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# EJKM Volume 21, Issue 2

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# How to Measure Knowledge Economy

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**Abstract:** The paper's primary goal is to analyse the development of Knowledge Economy (KE) measurement methods ranging from those based on national income to indices identifying and combining the relevant indicators. The paper focuses on four current global and European KE level indices: Global Innovation Index (GII), Global Knowledge Index (GKI), European Innovation Scoreboard (EIS), and Digital Economy and Society Index (DESI), highlighting persistent significant differences in the perception of the very essence of KE, as there is no clear interdisciplinary definition of the initial concept of knowledge, leading to further problems with ambiguous and insufficiently specific definitions and measurement of KE. Tacit aspects of knowledge are rarely part of KE definitions or measurements, excluding a large part of the knowledge system from KE measurements. The results of the analysis show that the set of KE indicators used by the individual KE indices is heterogeneous, with the set of intersecting indicators having different weights in terms of importance. Frequent interventions in the indices by their authors were observed, such as changes in index methodology, the indicators used, main pillars (subindices), etc. Despite the high heterogeneity in the approach to measuring KE, we identified the pillars, which can be viewed as the core pillars of KE. These include, for example the level of ICT, R&D, human resources, innovation, patents, and education.

**Keywords**: Knowledge economy, Measurement, Knowledge index, Tacit knowledge

## 1. Introduction

The 1960s represent the initial phase of significant socioeconomic changes related to the massive deployment of automation and scientific discoveries. While 1915-1965 was a period of stability and continuity with the smallest changes over the last 300 years, the 1960s started a period of discontinuity in the context of the world economy. A period of changes in technology, in the economy, in the structure of industry, in the necessary knowledge, and in the knowledge to manage these changes has begun. With the arrival of computers, we realised that information is a form of energy. While electricity has been perceived as the cheapest form of energy for mechanical work, information began to be perceived as energy for the work of the mind. In the 1960s, energy for the work of the mind became more and more readily available (Drucker, 1992). The emergence of the so-called information society was discussed in the mid-1960s in the Japanese magazine Hoso Asahi focused on broadcasting, published by the television network and newspaper publisher Asahi, where the emergence of the information society and television culture was a frequent topic of discussion (Steinberg and Zahlen, 2017). Several authors such as Tadao Umesao, Yondji Masuda, and Jiro Kamishima published articles about the information society in the journal, (Duff et al., 1996). However, at the same time, we can assume that back then could have already been influenced by the publication of the economist F. Machlup (1962), who decided to analyse the American economy in terms of production and distribution of knowledge. Naturally, the forthcoming changes also began to be discussed among sociologists (Bell, 1973; Toffler, 1980). The transition from the industrial to the post-industrial economy has also been interpreted in social sciences using a wave model when an older wave is not yet exhausted as a new wave is arriving. Individual countries of the world may sense the impact of both waves combined, and thus the industrial and knowledge economy operate side by side (Toffler et al., 1995). Giving the new incoming society a common name has been a great challenge so far. In social sciences, terms such as information society, post-industrial society, white collar revolution, connected society, telematic society, information revolution, digital revolution, or information era were used at that time. We decided to conduct a short informetric survey in the Web of Science (WoS) Core Collection bibliographic database with the aim of identifying the most relevant designation of the new economy in our paper and to determine the most frequently identified names of the new economy (information economy/information economics; knowledge-based economy; knowledge economy) being the most preferred in the current expert discourse. For this purpose, we formulated four queries, TOPIC: ("information economy"/"information economics"), TOPIC ("knowledge economy") and TOPIC ("knowledge-based economy"). All queries were refined by time span 1900-2022, and indices SCI-EXPANDED, SSCI, A & HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC. It turned out that the first records of scientific papers using the phrase "information economy" appeared already in the early 1970s, but later their use weakened. We also observe that the actual



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professional interest in the topic of knowledge economy began in the late 1990s, with the frequency of occurrence of the terms Knowledge Economy (KE) and Knowledge-Based Economy (KBE) having increased significantly, while the designation KE is currently used in professional literature approximately twice as often as KBE. These results are shown in Figure 1. For this reason, we decided to use the term Knowledge Economy (KE) in our paper.

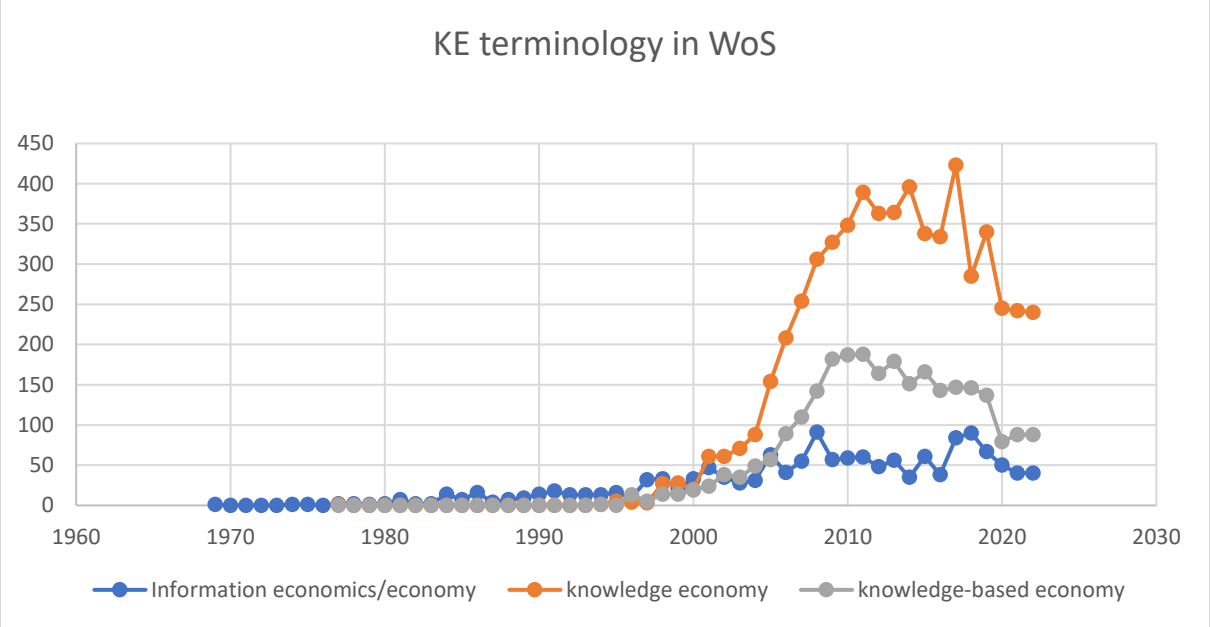


**Figure 1: The Evolution of KE Terminology in the WoS Database**

## 2. The Advent of KE

Some authors trace the origins of the KE's first wave back to the work of J. Schumpeter on the importance of innovation within the concept of development (Schumpeter, 1934) or Hayek's theory of knowledge (1937; 1945), which made a significant contribution to economics and to social sciences. Hayek (1945) tried to capture the relationship between knowledge and economics, perceiving knowledge more as subjective cognitive processes. He pointed out that social knowledge is more like incomplete and often mutually exclusive knowledge owned by individuals. In fact, in real life, no one has perfect information, but we have the skills and abilities to find it. However, such a kind of knowledge is largely subjective and is difficult to cover by statistics. In 1949, philosopher G. Ryle formulated the idea of subjective knowledge, adding the know-how type of knowledge to the traditional know-what notion, defined as disposition, skill, and a matter of competence (Ryle, 1949), followed by the philosopher M. Polanyi (1962), who came up with a theory of (subjective) inexpressible, tacit knowledge.

Probably the most frequently mentioned milestone on the path to KE is the work by F. Machlup (1962), who pointed out the increasing share of knowledge in the national budget, that knowledge is closely related to the increase in productivity, and that we are witnessing a shift of requirements from physical labour to "brain workers". He therefore decided to define the concept of knowledge and, consequently, based on the definition, to be the first to measure the production and distribution of all types of knowledge in the USA. When defining knowledge, he continued the established trend of G. Ryle and F. A. Hayek and expanded focus to subjective types of knowledge. Thus, in his understanding, knowledge is not only traditional "true" knowledge, breaking out of a purely positivist perception of knowledge. His take on knowledge also included statements, assumptions, hypotheses, regardless of the degree of their verification. He divided the set into 5 subsets of knowledge: practical, intellectual, small-talk, spiritual, and "unwanted" (Godin, 2010). In addition, while other measurements at that time were devoted to measuring the production of exclusively scientific knowledge, without measuring the distribution of this knowledge in society, Machlup decided to take a broader view of the context of knowledge in society and extended the scope of interest from creation to distribution of knowledge as another economically significant stage of the knowledge process in society.

A few years later (1969), P. Drucker's book The Age of Discontinuity is published, which provides straightforward evidence of significant socioeconomic changes and the end of a relatively lengthy period of continuity. In his

 

publication, Drucker as a management theorist analysed changes in society, the emergence of the knowledge industry and the KE, and he considered the measurement of the so-called knowledge workers – a term coined by himself – as the basis for measuring economic potential and economic power. In the scientific community, he is considered the founder of the discipline of Knowledge Management (KM), a novel approach to managing knowledge workers as knowledge owners. He pointed out that knowledge rather than science as such became the basis of modern economics and drew his attention to practical application of knowledge. Knowledge becomes the main cost, investment, and main product of developed economies and the livelihood of the largest groups on the population (Drucker, 1992).

In 1973, sociologist Daniel Bell joined the scientific debate with his publication The Coming of Post-Industrial Society (1973). He pointed to the shift from manufacturing to services and the rise of a new technical elite, yet his perception of knowledge was limited to theoretical knowledge and new science-based industries. Two years later he pointed out in his work Social Framework of the Information Society that at that time 70% of the workforce was in the services sector, which was also too heterogeneous in terms of knowledge intensity. He therefore proposed to distinguish five sectors of the economy: primary (agriculture, mining, fishing, carpentry, etc.), secondary (goods production, construction industry, production of stable and unstable goods), tertiary (transport, shipping, utilities), quaternary (trade, finance, insurance, real estate), and quinary (health, education, research, state administration, etc.). (Bell, 1980).

In 1977, Marc Uri Porat elaborated a report for the U.S. Department of Commerce/ Office of Telecommunication titled The Information Economy (Porat, 1977) to define and measure information activity in the U.S. economy. He dedicated his work to F. Machlup and D. Bell, who had served him as the basis for his work. The Porat's report launched a series of similar analyses in various countries and international organisations.

The 'first wave' of KE also includes the publication by futurologist and sociologist Alvin Toffler – The Third Wave (Toffler, 1980), focused on technologies such as waves introduced by people throughout history. He distinguished three waves: agrarian, industrial, and postindustrial, the latter being characterised by the mass deployment of ICT that creates unlimited possibilities for the transmission of information. He discusses postindustrial economy, where information and what people can do with it with their intellect play a vital role.

The second wave of KE has been mapped since the 1990s and extends till the present day and is associated with increased interest of international organisations in KE and the possibility of its measurement, as well as with the arrival of KM as an academic discipline.

As we have indicated, against the background of several emerging problems, we see that there is a problem with a clear definition of the semantic content of the concept of knowledge and with its precise comprehensive delimitation. This problem can then be implicitly perceived in subsequent complications with the creation of a KE definition and with the possibilities of KE measurement. Smith (2002) and, similarly, Carlaw (2006) state that there is no coherent KE definition. The definitions offered by international institutions are too broad and too abstract for measurement purposes. For example, the Organisation for Economic Co-operation and Development (OECD) (1996) defined KE as an economy that is directly based on the production, distribution, and use of knowledge and information. The World Bank (Chen and Dahlman, 2006) views KE as one that utilises knowledge as the key engine of economic growth. It is an economy where knowledge is acquired, created, disseminated, and used effectively to enhance economic development. Authors of scientific papers devoted to KE are more interested in identifying the main attributes of KE rather than in its exact definition. A partial consensus was found among experts, most of whom refer to the four pillars of KE as defined by the World Bank (Chen and Dahlman, 2006): an economic incentive and institutional regime; educated and skilled workers; an effective innovation system; a modern and adequate information infrastructure. Apparently, as it turns out, there is no definition alone that can capture all aspects of KE, and as Brinkley (2006) stated in the results of his analysis, there are hardly any definitions that describe KE in such a way that would make it possible to measure and quantify it. In addition, the tacit aspects of knowledge are rarely part of KE definitions, and likewise if we try to measure KE, then in most cases we will be limited to measuring those parts of the knowledge system that can be codified (patents, investments in formal R&D, papers published and cited, etc.). Economic research was mostly constructed on codifiable knowledge, which implies that we ignore a large part of the knowledge in the economy (Ducatel, 1998).

Despite the above ambiguities, we have been monitoring the efforts to measure the level of KE for about 60 years. It is natural that due to the issues outlined the measurement methods vary, and even the present day's methods of measurement via KE indices are not uniformly consolidated.

## 3. The Early Approaches to KE Measurement

Measurement can be seen as a process of assigning scaled numbers to items in a manner that makes it possible to express the relationships existing among the possible states of the variable in the relationship among the numbers on the scale (Andriessen, 2003). Knowledge measurement can be studied at two levels: at the level of an individual firm or at a national (macroeconomic) level.

Measurements at the level of an organisation involve a combination of accounting and nonfinancial indicators measuring stocks of intellectual or knowledge capital and flows of changes in knowledge stocks The knowledge capacity of firms is proxied by means of instruments like Balanced Scorecards (Kaplan and Norton, 1996), Intangible Asset Monitor (Sveiby, 1997), Skandia Navigator (Edvinsson and Malone, 1997), Technology Broaker (Brooking, 1996) Citation-Weighted Patents (Bontis, 1996) Value Chain Scoreboard (Lev, 2001). However, due to the nature of knowledge, all such measurements include, in addition to direct measurements, proxies, and indirect estimates (Shapira et al., 2006). Thus, none of these assessment methods are perfect. However, organisations seek to find a measuring tool that would be the most suitable for them in the given context under the given circumstances (Bontis et al., 1999).

At the macro-level, economic models have been built that capture the creation of new knowledge and its connection with wealth in the production function. The basic Cobb-Douglas function (1928) had problems in handling innovation and endogenous technical changes and was therefore improved by Solow (1957) from 1957 onwards. The literature that followed, referred to as growth accounting, attempts to disaggregate the residual in the standard production function using increasingly sophisticated econometric methods, often embodied in technical change (Shapira et al., 2006). Similar calculation were initiated by *Machlup* (1962), whose work is a milestone on the path to KE, with an attempt to define knowledge, measure its contribution to the economy and identify policy issues. His definition of knowledge integrates all kinds of knowledge and points out that it is important both to create (discovering, inventing, designing, planning) and to distribute knowledge (disseminating and communicating). He was aware that knowledge had always played a role in economic analysis and considered the increase in technical knowledge and the resulting increase in productivity to be crucial factors in analysing economic growth. When Machlup published his work in 1962, economic analyses of science were still beginning to develop. At that time, there were two types of accounting measurement: growth accounting and national income accounting (Kuznets, 1946). Machlup chose the national accounting method for his calculations, which, unlike formalised growth accounting, relied on descriptive statistics. National accounting developed after the Second World War and allowed the National Bureau of Statistics to systematically collect data on the production of economic goods and services in the country, but without data on "knowledge". Machlup had to collect data for his calculations from various private and public sources, too. Therefore, the goal of his effort was not the statistical accuracy of calculations, but a general message that knowledge is an important entity of the economy, even if it does not correspond to economic logic.

In his work, he analysed areas such as: *education* (in the home, on the job, elementary and secondary, colleges and universities, etc.); *R&D* (basic and applied research); *printing and publishing* (books, periodicals, newspapers, etc.); *information machines* (printing trades machines, motion pictures apparatus, telephone and telegraph, typewriters, electronic computers, etc.); *personal services* (legal, engineering and architectural, accounting and auditing, medical); *financial services; photography; stage, podium* (theatres and concerts, motion pictures, etc.); *radio and television, advertising; telecommunication media* (telephone, telegraph, postal service); *conventions* (check-deposit banking, securities brokers, insurance agents, real estate agents); *wholesale agents; miscellaneous business services; government* (federal, state, and local). In his analyses, he focused on groups of professions and distinguished white- and blue-collar workers, showing that KE accounted for up to 29% of GNP in 1958 and such people as knowledge-producing workers (education, R&D, media of communication, information machines, information services) accounted for almost 27% of the national income. His message was therefore directed towards focussing more on education, R&D and information technology revolution as source of growth and productivity and structural change and unemployment by automation.

Unlike Machlup, *M. Porat* strictly follows the national income accounting framework. In the introduction, it defines information activity as one that includes specific industries and professions having their primary function to produce, process or transmit economically valuable information. Information activity includes all the resources consumed in producing, processing and distributing information goods and services. Porat describes the distinct types of "information workers" who make a significant contribution to the creation of knowledge, the communication of ideas, the processing of information, and the transformation of symbols from one form to another. These include, for example, research scientists, engineers, designers, draftsmen, managers,

 

secretaries, clerks, advertising managers, communications officers, etc. His work contains information definition (data organised and communicated) and includes a formal set on National Income and Product Accounts for the *primary* and *secondary information sectors* (with input-output matrices for both sectors) specifying information-related occupations of both primary and secondary information sectors (Porat, 1977). He asserted that certain occupations are primarily engaged in the manipulation of symbols, either at a high intellectual content (production of new knowledge) or at a more routine level (feeding computer cards into a card reader). That means it is a division by level (of degree not of kind). In such a manner, he divided the 422 occupations reported by the U.S. Census and the Bureau of Labor Statistics into two main groups (information and noninformation). He defined the *primary* information sector that includes firms that supply the bundle of information goods and services exchanged in a market context and the *secondary* information sector that includes all the information services produced for internal consumption by government and noninformation firms. Based on the matrix created he found out that in 1967, the *primary* information sector accounted for 21.9% of final demand (GNP), the *secondary* information sector 3.4% of GNP, and the *noninformation* sector 74.6% of GNP. He further states that since 1955 the information sector had become predominant, growing from 15% of workforce in 1901 to almost 40% in 1970, with information workers earning more than 53% of all labour income in 1967. He saw this as an argument that the U.S. had emerged as an information-based economy (Porat, 1977).

## 4. Indicator-Based Measurement

When the arguments about the transition to KE were quite strong and visible, international economic organisations began to discuss possible indicators of relative knowledge intensity of economies (Karahan, 2012) capturing inputs and outputs, or elements of the cause and effects of knowledge processes. A broad system of statistical indicators and metrics has been developed to describe KE. The measurement of KE was started using a set of indicators collected under the umbrella of "knowledge" as a collection of available statistics capable of capturing some dimensions of knowledge and KE. Such a method of measurement is a comprehensive and complicated process, and even the perception of the basic concept of knowledge is not unambiguous, leading to many discussions at the international level on measurements through indicators. Currently, we are witnessing the application of various approaches, both in the selection of indicators and in determining the weight of individual indicators in the calculation of the knowledge index. Gradually, it becomes clearer which indicators are more relevant and reflect the true features of KE and which are troublesome. Back in 2008, Arundel et al. pointed to the problem of the excessive importance placed on knowledge *production* (Arundel et al., 2008), especially in the initial stages of measuring KE, where the measurement of scientific articles and patents was one of the main indicators of KE's level. The need to integrate "softer" indicators of sociocultural factors as well as knowledge diffusion and knowledge impact into the measurements has been shown in the case of the so-called European paradox. Indeed, it turned out that Europe is to outperform the U.S. in the production of new knowledge when measured through scientific publications; however, the EU lags behind in the commercial exploitation or use of this knowledge base (Arundel et al., 2008). Another assumption that new start-ups automatically generate more successes proved to be problematic too, however, there is not enough empirical data for that, and excessive clinging to insufficient data may lead to risks of socially inefficient overinvestment in projects that are doomed to fail (Parker, 2005). Similarly, the traditional measurement of the *science* system may encounter a problem as in KE the science system is implicitly expected to change its traditional function of producing new knowledge through basic research and educating new scientists toward a new role as an entity cooperating with industry (OECD, 1996), which has not happened in some countries. In fact, ineffective cooperation among KE actors has been found to undermine the effects that a higher investment in education, R&D and innovation would bring. The importance of regional relationships in starting up innovation is shown by the Triple Helix as 3H (Etzkowitz and Leydesdorff, 1997) or Quadruple Helix as 4H (Carayannis and Campbell, 2010; Ivanova, 2014) and Penta/Quintuple Helix as 5H (Carayannis et al., 2012; S Halibas et al., 2017) models.

### 4.1 The Organisation for Economic Co-operation and Development (OECD) 1995 - 2017

*Included countries: 38 OECD + Argentina, Brazil, China, India, Indonesia, Russia, Saudi Arabia, South Africa*

The first crucial effort to measure KE by an international organisation dates back to 1995, when the OECD discussed KE in the context of new growth theory and innovation performance (OECD, 1995). The OECD started to conduct research on KE (KBE) with attempts to compile statistical indicators on KE based on their work of developing and publishing science and technology (S&T) indicators (OECD, 1996). They discussed the need for improved KE indicators in the context of measuring knowledge inputs, knowledge stocks and flows, knowledge outputs, knowledge networks, and learning (OECD, 1996). In 1999, the OECD launched a two-year study called the “Growth Project” to analyse the causes underlying differences in growth performance in the OECD countries

and to identify factors, institutions and policies that could improve long-term growth prospects (OECD, 2000b, 2000a, 2001) where broad elements of a KE were named as: stable and open macroeconomic environment with effectively functioning markets, the diffusion of ICT, fostering innovation, investing in human capital, and stimulating firm creation.

In general, the OECD attempted to measure knowledge directly. The relevant statistics have been made comparable among nations by the OECD and Eurostat, and the focus of the efforts has been to develop indicators of the relative knowledge intensity of industrial sectors (Leydesdorff et al., 2006). The creation of KE indicators was largely a transformation of indicators from the Industry and Technology Scoreboard of Indicators, which were published by the OECD every two years and consist of 76 *indicators* grouped into five main categories: *R&D and Innovation* (15), *Human Resources in Science and Technology* (10), *Patents* (11), *ICT* (17), *Knowledge Flows and the Global Enterprise* (12), *The Impact of Knowledge on Productive Activities* (11). Basically, most of the collected indicators used by the OECD long before were subsumed under the concept of KE. For example, indicators such as "science and technology policies" and "output and impact" were changed to the category "creation and diffusion of knowledge" (Godin, 2006).

The main categories of indicators observed by the OECD would be gradually adjusted, e.g., in 1999 (OECD, 1999) they developed a scoreboard of 32 indicators where five dimensions were observed: *Knowledge-Based Economy; ICT; Science & Technology Policies; Globalization; and Output and Impact*. In 2001 (OECD, 2001) four main categories of indicators were developed: *ICT; innovation and technology diffusion; human capital; firm creation and entrepreneurship*, and in 2003 the indicators were arranged into classes: *Investment in Knowledge; Investment in ICT; Trends in Trade and Investment Flow* (OECD, 2003). The reports were published under the title until 2017 when the OECD analysed six groups of indicators: *Knowledge economies and the digital transformation; Knowledge, talent, and skills; Research excellence and collaboration; Innovation in firms; Leadership and competitiveness; Society and the digital transformation* (OECD, 2017).

### 4.2 World Bank Institute's Knowledge for Development Program (K4D) 1999-2012

*Included countries: 128.*

The World Bank (WB), more specifically the Knowledge for Development (K4D) initiative, which developed the Knowledge Assessment Methodology (KAM) in 1999, a simple KE benchmarking tool, providing a basic assessment of readiness of countries and regions for the KE, is considered a significant milestone in the measurement of KE using indicators. As Chen and Dahlman suggest, the unique strength of the KAM lay in its cross-sectoral approach that allows a holistic view of the wide spectrum of factors relevant to the KE (Chen and Dahlman, 2006). They argue that a successful transition to the KE involves elements such as investments in education, developing innovation capability, modernising the information infrastructure, and having an economic environment that is conducive to market transactions, the four KE pillars.

The KAM consists of data for 80 variables, describing the four pillars of the KE, as well as economic and social performance, governance, and gender issues. Indicators (variables) that are contained in the KAM span over different ranges of values, all indicators are normalised from 0 (weakest) to 10 (strongest), and the 128 countries are ranked on an ordinal scale. It was the first web-based user-friendly diagnostic tool that allowed individual countries to understand their strengths and weaknesses within the EC by comparing themselves with other countries analysed.

The tool offered the possibility of simplified conversion of the so-called basic scorecard, which provided an overview of countries' performance in terms of all four pillars of the EC. It included 14 standard variables: two performance variables (*%Average annual GDP growth; Human Development Index*) + 12 knowledge variables under the four pillars (see Table 1):

**Table 1: KAM Pillars and Subpillars (World Bank Institute, 2004)**

| | |
|---|---|
| **Economic Incentive and Institutional Regime:** | *Tariff and non-tariff barriers* |
| | *Regulatory Quality* |
| | *Rule of Law* |
| **Education:** | *Adult literacy rate % age 15 and above* |
| | *Secondary enrolment* |
| | *Tertiary enrolment* |

 

| | |
|---|---|
| **Innovation:** | *Researchers in R&D/million population* |
| | *Patent applications granted by the USPTO/million population* |
| | *Scientific and technical journal articles/million population* |
| **ICT:** | *Telephones per 1,000 persons* |
| | *Computers per 1,000 persons* |
| | *Internet users per 10,000 persons* |

The four KE pillars mentioned are perceived by experts as the main pillars of KE to this day. The level of KE of a given country, or a comparison of a country's progress over time, or a comparison with selected countries, offered an instrument both in the traditional tabular form and in the spider, diamond, and bar chart form of visualisation. The basic scorecard was used to create the Knowledge Economy Index (KEI), which integrated the four KE pillars, and to calculate the Knowledge Index (KI) consisting of only three pillars (without the Economic Incentive and Institutional Regime pillar). (World Bank Institute, 2004).

