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Personal Knowledge Management: Systematic Review and Future Direction

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Abstract**—**Personal knowledge management is the aspect of knowledge management that relates to the way in which individuals organize and manage their own set of knowledge. While in that respect, there has been research in this area for the past 25 years, it is at present necessary to speculate upon what research has been done and what we have discovered about this arena of knowledge management. In contrast to organizational knowledge management, which focuses on a firm's profitability and competitiveness, personal knowledge management (PKM) is concerned with the person's self-effectiveness, competence and success. People are concerned in managing their knowledge in order to become more efficient in a variety of personal and organizational interests. This study presents a systematic review of PKM studies. Articles with PKM concepts are reviewed with the objective of clearly defining PKM, identifying the benefits of PKM, classifying the tools that enable PKM and finding the research gaps to indicate future research directions in the area. Consequently, we have developed a definition of PKM and identified the benefits of PKM, including an understanding of who seeks PKM and for what. Tools enabling PKM are identified and classified under three categories Web 1.0, 2.0 and 3.0 and finally the research gap and future directions are suggested. Research which facilitates collaboration by using semantic technologies is suggested to be studied further to improve PKM effectiveness.

Keywords**—**Knowledge management, organizational knowledge management, personal knowledge management, systematic review.

I. Introduction

INTEREST in PKM stems from both the personal perspective in understanding how to best manage personal knowledge, as well as the organizational perspective, largely due to the fact that the return from organizational knowledge management has not been as expected [1]. Due to these reasons, PKM has begun to flourish both within academia and in personal practice. This paper will provide a systematic review of PKM articles with the objective of clarifying its definition, benefits, enablers and identifying research gaps.

Knowledge definition is an ongoing debate that will not be resolved on this theme. From knowledge hierarchy Data→ Information→Knowledge→Wisdom, Knowledge can be taken as a result of information processed [2]. According to Davenport and Prusak [3], to convert information into knowledge one of the five C method ('Contextualized, Categorized, Calculated, Corrected, and Condensed') should be applied to information to transform it into knowledge. The other popular definition of knowledge, which has been frequently used in Knowledge Management articles, is that knowledge as a consequence of experience, values, information and insights to be a framework for evaluating newly added info and experiences [3].

The term Knowledge Management was coined in relation to organizational knowledge [4]. Organizational knowledge is knowledge applied by employees to match the organizational objective which is a result of the organizing rules, shared opinions and procedures [5]. Knowledge Management is handling organizational knowledge starting from its beginning to its end with two major research focus areas, Knowledge Creation and Knowledge Transfer.

Nonaka [6] classifies organizational knowledge creation into two dimensions, epistemological and ontological. Epistemological knowledge creation ponders on the SECI model. SECI (Socialization, Externalization, Combination and Internalization) model deals with the conversion of the knowledge format between tacit (implicit) and explicit. Tacit knowledge is implanted in the minds of individuals and very difficult to reveal. The degree of difficulty to extract the tacit knowledge depends on the degree of tacitness. Explicit knowledge is comprehensible knowledge which has already been put in real media. Socialization allows the transferable of tacit Knowledge owned by an individual, which is then shared among individuals, this is known as tacit-to-tacit conversion. Knowledge begins from an individual's mind and through the process of codifying it is converted to explicit knowledge, this is referred to as externalization. The combination is the mix of externalized explicit knowledge with other explicit knowledge. Finally, Internalization takes place where individuals internalize the explicit knowledge to build it their tacit knowledge. According to Nonaka [6], this cycle of conversion results in organizational knowledge creation. The ontological dimension adds the social context to the SECI model. Social interaction, organizational structure, commitment to the knowledge subject and the managerial approach, are all important areas to consider in knowledge creation within an organization [6].

The second angle in organizational knowledge management research after organizational knowledge creation is knowledge transfer. Inter and intra-organizational knowledge transfers are the two major aspects that will be considered here. Inter-organizational knowledge transfer is from external organization to the organization and intra-organizational knowledge transfer is the diffusion of knowledge between the departments of the organization [7]. According to Argote and Ingram [8], knowledge is said to be transferred from point A to B, when A has significant influence on B, in such a way

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that results in a knowledge transfer manifested through either practice or cognitive knowledge change.

