, this survey is based on Portuguese company members, so the findings may not be applicable to other countries or cultures. Therefore, future studies may draw conclusions for other industries or regions to obtain a balanced view and to test whether the results are applicable from an international perspective.

Secondly, the data collection for the research was carried out at specific time points. For future studies, it will be of major advantage to analyse the firm at different points in time to observe the impacts of KM and organisational agility.

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Appendix

Questionnaire

Dear respondent;

This questionnaire is in line with an article on 'The Relationship Between Knowledge Management and Organizational Agility'. It has been compiled in two separate sections (questions related to **Agility** and questions related to **Knowledge Management**).

Agility
Agility is the rapid response to environmental changes and competitive needs.

Knowledge Management
Knowledge Management is the acquisition of the right knowledge for the right people at the right time for their precise decision making.

Please compare the **Agility** of your company to the strongest competitor according to the description provided and choose one of the following five options that represent the status of your company.

Too much: You are much stronger than your competitors in this field

High: You are stronger than your competitors in this field

Medium: You are equal to competitors in this field

Low: You are weaker than your competitors in this field

Very low: You are much weaker than your competitors in this field

However, in the **Knowledge Management** Questions section, select one of the five available options that show the status of knowledge Management in your company.

Example

In the first question: the level of readiness of the company's production system for the production of various products:

Select option (1) if the company's product diversity is very small compared to the most powerful producer in the country. In the same way, as the variety of your products increases compared to the superior competitor, change your answer to higher options.

Participant information

1. **Gender**
   ☐ Male ☐ Female ☐ Other
2. **Age**
   ☐ 21–30 ☐ 31–40 ☐ 41–51 ☐ More than 51
3. **Education**
   ☐ Bachelor ☐ Master ☐ Ph.D.

4. **Work experience in the company**

☐ Less than 1 year ☐ 1–2 years ☐ 2–3 years ☐ More than 3 years

5. **Position**

☐ Manager ☐ Employee ☐ Researcher

Agility Evaluation Questions (Comparison with the strongest competitor)

		Very low	Low	Medium	High	Very high
Flexibility						
1	The level of readiness of the company's production system to produce various products					
2	The degree of readiness of the company to change the production volume of products at the appropriate time					
3	The ability of company employees to perform a variety of tasks					
4	The possibility of changing the number of employees of the company in consecutive time periods					
5	The degree of attention to flexibility in formulating strategies					
Responsiveness						
6	The ability of the company to respond to diverse customer demands (in terms of product variety and quantity)					
7	The extent of the company's ability to respond appropriately to changes in the environment (raw material prices, government policies, etc.)					
8	The extent of the company's ability to take advantage of environmental opportunities (seasonal changes, popularity in society, etc.)					
Culture of change						
9	The degree of willingness of senior management for the progress of the company					
10	The level of readiness and acceptance of employees for innovation in all areas of work					
11	The rate of formation of appropriate training courses for employees of different levels					
12	The degree of positive attitude to change in different areas of the company					
13	The amount of identifying opportunities and environmental threats and exploiting them					

(*Continued*)

Continued

		Very low	Low	Medium	High	Very high
Speed						
14	The ability of company employees to quickly learn new tasks					
15	The speed of action of employees in doing work					
16	The ability to produce and deliver goods needed quickly to customers					
Integrity						
17	The degree of coordination between the internal environment (employees, goals, rules, etc.) and the external environment (competitors, suppliers, market, etc.)					
18	The ability of employees to exploit the technologies used by the company					
19	The degree of coordination in the flow of raw materials (from warehouse to production line)					
20	The degree of coordination between raw material suppliers, production process and distributors					
Quality						
21	The quality of manufactured products					
22	The amount of necessary information about the product to customers					
23	The degree of continuity of product quality during its useful life					
Competence						
24	The degree of ability to deal with different risks simultaneously (competitors' pressure, demand reduction, etc.)					
25	Extent of measures taken to prevent competitors from copying the designs and technologies used by the company					
26	The ability of the company to form rapid cooperation with competitors and suppliers					
Human Resources						
27	The level of attention to employees' opinions in decision-making					
28	The degree of independence of employees in making decisions related to their work					
29	Employee access rate to the required information and knowledge					
30	The amount of work done by team					
31	The level of attention to the individual initiative of employees in the company					

Knowledge Management Evaluation Questions (in your company)

		Very low	Low	Medium	High	Very high
KNOWLEDGE MANAGEMENT INFRASTRUCTURE						
1	The possibility of implementing knowledge management in the company					
2	Existence of a positive attitude of high-level managers towards the implementation of knowledge management					
3	The degree of attention to acquire, support and develop knowledge as a tool of competitive advantage					
4	The degree of attention to the values of knowledge management in the company's programs					
5	Existence of leadership and senior management interested in knowledge management					
6	The degree of consistency of the company structure with the knowledge management process					
7	Existence of information technology infrastructure in accordance with the goals and needs of the company and employees					
8	Ability to record existing information and knowledge through information technology tools (computer databases, etc.)					
9	The possibility of using computer and Internet networks to exchange information					
10	Existence of training courses to develop and improve the knowledge of employees and managers of the company					
KNOWLEDGE MANAGEMENT PROCESS						
11	The readiness of the company to create and accept new knowledge					
12	Existence of access to experiences, technologies, advanced and new skills					
13	Take appropriate measures to maintain (record) knowledge and promote innovation in the company					
14	Ability to organize and codify knowledge in existing databases					
15	The amount of effort to survive and maintain knowledge (after entering and acquiring it)					
16	Number of seminars, learning programs and working groups to strengthen knowledge					

(*Continued*)

Continued

		Very low	Low	Medium	High	Very high
17	The degree of ease of access to knowledge due to the proper arrangement of processes					
18	Ease in the process of receiving and transmitting information (created or acquired)					
19	The appropriateness of staff knowledge with their needs					
20	The use of existing (known) knowledge to make decisions and achieve company goals					