## 5. Current Global and European Indices Measuring the Level of KE

During our research conducted since 2019, we have identified several initiatives to measure the main attributes of KE. Based on the results of the content analysis of studies devoted to the main attributes of KE, we decided to conduct a detailed analysis and mutual comparison of what we see as the four most important KE indices, which allow mutual comparison of the level of KE of individual countries, which functions as a web-based tool with a data export option. We selected the Global Knowledge Index (GKI) and the Global Innovation Index (GII) from the existing global indices, and we chose the European Innovation Scoreboard (EIS) – Summary Innovation Index (SII) and The Digital Economy and Society Index (DESI) from the European indices.

The creators of GKI state that because global measurements of the World Bank KAM (KEI, KI) have been disconnected, they are the only index measuring knowledge at the global level (UNDP and MBRF, 2019). The EIS and GII indices are primarily perceived as innovation indices; at the same time, they can be perceived as KE indices because they capture the main drivers of KE and work with such indicators as employment in knowledge-intensive activities, etc. Our view is also supported by the statements of authors like Karahan (2012) and Leogrande (2022). We decided to choose DESI due to the fact that in 2019, when we started analysing and collecting data, the index was focused not only on the field of ICT and digital economy, but also on other areas of KE, such as research, innovation, and education.

A note related to terminology – index creators use a diverse terminology to describe the structure of indices, therefore, to improve clarity and facilitate subsequent comparison, we decided to use a uniform terminology for all indices. For global indices with four levels of hierarchy, the index is subdivided into subindices, pillars, subpillars, and indicators, and for European indices with three levels of hierarchy, the index is subdivided into pillars, subpillars, and indicators.

### 5.1 Global Innovation Index (GII)

*Included countries: 120-132.*

The Global Innovation Index (GII) project was launched by Professor Soumitra Dutta in 2007 during his tenure at INSEAD. The aim was to find and identify metrics and methods that could capture the most complete picture of innovation in society. WIPO started the association with GII in 2011 and co-published the GII jointly in 2012. In 2013, Cornell University joined INSEAD and WIPO as co-editors to publish GII until 2020. From 2021 GII is published by WIPO in liaison with the Portulans Institute, various corporate and academic network partners, and the GII Advisory Committee. The GII 2021 model includes 132 economies, representing 94.3% of the world population and 99.0% of world GDP in purchasing power parity in international dollars (WIPO, 2021).

In 2021, the GII consisted of two SUBINDICES, seven pillars (including 21 *subpillars)*. See Table 2.

**Table 2: GII Subindices, Pillars and Subpillars (WIPO, 2021)**

| INNOVATION **IN**PUTS | | INNOVATION **OUT**PUTS | |
|---|---|---|---|
| **Institutions:** | *Political environment* | **Knowledge and technology outputs:** | *Knowledge creation* |
| | *Regulatory environment* | | *Knowledge impact* |
| | *Business environment* | | *Knowledge diffusion* |
| **Human capital and research:** | *Education* | **Creative outputs:** | *Intangible assets* |
| | *Tertiary education* | | *Creative goods and services* |
| | *Research and development* | | *Online creativity* |
| **Infrastructure:** | *ICTs* | | |
| | *General infrastructure* | | |
| | *Ecological sustainability* | | |
| **Market sophistication:** | *Credit* | | |
| | *Investment* | | |
| | *Trade, diversification, and market scale* | | |
| **Business sophistication:** | *Knowledge workers* | | |
| | *Innovation linkages* | | |
| | *Knowledge absorption* | | |

There are minimal changes to the GII index. Sub-index names have not changed, or only slightly. The number of indicators decreased from 84 to the current 81, in contrast, the number of hierarchy levels increased from three to four. Similarly, the number of countries analysed increased from 120 to 132.

While the innovation input sub-index includes only two pillars, it has the same weight as the innovation output sub-index for calculating the overall GII score. Each of the five input and two output pillars is divided into three subpillars, each consisting of individual indicators. The subpillars are calculated using the weighted average of their individual indicators and normalised to form a score ranging from 0 to 100. The score of a pillar is calculated using the weighted average of the scores of its subpillars (Dutta, Lanvin, and Wunsch-Vincent, 2021). The GII structure and sub-index weights are shown in Figure 2.

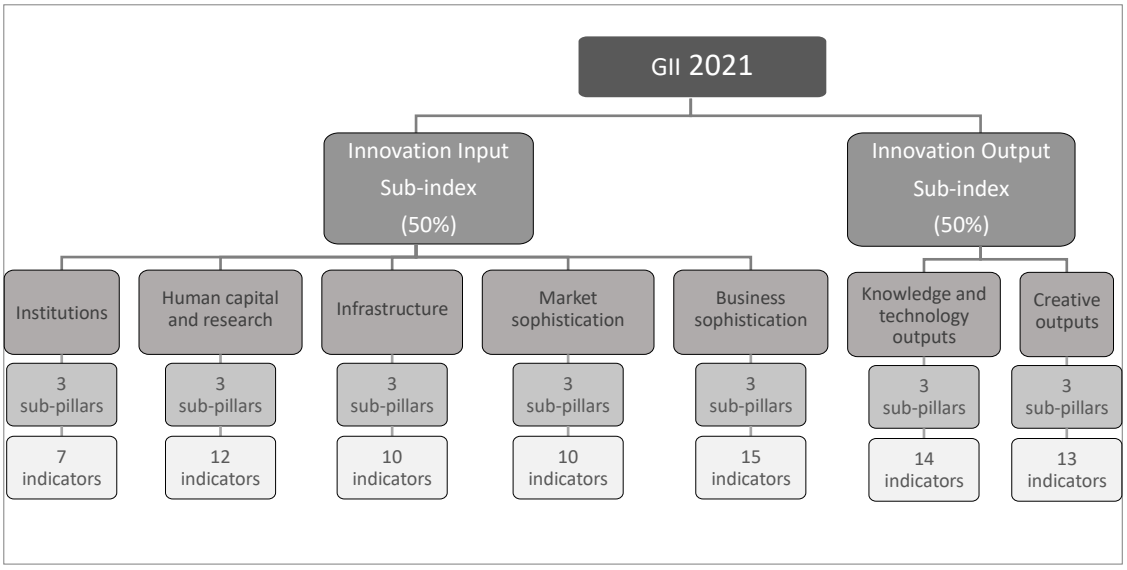


**Figure 2: The Structure of GII**

 

### 5.2 Global Knowledge Index (GKI)

*Included countries: 140-155.*

GKI was introduced in 2017 to measure the state of knowledge among 136 countries around the world. As they state, because KAM measurements (KEI, KI) have been disconnected, they are the sole index measuring knowledge at the global level. The aim of the index is to measure the multidimensional concept of knowledge in relation to the "knowledge economy" and the "knowledge society" (UNDP and MBRF, 2019). GKI sought to raise awareness of the need to create a composite index that meets the methodological conditions necessary to contribute to international efforts tracking and monitoring knowledge, and the extent to which it supports comprehensive and sustainable human development. It was built by a multidisciplinary team of academic researchers, in consultation with a broader consulting team comprising independent experts and those affiliated with specialised international bodies. GKI is a joint initiative between UNDP and the Mohammed Bin Rashid Al Maktoum Knowledge Foundation (MBRF) (UNDP and MBRF, 2021). According to them, GKI is the first of its kind in the world to establish a connection between knowledge and future technologies. This is especially relevant in the context of the Fourth Industrial Revolution, which emphasises both KE and advanced technology (UNDP and MBRF, 2022).

In 2021, the GII consisted of seven SUBINDICES, seven pillars (including 50 *subpillars*). See Table 3.

**Table 3: GKI subindices, pillars and subpillars (UNDP and MBRF, 2021)**

| I. PRE-UNIVERSITY EDUCATION | | V. INFORMATION AND COMMUNICATIONS TECHNOLOGY | |
|---|---|---|---|
| **Knowledge Capital** | *Enrolment* | **Infrastructure** | *Coverage* |
| | *Completion* | | *Quality* |
| | *Outcomes* | | *Affordability* |
| **Educational enabling environment** | *Expenditure* | **Access** | *Subscriptions* |
| | *Resources* | | *Skills and employment* |
| | *Early learning* | **Usage** | *Services* |
| | *Equity and inclusiveness* | | *Outcomes* |
| II. TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING | | VI. ECONOMY | |
| **TVET Components** | *Continuous training and skilling* | **Economic competitiveness** | *Infrastructure investment* |
| | *TVET structure* | | *Business agility* |
| | *TVET quality and qualifications* | **Economic openness** | *Trade and diversification* |
| **TVET labour market** | *Efficiency of the labour market* | | *Financial openness* |
| | *post-TVET employment* | **Financing and domestic value added** | *Financing and taxes* |
| | *Equity and inclusiveness* | | *Domestic value added* |
| III. HIGHER EDUCATION | | VII. ENABLING ENVIRONMENT | |
| **Inputs** | *Expenditure* | **Governance** | *Political environment* |
| | *Enrolment* | | *Quality of institutions* |
| | *Resources* | **Socio-economic** | *Gender equity* |
| **Learning environment** | *Diversity and academic freedom* | | *Social inclusion* |
| | *Equity and inclusiveness* | | *Standard of living* |
| **Outputs** | *Attainment* | **Health and Environment** | *Health* |
| | *Employment* | | *Standard of living* |
| | *Impact* | | |
| IV. RESEARCH, DEVELOPMENT, AND INNOVATION | | | |
| **Inputs** | *Inputs of R&D institutions* | | |
| | *Inputs of R&D in business enterprises* | | |

| | | | |
|---|---|---|---|
| | *Inputs of societal innovation* | | |
| **Outputs** | *Outputs of R&D institutions* | | |
| | *Outputs of R&D in business enterprises* | | |
| | *Outputs of societal innovation* | | |
| **Impact** | *Quality* | | |
| | *Linkages* | | |
| | *Business development* | | |

Changes to the GKI: Sub-index names have remained almost unchanged. The number of indicators increased from 133 to 155, the number of hierarchy levels is not changed, and it has had four levels since the beginning of the measurement. The number of countries analysed increased from 140 to 154.

GKI is calculated with each of the six sub-indices having a weight of 15%, with the exception of enabling environment, which is accorded a weight of 10%. Weighting across the different components of the index (subindices, pillars and subpillars) was not unified; rather, it varied according to the nature of the components and their relative importance. The weightings identified for the seven constituent indices ranged from equal weighting and budget allocation to factor analysis (UNDP and MBRF, 2021). The GKI structure and sub-index weights are shown in Figure 3.

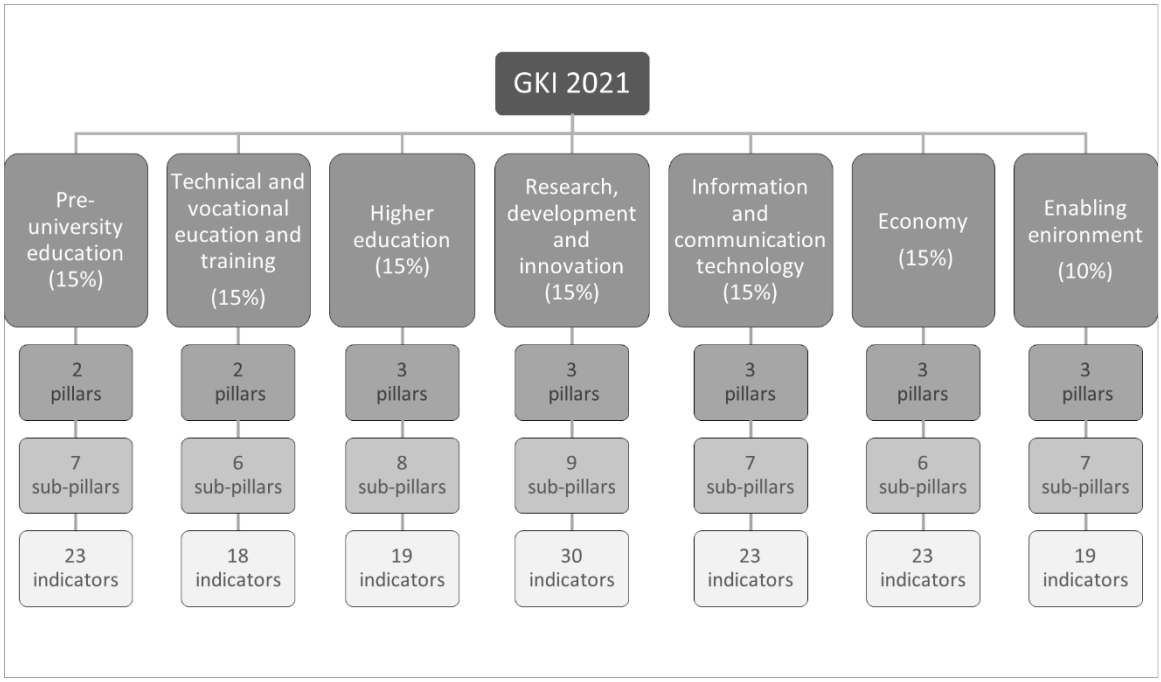


**Figure 3: The Structure of GKI**

### 5.3 European Innovation Scoreboard (EIS) - Summary Innovation Index (SII)

*Included countries: 38 (EU countries + United Kingdom, Switzerland, Norway, Iceland, Israel, Serbia, Turkey, Montenegro, North Macedonia, Bosnia and Herzegovina, Ukraine)*

Since 2001, the European Commission has been developing the European Innovation Scoreboard (EIS) as a comparative analysis of research and innovation performance in the EU, other European countries and regional neighbours (EU + United Kingdom, Switzerland, Norway, Iceland, Israel, Serbia, Turkey, Montenegro, North Macedonia, Bosnia and Herzegovina, Ukraine), which was introduced as part of the Lisbon strategy. Since 2003, the Summary Innovation Index (SII) has been calculated to evaluate the innovation performance of EU member states, drawing on statistics from a variety of sources (Hollanders, 2009).

In 2021, the EIS-SII consisted of four pillars (including 12 *subpillars)*. See Table 4

 

**Table 4: EIS-SSI Pillars and Subpillars (Hollanders & Es-Sadki, 2021)**

| | |
|---|---|
| **Framework conditions:** | *Human resources* |
| | *Attractive research systems* |
| | *Digitisation* |
| **Investments:** | *Finance and support* |
| | *firm investments* |
| | *Use of IT* |
| **Innovation Activities:** | *Innovators* |
| | *Linkages* |
| | *Intellectual assets* |
| **Impacts** | *Employment impact* |
| | *Sales impact* |
| | *Environmental sustainability* |

Some major changes in the construction of EIS-SII occurred in 2008 (Hollanders, 2009), in 2017 (Hollanders and Es-Sadki, 2018), and most recently in 2019, when the author of the report points out that results from EIS-SII 2018 and EIS-SII 2019 cannot and should not be compared between different EIS-SII reports because for several indicators data has been revised in the external sources from which data have been extracted; the time period covered in both reports is different, with the older used in EIS-SII 2018 no longer being used in EIS-SII 2019; data transformations have been applied to a slightly different set of indicators (Hollanders, 2020).

Between 2001 and 2021, the number of indicators increased from 17 to 32. The levels increased from two to the current three (as of 2017). The total number of countries analysed naturally increased to 38 as more countries became EU members (change from 17 to 27).

EIS-SII is calculated as the unweighted average of the rescaled scores for all indicators that have been assigned the same weight (1/32, where data is available for all 32 indicators) (Hollanders & Es-Sadki, 2021). The structure and weights of the EIS-SII pillars are shown in Figure 4.

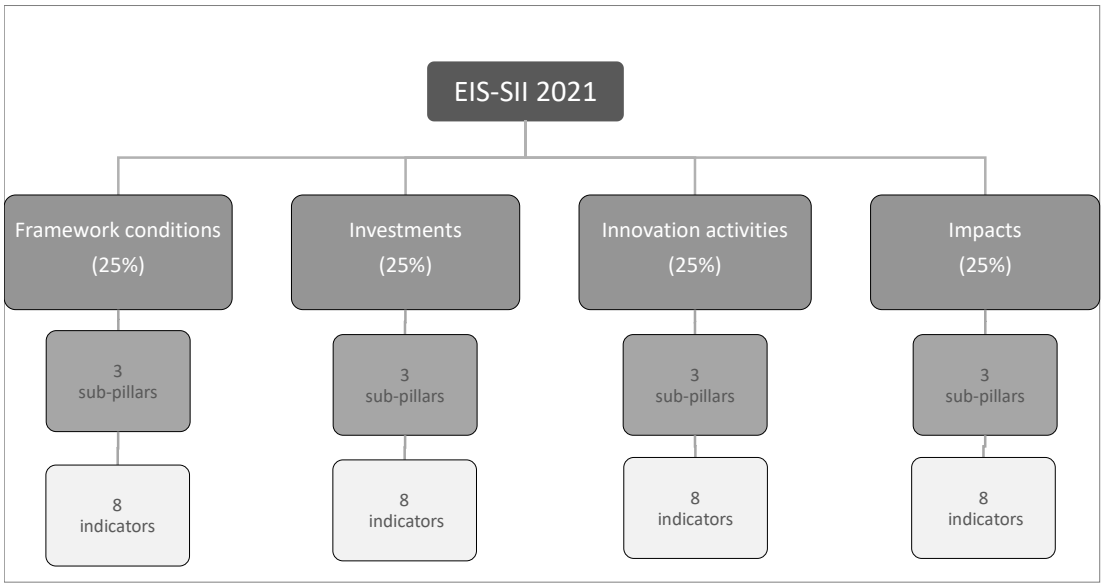


**Figure 4: The Structure of EIS-SII**

### 5.4 The Digital Economy and Society Index (DESI)

*Included countries: 28/27 EU countries.*

Since 2014, the European Commission has been monitoring member states' digital progress through the Digital Economy and Society Index (DESI) reports. DESI was developed according to the guidelines and recommendations in the OECD's *Handbook on Constructing Composite Indicators: methodology and user guide*. Each year, DESI includes country profiles that support member states in identifying areas requiring priority action as well as thematic chapters offering a European-level analysis across key digital areas, essential for underpinning policy decisions (European Commission, 2021). In 2021, the Commission adjusted DESI to reflect the two main policy initiatives that will have an impact on digital transformation in the EU over the coming years: the Recovery and Resilience Facility and the Digital Decade Compass (European Commission, 2022).

In 2021, DESI consisted of four pillars (including 10 *subpillars*). See Table 5.

**Table 5: DESI pillars and subpillars (European Commission, 2022)**

| | |
|---|---|
| **Human Capital:** | *Internet user skills* |
| | *Advanced skills and development* |
| **Connectivity:** | *Fixed broadband take-up* |
| | *Fixed broadband coverage* |
| | *Mobile broadband* |
| | *Broadband prices* |
| **Integration of digital technology:** | *Digital intensity* |
| | *Digital technologies for businesses* |
| | *e-Commerce* |
| **Digital public services:** | *e-Government* |

Changes in the DESI index: The names of the pillars have remained almost unchanged. Their number decreased from five that the index had in 2015-2020, except for 2019 when Research and Development ICT was added and the index had as many as six, to four that it has had since 2021 (the Use of Internet pillar was removed).

To align DESI with the four cardinal points and the targets under the Digital Compass, to improve the methodology and take account of the latest technological and policy developments, the Commission made several changes to the 2021 edition of the DESI. Those indicators that had no significant changes in quantity and varied around the current number of 33 are now structured in the four main areas in the Digital Compass, replacing the previous five-dimensional structure (European Commission, 2021). The number of hierarchical *levels* increased from two to the current three.

In DESI, the aggregation of indicators into subdimensions, of subdimensions into dimensions, and of dimensions into the overall index, was conducted from the bottom up using simple weighted arithmetic averages following the structure of the index. The DESI structure and pillar weights are shown in Figure 5.

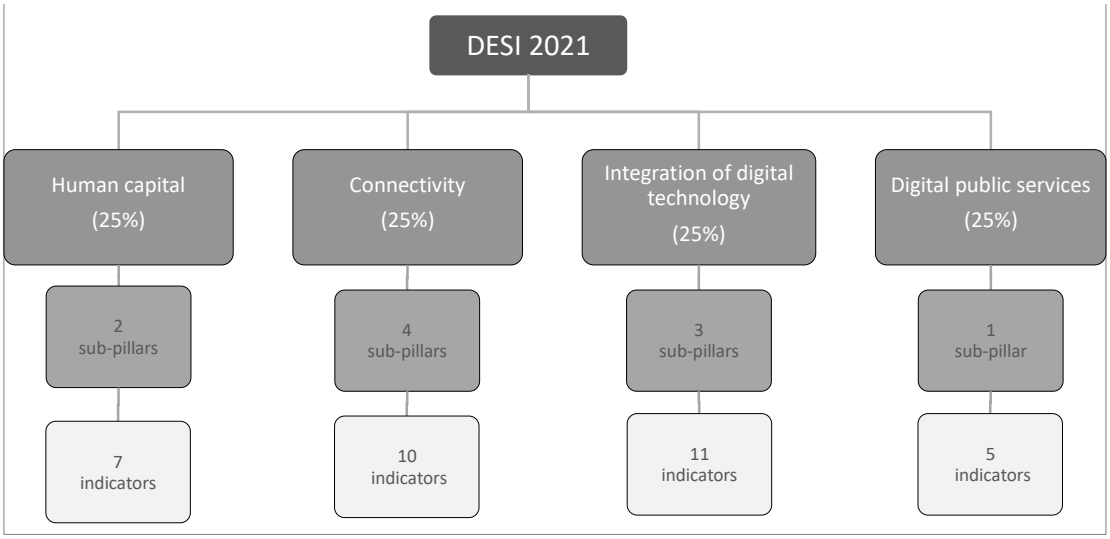


**Figure 5: The Structure of DESI**

 

## 6. Conclusions

The methods of measuring KE at the macroeconomic level have evolved over time, from measurements based on national income accounting to the creation of indices based on the identification and combination of relevant indicators. The paper points out a few issues associated with the measurement of KE, for example, an issue concerning a definition of KE that would be sufficiently specific and generally accepted to allow unambiguous approach to measurement of KE. We believe that, based on the existing definitions, it is not possible to carry out a clear measurement of KE. The problem with the definition of KE stems, among other things, from the semantic ambiguity of the concept of knowledge and the definition of its scope, which is usually limited to explicit scientific facts, unlike knowledge management in the socioeconomic literature, resulting in a large part of the knowledge system being eliminated from KE calculations. The creators of the four KE indices subject to analysis utilise a certain amount of KE indicators or pillars, which can be viewed as a shared core matching the pillars defined by the World Bank. These include, for example, the level of ICT use, used by Machlup in his calculations (information machines), as well as OECD, WB, and the EIS-SII, DESI, GII and GKI indices. Similarly, the level of *R&D* that is included in the calculations according to Machlup, OECD, WB, EIS-SII, GII and GKI is measured. The area of *human resources* can be found in OECD, WB or EIS-SII, DESI, GII and GKI calculations. *Innovation* is part of the OECD and WB measurements as well as the EIS-SII, GII and GKI indices. In the context of KE, *patents* are observed in OECD, WB or in the EIS-SII, GII and GKI indices. Similarly, the field of *education* was integrated into the measurements according to Machlup, WB or the EIS-SII, GII and GKI indices. Despite these shared areas, there are apparent differences among the individual KE indices. In addition to the set of such intersecting indicators and pillars, we can also identify a relatively large set of unique and distinct indicators and pillars used to build individual KE indices. We also identified a small number of indicators that capture more subjective types of knowledge, for example, in the GKI index: creative services exports as % of total trade in services; Entertainment & Media market/th pop. 15-69; Mobile app creation/bn PPP$ GDP (GKI). Naturally, we encounter the fact that the creators of different indices assigned various weights to the same or intersecting indicators. Moreover, we identified inconsistency even within the individual KE indices as their authors quite often changed their methods to create indices, as well as the KE pillars and indicators themselves and their weights, which also points to varying perception of KE principles by the index creators themselves. To broadly assess the meaningfulness of such inconsistent KE measurements in each situation, it will be necessary to carry out at least a correlation analysis of measurement results and a semantic analysis of indicators of individual indices, which will be the goal of our further work.

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# Employees' Perceptions on the use of Online Internal Communication for Knowledge Sharing

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**Abstract:** The primary objective of this study was to assess employees' perceptions on the use of online internal communication (OIC) for knowledge sharing from a personal/individual perspective. This is important because of the emphasis placed on the relevance of knowledge management (KM) in transforming ordinary organisations into learning ones, and to a greater degree through the use of new media technologies. One of the important dimensions of KM that is crucial for organisational learning is knowledge sharing (KS). However, the use of OIC to share knowledge among employees in deposit-taking savings and credit co-operative societies (SACCOs) in Kenya is still low. Therefore, it is necessary to explore employees' perceptions and personal/individual factors influencing employees' online KS using the available OIC tools. A cross-sectional survey design was adopted. Primary data were collected using an online structured questionnaire targeting the accessible population of 485 mid-level employees of deposit taking SACCOs in Kenya, and data were migrated to SPSS version 25.0 to generate descriptive statistics. Thematic coding of data obtained from eight focus group discussions involving 72 employees and in-depth interviews with eight senior managers were presented as narrative analysis. The findings of this study indicated that most employees lacked the requisite knowledge, skills and attitude for adopting OIC for knowledge sharing (KS), and emphasised the need for training prior to the implementation process and an organisational environment that is conducive for attutude modification in the use of existing OIC. This study is unique and adds to the existing body of knowledge in the proposed theoretical framework emphasing the need to enhance KS through OIC, specifically on a personal/individual level, considering the managerial/organisational and technical levels as well, to contribute to organisational learning and innovation to ensure sustainable competitive advantage.