The term knowledge management refers to organizational knowledge at the start of the process. But nowadays there are more articles which use this term for personal cases and PKM [9]-[12]. PKM dates from the requirement for knowledge workers to be accountable first for their own knowledge creation and development [13]. Individuals' Knowledge can be built through the use of tools and technology, which initiate the idea of PKM [11], [12]. Similar to organizational knowledge management, which has its origins from multi-disciplines, PKM originates from organizational knowledge management, Personal Information Management (PIM), cognitive psychology, philosophy, management science and communication [12], [14].

According to Świgoń [15], PIM and PKM are similar in definition. PIM is all about acquiring, processing, storing and finally disseminating information. Knowledge management is holding the same activity for knowledge, as is done for information management. The difference lies only on the subject to be managed, i.e. information and knowledge, respectively. Swigon [15] suggests combining the two terms to create 'personal knowledge and information management (PKIM)'. As a critique on PKM the idea focusing on the individual is not acceptable. KM experts reflect their comment on PKM by saying it is more than enough to consider PIM for personal case knowledge; by itself it is for organizations and large group [11]. For Pauleen [19], the two terms, personal knowledge and PIM, are distinct. PKM is above information management as it builds "on skills and attitudes that lead to more effective cognition, communication, collaboration, creativity, problem solving, lifelong learning, social networking, leadership and the like". In this paper, we take the two terms as distinct and we will define the term PKM in the research findings section.

Research Question: The following are the research questions and objectives of this systematic review of PKM study: In past literatures,

- *What definitions of PKM have been given?*
- *What benefits of PKM have been identified?*
- *What tools have been identified to enable PKM?*
- *What research gaps have been identified?*

II. Research Methodology

The research methodology used to conduct this study is a systematic literature review. A systematic literature review is a research methodology which mainly contains reviewing prior studies with clearly set objectives using a well-defined and explicit method [16]. The five steps of a systematic literature review outlined below are taken to make the methodology reproducible [17].

Stating objective: Explicitly stating objectives before conducting a systematic review is paramount. Then pre-define criteria to select studies to be considered in the review is required. The objective of this study is to address the four research aims, which are restated as follows:

- Identifying definitions of PKM.
- Identifying benefits of PKM.
- Identifying tools used to enable PKM.
- Identifying the research gap from prior PKM studies.

Therefore, the criterion to choose studies to be included in this systematic review is the inclusion of the term 'personal knowledge management' in their key words section. Also, some studies which use other synonyms for 'personal', like individuals, are also considered.

Showing method: The technical steps taken to make the review should be explicitly outlined in black-and-white, so as to make the research repeatable. Accordingly, Fig. 1 clearly shows the steps undertaken to get the intended results from this systematic review.

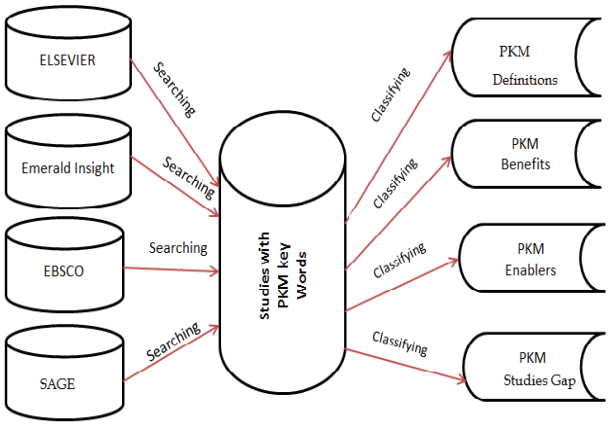

Fig. 1 Method of the systematic review

***Searching studies*:** This is the critical point to present a sound review of the topic area. Ideally, all articles, both published and unpublished, would be used to review this topic. However, trying to incorporate un-published papers is very hard. We tried to use the university database Thesis and Dissertation Library (TDL) at Addis Ababa University, which is a digital library, to look through un-published students and dissertations, but found no matches based on the established criteria. Unpublished works are therefore not included in this systematic review as the access is very difficult. We restricted our search to publish articles from EBSCO, Emerald Insight, Elsevier, and the SAGE databases in addition to Google Scholar search results. A total of 52 articles was founded based on the criteria with the word starting of the term PKM. Among the 52 articles, 32 of them were selected and used because they matched with the intended objective of this systematic review. The remaining 20 research papers, though discussed PKM, were not helpful to address the research aims. In other words, articles which say something about the benefit of PKM, the tools for enabling PKM and the trends for effective PKM are included in the review.