**Keywords:** Employees' perceptions, Innovation, Knowledge management, Knowledge sharing, Online internal communication (OIC), Organisational learning, Savings and credit co-operative societies (SACCOs)

## 1. Introduction

The field of organisational communication has experienced drastic transformation in the last few decades. A notable example is the introduction of management systems, especially knowledge management (KM), which has affected how organisations communicate. KM refers to a systematic process through which organisations can create, identify, acquire, select, organise, share, disseminate and store important information, knowledge and skills, and use them for their own benefit (Chibuzor, Jovita and Onyemachi, 2019, Kaira and Phiri, 2022; Tajpour et al., 2022). Moreover, the advancement of new media technologies and the changing landscape in the business environment have seen a surge in the use of online communication in organisations to leverage organisational knowledge (Lee, 2018; Deng, Duan and Wibowo, 2022). For the purpose of this study, reference is made to online internal communication (OIC) which is defined as the "communication used by employees in their internal communication efforts within the organisation by using specific Internet resources to perform specific action" (Waititu, 2022 p.64). In recent literature (Appel-Meulenbroek, Weggeman and Torkkeli, 2018; Lee, 2018; Du et al., 2019; Alyammahi et al., 2022), knowledge is considered as a critical resource to enhance an organisation's competitive advantage in the knowledge-based economy. Indeed, various studies (Dong et a., 2017; Al Kashari and Al Taheri, 2019; Lee, 2018; Chibuzor et al., 2019; Kaira, and Phiri, 2022; Tajpour et al., 2022) have identified the need for knowledge sharing (KS) to empower employees to be creative and innovative. In the regard, Yeşil and Hırlak (2019, p.100) define KS as "the successful implementation of creative ideas within an organisation".

Although considerable research has been devoted to KM and KS (Razak et al. 2016; Alyammahi et al., 2022, Eshak et al.( 2022), research into the use of OIC for KS among employees to create, collect and communicate knowledge is scarce. Consequently, this limited insight has made OIC for KS difficult to implement and be accepted by employees, specifically to establish users' perceptions thereof (Yusuf and Wanjau, 2014; Wamitu, 2015). Based on these limited insights, the research problem is the lack of information on the perceptions of employees to accept and adopt online internal communication for knowledge sharing. Although this study does



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not intend to test hypotheses, the independent variables are employees' perceptions and individual determinants for KS while the dependent variable is the adoption of OIC for KS. Hence, this study sets out to answer the following research questions:

RQ1: What perceptions do employees of deposit-taking SACCOs in Kenya hold about their adoption of OIC for KS?

RQ2: What are the individual determinants for KS in the deposit-taking SACCOs in Kenya?

## 2. Literature Review

### 2.1 Theoretical Foundation

Three theories formed the basis of this study. The first is the Social Network Theory (SNT) (Granovetter, 1973; Granovetter, 1983), with its primary concerns being the structural features of networks and the type of ties or relationships between employees (Granovetter, 1973; Granovetter, 1983; Chung and Crawford, 2016; Zeng, Deng and Liu, 2022). According to Bhutto et al., (2020), there is a need to form strong relations or ties among employees through various interactions as emphasised by SNT. The interactions can enhance relationship building to assist in modifying KS behaviour and social networks. In addition, this theory focuses on employees' social relationships and the impact of these relationships on KS behaviour. This theory is specifically relevant to this study as it is argued that if strong relationships do exist between employees, they are more likely to develop positive perceptions toward sharing of knowledge while using OIC tools because of the trust-based relationship building that takes place. This relates to the personal/individual perspective to share organisational knowledge.

The second theory is the Social Exchange Theory (SET). This theory focuses on social interactions and cost-benefits analysis of ensuing relationships and was formulated by Gouldner (1960) and Emerson (1976) and later reinforced by scholars like Razak et al. (2016) and Elita, Moordiningsih and Sinthia (2020). Again, this theory is also relevant as it focuses on the managerial/organisational perspective of knowledge sharing which in this case creates the structures and processes for social interactions to manage personal/individual factors to enhance knowledge sharing through these relationships.

The third theory is the Technology Acceptance Model (TAM) (Davis, 1989), which is used to assess users' beliefs about the adoption of new technology based on three determinants, namely perceived usefulness, perceived ease of use and attitude towards technology. According to Mugo et al. (2017), this theory influences users' decision to use new technology, hence it is also included to address the technical perspective on the use of OIC tools for KS.

### 2.2 Knowledge Sharing in the Organisation

KS is considered by Dong et al. (2017) and Du et al. (2019) as those activities that involve the exchange of information and skills among employees in various positions in the organisation in a creative manner. Through those activities, employees are able to modify their KS behaviours by enhancing their interactions as envisaged by SNT; and using multiple communication channels to share organisational knowledge (Osman, et al., 2015; Bhutto et al., 2022). Authors like Gaál et al. (2015) and Yeşil and Hırlak (2019) posit that in organisational communication, KS is considered from the personal/individual, technological and managerial/organisational perspectives. The personal/individual perspective (the effects of the phenomenon on an individual, either directly or indirectly, especially when dealing with tacit knowledge) considers how communication tools can be embraced by employees to share knowledge effectively; the technological perspective (investigates and clarifies the effects of the phenomenon on team-related activities and can include both explicit and tacit knowledge) looks at how KS can be achieved using new digital tools as posited by TAM; and the managerial/organisational perspective (the effects of the phenomenon on the organisational structures and processes, especially when dealing with explicit knowledge) considers how KS through OIC can be used by the management to enhance productivity and create a competitive niche (Al Kashari and Al Taheri, 2019). This article focuses on the adoption of OIC for KS at all levels, but with specific relevance to personal/individual employee level. However, in order to do so, it considers the technological perspective to investigate how KS can be achieved by using new technology in line with the TAM model and the managerial/organisational perspective which focuses on the structures and processes to encourage the sharing of explicit knowledge within individuals.

Several scholars (Chandran and Ha, 2017; Al Kashari and Al Taheri, 2019; Alyammahi et al., 2022) argue that KS can increase the business competitiveness of an organisation and Al Kashari and Al Taheri (2019) state specifically that it can improve employees' performance, enhances efficiency and reduces operational costs. In terms of the personal/individual perspective, KS is based on various factors such as mutual relationships, trust,

 

work efficiency, innovation and organisational learning. As proposed by SNT, Chau (2018), Du et al. (2019) and Eshak et al. (2022) argue that positive KS behaviours are quickly achieved when trust-based relationships are adopted among all members in the organisation. According to Sigalaa and Chalkiti (2015) and Asiedu, Abah, and Dei (2022), different KS strategies are used to share different types of knowledge. As indicated by Chau (2018), it is not difficult to share explicit knowledge as it is already codified and stored in the organisation repository as databases, documents or manuals ready to be used by employees. However, other studies (Appel-Meulenbroek et al., 2018; Chau, 2018; Al Kashari and Al Taheri, 2019; Asiedu et al. 2022; Zeng et al., 2022) show that it is a challenge for employees to share tacit knowledge because of its subjective nature as it comprises of individuals' traits such as attitude, thought and emotions, which are derived from human perceptions. Thus, negative perceptions are likely to affect employees' knowledge sharing behaviours and endanger KS in the organisation (Vines, Jones and McCarthy 2015; Girard and Girard, 2015). Therefore, in line with SNT, a personalisation strategy through socialisation is recommended for sharing tacit knowledge and a codification strategy for explicit knowledge. Based on the discussion above, KS is defined as the process of exchanging both tacit and explicit knowledge through various interactions with the aim of retaining this knowledge in the organisation.

Various studies (for example Phung, et al., 2017; Eshak et al., 2022; Kaira and Phiri 2022) suggest the need to enhance the quality of the knowledge being shared. In view of this, it is important for the organisation to understand and promote various employees' interactions and relationships as suggested by the SNT, to enhance the quality of knowledge. However, it is argued that despite the high quality of knowledge, it may not be of any benefit to the organisation if it is not shared among employees (Asrar-ul-Haq and Anwar, 2016). As a result, a conducive environment for promoting KS is advocated in the organisation. Individual and team efforts are needed to enhance positive employees' knowledge sharing behaviours. This can be achieved through capacity building, encouraging employees to interact more and to consider documenting and sharing their experiences as a routine activity (Chau, 2018; Lee, 2018).

Since tacit knowledge is commonly shared through personalisation, employees should be encouraged to embrace online social platforms to promote virtual sharing of this knowledge. Additionally, these interactions outlined in the SNT, should be well coordinated to allow for effective sharing of knowledge among all employees (Sigalaa and Chalkiti, 2015). In this regard, cross-functional, multimedia online internal communication (OIC) tools should be implemented. Moreover, employees who are ultimately the end users need to be consulted and involved in this process. Incidentally, as proposed by TAM, new digital innovations should be considered and adopted to enhance the creation, storage and online sharing of knowledge in the organisation (Chibuzor et al., 2019). Moreover, employees need to be adequately trained on new technologies as to help improve the state of KS in the organisation (Jones, 2017; Tajpour et al., 2022).

### 2.3 Knowledge Sharing in an Online Environment

Several scholars, among them Chibuzor et al. (2019), have researched the relationship between KS and innovation in organisations. According to Noor, Hashim and Ali (2014) and Alyammahi et al. (2022), the adoption of innovations is heavily determined by the creation and sharing of knowledge in this technological age. In their studies, Deng et al. (2022), Kaira and Phiri (2022) Bhutto, Khoso and Mehmood, 2022 and Tajpour et al. (2022) indicated that the adoption of innovations in KS has the ability to encourage employees to share new information, concepts and views in organisations. Further, new innovations such as OIC platforms and tools can positively motivate employees to seek new knowledge and improve their knowledge sharing behaviour as echoed by TAM.

In the current era, the Internet has transformed the way employees interact, hence the need to intensify KS though online networks as suggested by the SNT (Jinyang, 2015). The prerequisite is for employees to adopt OIC tools for their interpersonal relationships through numerous virtual communities with numerous networks, new media tools and platforms that are globally interconnected as suggested by the SNT (Page, Firth and Rand, 2015; Tajpour et al., 2022). Consequently, those changes require employees to positively modify their perceptions and significantly increase their online interaction and their ability to use OIC tools as advocated by TAM.

Researchers (for example Chibuzor et al., 2019; Bhutto et al., 2022) show that management support is greatly needed in enhancing employees' use of innovation in the organisation. Consequently, employees' acceptance of innovation and adoption of OIC tools in their interactions could be greatly enhanced (Gaál et al., 2015) as proposed by TAM. Accordingly, Brčić and Mihelič (2015) posit that employees are likely to develop positive knowledge behaviour change that is necessary for creating and sharing knowledge and propagating new concepts in an online environment. Therefore, the ability of employees to create and share knowledge virtually is dependent on their acceptance and adoption of the online innovations.

### 2.4 Perceptions Favourable for Knowledge Sharing in an Online Environment

According to various studies (Chau, 2018), the prominence of KS is growing in organisational communication as organisations attempt to cope with emerging contemporary changes. Currently, various multimedia channels are used in or across organisations by employees to share knowledge (Tajpour et al., 2022). In order to achieve KS to an acceptable level of adoption in an online environment, a complex process comprising knowledge creation, collection, immersion, sharing, transfer and conversion is required. This can be achieved through unhindered interactions, up-to-date and easy to use OIC tools, and easy access to the organisation's repository (Chibuzor et al., 2019) as recommended by TAM. Recent studies by Chibuzor et al. (2019), Lee (2018) and Asiedu et al. (2022) show that knowledge can easily be created and shared online when employees interact virtually; this can best be achieved when appropriate innovations are implemented. Conversely, these innovations can only be effective if they are acceptable and meet the individual needs of employees. Likewise, the ability to adopt new technologies is dependent on how employees perceive innovations and their implementation in the organisation. These perceptions are considered to be critical in shaping employees' KS behaviour and hence have the ability to influence their adoption of OIC tools (Chmielecki, 2015). Because negative perceptions may result in resistance due to fear of disrupting the current status, organisations that are willing to succeed in this change-oriented turbulent environment must be ready to mitigate its employees' perceptions in its favour. In addition, the organisation should also address any communication barriers that may be perceived to hinder the successful implementation of OIC tools for KS. Barriers at individual level include inadequate OIC training, poor relationships among employees, unhealthy competition, negative attitudes, reluctance to share knowledge, ineffective communication, and mistrust of online communication systems and processes (Šárka, 2014; Cacciattolo, 2015; Tajpour et al., 2022 ).

## 3. Research Methodology

This study employed a quantitative and qualitative approach using a cross-sectional design with the aim to study the existing perceptions of employees in the cooperative sector in Kenya. Triangulation, a strategy that combines various research techniques to view or explore a phenomenon, was used in data collection and analysis. Through triangulation, the validity and reliability of the findings were enhanced as it was possible to view and depict the phenomenon in question in a more thorough, contextual and universal manner than when using a single approach.

The target population were employees of deposit-taking SACCOs in Kenya. The accessible population consisted of 485 permanent and contracted mid-level employees stationed in eight branches of the eight selected deposit-taking SACCOs in the city of Nakuru. These employees had direct access to the organisations' OIC system. It is from the accessible population that the sample was drawn. Individual employees of the eight selected deposit-taking SACCOs were the unit of analysis.

The study employed purposive sampling (a non-probability sampling method) and simple random sampling (a probability sampling method). Out of a total of 178 deposit-taking SACCOs operating in Kenya, the researchers purposively selected eight SACCOs based on locality, the use of OIC and their large size in terms of membership. Furthermore, eight branches of the selected SACCOs were purposively selected. The researchers randomly selected 245 employees from the eight SACCOs to participate in the survey. Random sampling was also used to select participants for focus group discussions from the respective branches of the eight selected SACCOs. In addition, purposeful sampling was used to select participants based on the use of predetermined criteria pertinent to find individuals who can provide the most incisive views on particular topics or experiences, which in this case included eight senior managers representative of each selected SACCO and who are knowledgeable on the field for in-depth interviews.

Primary data were collected using a survey, focus group discussions and in-depth interviews, whereas secondary data were obtained from the literature review. The researchers first conducted a survey of 245 permanent mid-level employees who had direct access to the SACCOs' OIC systems. The researchers then conducted eight focus group discussions, involving 72 employees who had participated in the survey that included employees from each of the eight selected SACCOs. In addition, the researchers carried out eight in-depth interviews with senior managers, interviewing one manager from each of the selected SACCOs.

An online self-administered questionnaire, which was created on the Google platform and made accessible via an e-mail link, was used in the survey to collect quantitative data. The eight focus group discussions, using a moderator's guide, were used to collect information from the participants who were respondents in the survey. In addition, interviews were also used to collect information from eight senior managers of the selected SACCOs

 

using an interview schedule. The moderator's guide and the interview schedule were designed using the relevant information obtained from the quantitative data that the researchers felt needed further exploration.

A mixed-method approach was used to analyse and interpret both qualitative and quantitative primary data. Quantitative data, captured on the Google docs platform, were migrated to the Statistical Package for the Social Sciences software (SPSS version 25.0) to generate descriptive statistics. Cronbach's alpha coefficient analysis was carried out to test the reliability of the items in the questionnaire and thus to ensure internal consistency. The subsequent results were used to correlate various variables to verify the research questions. In addition, regression analysis was used to establish effects between variables. In the qualitative data analysis, themes were formulated through thematic coding. Once coding had been completed, the researchers, through their own theoretical contextualisation, analysed and organised the themes from the codes into categories to represent common, relevant and significant themes. The emerging data were then edited and summarised into key themes in line with the research question. The exploratory patterns and key interpretations were highlighted, and their possible consistencies, relationships and differences were developed to help the researcher answer the research questions.

## 4. Results

Both quantitative and qualitative data were analysed in order to assess the perceptions of employees on the use of online internal communication (OIC) for knowledge sharing in line with the research problem and to answer the questions (RQ1 and RQ2)

### 4.1 Quantitative Data on Individual Perceptions

The quantitative data is presented as follows**.**

#### *4.1.1 Demographic Characteristics*

An online self-administered questionnaire was used to collect quantitative data. Of the 187 respondents (76%) in the sample set of 245, more than half of the sample was female (52%) and 48% were male. At the same time, 79.1% of respondents had attained post-secondary education. The majority of the sample was aged 20–50 years (82%); only 3.7% were below the age of 20 years and 1% above 60 years. The majority of the respondents (77.5%) had computer experience of five years and more. The study revealed that there was no major gender disparity and that most SACCOs' employees were below the age of 50 years. All were literate and with vast computer experience, a scenario that is favourable for adopting OIC for KS.

#### *4.1.2 Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity on employees' perceptions of the nature of KS*

The Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were used to measure sampling adequacy and the suitability of data for statistical analysis. The KMO was used to test whether the collected data had attained the acceptable minimum criteria based on a factor-loading cut-off value of 0.6. The analysis conducted passed both tests, where the KMO test was 0.857 and Bartlett's Test of Sphericity had a significant value of 0.000. Hence, the data were further subjected to factor analysis.

Factor analysis component matrix on individual perceptions of knowledge sharing in the SACCOs was conducted on sixteen determinants. Four items were extracted from the factor analysis conducted, as they exhibited the highest variance in the component matrix table. These four items were: *I am adequately trained on the use of OIC tools for KS* (0.731); *Collaborating with other employees is necessary for my KS* (-0.474); *The available OIC tools are adequate for my adoption of KS* (0.556); and *The use of OIC tools improves my work output* (0.479). From the descriptive statistics of the shortlisted items under the construct *individual determinants,* it was shown that the items were oscillating between 2.46 and 3.01, where 2.0 to 2.99 was represented by Agree and 3.0 to 3.99 was represented by Disagree. The data were also subjected to regression analysis of variance (ANOVA). Table 1 below summarises the correlation and regression analysis carried out to determine the strength of the relationship between the independent variable and the dependent variable. It is shown that individual determinants are significant with an F value of 14.401 and a significance value of 0.000. However, the multiple correlations were positive with a coefficient of 0.490. Items in this variable that were significant accounted for 24.0 % of variation in the dependent variable *Training of other employees.* The value of Durbin Watson at 2.232 conferred that the coefficient was statistically different from zero. The findings also showed that there was no serial correlation. The regression analysis of individual determinants for KS revealed that one item, namely *I am*

*adequately trained on the use of OIC tools for KS*, had a significant influence on KS, with a significant value of 0.000 when tested at 95% confidence level.

**Table 1: ANOVA Table for Employee Perceptions of KS**

| **Model Summary** | | | | | |
|---|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
| 1 | .490[a] | 0.240 | 0.224 | 0.815 | 2.232 |

| **ANOVA[a]** | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | Df | Mean Square | F | Sig. |
| 1 | Regression | 38.224 | 4 | 9.556 | 14.4011 | 0.000 |
| | Residual | 120.771 | 182 | 0.664 | | |
| | Total | 158.995 | 186 | | | |

As shown in Table 2 below, a unit increase in *Training on the use of OIC tools for KS* would lead to 0.416 unit increase in *training of other employees*. The result also shows that the item *The available OIC tools are adequate for my adoption of KS* had a negative coefficient -0.039 though not statistically significant when tested at 95% confidence level. Therefore, a unit increase in the item: *The available OIC tools are adequate for my adoption of KS* will result in 0.039 unit decrease in *Training of other employees* which represented KS.

**Table 2: Coefficients Table for Individual Determinants for KS**

| **Coefficients[a]** | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Unstandardised Coefficients | | Standardised Coefficients | t | Sig. |
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 1.445 | 0.266 | | 5.437 | 0.000 |
| | [I am adequately trained on the use of OIC tools for KS] | 0.416 | 0.074 | 0.416 | 5.642 | 0.000 |
| | [Collaborating with other employees is necessary for my KS] | 0.085 | 0.076 | 0.080 | 1.107 | 0.270 |
| | [The available OIC tools are adequate for my adoption of KS] | -0.039 | 0.085 | -0.033 | -0.464 | 0.643 |
| | [The use of OIC tools improves my work output] | 0.133 | 0.086 | 0.114 | 1.551 | 0.123 |
| a. Dependent Variable: Adoption of OIC for KS | | | | | | |

### *4.1.3 Descriptive analysis individual determinants for KS*

The quantitative analysis identified two individual determinant for KS as being more significant. The first important determinant was whether employees were adequately trained in the use of OIC for KS. As indicated in Figure 1 below, over half of the respondents were of the contrary opinion with the above statement where 31% strongly disagreed and 24% disagreed.

 

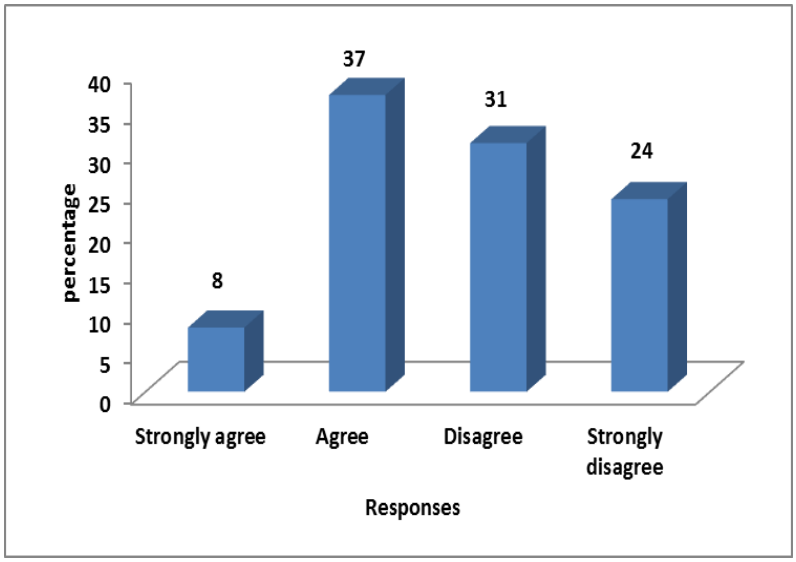


**Table 1: Adequately Trained in the use of OIC for KS**

The other significant issue was whether collaboration of employees is necessary in enhancing KS. As shown in Figure 2, slightly over 50% of the respondents responded in affirmative with 12% strongly agreeing and 41% agreeing with the above statement.

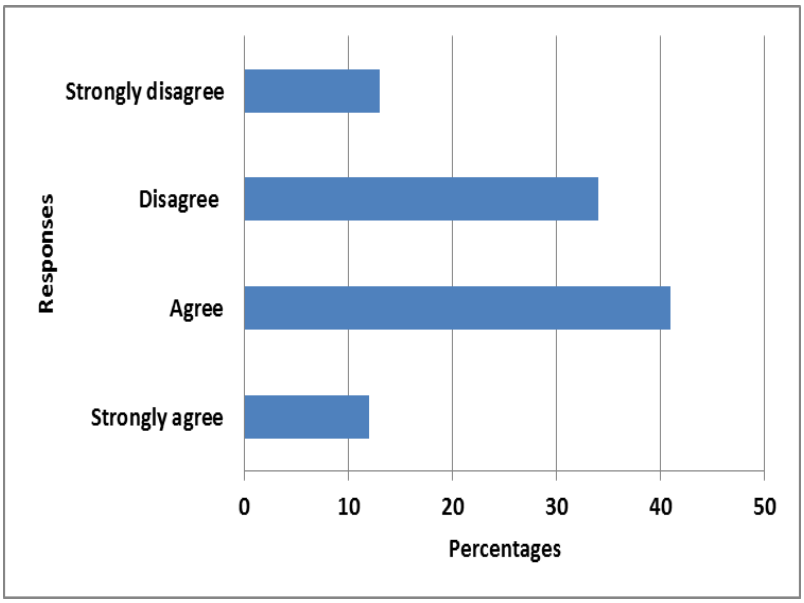


**Table 2: Employees' Collaboration is Necessary in Enhancing KS**

### 4.2 Findings of the Qualitative Data Analysis

The qualitative data were based on and derived from the analysis of the quantitative data to provide more insights into employees' individual perceptions in their attempts to adopt OIC tools for KS in their organisations to addressed RQ1 specifically. Several themes emerged from the qualitative data. The most visible themes included training and development and employees' attitude towards the use of OIC tools.

The majority of responses related to the theme of training and development, and covered issues pertaining to employees' training and skills improvement for adopting OIC tools. Although the study's participants indicated that they were actively engaging with OIC tools in their routine work, they generally felt that they were not adequately trained on using these tools beyond their assigned tasks. This is confirmed by a participant who commented that: *"Most of my skills in the use of computer are by self-effort but I understand anything new comes with its challenges… Well, it all depends on whether other employees will teach us … new things because the SACCO seems not to care."* Another one remarked that *"Well… how are we expected to share knowledge with what we have not been trained? We need to first know how OIC can improve work before we can talk of*

*knowledge sharing."* A senior manager remarked that: *"Training is necessary for employees to effectively use new innovations."* Even though there was an impression that most employees lacked the necessary and relevant training on KS, they nevertheless appreciated the potential of OIC tools for enhancing KS. It can be construed that employees were aware of the need to have the necessary skills, and of the importance of training on short-term and longer-term interventions for embracing KS.

The second theme concerned participants' attitude on the use of OIC, which encompasses the use of OIC tools in their daily activities and their ability to interact online as part of their internal communication to promote KS. The participants confirmed the availability of OIC tools and most of them indicated that they had no problem accessing and using some of the OIC tools at their workplace. One participant commented: *"To say the truth, I wouldn't say that I have any issue accessing the tools in our SACCO. Most of my work is done online."* However, they had no impetus on using them for KS. This was reinforced by a substantial number of senior managers who indicated that OIC provided employees with an array of tools that were suitable for social interaction in the respective organisations as suggested by SNT. One senior manager commented that: *"Online tools are available in our SACCO, but our employees do not use them as they do with their phones and I don't know the reasons why."* This was an indication that the employees had full access to the available OIC tools and were actively using them to carry out their duties but were not utilizing them for KS. The findings further showed that employees' use of specific OIC tools was influenced by their personal perceptions of those tools, (namely the usefulness, ease of use and standpoints on OIC tools as proposed in TAM), the services offered by their SACCOs, the envisaged use of those tools, their involvement in the implementation of the tools and their ability to integrate those tools for KS. This suggests that the low utilisation of OIC tools in the SACCOs for internal interactions was influenced by employees' negative attitudes of OIC tools for KS, thus affecting their perceptions on online networking ability in their organisations.

## 5. Discussion

Both the quantitative and the qualitative findings indicated that all levels of KS affect the use of OIC in SACCOs, that is from the personal/individual, technological and managerial/organisational perspectives. The need of training is one of the most important factors that was identified which confirms the importance to share tacit knowledge on both the personal/individual level through relationship building and the need for processes and structures at managerial/organisational level to empower individuals to change implicit knowledge to explicit knowledge which is accessible to all employees. This is evidenced in viewpoints from the participants that they did not possess the competencies needed to use OIC for KS. It was evident that most of the participants were not very proficient in using OIC tools for KS despite having long exposure to computer technology which could be achieved through the technology perspective by using new digital tools for explicit knowledge creation and sharing as posited by TAM. Most senior managers cited a lack of training as one contributor to employees' apathy towards KS. However, it was apparent that most participants and respondents were cognisant of the importance of training on KS and the potential benefits of being competent in the use of OIC tools beyond their current uses. This finding shows that both the senior managers and employees are fully aware of, and actually appreciate, the role of capacity building in enhancing their online relationships in their respective organisations as earlier suggested by Chau (2018), Du et al. (2019) and Eshak et al. (2022. Most of them agreed that having sound and relevant training programmes is critical for modifying employees' perceptions towards adopting KS and subsequently enhancing the trust-based relationships. Consequently, the findings place training and development in a pivotal position in the promotion of OIC for KS. This viewpoint confirms those of Chau, (2018), Lee, (2018) and Tajpour et al. (2022), namely that the introduction of innovation should always be complemented with relevant training as a way of ensuring that employees grasp the necessary skills and pose positive attitudes for coping with change.

It was established from the findings that OIC tools were readily available and accessible to employees for enhancing service delivery in the SACCOs in Kenya. The participants confirmed the availability and most of them indicated that they had no problem accessing the OIC tools at their workplace. However, most of them indicated that they were not enthused to use them for KM. This implies that availability and accessibility of OIC tools does not automatically lead to their use for KM. In this regard, organisations need to implement processes and structure through new strategies to modify employees' perceptions that will motivate them to adopt new innovations for KM. The findings concur with those of Page et al. (2015) and Asiedu et al. (2022), who assert that despite most organisations having indeed implemented multifaceted technological systems for online communication, users need to be motivated to utilize them for the various purposes.

 

Both the literature and the findings of this study imply the need to modify employees' perceptions towards the use of innovations for KS in the SACCOs. The findings show that employees had a negative perceptions towards the use of OIC for online KM and there were no sufficient online forums available to motivate employees to engage and share knowledge. However, some participants recognised that some conditions in their workplace had an impact on their desire to adopt OIC tools for KS. They emphasised the need to build their work capacity in order to enhance their ability to use OIC to collaborate and interact with other employees. Hence, more efforts should be orientated towards behaviour modification of employees' perceptions and to impart new knowledge and skills on online KS. As indicated by Mallasi and Ainin (2015) and Omotayo (2015), the implementation of sound KS is still a challenge in many organisations owing to a lack of appropriate strategies and guidelines, resulting in unfavourable attitudes by employees. It is therefore proposed that a strategy for modifying personal/individual employees' perceptions towards online interactions while using OIC tools for KS is necessary for enhancing sustainable competitive advantage in the competitive global environment.

Based on the findings, it is posited that the eight selected deposit-taking SACCOs had not fully built the capacity of their employees to overcome barriers to the adoption of OIC for KS. It is suggested that the management of the respective SACCOs must equip their employees with the necessary knowledge, skills and attitudes to implement and adopt OIC in the context of KS. Consequently, it is concluded that capacity building may address employees' individual determinants of KS, such as the adoption and integration of new technologies in the workplace, personal mastering of innovations, motivation, empowerment, open communication, free online exchange of information, online interactions, perceived ease of use, perceived usefulness, attitudes, credibility and trust. This links to results from a recent study conducted by Anand et al. (2021) who emphasise the need for a strategic focus on human resources (organisational learning, relationship building, etc.); innovation, trust and performance central to human factors linked to KS; and the need for KS based practices leading to a better understanding of strategies that enable the long-term storage and retrieval of tacit and explicit knowledge in the organisation.

## 6. Limitations and Strengths

The main limitations of the study are that its findings are bound to be affected by the issue of transferability, since they were generated from employees' perceptions and experiences in a specific context and the study was cross-sectional in design as data were collected at a particular point in time. However, Louw (2018) acknowledges that the worthiness of any research is determined by the extent to which it contributes to knowledge, both theoretical and in practice. Hence it is posited that this study is new and unique and contributes to the existing body of knowledge in communication research and organisational communication practice in several ways.

Owing to the technological advancement leading to numerous innovations and the rapid inclination towards the knowledge-based economy, there is a need for similar studies to be carried out in other sectors of the economy using similar or different study approaches and population strata. Further research in this area, for example longitudinal studies, is also recommended to determine the use of OIC for KS across the board.

## 7. Conclusion

In this research, the lack of research into the adoption of OIC for KS on a personal/individual level was addressed, specifically in the context of deposit-taking SACCOs in Kenya. It was posited that for SACCOs to leverage their full KS potential, they must understand their employees' perceptions of KS in order to address the factors affecting the KS process as a whole. In summary, it was found that that despite the availability and accessibility to OIC tools, most employees lacked the required knowledge, skills and attitudes for adopting OIC for KS. Thus, the above factors can be considered to be affecting employees' personal/individual opportunities for adopting OIC for KS that are critical to the success of any knowledge-based organisation. This scenario needs to be remedied if the SACCOs are to attain a competitive edge in the knowledge economy. The study is, therefore, expected to assist the management in improving the adoption of OIC for KS among employees in the SACCOs industry in Kenya and supports the following argument by Lauring and Selmer (2011, p.1):

> *Promoting knowledge creation and knowledge sharing within organisations is an essential challenge in today's business environment. Knowledge sharing is argued to lead to better performance due to improved decision making and better coordination.*

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# Strategies for Knowledge Sharing Among Rice Farmers: A Ghanaian Perspective

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**Abstract**: *Purpose*: This article investigates knowledge sharing practices amongst rice farmers in Ghana and suggests a strategy for improving knowledge sharing in rice farming communities in Ghana. *Design/methodology/approach*: This study is underpinned by the pragmatic paradigm where concurrent triangulation mixed-method design was used for the study. Data was gathered with survey and interviews. A total sample of 110 was used, involving 101 survey respondents and 9 interview participants. The survey data was analyse descriptively using Statistical Package for the Social Sciences (SPSS), version 26. The interview finding was analysed using thematic analysis. The findings revealed informal knowledge sharing practices among the rice farmers and suggests a strategy for knowledge sharing that involve partnerships between stakeholders in different sectors, such as government agencies, rice-farming communities; rice production-based NGOs, and researchers. Successful implementation of knowledge sharing would depend on finding and connecting the tools, technologies, and techniques practices. *Limitations***:** The results could not be generalised to knowledge sharing practices among rice framers in Ghana because only three regions were targeted. There is a need for a quantitative comparative study of knowledge sharing by rice farmers in all regions where rice is produced in Ghana. *Practical Implications*: Rice is an agricultural cereal crop in Ghana and an important source of livelihood for rural poor households. It is consumed and cultivated by many people in the country. When rice farmers engage in efficient knowledge sharing practises knowledge will spread easily among rice farming communities resulting in sustainable agricultural practices that may eradicate hunger and poverty Effective knowledge sharing, offers great potential for addressing the challenges of rice production in Ghana. It will increase rice production, improve the quality of rice yield and safeguard the quality of the natural environment simultaneous. *Originality/Value*: This article adds to the body of knowledge on knowledge sharing from an agricultural perspective with specific reference to rice farming. Effective knowledge sharing will enhance food security, alleviate climate change challenges, improve nutrition, and promote sustainable agriculture, thus contributing toward the realisation of Goal 2 of the United Nations 2030 Sustainable Development Goals. The findings of this article form part of the finding of the doctoral studies.

**Keywords:** Ghana, Knowledge, Knowledge management, Knowledge sharing, Strategy, Agriculture, Rice, Rice farmers

## 1. Introduction

Knowledge sharing is becoming important in the drive towards sustainable agriculture in farming communities in Africa, as well as in low and middle-income countries elsewhere where agriculture is less mechanised (Adetimehin, Ounlola,and Owolabi, 2018; Buendía, Garces and Aceros, 2023; Qureshi, Sutter and Bhatt, 2017; Wijitdechakul, 2018). Knowledge sharing amongst rice farmers ensures that farmers get access to relevant and timely knowledge to improve their farming practises. It is a critical pathway to bringing innovation and modernization into rice farming in developing countries (Laforge and McLachlan, 2018).

Rice is one of the most widely consumed food commodities, which can be harnessed for addressing food insecurity in Africa (Nimoh. Tham-Agyekum and Nyarko, 2012). It is an agricultural cereal product belonging to the *Oryza sativa or Oryza glaberrima* grass species (Tariq et al., 2018). The parent species of rice (i.e., Oryza sativa) is native to Asia and certain parts of Africa, but, due to centuries of trade and exportation, rice has become commonplace in many countries worldwide, directly feeding more people than any other food crop (Tippe et al., 2017:94). As a cereal grain, rice is the most widely consumed staple food for the largest part of the world's human population, and the third-highest agricultural commodity with worldwide production, coming after sugarcane and maize (Buendía, Garces and Aceros 2023; Moglia et al., 2018:86). Sustainable farming practices offer opportunity for improving the livelihoods of individuals, households and communities involved in agriculture, especially smallholder farmers in sub-Saharan African countries (Qureshi, Sutter and Bhatt, 2017:18; Wijitdechakul, 2018:11).



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Rice production has a significant impact on addressing poverty and food security. This is in line with agenda 2030 of Sustainable Development Goals (SDGs), signed in 2015 by the United Nations member countries, of which Ghana is a signatory. Goal 1 seeks to end poverty, goal 2 seeks to ensure food security. Ortolani et al (2015:22) noted that knowledge sharing is linked to sustainable agricultural practices. Knowledge sharing provides social and economic opportunities and therefore serves as a pathway out of poverty and social exclusion (Qureshi., Sutter and Bhatt, 2017:20). The different types of rice farmers are subsistence, small holder rice farmers, and commercial rice farmers (Andre et al., 2017:888). The subsistence rice farmers mostly grow rice on a microscale, mainly to feed their family or households. In low and middle-income countries, subsistence farmers are mainly found in deprived villages. Smallholder farmers, on the other hand, grow rice on a small scale for the purposes of both selling some and feeding their households from the farm (Buendía, Garces, and Aceros, 2023; Tippe et al., 2017:94).

Ghana is a lower-middle-income West African country where rice holds growing relevance as a food staple and where the rice sector plays a crucial role in the national economy (Braimah, and Rosenberg, 2022; Nimoh, Tham-Agyekum and Nyarko, 2012). The reason for this lies in increased dietary shifts from traditional Ghanaian foods (such as *fufu, kenkey, and gari)* to rice foods, particularly in urban areas. Rice is currently the second most important staple food in Ghana after maize, and its consumption is forecast to continue to rise because of population growth, urbanisation, and the associated changes in dietary patterns and habits (Cadger et al., 2016). Rice has permeated the socio-cultural fabric of Ghana's food space, now being more common than any of Ghana's traditional foods (Nimoh, Tham-Agyekum, and Nyarko., 2012). It is eaten by all Ghana's ethnic groups and tops the list of foods served during various cultural activities, including funeral ceremonies, marriage ceremonies, naming ceremonies, and other social gatherings.

The agricultural sector in Ghana contributes between 35-40% of Ghana's Gross Domestic Product (GDP) and provides livelihoods for an estimated 57% of the total labour force (Cadger, et al., 2016:32). The agricultural sector, in general, is dominated by smallholder farmers mainly in rural areas. Among the three regions where rice is predominantly produced in Ghana, are the Eastern Region, Northern Region and Ashanti Region (Cadger et al., 2016:35; Muhammed, Tela, and Wahab, 2022). The study was conducted in the Eastern Region of Ghana because rice farmers in this region are estimated to contribute more than half of all rice produced in Ghana for local consumption (Braimah, and Rosenberg, 2022; Donkor, Matthews and Ogundeji, 2018:157). The three rice-farming communities that dominate rice production in this region are: *Akuse, Asutsuare, and Kpong*. The Eastern Region also shares regional boundaries with Ashanti, Greater Accra, Western, and Volta regions.

Despite, the critical importance of rice farming, rice yield has been slowing down, especially among smallholder farmers in Ghana (Braimah, and Rosenberg, 2022; Moglia et al., 2018:85). For instance, the average rice yields potential is 10t/ha; however, the global average rice yield has hovered around 7-8 t/ha, with average yield from developing countries hovering around 4-5t/ha (Moglia et al., 2018:86). The rice production in Ghana has not paralleled the growing preference for rice meals, necessitating importation from other countries to augment rice consumption (Muhammed, Tela and Ab Wahab, 2022; Tinsley, 2009:14). Part of the problems contributing to low rice yield, especially in developing countries including Ghana, include lack of technology and efficient knowledge sharing practices and knowledge management in general among smallholder farmers (Tariq et al., 2018:73).

Several studies on rice farming and knowledge sharing have been on high income countries. There are no studies on how knowledge is shared among rice farmers in Ghana. Knowledge sharing can help to improve rice production by improving farming practices, developing collaboration and innovation among rice farmers and preventing loss of critical know-how in rice farming (Tariq et al., 2018:73). This article, therefore, focuses on understanding knowledge sharing in rice farming communities in Ghana, drawing on two theories, the Socialisation, Externalisation, Combination, and Internalisation (SECI) model by Nonaka (1991:6) and social exchange theory (SET) by Homans (1958) as a framework.

### 1.1 Problem Statement

Knowledge sharing is an important part of rice farming. Knowledge sharing among rice farmers ensures access to timely and relevant knowledge on best practices in improving rice productivity (Wijitdechakul, 2018:4). Knowledge sharing is even more critical in countries where the mechanization of agriculture still evolves (Qureshi, Sutter and Bhatt, 2017:12). In many rice farming communities in Africa, knowledge sharing among rice farmers constitutes a critical pathway for boosting rice production, ensuring collaboration and preserving critical know-how (Mashavave, et al., 2013:6). Farmer-led extensions are increasingly focused on improving agricultural practices and productivity in especially rural areas (Kiptot, et al, 2016:169).

However, rice farmers in Ghana, face severe challenges in their rice production. The challenges include pest infestation, less quality of rice grains and difficulties in proper fertilizers application (Tinsley 2009:7). These challenges faced by rice farmers have been attributed to the fact that there are limited knowledge sharing on best rice farming practices, even in rice farming communities where usable knowledge exists (Muhammed,, Tela and and Ab Wahab, 2022; Tsinigo and Behrman, 2017:49). The challenges of knowledge sharing practices among rice farmers, is a crucial factor accounting for the low rice productivity in Ghana (Donkor, Matthews and Ogundeji 2018:155). The limited knowledge sharing impedes the productivity of rice, undermines collaboration among rice farmers and preservation of critical know-how in rice farming in Ghana (Nimoh Tham-Agyekum. and Nyarko, 2012:36). For instance, several attempts by the Ministry of Agriculture to bring innovation into rice farming in Ghana were unsuccessful due to limited understanding of knowledge flow among smallholder farmers in Ghana (Tsinigo and Behrman, 2017:49). Against this backdrop this study investigates knowledge sharing amongst rice farmers in Ghana.

## 2. Literature Review

Knowledge sharing is an integral part of the broader knowledge management process (Balaji, Meera and Dixit, 2007:11; Clappison et al., 2013:60). It is through knowledge sharing that knowledge gets exchanged among individuals within an organisation. Knowledge sharing is defined as the exchange of knowledge between individuals (Kaewchur and Phusavat, 2013:181; Kim, Yagi and Kiminami, 2023.). Knowledge sharing is also defined by Prins et al. (2015:18) as the activities of transferring or disseminating knowledge from one person, group, or organisation to another. Knowledge transfer refers to the sharing or dissemination of knowledge or expertise from one part of an organisation to another (Andre et al., 2017:896; Kim, Yagi and Kiminami, 2023). The terms knowledge sharing, and "knowledge transfer" have been used interchangeably in the literature. In this study knowledge sharing is defined as the practices involved in how critical information resources are communicated or exchanged among the rice farmers and other stakeholders involved in rice farming in the Region.

### 2.1 Knowledge Sharing Practices

Knowledge sharing practices are all the activities that are intended to improve the internal flow and use of knowledge within a team in an organisation. It includes enablers, barriers and strategies adopted by individuals in exchanging knowledge among themselves which will be discussed in the subsequent sections. The factors that enable knowledge sharing have been categorised as individual-level factors, social and cultural factors organisational factors and technological factors (Cadger et al., 2016:42). Individual factors are qualities of individuals that make them more willing to share knowledge with others (Escobar, et al., 2022; Rosenberry and Vicker, 2017:28). Amongst these individual factors that enable knowledge sharing are self-efficacy, effective communication skills, personal relationships and interpersonal trust, and motivation (Ortolani et al., 2015:25).

Social and cultural factors create safe social spaces and opportunities that make individuals feel comfortable about sharing knowledge (Chhim, Somers and Chinnam. 2017:753; Escobar, et al., 2022). Socio-cultural factors involve high sense of trust, frequent interaction between individuals and workers and integration of knowledge sharing in work processes (Chhim., Somers and Chinnam, 2017:751). Other socio-cultural factors are collectivism, high sense of dependence and communality (Garcia, Galeon and Palaoag, 2018:32; Ortolani et al., 2015:22).

Some of the organisational factors that can act as facilitators to knowledge sharing among individuals in organisation or Communities of Practice are reward systems, leadership and management support, social networking, participation and democratic involvement and learning communities (Hislop, Bosua and Heims, 2018:15; Kim, Yagi and Kiminami, 2023; Nadason, Saad and Ahmi, 2017:34).

Some of the technologies that enable knowledge sharing are internet, intranet, e-mails, skype, blogs, social media, video conferencing and instant messaging (Yeşil and Hırlak, 2019:22). Other knowledge sharing systems include expertise locator systems, best practice databases, knowledge repositories and incident report databases, electronic performance support systems, digital learning repositories and digital object repositories (Assem and Pabbi, 2016; Taskin and Van Bunnen, 2015:159). Digital knowledge repositories have several key features that make them very effective. First, there is centralisation feature which allows wide varieties of digital contents curated from multiple sources to be housed in a central location, where the content can be shared

The different factors that undermine knowledge sharing among individuals in organisations may be grouped as individual, social, cultural, organisational barriers and technological barriers. Some of the personal factors identified include trust and perceived power (Cadger et al., 2016:35; Kim, Yagi and Kiminami, 2023). Others

 

include knowledge hoarding, mistrust, and dominance of sharing, explicit over tacit knowledge, individual differences, poor communication skills and time constraints (Rosenberry and Vicker, 2017:28).

Social and cultural factors create the atmosphere within organisations or communities of practice that influence how individuals behave (Navarro and Hautea, 2014:66). Within the context of work, for instance, the socio-cultural factors include factors within the cultural and social fabric of life that act as disincentives to the workers to share information. Family ties constitute the major cultural factor and social network cohesion constitutes the major social factor that affects knowledge sharing among workers (Siziba et al., 2012:16). Other factors included elements of mistrust, suspicion, and animosity, among others (Feng and Xue, 2014:11).

Organisational barriers constitute the factors at the level of organisations (in more formal sense) or communities of practice (in less formal sense) that impede or inhibit how individuals within the organisations share knowledge (Feng and Xue, 2014:11). Some of the organisational factors that act as barriers of knowledge sharing are financial constraints, lack of leadership and managerial support, hierarchy of work and organisational culture.

Several studies have identified potential technological barriers to knowledge sharing (Yeşil and Hırlak 2019:22; Ganguly, Talukdar and Chatterjee, 2019) The lack of technical support and lack of integration of information technology systems and processes impedes the way people do things and constitutes a critical technological barrier to knowledge sharing among smallholder farmers. Other technological barriers include lack of compatibility between diverse IT systems and processes (Adamides and Stylianou, 2013:6) and lack of training regarding workers' familiarisation with new IT systems and processes (Assem and Pabbi, 2016:482).

Amongst the strategies of knowledge sharing are Communities of Practice (CoP) mentoring and tutoring, expertise location, job rotation and SharePoint Communities of practice. Communities of Practice are a group of individuals or people who share a profession or craft (Boateng and Agyemang, 2016:218). Communities of Practice can be created deliberately, through the process of sharing knowledge or from experiences within a group of workers (Chen, et al 2015:1435).

Tutoring and mentoring as strategy for knowledge sharing is defined as a semi-structured forms of guidance in which individuals share their skills, knowledge and experience to assist other individuals to progress in their careers (Escobar et al., 2022; Garcia, Galeon and Palaoag, 2018:287). Expertise location provides organisations with support needed in achieving organisational learning goals (Dzandu, Boateng and Tang, 2014:349). Job rotation is a strategy used by organisations to rotate their employees' assigned jobs throughout their employment. Employers practice this technique for several reasons (Hislop, Bosua and Helms, 2018:46). Job rotation is usually designed to promote flexibility of employees and to keep employees interested in staying with the company/organisation, which employs them (Gava, et al., 2017:108).

### 2.2 Knowledge Sharing Amongst Rice Farmers

The basic goal of knowledge sharing among farmers is to leverage the available knowledge that may help rice farmers carry out their tasks efficiently and effectively. Knowledge sharing amongst rice farmers is even more critical in countries like Ghana where the mechanisation of agriculture is still evolving (Escobar et al., 2022; Qureshi, Sutter and Bhatt, 2017). In low and middle-income countries where agriculture is less mechanised (Mashavave, et al., 2013), knowledge sharing among rice farmers constitutes a critical pathway for boosting rice production (Donkor, Matthews and Ogundeji,. 2018).

Farmers-led extensions are becoming increasingly important for improving agricultural practises and productivity, particularly in rural areas (Kiptot, et al.,2016). Several studies have examined the types of knowledge shared among farmers (Gava, et al., 2017; Kim, Yagi, et al 2023; Mwesigwa et al. 2016; Meijer, et al., 2015 and Siziba et al. 2012). Rice farmers share knowledge on various rice harvesting, processes and marketing approaches (Guo, et al., 2015).

Knowledge sharing on climate change is critical for farmers because climate change has had and continues to have a catastrophic impact on human settlements and livelihoods (Clappison, et al., 2013). Climate change adaptability is therefore seen as a case of risk management, aimed at securing food, water, timber and other means of livelihoods (Balaji, et al 2007). Studies by Chen, Shanthikumar and Sheb. 2015, Feng and Xue 2014, Garcia, Galeon and Palaoag, 2018, Ortolani et al. 2015, Tariq et al. 2018 and Wood et al. 2014 also provide insight into the potential of knowledge sharing practises among farmers that can impact on climate change.

Kamarudin et al., 2015 noted that farmers willingly shared farming knowledge among themselves and were working cooperatively and closely in undertaking their farming activities. The culture of cooperation and collective interest among these rice farmers improved knowledge sharing. Tariq et al. 2018 also examined

knowledge sharing in the assessment of mitigation practises for the dissemination of climate-friendly rice production systems in Vietnam. The findings showed that involving rice farmers in decision-making processes in a participatory manner enhances knowledge sharing practises among them Tariq et al., 2018.

Guo, et al., 2015 randomised controlled trial (RCT) to examine how Farmer Field Schools (FFS) affect knowledge acquisition among rice farmers in China (Escobar et al., 2022; Guo et al. 2015), observed that participatory involvement of rice farmers improves both knowledge acquisition and knowledge sharing in China. Notwithstanding the importance of knowledge sharing, sharing constitute a major challenge, among farmers in general and rice farmers for several reasons, including the fact that some farmers tend to resist sharing their knowledge with others (Assem and Pabbi., 2016:480). This situation leads to knowledge hoarding in rice farming communities (Prins et al., 2015:18). Amongst the reasons why rice farmers fail to share knowledge with their colleagues are protecting their competitive edge, lack of trust among rice farmers, lack of rewards of sharing of knowledge and personal characteristics, among others (Adamides and Stylianou, 2013:6; Escobar et al., 2022). It is therefore imperative that these issues are adequately addressed among rice farmers to improve knowledge sharing between and among them.

### 2.3 Theories on Knowledge Sharing

This study uses the Socialisation, Externalisation, Combination, and Internalisation (SECI) model and the Social Exchange Theory (SET) as a framework for understanding knowledge sharing strategies in rice farming communities in Ghana. The SECI model was proposed by Nonaka and Takeuchi (1996), and has become an integral framework of knowledge creation, knowledge sharing and knowledge transfer (Hislop, Bosua and Helms 2018).

The SECI model is based on the two main types of knowledge: tacit knowledge and explicit knowledge. According to the SECI model, there are four modes through which organisational knowledge is created and shared: socialisation, externalisation, combination and internalisation (Hislop, Bosua and Helms, 2018; Nonaka, Toyama and konno, 2000). Socialisation is defined as the processes involved in the transfer of tacit knowledge between and among individuals within an organisation through observations when working with more skilled and knowledgeable workers (Nonaka and Takeuchi, 1996). Externalisation encompasses the entire process involved in turning or converting tacit knowledge into explicit knowledge through documentation and verbalisation (Hislop, Bosua and Helms, 2018). Externalisation is, however, deemed a particularly important, yet difficult knowledge conversion mechanism (Karadsheh et al. 2009). Tacit knowledge is defined as the type of knowledge that is codified into documents (e.g., manuals and web pages) so that it can be circulated easily throughout an organisation. Examples of tacit knowledge creation are face-to-face interactions or meetings, and video and teleconferences. In this sense, knowledge is therefore passed on from experienced to less experienced workers through guidance, practice, imitation, and observation. In applying the socialization to the current study, rice farmers gain new knowledge from outside its boundaries, such as through interacting with customers, suppliers and stakeholders. The externalisation process helps to examine the processes by which the rice farmers convert tacit rice farming knowledge into explicit knowledge to guide their rice farming activities.