Analyzing studies: This is the step that includes looking through the studies to meet the objectives identified by the reviewers. Studies were classified, grouped, compared, contrasted and/or summarized. In this review studies were grouped into four categories Introduction (definition),

benefits, enabler and the research gap to identify the respective reflection through PKM studies and summarized what is said about the topic.

***Reporting findings*:** Finally, findings from the systematic review are reported. In this paper the findings and the answers to the three research questions and the review objective are presented under the research findings section. Based on the findings, future directions are indicated by pointing out research gaps in the subject.

III. Research Findings

This section classifies and summarizes the prior studies regarding PKM and is based on the findings from the studies selected for analysis. The research findings answer the basic research questions: PKM is defined, the benefits of PKM are listed and the PKM enablers (tools used to enable PKM) are identified, and the PKM research gaps are indicated.

A. Definition of PKM

TABLE I
Definitions of PKM in Prior Studies

PKM is defined as a mental model to combine information gathered into more relevant, personal knowledge base [9].
PKM is a composition of seven skills to solve problems and make sound decisions. These skills are information retrieval, evaluation, organization, analysis, presentation, securement and collaboration [18].
PKM is personalizing organizational knowledge management. Managing individuals' knowledge for individuals' sake [10]-[12], [19].
PKM is a term which integrates PIM and knowledge management [11].
PKM is a process of knowledge searching, retrieving, sorting, storing and sharing in the day-to-day activity of individuals [20]
PKM is created by individuals to assist them in managing their own information, knowledge and experience [21].

The six definitions given in Table I, addresses two questions to define PKM, how PKM is composed as an output of a process and for whom this output is useful and how. Considering this, we define PKM as *the process of creating, sharing, and storing knowledge acquired by individuals for the sake of improving individual's ability of problem solving, decision making, competence and innovation.*

B. Benefits of PKM

Two perspectives held regarding the need for PKM were found from the studies: PKM for individuals and PKM for organizations [22]. The main question to be addressed under PKM from the individuals' perspective is who needs PKM. Five groups of individuals are presented specifically and the sixth one is more general. *(1) Knowledge workers*: as mentioned earlier in the introduction section of this paper the beginning of PKM also relates to knowledge workers. For knowledge workers managing what they know is a big issue. PKM helps those individuals in managing and being responsible for their own knowledge before presenting it to their organization and the public [23], [11]. *(2) Employees*: For employees the chance to be employed elsewhere as a result of being competent increases in using PKM. Also organizations expect their employees to be efficient at PKM so that they can benefit both themselves and the organization. PKM helps employees stay proficient and to be one of the most important employees in an organization [24]. *(3) Students*: For students undertaking the formal learning process at levels varying from high schools to colleges and universities, the knowledge transfer for all the courses a student undertakes could lead to information overload unless well-managed with the personal mental skill of managing information. Helping with this knowledge managing process through PKM, the student will become more effective. Studies [25]-[27] indicate how to support the teaching-learning process in order to manage knowledge through PKM *(4) Researchers*: Graduate students and researchers need to manage academic articles available about their research interest [28]. It is difficult and stressful to carry out a literature review and create knowledge from gathering multiple papers. PKM can help researchers the same way as of knowledge workers, in managing what they know from such scholarly articles. *(5) Intellectuals*: skill-full professionals who possess knowledge of how-to-do something in a company need to manage their knowledge so it can be transferred to the next generation [11]. Similar for artists, they need to manage their work. They might own a huge assemblage of initial ideas, drafts, and finished artistic products. Seeing a desired product from such collection will be unmanageable. PKM helps for easy management of their work and as a means of a knowledge repository [28]. *(6) Any individual*: Individuals with managing knowledge, interest need PKM. In the current information age where information is released via the Internet in seconds where it can be reached by millions, Information overload has become a big issue and may make it more difficult to make a sound decision. For this reason, individuals began to seek managing their knowledge [9], [19]. The tools and technique presented by PKM help individuals to overcome the information overload problem and to be effective in decision-making and problem-solving. Through the tools one can choose the amount, content, structure and network for specific information [10]. PKM helps individuals in managing their surroundings for personal, organizational and social reasons, which improves their career, social aspects and life choices [12], [24].