Combination is the mode of knowledge conversion involving the combination of different types of explicit knowledge (Nonaka and Takeuchi, 1996) and it is the simplest form of knowledge sharing. In applying combination to this study, codified knowledge sources (such as documents) are merged to create new knowledge for rice farmers in Eastern Region of Ghana. This was intended to help discover how the rice farmers of the Eastern Region sort and categorise explicit knowledge, thus allowing it to become a more valuable source for planning and decision-making purposes.

Internalization refers to the processes by which people internalise explicit knowledge in order to develop tacit knowledge (Sanchez, Arroyo and Moreno, 2018; Singh, 2018). The internalisation process occurs as the user's existing tacit knowledge is modified through the use and learning of explicit sources (Hislop, Bosua, Helms. 2018). This means that when rice farmers are exposed to new rice farming knowledge, they internalise it by forming mental representations of the new knowledge (Sanchez, 2018). Internationalisation helps to examine how new knowledge become internalised among the rice farmers (Singh, 2018).

The Social Exchange Theory (SET) was incorporated into the SECI model to explain social exchange as negotiation processes among rice farmers. The SET proposes that human exchanges are guided by subjective cost-benefit analysis, where individuals consider what they will lose or gain by exchanging something (Cropanzo et al., 2017).

The SET was chosen to help form an understanding of the motivations (cost-benefit analysis) of knowledge sharing among the rice farmers. Knowledge sharing, fundamentally, encompasses individuals who have access

 

to knowledge and who therefore decide to make that knowledge available to others. In the case of rice farmers, knowledge sharing becomes an exchange of relevant information about best rice farming practises with their colleague farmers. Therefore, using the SET, it is assumed that farmers who hold critical rice farming knowledge or information will engage in subjective cost-benefit analysis before deciding whether to share their knowledge or not. Using the SET to examine knowledge sharing among rice farmers therefore provides deeper understanding into the motivating factors underlying knowledge sharing practises among the farmers.

Integrating the SECI model, the SET helped in exploring the different dynamics associated with how tacit and explicit knowledge are shared among the farmers. This, in turn, assists in uncovering the nuances in knowledge sharing and the challenges faced with the various different kinds of knowledge among the farmers.

## 3. Methodology

This study adopted the pragmatic paradigm and triangulation of quantitative and qualitative methods of data collection and analysis from three rice farming communities from the Eastern region of Ghana namely Akuse, Asutuare and Kpong. A survey research design was adopted for the quantitative part of the study. A census of all the rice farmers and other stakeholders whose activities directly influence rice farming within the communities involved was undertaken. The other stakeholders included agricultural and extension officers, as well as some farm managers.

The quantitative data was gathered through a survey, by administering questionnaire to the respondents used to examine benefits of knowledge sharing, inhibitors of knowledge sharing, enablers of knowledge sharing and strategies for enhancing knowledge sharing among the rice farmers.

The questions were adapted from the previous studies of authors such as Adetimehin et al (2018), Donkor et al (2018), Nimoh et al (2012), Tsingo, and Behrman (2017), Boateng and Agyeman (2016) as well as Kodua-Ntim and Fombad (2020). The others are Dei and van der walt (2020), Kommey (2020) and Fambad (2008)

The questions proved valid in the previous studies and therefore appropriate for the current. After formulating the questions, the researcher had two rice farming experts review all the questions and made suggestions. After that, the subject matter expert on knowledge sharing, who is a professor reviewed and approved the questionnaire for data gathering. This was also reviewed and approved by the supervisor who is also an expert in the subject under discussion. The questions were modified for the study. The data was part of a larger PhD thesis conducted in 2020 titled 'Knowledge Sharing Practices among Rice Farmers in the Eastern Region of Ghana. See Tables 1 and 2.

**Table 1: Adapted Questions Items and Authors for Improving Knowledge Sharing**

| **Adapted Questions Items** | **Source(S )** |
|---|---|
| Use of appropriate technology | Donkor, Matthews and Ogundeji, (2018), Tsingo and Behrman (2017). |
| Leadership and management support | Tsingo and Behrman (2017). |
| Integration of knowledge sharing initiatives in goals and strategies | Adetimehin, Okunlola and Owolsbi (2018), Donkor, Tham-Agyekum and Nyarko, (2018) |
| Provide space and opportunities for knowledge sharing | Donkor, Tham-Agyekum and Nyarko, , (2018), Tsingo and Behrman (2017). |
| Various forms of knowledge sharing and farming systems are encouraged among rice farmers here | Nimoh, Tham-Agyekum and Nyarko, (2012) |
| Constant training and retraining of the rice farmers | Nimoh, Tham-Agyekum and Nyarko, (2012) |

| **Adapted Questions Items** | **Source(S )** |
|---|---|
| Build trust | Adetimehin Okunlola and Owolsbi (2018), Tsingo and Behrman (2017). |
| There are reward systems for rice farmers who willingly share their knowledge on rice farming with their colleagues | Adetimehin Okunlola and Owolsbi (2018) |
| We set aside time for face-to-face collaborations and knowledge sharing | Nimoh, Tham-Agyekum and Nyarko, (2012) |
| Investment and financial support | Tsingo and Behrman (2017). |
| Opinions and inputs are sought from new rice farmers on all issues | Donkor et al (2018), Nimoh, Tham-Agyekum and Nyarko, (2012) |
| Familiarisation of other categories of knowledge | Nimoh, Tham-Agyekum and Nyarko, (2012) |
| All individuals who enter rice farming are given mentors | Nimoh, Tham-Agyekum and Nyarko, (2012) |

**Table 2: Adapted Questions Items and Authors for Improving Knowledge Sharing Practices**

| | |
|---|---|
| What Strategies do you use to enhance knowledge sharing among rice farmers in this region | Boateng and Agyeman. (2016) |
| Do you have leadership and Management support for the rice farm enhancement- | Tsinigo and Behrman (2017) |
| Do rice farmers get investment and financial support in rice farming | Cadger et al., 2016 and Chhim Somers and Chinnam, (2017) |

The responses were determined using a Likert scale ranged as follows; 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neutral (N), 4 = Agree (A), 5 = Strongly Agree (SA). The Yes-No responses were also used. A 'somehow' option was provided in the case that respondents were not so sure of their response. The quantitative data was a survey of 101 respondents amongst who were 75 rice farmers, 21 agriculture and extension officers and 5 farmer managers. The response rate was 100% for all three groups. Data was analysed by descriptive statistics using the Statistical Package for Social Sciences (SPSS) version 26.0.

To obtain in-depth information about the experiences of the rice farmers in knowledge sharing so as to complement the findings from the quantitative data, the qualitative data was analysed using semi-structured interviews from the three communities. An interview guide was developed to guide the interview process. The interview guide opened conversations into issues addressing knowledge sharing practices and strategies among the farmers. The interview guide served as an entry into the conversation, and after that, several probing questions are asked based on responses from the respondents. The probing questions helped to delve deeper into contextual issues relating to knowledge sharing in rice farming within the communities where the study was conducted. Qualitative data was drawn from the open-ended questions and the semi-structured interviews. The interviews were audio recorded, transcribed, and analysed. Participants were coded as R in respect of the

 

qualitative findings from the open-ended questionnaire and as P in respect of the qualitative findings of the interviews.

The instruments for data collection were pre-tested in Asuogyaman District. This area was chosen because the Asuogyaman District also had the most rice production in the Eastern Region. Asuogyaman District is one of the thirty-three districts of the Eastern Region of Ghana. The sample for the pretesting was thirty-three (33) for both questionnaires and interviews. Twenty (20) rice farmers, five (5) managers, and five (5) extension/agricultural officers were selected for the quantitative phase. However, for the qualitative phase, one (1) farmer, one (1) manager and one (1) extension officer were also interviewed for the qualitative phase. The point of the pre-test was to check the questionnaire or interview questions for consistency, accuracy, and whether they could be used.

Cronbach's Alpha was used to determine the internal consistency of items in the survey questionnaire to gauge its reliability. The instrument's overall internal consistency yielded an alpha level of = 0.822, indicating that it was reliable. The trustworthiness of the qualitative component was ensured using dependability, confirmability, credibility, and transferability (Lincoln and Guba, 1985:13; Silverman, 2015:28).

## 4. Findings

The purpose of this article was to explore the knowledge sharing practices amongst rice farmers in the Eastern Region of Ghana to suggest a strategy to enhance knowledge sharing. The demographic findings from the quantitative data revealed that majority of the respondents (70.9%) were males while 29.1% were females. Their ages ranged between 19 and 64 years, with 38% aged between 51 and 60 years, 27.3 between 31and 40 years and 8.2% between 21 and 30 years. Educational levels were generally low, which is characteristic of farming communities in Ghana. Majority of the respondents constituting 68.2 had worked for between 6 and 10 years, with 15.5 of them having been involved in farming activities for between 11and 15 years. For the qualitative data, the nine participants were represented by the identity with a serial number based on their location and titles. For instance, Interviewee Farmer Manager from the Akuse District was coded as (IFMAD-1). Again, Interviewee Farmer Manager from the Kpong District (IFMKD-2. Most of the participants were males.

### 4.1 Knowledge Sharing Practices

The qualitative findings revealed the different knowledge sharing practice used amongst farmers as forum discussions, workshops, training, peer assistance or advice, storytelling or film shows, action reviews by experts, communities of practice, mentoring and coaching.

For instance, IFKD-5 commented that;

> *The extension officer organises workshop for farmers normally in the first and last quarter of the year. This programme has helped us to know our colleagues in different districts who are in rice production".*

Manager, Asutsuare farms-IFMAD-3 also indicated that

> *On our farms, knowledge is shared mainly through the meeting. Rice farmers are allowed to share their experiences and difficulties encountered on the farms. It improves learning by doing on the farms. It also provides opportunities for rice farmers to share their expertise and skills."*

On the issue of workshop organisation, IFMAD-1 also supported that workshops and training are organised for farmers. *The interviewer asked, "How are such workshops and training organised?" IFMAD-1 said that farmers in each district are grouped in zones based on the type of crop they produce. Venues are announced to them either through their WhatsApp platform or community radio available in that district.*

IFKD-5 claimed that they had just ended their workshop for the first quarter which was held at the district assembly hall. *On the contrary, IAOAD-9 said that they already had existing groups, so the extension officers come to talk to them. The interviewer asked if there was a specific time for meetings.* IAOAD-9 responded that there was not because the extension officers are always with them, educating and guiding them from land preparation to harvesting and the marketing stage.

Other interviewees (IFMAD-1) and (IFMKD-2) *shared a similar comment, saying that co-operative organisations or NGOs who are into farming activities also organise discussions or meetings with farmers. IFMKD-2 further said that this normally happens in the form of visits to check if the farmers are implementing the right mechanisms that they were taught during their public forums*. IFMAD-3 *added that most municipal or district assembly agricultural directors or officers normally or most often organise meetings for farmers not solely for*

*rice farmers but all farmers. Probing, the interviewer asked where they held the meetings and what was the purpose of such meetings. IFMAD-3 said that they were held at the assembly premises/hall or at one zonal community centre. This is normally done as a form of follow-up or in the form of re-educating farmers on pesticide application or other mechanisms of farming.*

To make an in-depth assessment, the interviewer asked the farmers, "What is the procedure used in sharing knowledge among yourselves?". *Leaders were chosen from each group and a new farmer who was yet to start a rice production area to mentor them* (IFAD-4). *Normally, with peer assistance, farmers share knowledge with their colleagues* (IFAD-6). *Contrary to what IFAD-4) and IFAD-6) stated IFKD-5 cited that farmers are asked to share their story on the previously implemented mechanism on how they are benefiting from such an innovation.*

Within the groups', experienced farmers are chosen as coaches or team leaders (IFMKD-2). Probing, the interviewer asked, "What is the work of coaches and team leaders?" New farmers are asked to understudy the experienced ones (IFMKD-2). IFMAD-1 explained that:

> *"Before I started my rice farming, I studied previous rice on land preparation, planting and how to prevent birds from coming into contact with your farms. The skills acquired from my mentor has made me gain knowledge on harvesting, pesticides control and marketing."*

IFMAD-3 added:

> *"As a beginner to any profession, mentorship is very important? Because the key knowledge to succeed in such a profession lie on professional knowledge/development from people who have been in such occupation for a long time."*

### 4.2 Strategies to Improve Knowledge Sharing Among the Rice Farmers

The respondents in the quantitative findings were provided with a Likert scale consisting of several possible strategies to improve knowledge sharing amongst rice farmers. The responses of the participants are provided on Table 3.

**Table 3: Strategies for Improving Knowledge Sharing**

| Strategies for improving knowledge sharing among the rice farmers | Strongly agree % | Agree % | Somewhat % | Disagree % | Strongly disagree % |
|---|---|---|---|---|---|
| **Use of appropriate technology** | 87.3 | 1.8 | 3.6 | - | 7.3 |
| **Leadership and management support** | 82.7 | 1.8 | - | - | 15.5 |
| **Integration of knowledge sharing initiatives in goals and strategies** | 78.2 | 4.5 | - | 9.1 | 8.2 |
| **Provide space and opportunities for knowledge sharing** | 74.5 | 13.6 | - | 4.5 | 7.3 |
| **Various forms of knowledge sharing and farming systems are encouraged among rice farmers here** | 72.7 | 11.8 | 1.8 | - | 13.6 |
| **Constant training and retraining of the rice farmers** | 74.5 | 7.3 | - | 10.0 | 8.2 |
| **Build trust** | 72.7 | 10.0 | - | 7.3 | 10.0 |
| **There are reward systems for rice farmers who willingly share their knowledge on rice farming with their colleagues** | 76.4 | 6.4 | - | - | 17.3 |
| **We set aside time for face-to-face collaborations and knowledge sharing** | 70.0 | 13.6 | - | - | 16.4 |
| **Investment and financial support** | 72.7 | 1.8 | 8.2 | 1.8 | 15.5 |

 

| Strategies for improving knowledge sharing among the rice farmers | Strongly agree % | Agree % | Somewhat % | Disagree % | Strongly disagree % |
|---|---|---|---|---|---|
| **Opinions and inputs are sought from new rice farmers on all issues** | 68.2 | 17.3 | - | 7.3 | 7.3 |
| **Familiarisation of other categories of knowledge** | 67.3 | 8.2 | - | 7.3 | 17.3 |
| **All individuals who enter rice farming are given mentors** | 68.2 | 1.8 | - | 13.6 | 16.4 |

The most frequently used strategies were "use of appropriate technology" (87.3% strongly agree), leadership, and management support (82.7% strongly agree). These were followed by giving space and opportunities for sharing knowledge (88.1% strongly agree), encouraging different ways of sharing knowledge (84.5% strongly agree), building trust (82.7% strongly agree), and making time for face-to-face collaborations and sharing knowledge (83.6% strongly agree).

Findings from the open-ended questionnaire indicated. Other strategies of sharing knowledge that were not already captured in the questionnaire. For instance, an Agric Extension Officer admonished their leaders

> *"Do away with favouritism among the rice farmers." A farm manager also indicated that "knowledge should be provided in videos and pictures so everybody can understand and share."*

The rice farmers themselves also indicated other strategies of improving knowledge sharing. For instance, a male rice farmer also indicated that "*some of the knowledge should be translated into the local language so we can all understand*." A female rice farmer also entreated their leaders to *"promote the culture of knowledge sharing."* Other suggestions that emerged also included:

> *"Rice farmers should be rewarded financially" (male rice farmers);*
>
> *"Let us nurture a learning culture" (male rice farmers);*
>
> *"Leaders should initiate knowledge sharing and knowledge transfer policy" (Agric/extension officers)*

Complementary findings from the qualitative data also added impetus to the quantitative findings. The participants in the qualitative finding suggested that the strategies needed to improve knowledge sharing within the rice farming communities included leadership and management support, financial support, building trust, integration of knowledge-sharing initiatives, the use of appropriate technology, and continuous training and re-training. The narratives from the participants mainly focused on leadership roles in improving knowledge sharing. For instance, some of the participants indicated that

> *Leadership factors are very essential strategies to enhance knowledge sharing (Male Agricultural Officer).*
>
> *"To have high or low production in a farming season mostly depends on leadership training and an extension officer's frequent visitation to the farms." (Male farm manager)*
>
> *A leader could be good or bad. If you are lucky to have good extension officer, he/she will always assemble farmers to give pep talks about how to increase yields or pest control, but others will come as normal visitation (Male Farm Manager).*
>
> *A good leader must be a person with a high level of intelligence and must possess certain qualities like a good human relationship, different ideas, methods and systems to help farmers in solving their problems" (Male Agriculture Officer).*

Other views from farmers that echoed enablers to knowledge sharing are leadership, personal relationship, training, conferences and trust

> *Management support could be a strategy to help enhance knowledge sharing among rice farmers. Good management can provide efficient and effective services to their farmers. Management can do this through the organizing of workshops, upgrading of farmers knowledge or skills*

> *to make them know the modern tools and practise available. Management should always seek the interest of their farmers and help them to achieve high production (Female Rice Farmer)*
>
> *If the leadership of the farmer's associations create an enabling environment or good personal relationship, farmers would be willing to share knowledge among themselves (Male Rice Farmer)*
>
> *Farmers need to the knowledge shared about investors, good financial support and where to purchase agrochemicals for their farm product (Female Rice Farmer)*

Others also commented that financial support and other support services must be known to them, such as educational scholarships for their children. However, 50-year-old male farm manager highlighted that "*farmer cooperative unions should share appropriate financial knowledge to help the farmers on how to access funds. Again, knowledge of business advisory services should be shared to them on how to get access to an already established market for their farm products".*

Other participants also indicated the relevance of practice, training and conferences in promoting knowledge sharing among smallholder farmers. For instance,

> *Constant practice makes one perfect. There should be intensive training for farmers on the practises that can help in sustaining and making them productive. As time fades, so are new methods and instruments that come out." (Female Rice Farmer)*
>
> *On a regular basis, seminars and conferences should be organized so as to inform and train them on climate changes and their effect on farming." (Male Rice Farmer)*
>
> *She also said that knowledge sharing from experts would help them in their production. As time goes on, does knowledge and other methods of farming fade out. Corporative organization and farmers association should establish training programmes to enhance the knowledge sharing among expertise in rice farmers.*
>
> *Building trust among farmers is a fundamental concept for knowledge sharing procedure. When farmers trust their superiors, who is giving the information, how would they know, understand and believe in their knowledge shared to them.*

## 5. Discussion

### 5.1 Leveraging Knowledge Sharing Strategies Among Rice Farmers

Drawing from the findings from the qualitative and quantitative study it is evident that knowledge sharing amongst rice farmers is practiced at an elementary level. Amongst the strategies suggested: use of appropriate technology, leadership and management support, integration of knowledge sharing in goals and strategies, providing spaces and opportunities for knowledge sharing, training and retraining, and using reward systems.

Other strategies suggested were building trust, setting time aside for face-to-face meetings, financial support, seeking opinions and inputs from new rice farmers and mentorship to new rice farmers, reducing favouritism among leaders, translating knowledge into the local language, promoting a knowledge sharing culture, using videos and pictures, and rewarding knowledge sharing.

Ensuring that knowledge sharing becomes effective requires the implementation of these strategies within the rice farming communities. However, their implementation has not been sustainable and successful. Still, in order to use these strategies, it is important to have a critical understanding of the strategies that have already been used (André et al., 2017). On the operational level, strategies for improving knowledge sharing were defined in terms of specific context-relevant approaches used to overcome knowledge sharing challenges (Boateng and Agyemang, 2016:218)

The results of this study concur with previous studies that suggest strategies for improving knowledge sharing to revolve around leadership and management support (Tsinigo and Behrman, 2017), the use of appropriate technology (Garcia, Galeon and Palaoag., 2018; Ortolani et al., 2017), investment and financial support (Cadger et al., 2016; Chhim Somers and Chinnam, (2017)), building trust (Holten et al., 2018).

It was evident that participants had an understanding into the strategies that must be put in place to improve knowledge sharing among the rice farmers in the study communities, although no practiced amongst them. Some of the strategies would require a long-term approach, while others would be addressed over a shorter period. For instance, when it comes to investment and financial support and the provision of technological

 

infrastructures, these will require long-term investments, particularly at the national level, as well as investment in expanding internet connectivity and telecommunication within the rice farming communities in the Eastern Region and, by extension, other similar rice farming communities.

Organisational, social and individual level enablers; it can be addressed within the short-to-medium term. For instance, there is a need to create leadership support for knowledge sharing among the rice farmers. Strategies such as building trust, integrating knowledge sharing in goals and strategies, training, tutoring, mentoring, and providing space and opportunities for knowledge sharing can be implemented without waiting to address the technological issues. These strategies fall within the capacity of the individual rice farmers and the Communities of Practice that exist within the rice farming communities.

### 5.2 Strategies for Improving Knowledge Sharing Amongst Rice Farmers

The article draws from the qualitative and quantitative findings to suggest a strategy for improving knowledge sharing among farming communities in Ghana. The researcher recommends that successful implementation of knowledge sharing would depend on identifying and linking knowledge sharing enablers to tools and technologies, as well as to strategies.

It is hoped that this strategy, if well implemented, will lead to sustainable improvement in knowledge sharing among rice farmers in Ghana, as well as among other rice farming communities in other African countries whose contexts are like Ghana. The strategy targets barriers at the structural, community and interpersonal levels that undermine knowledge sharing. Implementation of the strategy would involve partnership between stakeholders in different sectors such as government agencies, rice-farming communities; rice production-based NGOs and researchers. The researcher recommends that a successful implementation of knowledge sharing would depend on identifying and linking knowledge sharing enablers to tools and technologies, as well as to strategies, as presented in Figure 1. What is important are strategies to address the short-term challenges while advocating to have structural inhibitors addressed.

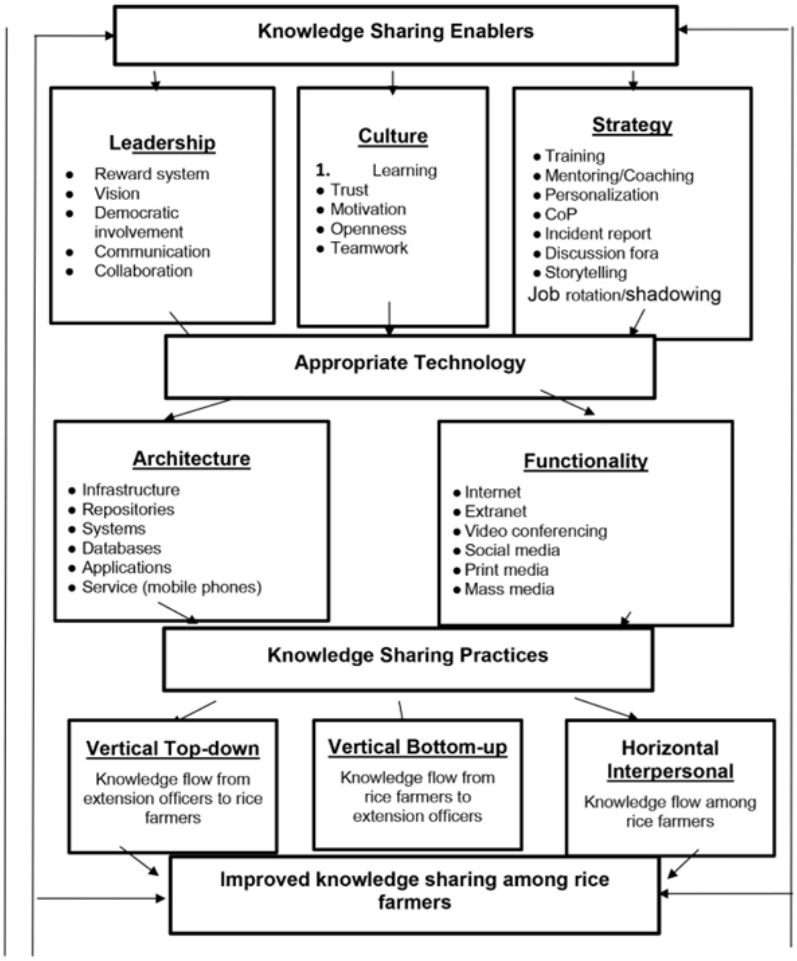


**Figure 1: Strategies for Improving KS in Rice Farming Communities**

As shown in Figure 1, a leadership, culture, strategy and technology are crucial for knowledge sharing amongst rice farmers Leadership would ensure that the right conditions are created for knowledge sharing, through the development of a culture that promotes knowledge sharing. As emphasised by the Social Exchange theory, when leadership creates a compelling vision and a strong reward system, as well as ensuring democratic involvement, collaboration and communication a culture that enables knowledge sharing will emerge, built on critical factors such as mutual trust, openness and teamwork.

Drawing on the SECI model, strategies such as training, mentoring, CoPs, job rotation and discussion fora can be leveraged to create and share knowledge that are pertinent to rice farming. Appropriate technology is also essential, and that is where leadership once again becomes critical. Leadership is needed to provide the necessary technological infrastructures, in terms of architecture and functionality, to facilitate knowledge sharing practises among the rice farmers. This would help to tackle the bottlenecks in knowledge sharing, thus ensuring an easy flow of knowledge, both vertically and horizontally.

- Based on the strategy described above, the following specific suggestions are made to help rice farming communities share knowledge better: In developing appropriate strategies to improve knowledge sharing in rice farming communities, there is the need to link knowledge sharing enablers to appropriate technology and knowledge sharing practises.
- In the rice farming communities, leadership, culture and strategy are critical enablers. Leadership is needed to create reward systems, vision, democratic involvement, communication and collaboration among the rice farmers.
- There is also a strong need to establish a culture of learning, the trust through participation, motivation to share, openness to new knowledge, and teamwork among the farmers.
- Training (in the form of seminars and workshops), mentoring, coaching, personalisation, communities of practice, meetings and discussion forums and storytelling all need to be well implemented.
- Technology is a major inhibitor of knowledge sharing among rice farmers. There is a need for technology that is appropriate in terms of its architecture and functionality. Providing such architecture would involve putting in place the needed technological infrastructures, such as services for mobile phones, applications, repositories, systems and databases.
- Knowledge sharing functionality would involve implementing technological tools that function within technological infrastructures. These would involve internet services (e.g., for email service), extranet, video conferencing, social media (e.g., Facebook, Twitter, Instagram, etc.), print media (e.g., magazines and brochures), and mass media (particularly community-based, such as community knowledge centres).

## 6. Conclusion

The article explored the knowledge sharing practices among rice farmers in Ghana and suggests a strategy to improve knowledge sharing in rice farming communities that will also strengthen knowledge sharing amongst smallholder farming communities in Ghana. It reveals that knowledge sharing strategy amongst rice farmers depend on identifying and linking knowledge sharing enablers to tools and technologies. It suggests the need to improve knowledge sharing practises on the following three levels; vertical top-down (where knowledge flows from leadership and extension officers to rice farmers), vertical bottom-up (where knowledge originates and flows from rice farmers to leaders and extension officers) and horizontal or interpersonal (where knowledge flows between and among the rice farmers). Appropriate and sustainable knowledge sharing strategies implemented in rice farming communities in Ghana will improve yield and productivity.

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# Knowledge Management System for Handcrafted Reog Ponorogo Products

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**Abstract:** Reog is one of the distinctive cultural practices of Ponorogo. Typically, this art is performed in an open space with many entertainers. Reog Ponorogo enthusiasts will primarily purchase trinkets and handicrafts. Numerous artisans in Reog Ponorogo are members of Micro, Small, and Medium-Sized Enterprises (MSMEs). However, because of the global Covid-19 pandemic, Reog Ponorogo artisans have encountered numerous challenges, beginning with the procurement of raw materials, and continuing through the production process and marketing. This even put them out of business with the Reog artisans. A knowledge Management System (KMS) is one of the technologies that can be utilized to surmount the problem under these conditions. Knowledge Management System (KMS) is a centralized database utilized to organize, store, and disseminate organizational knowledge with employees and customers. In this study, the KMS was developed to assist MSME actors in acquiring information and knowledge concerning MSME Products in Reog Ponorogo Handicrafts. Currently, information about Reog Ponorogo is widely available in print and digital media, but it is not governed by a comprehensive information management system. Therefore, building KMS for Reog Ponorogo Handicraft MSMEs is still necessary. In this research, a modified variant of the Knowledge Management System Life Cycle (KMSLC) was used to develop the KMS. This research was conducted in multiple phases, including infrastructure evaluation, team formation, knowledge capture, and KMS design. This study contributes to the creation of a knowledge management system for MSME Reog Ponorogo artisans based on the life cycle of knowledge management systems. This study's findings serve as the basis for the Reog Ponorogo craft knowledge management system. Further research can concentrate on developing the Reog Ponorogo UMKM KMS on Android and iOS mobile phones, enhancing the KMS user interface, and granting both experts and UMKM administrative access to the KMS.

**Keywords:** Knowledge management system, Knowledge management system life cycle, Reog handicrafts, Ponorogo

## 1. Introduction

Reog Ponorogo A Meaningful Performance An ancient performance art that has withstood the test of time and possesses aesthetic as well as moral qualities (Indonesia Kaya, 2021). Reog Ponorogo is an ancient art form (Kartomi, 1976). Because art is ancient, there are numerous variations on the origins of Ponorogo reog. There are two widely used variations. The Wengker version is shown first. relates how Ki Ageng Kutu (Demang Suryongalam), a Majapahit Kingdom servant, established a hermitage in Wengker and produced reog art as mockery and opposition to King Brawijaya V. The Bantarangin variation is the second. It describes the marriage proposal made by Kelana Sewandana, the king of Bantarangin, to Dewi Sanggalangit, the daughter of Kediri. Making a new gamelan model and a person with a tiger head is one of the requirements for the application, according to Harsono (2019). Reog Obyog and Reog Festival are the two distinct varieties of Ponorogo reog that are now recognized. Reog obyog, who reside in rural areas, often perform in the yard or on the street without adhering to any standards. Typically, it fills up with festivities, cleans the village, and entertainment-only performances. Since 1997, the Ponorogo City Government has organized the yearly Reog Festival event, during



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which the Reog Festival has undergone adjustments and is presented in accordance with standards (Kurnianto, 2017).

The Indonesian cultural art form of Reog Ponorogo has persisted to the present day. It is performed for public entertainment and as part of religious rites (Kristianto, 2019). It is no wonder that Reog Ponorogo has attracted attention at local, national, and international levels (Supariadi and Warto, 2015). The number of Ponorogo and non-Ponorogo tourists who wish to view the Reog show increases periodically. Micro, small, and medium-sized (MSME) business actors use these opportunities to sell Reog Ponorogo handicrafts (Masykur, Antarukmi and Risfaula, 2016.). However, Reog Ponorogo artisans have encountered numerous challenges related to the global Covid-19 pandemic, from sourcing raw materials to promoting their products (Sakti, 2020). These problems have even forced some Reog Ponorogo artisans out of business. In these conditions, technology plays an essential role. Knowledge management systems (KMS), which blend technology and the knowledge management process, could help (Becerra et, al, 2010).

Knowledge management is a process that helps businesses discover, select, organize, and disseminate knowledge that is vital for problem-solving, dynamic learning, and drawing conclusions (Ahmady, Nikooravesh and Mehrpour, 2016). Knowledge management can also be described as the implementation of an all-encompassing framework that fosters the expansion of organizational knowledge (Salisbury, 2003). This research (Gao, Chai and Liu, 2018) focuses on providing a comprehensive survey and analysis of the theory behind knowledge management. First, we summarized and analyzed the theoretical conceptions of Knowledge management, which include conception and stages; then, we examined some major approaches for designing the Knowledge management system from various vantage points, including knowledge representation and organization, knowledge sharing, and performance.

For example, knowledge and experience are sustainable resources and thus represent competitive advantages. Knowledge consists of tacit and explicit components (Retnoningsih and Khasanah, 2019; Kaawoan, Sentinuwo and Sambul, 2017). Consequently, it is necessary to develop a knowledge management system (KMS) capable of managing, combining, and integrating explicit and tacit knowledge management tasks (Kaya and Erkut, 2018). It is envisaged that this will enable small and medium businesses to discover answers to their difficulties (Retnoningsih and Khasanah, 2019). The paper (Chaithanapat et al., 2022) focuses on three key issues regarding the use of knowledge management systems. Initially, SMEs adopt and use more intensively traditional tools (KMTools) as opposed to newer, cheaper, and easier-to-use tools that are generally more updated. Second, SMEs implement and make greater use of practices (KM-Practices) that do not solely concentrate on the knowledge management process, but rather seek to adapt practices they are already familiar with to the knowledge management requirements. The paper concludes by highlighting the reciprocal relationship between KM-Tools and KM-Practices: one reinforces the other and vice versa. The paper proposes a taxonomy of SME strategies for utilizing KMSs. Four strategies are identified in particular: guidepost, explorer, exploiter, and latecomer.

From the background and problems of Reog Ponorogo artisans and MSME actors, this research applies KMS to help MSME actors gain knowledge and information about Reog handicraft products which are used to improve product quality and expand product marketing not only in offline stores but also online stores. Currently, many print and digital sources contain information about Reog Ponorogo, but there is no comprehensive system for maintaining this information. This research aims to develop KMS based on Knowledge Management System Life Cycle (KMSLC). Infrastructure Evaluation, Formation of KM Team, Capturing Knowledge, Development of KMS Blueprint, KMS Verification and Validation, KMS Implementation, and KMS Testing are incorporated in the research phase (Mathew, Salalah and Oman, 2011). This research provides a knowledge-based standard of Reog craft, which can be used to learn more about Reog craft.

## 2. Literature Review

The goal of (Retnoningsih and Khasanah, 2019) research is to improve the performance of government management of Bekasi city SMEs using the KMS (Knowledge Management System). The suggested framework can be used by DISKOP UMKM to manage tacit and explicit knowledge through the KMS system on mobile devices in Bekasi City. The KMS that was built is available for all MSME centers in Bekasi City with the aim of being a place to share and gain management knowledge to improve the quality and income of MSMEs in Bekasi City. This paper (Al-Alshaikh, Mirza and Alsalamah, 2020) This paper proposes a paradigm for defining and eliciting the tacit knowledge generated during the process of requirements elicitation. The model is founded on adopting and extending the rationale model for requirements rationale knowledge elicitation within the context

of requirements elicitation. In addition, this article presents a representation code for expressing the tacit knowledge in this context.

Knowledge is an asset for every individual, business, or corporation(L, Chen and Chen, 2009). Strong knowledge management helps companies progress, and the successful management of knowledge about the company's organization, sales, and others can also positively affect sales. Knowledge management is a process that helps businesses identify, select, organize, disseminate, and transfer crucial knowledge (Mathew, Salalah and Oman, 2011). Research (Cerchione and Esposito, 2017), This paper argues that small and medium-sized enterprises (SMEs) could enhance the impact of knowledge management (KM) by better exploiting the opportunities offered by new ICTs (such as cloud computing, crowdsourcing systems, collaborative filtering, and wiki). This paper emphasizes, from the perspective of KMS providers, that SMEs typically lack the resources necessary to monitor the innovation process in the field of KMSs. Nonetheless, they may represent a substantial market. To capitalize on this opportunity, it is necessary to establish not only a new market segment dedicated to SMEs, but also direct (even virtual) communication channels between SMEs and KM providers.

Many businesses have utilized KMS Knowledge Management System (He, Qiao and Wei, 2009). An organization can manage knowledge by managing its human resources or company resources (Widayanti, 2007). Therefore, knowledge is significant for any organization or company and will determine its continuity if managed effectively. Prior studies have highlighted the significance of knowledge in organizations regarding the exchange of information and innovation that advances the company. Knowledge in organizations and businesses can be divided into four categories: normative, problem-solving, decision-making, and information technology utilization. A minor study (El Said, 2015) was conducted to assess the effect of employee intention to share knowledge on the utilization of KMS and found that a lack of contribution from registered users is a failure factor for KMS. In general, researchers evaluate KMS based on the frequency of their usage, ignoring the impact of the system on employee performance even though this influences the system's long-term success. This paper contributes to KMS research by extending Task Technology Fit (TTF). This model is widely used for analyzing KMS, to investigate the impact of the sharing of knowledge constructs on KMS performance. This paper has scholarly and practical consequences for KMS researchers, developers, and administrators.

In 2008, Research on Knowledge Management System Development performed a study on KMS which investigated the function and impact of Information Technology on the deployment of KMS within an organization. The study also examined how KMS can be made more effective and efficient through appropriate information technology (Tseng, 2008). A 2017 study focused on the dissemination and intensity of KMS use among small and medium-sized enterprises (SMEs). This study also presents a taxonomy for combining techniques for using KMS in SMEs (Cerchione and Esposito, 2017). A company engaged in web-based retail implemented KMS in 2018 to use it as a platform to share knowledge with its employees to improve their performance (Sutrisna, 2018). In 2019, a web-based KMS was developed in the education sector to document all teaching-related knowledge so that it can be exploited by young teachers and their students (Octaria, Ermatita and Sukemi, 2019).

Another KMS was created in the realm of education in 2021. This KMS offers instructional material on one university's web-based faculty to enhance the performance of education workers (Anardani, Riyanto and Setiawan, 2021). According to research by (Saleem, Ameen and Ashiq, 2021), each person adopts different attitudes and performs different actions when seeking, locating, storing, and organizing knowledge, and every person’s capacity and skill in memorization are also different. The study examined how research students in a life science discipline practice PKIM by focusing on five aspects: knowledge collection, organization, selection, sharing, and creation.

To combine the benefits of the two paradigms, (Jung, Choi and Song, 2007) suggest an architecture to connect knowledge management systems (KMS) with business process management systems (BPMS). The architecture, which is comprehensive because it is derived from extended life cycle requirements, will serve as the foundation for the research and development of process oriented KMS (Hartati and Hikmah, 2021). The paper first defines process knowledge and divides it into three categories. It then discusses how current KMS and BPMS capabilities could be extended to serve the three categories of process knowledge while meeting the knowledge and business process life cycle requirements. A prototype KMS is provided to illustrate that the proposed design is feasible.

In Research (Tejamaya et al., 2021) In order to develop a model of an occupational safety and health management system (OSHMS) for micro, small, and medium-sized enterprises (MSMEs) in Indonesia, the purpose of this review is to identify the most important factors associated with the implementation of such a

 

system in MSMEs. Methods: This systematic review is an exploratory study using a combination of two keywords that refer to the population and exposure variables in the PROSPERO Approach using the "AND" strategy to search multiple online databases. Each piece of literature is selected based on the PRISMA flowchart. For the assessment of the risk of bias, a Critical Appraisal Skill Programme (CASP) check list was utilized.

this paper (Peng, Jiang and Zhang, 2013) Designed and implemented a knowledge management system (KMS-THU) to facilitate knowledge service for Tsinghua's web-based learning platform, THU-WS. KMS-THU emphasizes on knowledge administration by individuals and summarizes unique knowledge services for courses. With campus cloud service and various mobile clients, it optimizes the learning experience with a ubiquitous learning style. In addition to illustrating the design of a knowledge service and the framework of a KMS for web-based learning, this paper presents the implementation details for KMS-THU.

## 3. Research Methods

The Knowledge Management System (KMS) Reog Ponorogo was developed using a modified version of the Knowledge Management System Life Cycle (KMSLC) concept which consists of 7 stages of system development from (Evans, Dalkir and Bidian, 1993;Widayanti, 2008; Shalihati, 2021). As shown in Figure 1, this research was conducted in several stages: Infrastructure Evaluation, form a team, Capture Knowledge, Designing the KMS Reog Ponorogo and Knowledge verification and validation.

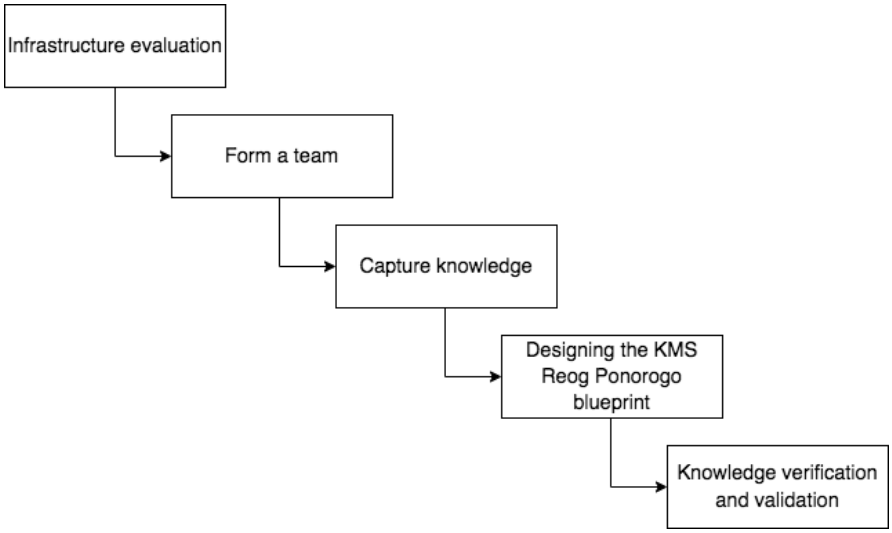


**Figure 1: Stages of the Reog Ponorogo KMS Research**

### 3.1 Infrastructure Evaluation

The Integrated Software Engineering Lab, Faculty of Engineering, Universitas Muhammadiyah Ponorogo, served as a point of reference for infrastructure evaluation in the development of the Reog Ponorogo KMS. The infrastructure evaluation for the Reog Ponorogo KMS comprised 6 components: hardware, software, netware, brainware, dataware, and process. Table 1 displays the results of the infrastructure evaluation.

**Table 1: Infrastructure Evaluation Results**

| No. | Infrastructure | Evaluation |
|---|---|---|
| **1.** | Hardware | Computer devices with the necessary capacities and specifications. |
| **2.** | Software | Software that supports the development of the Reog Ponorogo KMS, such as VSCode, XAMPP, and Browser. |
| **3.** | Netware | Access the Internet at speeds above 100 Mbps. |
| **4.** | Brainware | Experts in the field of computers and management. |
| **5.** | Dataware | Data were obtained from direct experts, such as Reog Ponorogo craftsmen and anthropologists, and from reference sources such as books, journals, and so on. |
| **6.** | Process | The data is taken from the results of interviews and from several references. Experts validate data results from references. |

### 3.2 Form a Team

The team was adapted to each member's area of competence. The KMS team was composed of a research team of three people, two experts, one analyst, a team of software developers, and one assistant for data administration in the field.

The team was composed of members with a variety of skills, including researchers in KMS information technology, reog ponorogo campaigners and historians, artisans, and merchants of reog ponorogo goods.

### 3.3 Capture Knowledge

Capturing knowledge begins with knowledge acquisition, followed by knowledge storage. The knowledge map is shown in Figure 2 result of the knowledge capture stage. Knowledge was acquired by conducting interviews (Sadiah and Gasbara, 2021). Experts, mainly Reog Ponorogo artisans who are members of Reog Ponorogo craft SMEs, were interviewed.

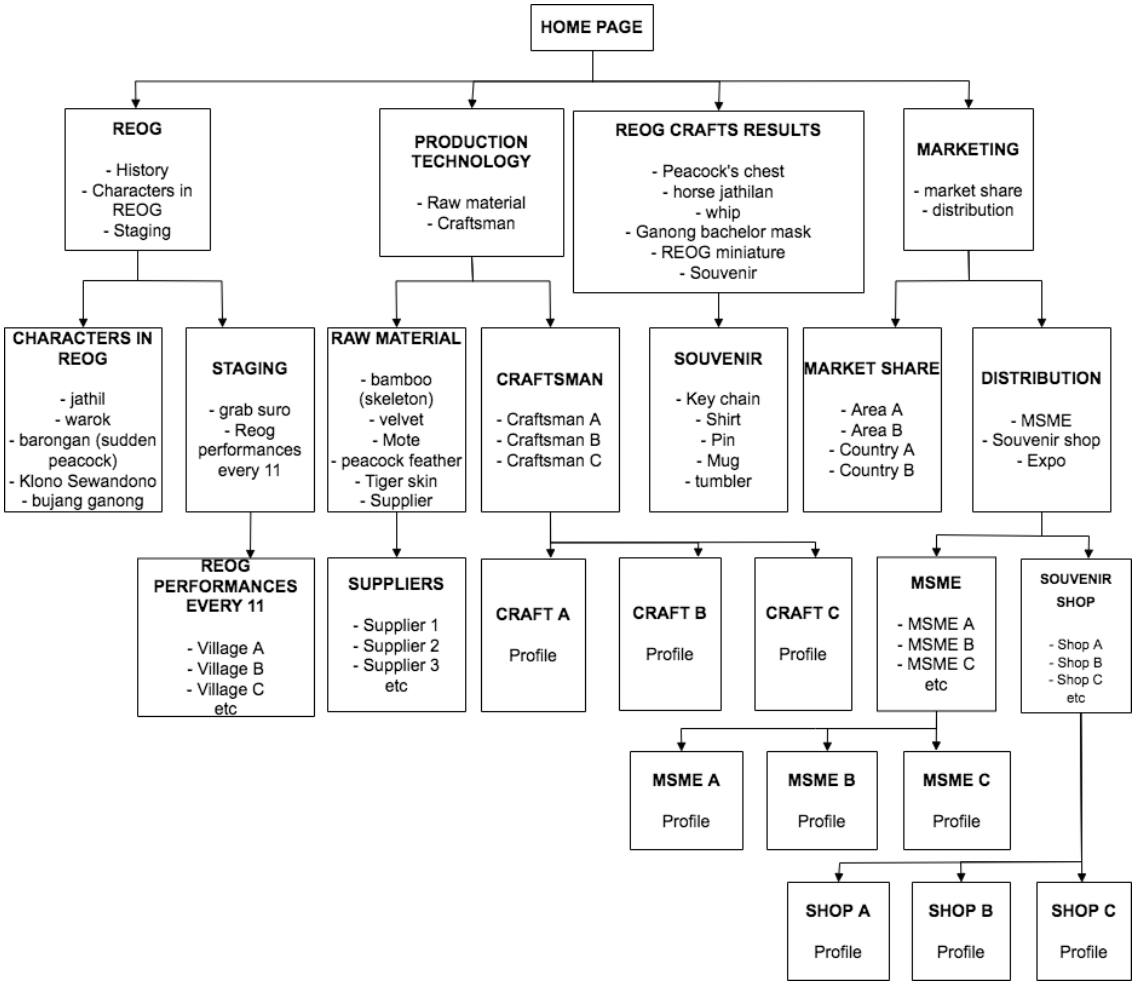


**Figure 2: Knowledge map of Reog Ponorogo**

### 3.4 Designing the KMS Reog Ponorogo Blueprint

The next step in this research is to create a blueprint for KMS Reog Ponorogo, a web-based system. The findings of literature reviews and conversations with Reog Ponorogo art specialists, artisans, and vendors of Reog Ponorogo crafts were used to create the KMS Reog Ponorogo blueprint.

### 3.5 Knowledge Verification and Validation

The outcomes of the creation of the KMS Reog Ponorogo blueprint were then validated and verified by KMS specialists. Reog Ponorogo specialists, Reog Ponorogo artisans, information technology professionals, activist students, and Reog Ponorogo lovers participated in a forum group discussion (FGD) to verify and validate the KMS Reog blueprint that was constructed.

 

## 4. The Knowledge Management System (KMS) Reog Ponorogo Blueprint Results

Knowledge Management (Clemente and Domingues, 2023) is crucial to the successful execution of undertakings. Due to the transient nature of projects and the teams that participate in them, the transfer, integration, and management of knowledge between projects is essential for promoting the sharing of best practices and preventing the repetition of past errors, thereby increasing the likelihood of success for both the projects and the organization. The purpose (Wimpertiwi et al., 2022) The purpose of this paper is to maximize university community service activities. This activity will produce an application that can be utilized by SMEs and the community. To create blueprints, there are design document templates: Idea Specifications, Standard Course Features, Design Strategies, Media Standards, and Team Management, with Observation, Literature studies, and Documentation as the approaches. This research (Idrees, Haider and Tehseen, 2023) The purpose of this paper is to demonstrate that knowledge management is integral to business strategy and can result in more effective new product development in high-tech companies. As businesses have realized the importance of managing knowledge to remain competitive in their respective markets, they have placed a greater emphasis on knowledge management methods. Knowledge Management (KM) is accountable for an organization's productivity, effectiveness, and creativity.

The Reog Ponorogo KMS was created in the context of industrial technology. As indicated in Figure 2, production technology is divided into numerous submenus, including raw materials, raw material providers, and artisans. In the Reog Ponorogo Knowledge map, a map of knowledge pertaining to Reog Ponorogo can be viewed; this knowledge map was collected through interviews with experts, mainly craftspeople. The compiled knowledge map describes all aspects of Reog Ponorogo, beginning with the history and figures of Reog Ponorogo as well as the schedule for the staging of Reog, followed by production technology, which includes the raw materials and craftsmen involved in Reog Ponorogo, the results of Reog Ponorogo crafts in the form of Reog Ponorogo souvenirs, and finally, the marketing section, which includes market research.

An Information Architecture IA-based system implementation plan for the Reog Ponorogo MSME KMS was designed based on the knowledge map. This system was designed using the PHP-MySQL programming language and includes a responsive display, which means that the Reog Ponorogo MSME KMS website will dynamically adapt to the different screen sizes of smartphones, tablets, laptops, and desktop computers. Figure 3 depicts the outcomes of the implementation of the Reog Ponorogo MSME KMS design plan.

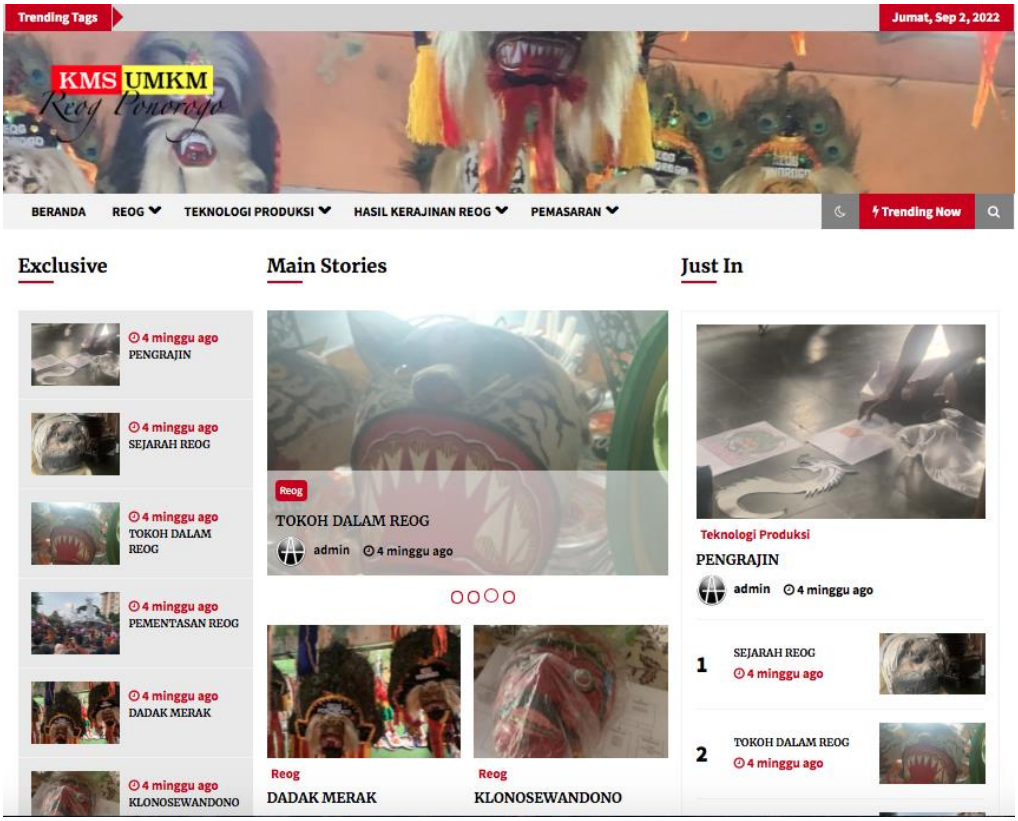


**Figure 3: The Interface of the Implementation of the KMS Blueprint**

As shown in Figure 3, the Navigation Bar menu is the primary menu in the Reog Ponorogo MSME KMS template. It contains the home menu and sections on Reog, Production Technology, Reog Crafts, and Marketing. These menus are the primary menus in the KMS, since they provide the foundation of the knowledge map of the Reog Ponorogo MSME KMS.

The KMS menu is designed according to the Reog Ponorogo knowledge map. The Reog menu contains submenus for Reog Ponorogo History, Characters in Reog Ponorogo and a Reog Ponorogo Performance Schedule; the schedule for Reog Ponorogo performances can be obtained from the tourism office and the Reog Ponorogo Foundation.

The Production Technology menu contains the Raw Materials and Craftsmen submenus. The links in the Raw Materials submenu describe the raw materials necessary for making the characters in Reog Ponorogo, and in the Craftsmen submenu, they provide a profile of Reog Ponorogo craftsmen.

The third menu in the KMS MSME blueprint for Reog Ponorogo crafts that was built is the Reog Crafts menu which contains the Reog Ponorogo Souvenirs submenu.

The final menu created for the KMS is the Marketing menu, which includes the Craft Market Share and Distribution submenus. The Craft Market Share submenu lists regions within and beyond Ponorogo from which people have ordered or purchased Reog Ponorogo souvenirs. The Distribution submenu describes the distribution of Reog Ponorogo merchandise and souvenirs, including in UMKM and the Reog Ponorogo souvenir shop in Ponorogo.

This research aimed to develop a KMS based on the KMSLC to help SMEs in Reog Ponorogo acquire information and knowledge about Reog Ponorogo handicraft products. Information on Reog Ponorogo is available in print and digital media, but it is not managed comprehensively. This research contributes by developing a blueprint for a Reog Ponorogo MSME KMS, based on the KMSLC, that moves information on Reog Ponorogo from upstream to downstream.

The Reog Ponorogo MSME KMS was developed using the KMSLC in five stages: infrastructure evaluation, the formation of a KMS Team, the collection of as much knowledge about Reog Ponorogo as possible, the design of a Reog Ponorogo KMS blueprint, and verification and validation of the collected knowledge.

Infrastructure Evaluation was the initial step in constructing the Reog Ponorogo KMS SME. The objective of the infrastructure evaluation was to establish the prerequisites for the development of the Reog Ponorogo MSME KMS. This research required six infrastructure components: hardware, software, netware, brainware, dataware, and process. All six elements were available for this research.

The second step was to build a KMS Team, the members of which were experts in creating knowledge maps and KMS designs. The team included the following members: a research team of three persons, two experts, one analyst, a team of software engineers, and an assistant for data administration in the field.

The third stage involved carefully and exhaustively locating the necessary materials for specific study topics and seeking out peers, colleagues, and professionals to benefit from their tacit knowledge. Respondents had a favorable view of sharing tacit knowledge. People generally value the experience, knowledge, insight, and skill of those with tacit knowledge through socializing and engagement in meetings and conversations.

The fourth stage of this research was to design the Reog Ponorogo MSME KMS blueprint based on the KMSLC and IA (Information Architecture). The KMS blueprint was built using the PHP-MySQL programming language, and a website with responsive and multi-platform display capabilities was created. The KMS blueprint website is compatible with all operating systems and mobile devices.

The fifth key stage of the Reog Ponorogo MSME KMS research was knowledge verification and validation: the Reog Ponorogo MSME KMS blueprint design outcomes were confirmed and certified by Reog Ponorogo KMS specialists.

The interface design of the KMS MSME Reog Ponorogo was made as user-friendly as possible based on the results of an examination of the production technology background. The incorporation of visuals within each piece of text makes the presentation more appealing and the content categories more recognizable. In addition, the responsive blueprint display of the Reog Ponorogo MSME KMS contributes to the user-friendliness of opening the website on a computer, laptop, tablet, or mobile device.

 

## 5. Analysis and Discussion

Infrastructure Evaluation is the first phase of this study; it reveals how prepared the hardware, software, Netware, Brainware, Dataware, and processes that were used to construct the Reog Ponorogo MSME Knowledge Management System (KMS) were.

The first part of the infrastructure that has been developed is the hardware, which consists of computers with capacities and specifications that are suitable for the KMS. The second piece of infrastructure that has been prepared is the software that has been placed on computers to aid in the construction of the Reog Ponorogo UMKM KMS. This software includes Visual Studio Code, Apache HTTP Server, and web browsers. The third kind of infrastructure is netware, which implies it has Internet connectivity at speeds greater than 100 Mbps. In addition to technological infrastructure, we have also developed the fourth infrastructure, Brainware, which consists of persons who are professionals in computer science and management. Dataware, the fifth infrastructure, is a device for storing research data collected from primary sources such as interviews with Reog Ponorogo artisans and cultural observers, as well as secondary sources such as books, journals, and encyclopedias. The process, the sixth infrastructure of Reog Ponorogo UMKM KMS study, is where the data gathering stage occurs, with information culled not just through interviews but also from a wide variety of sources. The KMS specialists will verify the accuracy of the reference data.

After the KMS infrastructure is ready, the next step we will take is Forming a KMS Team. The formation of the team is adjusted to the area of expertise of each member. In this study we formed a team consisting of 2 experts, 1 analyst, then 1 system developer team and 1 data management assistant in the field.

The next stage is that the team that has been formed carries out their respective tasks in the process of capturing the knowledge of the KMS UMKM Reog Ponorogo craft. In the process of acquiring knowledge in this study, the first stage was to collect and acquire knowledge, then proceed with storing knowledge in the KMS database. The acquisition process or getting the data is done by means of interviews. Interviews were conducted with experts including Reog Ponorogo craftsmen who are members of the Reog Ponorogo craft SMEs, the Cultural Arts Section of the Ponorogo Regency Tourism, Youth and Sports Culture Officeand Reog Ponorogo artists. The knowledge map in Figure 2 is the result of the stages of gathering knowledge.

The machine or human infrastructure for KMS already exists, the KMS team has been formed, then knowledge about KMS for UMKM Reog Ponorogo has been collected in the KMS database, the next process is to design a blueprint for KMS UMKM Reog Ponorogo. In this study the blueprint was built in the form of a website-based system, the website system was chosen because it is multi-platform, meaning that it cannot only run on one particular operating system. The results of the KMS UMKM Reog Ponorogo blueprint can be seen in Figure 3 above.

The final stage of the research that we carried out was Verification and validation of knowledge, this stage was carried out to verify and validate knowledge from the research stages that had been carried out previously starting from infrastructure preparation, team building, capturing knowledge to building a web based KMS Reog Ponorogo KMS blueprint. In this study, verification and validation of knowledge was carried out by interviewing and testing experts, including Reog Ponorogo craftsmen who are members of the Reog Ponorogo craft SMEs, the Cultural Arts Section of the Ponorogo Regency Tourism, Youth and Sports Culture Office and Reog Ponorogo artists.

The general validation test aims to test whether the Knowledge Management System (KMS) design for UMKM Reog Ponorogo is in accordance with the ongoing processes and can be used in UMKM Reog Ponorogo in Ponorogo. The validation test was carried out by conducting direct confirmation through interviews with Craftsmen and UMKM Reog Ponorogo Craftsmen, as well as the Cultural Arts Section of the Ponorogo Regency Tourism, Youth and Sports Culture Office. Based on the interview results, it was found that the knowledge about Reog Ponorogo and its crafts contained in the KMS Reog Ponorogo blueprint was in accordance with the reality in society, then the existing processes in designing the KMS UMKM Reog Ponorogo were aligned with the actual process currently This has been running in SMEs.

## 6. Conclusions and Further Research

Reog artisans encountered various challenges due to the global COVID-19 pandemic, beginning with the procurement of raw materials and continuing through the production and marketing stages. This has even driven some Reog artisans out of business. In these situations, technology is required; knowledge management systems are an example of how technology can help. Consequently, a knowledge management system is required. The

findings suggest that it is valuable for the Ponorogo tourism department, Micro, Small, and Medium Enterprises (MSMEs) owners, craftsmen, and Reog Ponorogo handicraft sellers to increase sales of Reog Ponorogo MSME products. Researchers can conduct more studies on Reog Ponorogo starting from its history and its original figures, to further confirm that Reog is the original culture of Ponorogo Indonesia. Also conducted research on the development of the condition of MSME craftsmen in Reog Ponorogo before and after the COVID-19 pandemic. Increased knowledge about all things related to Reog Ponorogo, starting from history, characters, staging schedules, raw materials for making Reog Ponorogo crafts, and so on. The Reog Ponorogo KMS (Knowledge Management System) was developed using a modified version of the Knowledge Management System Life Cycle (KMSLC) concept. This research was conducted in several stages: infrastructure evaluation, team formation, knowledge capture, and KMS design. This research has successfully developed a KMS production technology based on the IA (Information Architecture) concept and KMSLC methodology. The knowledge characteristics of Reog Ponorogo, Production Technology, Reog Crafts, and Marketing were developed during the system's growth. The KMS blueprint was developed using the expertise of Reog Ponorogo artisans. The results of the development of the KMS have been verified and validated by KMS experts. According to the experts, the KMS blueprint designed and constructed in this research contains all relevant information about Reog Ponorogo. It is consistent with the AI concept and the KMSLC approach. In addition, the KMS has the benefit of a responsive and user-friendly display. Further research could focus on developing the Reog Ponorogo MSME KMS on Android and iOS mobile phones, as well as developing the development of the user side of the KMS and providing access to KMS administration to both experts and MSMEs. The Reog Ponorogo MSME KMS is to provide upload permissions and post information on the Reog Ponorogo website.

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# Knowledge Management Evaluation Using Digital Capability Maturity Model in Higher Education Institution

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**Abstract:** In the higher education institutions, they recognize the value of knowledge management (KM) in enhancing organizational performance and productivity. However, the current KM system faces challenges in adapting to modern issues and suffers from inefficient utilization. This paper aims to address these shortcomings by identifying the maturity level of KM using a digital capability maturity model (DCMM). To achieve this objective, data were collected through interviews, questionnaire surveys, and observations, and a descriptive data analysis method was employed. The study utilized the model's eight Business Transformation Management (BTM) disciplines to gain a comprehensive understanding and holistic analysis of digital transformation. The research findings revealed a defined maturity level (Level 3) of Effective Knowledge Worker Digital Capability. This suggests the need for strategic improvements to propel the institution towards a higher level of digital readiness. To elevate the KM maturity level, the paper recommends the development of a web-based Knowledge Management System (KMS) as a pilot project within the IT Operational department, before its potential company-wide implementation. The proposed KMS includes eight essential features, including document management, lessons learned, project management, announcements, schedules, FAQ page, and forum. This web based KMS promises to enhance knowledge sharing, collaboration, and accessibility. Beyond the specific institution studied, the research offers valuable insights for other organizations seeking to evaluate and improve their KM performance. By adopting the digital capability maturity model and considering the suggested features in the KMS, institutions can drive innovation and better adapt to the evolving landscape of knowledge management. Ultimately, this research contributes to the advancement of knowledge management theory and practice in higher education institutions, offering strategies to boost organizational agility and knowledge utilization. The findings can guide decision-makers in enhancing their KM strategies, ultimately leading to improved organizational outcomes and increased competitiveness in today's dynamic and rapidly changing environment.

**Keywords:** Knowledge management, Knowledge worker, Digital capability maturity model

## 1. Introduction

Knowledge Management (KM) is increasingly becoming an important matter in any organization (Heisig et al., 2016; Hujala & Laihonen, 2021). KM refers to a multidisciplinary approach aimed at achieving organizational objectives by facilitating the capture, storage, transformation, and dissemination of knowledge to make the best use of it (Alavi & Leidner, 2001; Dalkir, 2017; Yee et al., 2019). Knowledge management has been identified as one of the key factors for innovation and competitive advantage in a knowledge economy (Darroch, 2005; Dasgupta et al., 2013; Zakariya & Bashir, 2021). On the other hand, universities must also manage their knowledge processes as part of a planned knowledge management strategy to remain competitive in the knowledge economy (Veer Ramjeawon & Rowley, 2017).

Geng et al. classified knowledge of interest to colleges and universities into two primary domains – scholarly knowledge and operational knowledge (Geng et al., 2005). Operational knowledge is held in diverse areas such as computer services, enrollment management, admissions, research support, student services, student organizations, and more. Therefore, managing knowledge and knowledge workers has become a top priority for organizations (Uhl & Gollenia, 2014). Higher Education Institutions understand that to provide high-quality education and a system of support, they must also continue learning and growing themselves. Higher Education Institutions have several departments, one of which is IT Operational. IT Operational is responsible for all



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information systems and for managing and sharing all organizational information, especially information related to IT.

The primary challenges lie in the inconsistent and confusing distribution and management of knowledge within the company. Currently, knowledge is treated as an individual's personal asset rather than a shared asset of the company, resulting in inadequate documentation. Although certain platforms store the same knowledge, updates are not synchronized. Knowledge sharing predominantly occurs through informal means, such as verbal communication from superiors to subordinates and among employees. This habit poses obstacles for IT Operations as they consistently encounter the same questions and issues, leading to a significant duplication of effort. Despite the presence of an online company guide for employees to find solutions to their queries, they persist in directly approaching IT staff. Another problem was caused by human error. Human error is a significant issue that contributes to misleading information. Mistakes made by individuals resulted in incorrect or inaccurate data being disseminated. These errors could occur at various stages, including data entry, analysis, interpretation, and communication. When misinformation spreads, it can have far-reaching consequences, leading to misguided decisions, misunderstandings, and ineffective actions.

Nevertheless, transformation is not as easy as it looks. The success of digital transformation does not depend solely on introducing new technology (Bican & Brem, 2020; Uhl & Gollenia, 2014). The foundation for digital transformation requires a complete understanding and holistic analysis of internal and external possibilities, feasibility, strengths, and weaknesses (Uhl & Gollenia, 2014). Knowledge maturity models can be used to assess the overall maturity level of an organization's knowledge management readiness (Dalkir, 2017). According to The Carnegie Mellon Software Engineering Institute, the maturity model is a descriptive model that depicts the stages through which organizations progress as they identify, implement, develop, and adjust their strategies (Dalkir, 2017). It serves as a guide for selecting process improvement strategies by determining current process capabilities and identifying critical quality issues and process improvement within a specific domain. The Capability Maturity Model (CMM) is an organizational model that explains the five evolutionary stages (levels) in which an organization controls its processes: initial, repeatable, defined, managed, and optimizing. The CMM can be expanded to incorporate knowledge management processes, allowing organizations to assess their existing readiness for knowledge management. This is especially important for KM projects because new procedures and technologies will be implemented (Dalkir, 2017).

Therefore, the Digital Capability Maturity Model was used to measure the degree of maturity of each Digital Capability. This model supports the analysis of the 'as-is' situation and provides instruments for planning the prospective 'to-be' scenario (Fisher & Director, 2004; Harmon, 2004; Uhl & Gollenia, 2014). The maturity levels of this model are based on the CMM by The Carnegie Mellon Software Engineering Institute (Dalkir, 2017). The company can improve employees' competency by transforming them into knowledge workers (Igielski, 2017). This study focused solely on IT Operational since it was intended to be a pilot project that demonstrates the sustainability of an idea before company-wide implementation.

Based on research background described in this section, research question of this paper is: "What are the challenges faced by organizations in managing knowledge, particularly in the context of IT Operational departments, and how can the Digital Capability Maturity Model be used to assess and improve knowledge management readiness?"

## 2. Literature Review

In today's rapidly evolving business landscape, organizations are increasingly recognizing the importance of knowledge workers and digital transformation to stay competitive and adapt to the demands of the modern economy. This literature review explores the concepts of knowledge workers, digital transformation, and the Digital Capability Maturity Model in the context of organizational management. The section on knowledge workers highlights their crucial role in driving innovation, performance, and sustainability in knowledge-based economies. Digital transformation, another important concept, is described as the process of using information, computation, communication, and networking technologies to bring about significant changes in organizational features. The literature recognizes that digital transformation is not solely about implementing new technologies but also requires a comprehensive understanding of their potential applications, benefits, and risks. The Digital Capability Maturity Framework provides a structured approach to assessing an organization's digital maturity across various dimensions. This framework encompasses management disciplines such as strategy management, value management, risk management, and more. By examining these concepts and frameworks, this literature

review sets the stage for understanding the challenges and opportunities organizations face in managing knowledge, driving digital transformation, and assessing their digital capability maturity.

### 2.1 Knowledge Worker (K Worker)

Companies functioning in a changing market must seek out new ideas to help them better adapt to the demands of the modern economy (Igielski, 2017). Knowledge workers are an important source of organizational innovation, performance, and sustainability in today's knowledge-based economies (Domenech, et al., 2016). Knowledge workers use high-level communication skills to complete complicated tasks both alone and collaboratively, frequently with the aid of cutting-edge technology. A knowledge worker is, above all, someone who can learn and adapt to a changing workplace (Sebastien, 2020). Knowledge workers became the center of organizational attention as the value of knowledge as an organizational asset began to acquire acknowledgment in the theoretical and practical sectors in the post-industrial society. In the knowledge economy, Intellectual engagement is important, and it may be attained by knowledge workers through managerial confidence and organizational willingness to rely on their abilities to make the right decisions (Iliescu, 2021).

The knowledge worker is a capitalist who sells his "human intellectual capital" to other capitalists: there are no more competing social classes as there were in the capitalism age. The biggest competitive weapon of today's organizations is a long-term business strategy attained through investments in knowledge worker. Knowledge workers are constantly exposed to and involved in the creation, distribution, and application of knowledge. They play a critical role in influencing company decision-making and, as a result, overall organizational performance (Sahibzada, et al., 2020).

Organizations must equip their staff with digital skills if they wish to reap the benefits of their technological investments in order to achieve organizational goals (Kane, et al., 2019) (Blount, et al., 2016). Westerman (2016) emphasized that "digital transformation requires a heart," warning managers not to "forget that it is people who make firms operate" and implying that misuse of digital forces can undermine employee relationships (Westerman, 2016). Implementing enterprise systems has strategic benefits not just in terms of incorporating critical data and technology, increasing knowledge worker satisfaction but also in terms of preparing for and accommodating human elements (Sahibzada, et al., 2020). Organizations must build ongoing digital workforce transformation competency and support workforce transformation to create a solid cultural foundation that enables the workforce to handle the turbulence and continual responsiveness to change (Eden, et al., 2019).

### 2.2 The Role of Knowledge Sharing

Knowledge sharing serves as the cornerstone of organizational growth, enabling knowledge workers to collaboratively innovate, perform, and sustain (Domenech et al., 2016). It is essential to recognize the pivotal role of knowledge-worker productivity as a conduit between knowledge management processes and innovation (Shujahat et al., 2019). This highlights the significance of understanding how knowledge is generated, shared, and applied as a precursor to the innovation process.

### 2.3 Digital Transformation

Digital transformation is the modern-day effort to survive the existential threat of digital disruption. A conceptual definition of digital transformation is a process that uses a combination of information, computation, communication, and networking technologies to better an entity by causing major changes to its features (Vial, 2019). Uhl (2014) stated that new market prospects emerge in the digital age, and businesses adapt their policy, structure, society, and operations by using the capacity and influence of digital technology and the Internet (Uhl & Gollenia, 2014). Companies can gain a strategic edge by using new and emerging technology (Uhl & Gollenia, 2014). As the result of COVID-19, digital transformation has become more important than ever for companies, brands, and enterprises. However, the world has no alternative. To secure employee safety and shift all processes remotely, companies must transform digitally. While most companies have been considering digital transformation for some time, the seriousness of COVID-19 is forcing forward-thinking businesses to embrace the pandemic entirely. Therefore after this pandemic, it is necessary to investigate the antecedents for digital transformation (Maxwell et al., 2021).

### 2.4 Digital Capability Maturity Framework

The Digital Capability Maturity Models outlined in Uhl et al. (2014, p43) book is based on CMM's calculation criteria and promote holistic 360-degree assessments of digital maturity (Uhl & Gollenia, 2014). It can determine all relevant market angles for each Digital Capability thanks to the integration of BTM2. The progress in digital change is not solely dependent on the implementation of modern technologies. Companies must investigate and

 

assess the potential applications, advantages, and threats of emerging technology developments. These evaluation instruments provide questionnaires for assessing the present situation and evaluating the desired outcome (Uhl & Gollenia, 2014). The first step toward being a Digital Enterprise is to conduct a Digital Capability Maturity Assessment. In addition, the Digital Capability Maturity Model offers a method for evaluating the transition criteria for each capability in a particular to-be scenario (e.g., which level can be reached using a certain technology).

Strategy management, meta management, value management, risk management, business process management, organizational change management, transformational IT management, program and project management, and competence and training management, are among the nine management disciplines that make up the digital capability maturity model. Additionally, according to the DCMM, digital business transformation management can be assessed in six areas of digital capabilities: Innovation Capability Maturity Model, Transformation Capability Maturity Model, IT Excellence Maturity Model, Customer Centricity Maturity Model, Effective Knowledge Worker Maturity Model, and Operational Excellence Maturity Model. Each of these maturity models is designed to evaluate an organization's ability to handle innovations, transformation, IT excellence, customer centricity, operational excellence, and knowledge workers to accomplish successful digital business transformation.

### 2.5 Connecting Knowledge Management to Digital Capability Maturity

To bridge the gap between knowledge management theory and digital transformation, the Digital Capability Maturity Model emerges as a transformative framework (Uhl & Gollenia, 2014). This model assesses an organization's digital maturity, enmeshing various management disciplines such as strategy, value, and risk management. The model's strength lies in its ability to gauge an organization's readiness to integrate digital tools for knowledge sharing. These capabilities—ranging from innovation and transformation to customer centricity and operational excellence—are threaded through the fabric of knowledge sharing (Table 1).

**Table 1: Summary of Knowledge Management and Digital Capability Maturity**

| Concept | Relevance to KM | Digital Capability Maturity |
|---|---|---|
| **Knowledge Sharing** | Foundation of KM (Domenech, et al., 2016) | Nurturing digital knowledge (Uhl & Gollenia, 2014; Kane, et al., 2019) |
| **Digital Transformation** | Alters KM dynamics (Uhl & Gollenia, 2014) | Facilitates KM evolution (Vial, 2019; Uhl & Gollenia, 2014) |
| **Digital Capability Maturity Model** | Extends KM to digital realm (Uhl & Gollenia, 2014) | Assesses digital readiness (Uhl & Gollenia, 2014) |

### 2.6 Related Research

The summary of related research provided in Table 2 gives us a broad view of research studies related to knowledge management and the capability maturity model. These studies look at different aspects of knowledge management, like how it affects innovation, job satisfaction, organizational factors, and overall performance in various situations, especially in higher education. All these studies together help us understand better how knowledge management works, what helps it, and what gets in its way, and how it affects how well organizations perform, especially in developing areas and in universities. What's interesting is that these studies highlight things like how productive employees are, how internal marketing plays a role, how the company's culture matters, and how good leadership and digital skills come into play. This paper takes these ideas and builds on them, using their insights to show its own unique contribution. It doesn't stop there, though—it goes further than current research by looking at how digital skills and knowledge management mix, how well knowledge management efforts last over time, how to better measure what comes out of it, and even how leadership and the company's culture play into it. By combining all these different research threads, this study has a special place in moving our understanding and practical use of knowledge management and digital changes forward.

**Table 2: Related Research**

| No | Title | Journal/Conference Title | Authors and Year | Summary |
|---|---|---|---|---|
| 1 | Translating the impact of knowledge | Journal of Business Research | (Shujahat, et al., 2019) | This study presents a new model that examines the key role of knowledge-worker productivity between knowledge |

| No | Title | Journal/Conference Title | Authors and Year | Summary |
|---|---|---|---|---|
| | management processes into knowledge-based innovation: The neglected and mediating role of knowledge-worker productivity | | | management processes (generation, sharing, application) and innovation. Findings underscore the importance of knowledge-worker productivity as a central challenge in 21st-century management, driving knowledge-based innovation. Additionally, the study highlights the superiority of human and cultural knowledge management approaches over Big Data and IT systems. |
| **2** | Catalyzing knowledge management processes towards knowledge worker satisfaction: fuzzy-set qualitative comparative analysis | Journal of Knowledge Management | (Sahibzada, et al., 2020) | This study explores how internal marketing, knowledge management processes, and knowledge worker satisfaction are connected. It suggests that certain combinations of internal marketing dimensions and knowledge management processes can enhance knowledge worker satisfaction. Results indicate that internal marketing significantly influences KM processes, and these processes substantially boost knowledge worker satisfaction. Multiple pathways for enhancing satisfaction were identified through fsOCA analysis. |
| **3** | Organizational factors and process capabilities in a KM strategy: toward a unified theory | Journal of Management Development | (Valaei, et al., 2017) | This study investigates the impact of KM enablers on KM activities in Malaysian SMEs. It explores how organizational culture, transformational leadership, organizational structure, and technology utilization affect knowledge acquisition, conversion, application, and protection. The findings reveal that technology utilization and organizational structure significantly influence KM activities. Organizational culture impacts knowledge conversion and protection, with no associations found for knowledge acquisition and application. Transformational leadership is positively related to knowledge acquisition, but hypotheses connecting it to other activities are rejected. |
| **4** | Knowledge Management in Higher Education Institutions in Mauritius | The Learning Organization | (Veer Ramjeawon & Rowley, 2017) | This research examines knowledge management enablers and barriers in a developing university sector, Mauritius. It aims to uncover factors influencing knowledge creation, sharing, and transfer. While universities in developing countries recognize the need for knowledge management, challenges in strategy implementation persist. Further research across developed and developing nations can enrich our understanding of knowledge management processes and policies. |
| **5** | From knowledge management to organizational performance: Modelling the mediating role of innovation and intellectual | Journal of Enterprise Information Management | (Amjad, et al., 2019) | This paper empirically studies how knowledge management (KM) enablers affect KM processes in research universities, and it explores the direct link between KM processes and organizational performance (OP). The study also examines how intellectual capital (IC) and innovation mediate the relationship between KM processes and university performance. |

 

| No | Title | Journal/Conference Title | Authors and Year | Summary |
|---|---|---|---|---|
| | capital in higher education | | | Findings show significant impacts of KM enablers on KM processes, with KM processes directly and indirectly affecting OP through innovation and IC. |
| **6** | Measuring digital capabilities of the higher education institution using Digital Capability Maturity Model | 37TH International Conference on Organizational Science Development | (Kozina & Valentina, 2018) | Digital business transformation employs digital technologies to create new value for customers through innovative business models. The paper introduces the Digital Capability Maturity Model (DCMM) as a modern approach to assess digital capabilities in any enterprise, including higher education institutions. DCMM gauges digital transformation through five maturity levels (initial, reactive, defined, managed, excellence), evaluated across six digital capability areas: innovation, transformation, IT excellence, customer centricity, effective knowledge workers, and operational excellence. As an example, the paper outlines the assessment of innovation capability maturity within this framework. |

These studies collectively contribute to the understanding of knowledge management and the capability maturity model, providing valuable insights for organizations and institutions aiming to enhance their knowledge management practices and digital capabilities. Further research in this area can continue to advance our knowledge base and improve the implementation of effective strategies and cultures for knowledge management.

Moreover, there are several potential knowledge gaps that can be identified:

Insufficient attention to the integration of digital capabilities and knowledge management processes: While some research acknowledges the importance of digital capabilities in knowledge management, there is a need for more focused exploration on how these two areas can be effectively integrated. Gaining a deeper understanding of how digital capabilities enhance knowledge management processes, and vice versa, would provide valuable insights for organizations aiming to leverage technology optimally.

Lack of understanding regarding the long-term impact and sustainability of knowledge management initiatives: Many studies primarily examine the immediate outcomes of knowledge management practices, such as innovation and organizational performance. However, there is a gap in knowledge regarding the lasting effects and sustainability of these initiatives. Further research that investigates the longevity of knowledge management practices and their ability to adapt to evolving organizational needs would be highly beneficial.

Inadequate measurement and evaluation of knowledge management outcomes: While some studies propose models and frameworks for evaluating knowledge management outcomes, there remains a need for more comprehensive research on effective measurement and evaluation approaches. Developing standardized metrics and assessment methods would facilitate comparisons across organizations and contribute to advancing knowledge management practices.

Insufficient exploration of the role of leadership and organizational culture in knowledge management: Although some research touches upon the influence of leadership and organizational culture on knowledge management, further investigation is warranted. Gaining a deeper understanding of how leadership styles, behaviors, and cultural factors impact the success of knowledge management initiatives can assist organizations in developing effective strategies and fostering an environment conducive to knowledge sharing and collaboration.

## 3. Methodology

### 3.1 Descriptive Analysis

Descriptive analysis was chosen as the type of research to determine the perceptions of product characteristics and the degree of association between variables (Maholtra & Dash, 2016). Data collection took place from December 2020 to January 2021 and involved observation, surveys, and interviews. The survey method was

employed to gather primary quantitative data through questionnaires. Respondents were asked various questions about their behavior, intentions, attitudes, awareness, motivations, as well as demographic and lifestyle characteristics related to knowledge management. Quantitative data collection was conducted by individually distributing online questionnaires.

### 3.2 Digital Capability Maturity Model for Effective Knowledge Worker

The Digital Capability Maturity Model for the Effective Knowledge Worker allows for a comprehensive, holistic, and integrative assessment of knowledge workers' capabilities in digital enterprises (Uhl & Gollenia, 2014). To leverage digital technologies to improve employee satisfaction, digital firms demand new competencies. Employees in digital business roles are encouraged to be creative and collaborate. Employees that work in a collaborative and creative environment become more loyal, independent, and self-assured (Uhl & Gollenia, 2014). During the digital transformation, leadership and its support are critical (Kozina & Valentina, 2018).

The questionnaire assesses essential business angles for each Digital Capability using the model's eight BTM disciplines. This questionnaire does not cover the Risk Management discipline because it is unrelated to the research subject, IT Operational. This section assesses the maturity level of this company's Digital Capabilities, which can contribute to an Effective Knowledge Worker. The maturity is measured on a scale of 1 to 5. Each level evaluates the parameters along an evolutionary path from ad hoc, disorderly processes (initial) to mature, disciplined processes (excellence). A higher degree means that the operations will achieve the desired result consistently and sustainably.

The BTM management disciplines are used to measure the maturity level of the Digital Capabilities in this company that will lead to Effective Knowledge Worker (Appendix A Table 3): (1) Meta Management is the overarching structure that integrates management disciplines, leadership, culture, and connectivity, allowing the digital transformation process to be successful. Since this specialty focuses on leadership, culture, and teamwork, the questions concern how leaders relate to information acquisition and how teamwork is accomplished in the IT Operational group. (2) Strategy Management concerned with how assists their staff in knowledge management. This discipline explores the factors for and causes of digital transformation and the extent of preparation for transformation. (3) Value Management assesses how the whole company, including administrators and staff, perceives the value of Knowledge Management. As a result, the questions include how staff and Higher Education Institution Community view the importance of knowledge management and how information is used and exchanged. (4) Business Process Management determines the extent of process enhancements as well as the planned performance improvements. As a result, the questions revolve around how expertise is used in Higher Education Institution processes and how Higher Education Institution offers opportunities to help workers work better. (5) Transformational IT Management determines the extent to which IT changes are required and develops strategies for implementing and testing new technologies. The questions include how Higher Education Institution investment on technology to support knowledge management activities in the company and how technology is used in knowledge management. (7) Organizational Change Management is concerned with identifying how innovations are implemented and perceived in an organization. Thus, the questions include how Higher Education Institution implements the transition, how Higher Education Institution communicates the changes to employees, and how employees perceive the changes. (8) Competence and Training Management relies on the Higher Education Institution training plan to support workers' competencies and their perceptions of the actual training situation. (9) Program and Project Management investigates how project management is carried out in the Higher Education Institution.

## 4. Result and Discussion

Respondent profiles were obtained from IT operational employees at a Higher Education Institution who were selected to fill out the questionnaire. The data collected from distributing the questionnaires is the primary data for the conducted research. The profiles of respondents, including their gender, age, length of work, education level, and position within the IT operational group, are described in Table 4 below:

**Table 4: Respondents' Characteristics**

| Characteristics | Percentage (%) |
|---|---|
| **Gender** | |
| Male | 78 |
| Female | 22 |

 

| Characteristics | Percentage (%) |
|---|---|
| **Age** | |
| 18-24 | 0 |
| 25-40 | 44.4 |
| 41-56 | 44.4 |
| > 56 | 11.1 |
| **Educational Level** | |
| High School Degree | 0 |
| Diploma Degree | 33 |
| Bachelor Degree | 56 |
| Master Degree | 11 |
| **Years at Higher Education Institution** | |
| < 5 | 22 |
| 5-10 | 34 |
| 11-20 | 22 |
| > 20 | 22 |
| **Position in IT Operational Group** | |
| Head of Department | 22 |
| Senior Manager | 11 |
| Manager | 22 |
| Supervisor | 11 |
| Staff | 34 |

The results of the maturity assessment for all eight management disciplines are shown in Table 5. The evaluation was conducted for all main areas within each management discipline. A low standard deviation value indicates that the data is clustered around the mean, while a high standard deviation value indicates greater variation or spread in the data. When the distribution is 0, it means that all data points have the same value. In Table 5, out of the 7 disciplines and 21 questions, only 1 question has a value greater than 1. Specifically, the standard deviation of the Business Process Management discipline regarding organization rules or procedures is 1.23. The remaining 20 questions have values less than 1, indicating that the variation in the data for the Analysis Result of Effective Knowledge Worker Digital Capability Maturity Level is around the mean. The statistical data is then assessed using a Heat Map (Figure 1).

**Table 5: Descriptive Statistics Analysis Result of Effective Knowledge Worker Digital Capability Maturity Level**

| Disciplines | Questions | Key Areas of DCMM | Min | Max | Mean | Standard Deviation | Maturity Level |
|---|---|---|---|---|---|---|---|
| **Meta Management** | In this organization, employees are encouraged to innovate if they have a new idea. Knowledge of all employees is seen as a core competence. | Culture | 3 | 4 | 3,67 | 0,50 | Managed |

| Disciplines | Questions | Key Areas of DCMM | Min | Max | Mean | Standard Deviation | Maturity Level |
|---|---|---|---|---|---|---|---|
| | Leaders provide the required knowledge to solve problems and channel of communication that helps knowledge transfer. | Leadership | 3 | 4 | 3,78 | 0,44 | Managed |
| | I believe that managing and sharing knowledge are important. | Values | 4 | 5 | 4,67 | 0,50 | Excellence |
| **Strategy Management** | Organization facilitates and encourages us to manage, share, and use knowledge to improve our work performance. | Vision and Goals, Business Models and Execution | 3 | 4 | 3,67 | 0,50 | Managed |
| **Value Management** | I believe that knowledge helps the organization succeed and improve the work of its employees. | Value Identification | 3 | 5 | 4,22 | 0,83 | Managed |
| | Organization stores information such as files in a managed and integrated location. | Value Realization Planning | 3 | 4 | 3,56 | 0,53 | Managed |
| | I use the internet and systems to find information that can help me with my work. | Value Realization | 4 | 5 | 4,44 | 0,53 | Managed |
| **Business Process Management** | Organization provides tools to ensure knowledge is accessible to all departments. | Governance | 3 | 5 | 4,00 | 0,50 | Managed |
| | Organization has a clear rules or procedure of what we must do to manage and use knowledge. | Methods & Tools, Process Optimization | 1 | 5 | 3,00 | 1,32 | Defined |
| **Transformational IT Management** | Organization has been investing and developing tools to better provide | Information Analytics | 3 | 5 | 3,78 | 0,67 | Managed |

 

| Disciplines | Questions | Key Areas of DCMM | Min | Max | Mean | Standard Deviation | Maturity Level |
|---|---|---|---|---|---|---|---|
| | knowledge management. | | | | | | |
| | Organization is doing their best to manage knowledge, analyze data from various sources, and collaborative platforms (ex. Microsoft Teams and Sharepoint). | Business Applications | 2 | 4 | 3,22 | 0,83 | Defined |
| | All sharing information activities were done by making use of current system in this pandemic situation. | Communication Technology | 2 | 5 | 3,56 | 0,88 | Defined |
| **Organizational Change Management** | Employees can adapt well to organizational changes. | Change Impact Analysis | 2 | 4 | 3,56 | 0,73 | Managed |
| | Organization makes a concrete plan for any organizational changes. | Change Management Planning | 2 | 4 | 3,33 | 0,71 | Defined |
| | Organization provides training for employees to adapt with the organizational changes. | Change Management Execution | 2 | 3 | 2,56 | 0,53 | Reactive |
| **Competence and Training Management** | Organization understands the needs and importance of training for employees. | Training Needs Analysis | 2 | 4 | 3,22 | 0,67 | Defined |
| | Training needs (training plans and content) are updated according to the current needs of employees. | Curriculum Development | 2 | 3 | 2,67 | 0,50 | Defined |

| Disciplines | Questions | Key Areas of DCMM | Min | Max | Mean | Standard Deviation | Maturity Level |
|---|---|---|---|---|---|---|---|
| | Organization supports employees' personal growth by facilitating employees to join seminars and training. | Training Education | 3 | 4 | 3,56 | 0,53 | Defined |
| **Program and Project Management** | Organization uses established programs or software in project management and shared across the entire organization. | Framework, Organization, Execution | 3 | 5 | 3,44 | 0,73 | Defined |

| Effective Knowledge Worker at IT Operational ABC College | | | | | | | |
|---|---|---|---|---|---|---|---|
| Meta Management | Strategy Management | Value Management | Business Process Management | Transformational IT Management | Organizational Change Management | Competence and Training Management | Program and Project Management |
| Culture | Vision and goals | Value identification | Governance | Information and Analytics | Change Impact Analysis | Training Needs Analysis | Framework |
| Leadership | Business Model | Value realization planning | Methods and Tools | Business Applications | Change Management Planning | Curriculum Development | Optimization |
| Values | Execution | Value realization | Process Optimization | Communication Technology | Change Management Execution | Training Execution | Execution |

Scale:

| Initial | Reactive | Defined | Managed | Excellence |
|---|---|---|---|---|

**Figure 1: Heat Map of the Digital Capability Maturity Assessment of Higher Education Institution's IT Operational Effective Knowledge Worker**

The assessment result is displayed in Figure 1. It reveals the institution has a defined maturity level (Level 3) of the Effective Knowledge Worker Digital Capability. Defined maturity level, according to Table I, means that digital capability is recognized. An established internal organizational schema mark it. It has developed a recorded and intra-organizational standard process that allows for project-related customization. It indicates that although the digital capability is recognized and supported, it is not yet understood by all stakeholders, including employees and the organization. Knowledge management can be seen in day-to-day business processes, but it is not yet wholly regulated. The company's next step should be to increase its maturity level into one higher level. However, increasing the maturity level of Effective Knowledge Worker Digital Capability is made easier since the digital transformation approach has been established and the benefits and risks of digital transformation have been assessed. Digital transformation initiatives have also been identified and reported.

There are methods for increasing maturity, one of which is to enhance digital capacity by optimizing the use of technology. Uhl et.al. (2014, p183) stated that the Effective Knowledge Maturity Model assumes that the maturity level increased if the following aspects are realized: (1) Knowledge is accessible and shared from anywhere at any time; (2) Leaders are visionary and pragmatic thinkers; (3) Continuous improvement of

 

knowledge workers' skills and competences; (4) Integration of knowledge-related activities across the entire ecosystem (Uhl & Gollenia, 2014).

The actual maturity level of Effective Knowledge Worker Digital Capability has an average value of 3.0, according to the obtained results. The following can be concluded from this value: digital capability within the institution is defined; digital transformation strategy is defined, and the values and digital transformation are realized; procedures for implementing new technologies have been developed.

There is a clear imperative for advancing Transformational IT Management, with a particular focus on information and analytics. Additionally, enhancing Business Process Management is crucial, aiming to achieve greater efficiency through innovative practices and improved monitoring and optimization. While considerable research has shed light on knowledge management practices in higher education institutions, there remains a vital need to expand this exploration to various industries and organizational contexts. Delving into how contextual factors impact the efficacy of knowledge management strategies will provide valuable insights and facilitate the tailoring of approaches to specific organizational settings. By addressing these areas, organizations can harness the full potential of IT, analytics, and knowledge management to drive sustainable growth and competitive advantage.

## 5. Conclusion

In conclusion, this study has delved into the Digital Capability Maturity Level of Effective Knowledge Workers in IT Operations at a Higher Education Institution. Through our research, we have identified the current level of maturity as Defined (Level 3), wherein knowledge management is evident in day-to-day operations but lacks complete control. Our findings underscore the importance of digital transformation, as reflected in the institution's recognition of its significance, the presence of a defined strategy, and established procedures for implementing new technologies.

One of the key insights we have uncovered is the need for improvement in Transformational IT Management, with a specific focus on enhancing information and analytics capabilities. This highlights an area of opportunity for the institution to strengthen its digital readiness and drive higher levels of efficiency and innovation.

To elevate the maturity level from Defined to Managed, we propose the implementation of a web-based KM Portal. Such a solution can empower knowledge workers with better access to information, improved collaboration, and streamlined knowledge-sharing processes. By leveraging this portal effectively, the institution can advance its digital capabilities, enhance knowledge management practices, and foster a culture of continuous improvement.

The significance of this research lies in providing valuable insights into the digital transformation journey of higher education institutions. It emphasizes the importance of cultivating a proactive approach to digital capability development and knowledge management in the dynamic landscape of today's IT operations.

While our study has made significant strides in this area, we acknowledge certain limitations, such as a focus on a specific institution and its context. Future research should expand the scope to include different industries and organizational settings to gain a more comprehensive understanding of digital capability maturity and knowledge management practices.

In summary, this research contributes to the broader discourse on digital transformation and knowledge management, offering implications for practitioners and scholars alike. It underscores the importance of embracing digital change, and we hope that our findings will serve as a catalyst for further exploration and advancement in this vital field of study. As institutions continue to navigate the digital age, informed decision-making and proactive adaptation will be crucial to staying at the forefront of innovation and remaining competitive in an ever-evolving landscape.

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## Appendix A

**Table 3: Maturity assessment of Effective Knowledge Worker Digital Capability - 8 management disciplines**

| Key Areas of DCMM | Initial (1) | Reactive (2) | Defined (3) | Managed (4) | Excellence (5) |
|---|---|---|---|---|---|
| Meta Management | | | | | |
| **Culture** | KM is not recognized. | KM is partially recognized. | KM is mostly recognized. | KM is recognized but there is no understanding by all stakeholders. | KM is fully recognized. |
| **Leadership** | Initiatives for the development of KM capabilities are not being undertaken. | Leadership partially supports initiatives to develop KM capabilities. | Leadership mostly supports initiatives to transform employees to effective K worker. | Leadership supports initiatives to transform employees to effective K worker. | Leadership fully supports initiatives to transform employees to effective K worker. |
| **Values** | Effective K worker capability is not valued. | Effective K worker capability is partially valued. | Effective K worker capability is mostly valued. | Effective K worker capability is evaluated since the values of such transformation are identified. | The effective capability of K workers is a strategic goal of the institution. |
| Strategy Management | | | | | |
| **Vision & Goals** | Effective K worker is not included in the vision of the institution. | Effective K worker is involved in the vision of the institution and partially aligned with the goals of the institution. | Effective K worker is included in the vision of the institution and mostly aligned with the goals of the institution. | Effective K worker is included in the vision of the institution and aligned with the goals of the institution. | Effective K worker is included in the vision of the institution and fully aligned with the goals of the institution. |
| **Business Models** | Business processes are not aligned with effective K worker goals. | Business processes are partially aligned with effective K worker goals. | Business processes are mostly aligned with effective K worker goals. | Business processes are aligned with effective K worker goals. | Business processes are fully aligned with effective K worker goals. |
| **Execution** | KM initiatives are not implemented. | KM initiatives are partially implemented. | KM initiatives are mostly carried out. | KM initiatives are implemented | KM initiatives are implemented. |

| Key Areas of DCMM | Initial (1) | Reactive (2) | Defined (3) | Managed (4) | Excellence (5) |
|---|---|---|---|---|---|
| | | | | but not fully executed. | The strategy is fully and effectively executed. |
| Value Management | | | | | |
| **Value Identification** | The business value of effective K worker for the institution are not identified. | The business value of effective K worker for the institution are partially identified. | The business value of effective K worker for the institution are mostly identified. | The business value of effective K worker for the institution are identified. | The business value of effective K worker for the institution are fully identified. |
| **Value Realization Planning (VRP)** | Effective K worker VRP is not implemented. | Effective K worker VRP is partially implemented. | Effective K worker VRP is mostly implemented. Mechanisms for measuring innovation values are poorly defined. | Effective K worker VRP is implemented. KPIs have been defined for these values. | The Effective K worker VRP is fully implemented. A framework for measuring qualitative and quantitative benefits derived from KM initiatives has been established. |
| **Value Realization** | The business value of effective K Worker is not realized. | The business value of effective K Worker is partially realized. The measurement is reactive. | The business value of effective K Worker is mostly realized. Value measurement is mostly performed. | The business value of effective K Worker is realized. Value measurement is performed. | The business value of effective K Worker is fully realized. Based on the measurement of values, decisions for improvement can be initiated. |
| Business Process Management | | | | | |
| **Governance** | The processes do not improve through KM initiatives. | The processes are partially improved through KM initiatives. | The processes are mostly improved through KM initiatives. | The processes are improved through KM initiatives. | Effective governance mechanisms are in placed to ensure that established tools and processes are used to ensure that knowledge is available throughout the ecosystem. |
| **Methods & Tools** | Ignore about tools, techniques, and execution when it comes to managing knowledge. | Tools partially support KM process. | Tools mostly support KM process. | Tools support the KM process but not fully integral. | Integral tools support KM process. |

 

| Key Areas of DCMM | Initial (1) | Reactive (2) | Defined (3) | Managed (4) | Excellence (5) |
|---|---|---|---|---|---|
| **Process Optimization** | There is no process optimization. | The efficiency of the business processes is partially monitored for optimization. | The efficiency of the business processes is mostly monitored for optimization. | The efficiency of the business processes is monitored using defined KPIs. | The efficiency of the business processes is fully monitored using defined KPIs. Improvements are initiated for the purpose of process optimization. |
| Transformational IT Management | | | | | |
| **Information Analytics** | Little thought to installing technologies for their K Worker. | Information analytic is partially focused on the amount and quality of data collected in its systems. | Sharing knowledge is not integral within institution. | Sharing knowledge is essential within institution. | Sharing and improving knowledge is integral within institution. |
| **Business Applications** | Business applications are not related. | Business applications are partially related. | Business applications are mostly related | Business applications are related. | Invest in value-added technologies to give their employees a competitive advantage. |
| **Communication Technology** | KM systems, enterprise data warehouses, collaboration platforms are in short supply. | Communication on technologies provide partial business integration. | Communication on technologies mostly provide business integration. | Communication on technologies provide business integration. | Communication on technologies provide high level of business integration. |
| Organizational Change Management | | | | | |
| **Change Impact Analysis** | No critical stakeholders have been identified to manage organizational change for K workers. | The changes are partially identified and their impacts on the operation of the institution is partially assessed. | The changes are mostly identified. Approving changes is not fully defined. | The changes are identified. Approving changes is fully defined and based on the change impact analysis. | The changes are identified. Approving changes if fully defined. Change impact analysis includes all financial, business, and technical aspects for the implementation of the necessary changes. |
| **Change Management Planning** | There is no auditing of communication requirements, nor are there any change management activities. | Change management is partially planned. | Change management is mostly planned. Mechanisms for monitoring the effectiveness of | Change management is planned, Mechanisms for monitoring the effectiveness of the | Change management planning is carried out with the involvement of all stakeholders through |

| Key Areas of DCMM | Initial (1) | Reactive (2) | Defined (3) | Managed (4) | Excellence (5) |
|---|---|---|---|---|---|
| | | | the implementation of changes are mostly defined. | implementation of changes are defined. | communication on possible consequences. |
| **Change Management Execution** | Change management is not executed. | Change management is partially executed. | Changes are performed with multiple iterations. | Change management is executed. It monitors and analyses the implementation of the change. | Change management is executed. It monitors and analysis the implementation of the change. Improvement plans are being developed regarding the implementation of changes. |
| Competence and Training Management | | | | | |
| **Training Needs Analysis** | K workers' training needs demands are not considered. | K workers' training needs demands are partially carried out. | K workers' training needs demands are mostly carried out. | K workers' training needs demands are carried out. | The ecosystem's training needs are regularly assessed and updated by integrating important partners. |
| **Curriculum Development** | There is no development of programs required for k workers to be effective. | There is partially development of programs required for k workers to be effective. | There is mostly development of programs required for k workers to be effective. | There is development of programs required for k workers to be effective. Not all stakeholders are involved. | Necessary resources and all materials to support staff and other stakeholders for k workers are understood. |
| **Training Education** | Training is sparsely distributed across particular units and departments. | Training is partially performed. | Training is mostly performed. | Trainings are conducted. Effectiveness of their implementation are monitored and evaluated. | The training program and curriculum are conducted and continuous monitoring and improvement are done. |
| Program and Project Management | | | | | |
| **Framework** | Absence of set frameworks or standards for k workers | Effective k worker project portfolio is recognized but partially defined. | Effective k worker project portfolio is mostly defined. | Effective k worker project portfolio is defined. External stakeholders are poorly involved. | Effective k worker project portfolio is fully defined. |
| **Organization** | Organization and planning of execution of KM projects are not implemented. | Planning of execution of KM projects is partially carried out. | Planning of execution of KM projects is mostly carried out. | Planning of execution of KM projects is carried out. Indicators for the | Planning is carried out through a combination of KM projects and efficient |

 

| Key Areas of DCMM | Initial (1) | Reactive (2) | Defined (3) | Managed (4) | Excellence (5) |
|---|---|---|---|---|---|
| | | | | implementation of innovation projects are defined. | use of available resources. A framework for measuring qualitative and quantitative benefits related to the implementation of KM projects has been established. |
| **Execution** | KM projects are not carried out. | KM projects are partially carried out. | KM projects are mostly carried out. | KM projects are carried out by monitoring their quality, cost, and execution time. | KM projects are fully executed, monitored, and improved. |