The second perspective of PKM is for organizations. PKM is not only for individuals, organizations will also see the benefits through its application. Organizations will benefit from having skillful employees who manage their personal knowledge [21]. While managing organizational knowledge, what to manage is not a thing or a process; it is very much linked with the individual. According to Amine Chatti [1], a Personal Knowledge Network (PKN) should be considered as a good model for KM, this is looking through PKM for the success of organizational KM relates the two dimensions of KM. Organizations can gain from PKM by implementing the same techniques of PKM to organizational knowledge. It will be much easier to span individual knowledge management style to the firm the 'bottom-up' approach than imposing the organization's knowledge management style on individuals 'top-down'. A top-down strategy will result in a win-loss - a win for the company and a loss for the individuals. However, in the bottom-up approach it will be a win-win strategy. A

bottom-up approach from the individual to the organization is more supportive to have a mutual learning medium; here it is good to remember that externalizing tacit-knowledge will be effective only through the will of the person and never by force [10], [33]. Table II gives a summary of the benefit of PKM in for individuals and organizations identified in prior studies.

TABLE II
BENEFITS OF PKM IN PRIOR STUDIES

PKM for managing individuals' knowledge: managing knowledge to overcome information overload, increase chance of employability, manage working and social environments through improved problem solving and decision making ability and finally to enhance self-competence and innovativeness [9], [10], [12], [19], [24], [29], [30].
PKM for learning: formal, informal and lifelong learning will be supported through PKM. Formal learning for students of all levels, including distant student and adult students through e-learning PKM.
Informal and lifelong learning is a need for any individual. Individuals will benefit through PKM by having a means to create, exchange and store knowledge and learn from the community [25]-[27], [31].
PKM for working on Knowledge: knowledge workers and researchers are always in need of a summarized version of the available overloaded information to present it to the public, so PKM will help such individuals in making this kind of summarized information and create knowledge to their required format [23], [32].
PKM for organizations: Organizations will benefit from PKM as their employees benefit and it is easy to spin the trend of PKM from the employees' concern to the organizational level [1], [10], [24], [33], [34].

C. Tools Used to Enable PKM

For organizational knowledge management Information systems that support the knowledge flow are presented as enablers. These include Expert systems, Knowledge Bases and document management systems. In the Internet era technologies such as e-commerce, e-learning, live-conferencing facilitates the faster transfer of knowledge management activities [11]. For PKM three tools were identified as enablers: Web 1.0 (WWW), Web 2.0 (Social Media) and Web 3.0 (Semantic Web).

Web 1.0 technologies are the first level requirement to enable PKM. It is hard to manage personal knowledge without the support of technology like search engines and WWW. PKM encompasses seven skills of information according to Avery [18]: searching, comparing, organizing, analyzing, presenting, securing and sharing. These seven skills can be enabled through using technology [35]. The seven skills also can be enabled through SaaS (Software as a Service) in this technology era, cloud computing will be one of the most useful components to enable PKM [25]. PKM basically focuses on managing three processes: problem solving, exploring and learning. According to the complex responsive theory (CRP), even if communication is complex, effective learning requires communication in order to learn the individuals need to interact with the community and this will be helped through technology [36].

Web 2.0 or the Social Web takes the first place in enabling PKM at the present time. The Social Web has become a very important tool for PKM, because it provides three basic things which knowledge seeks: social (community) interaction, feedback and a network [37]. These days users of social webs multiplies each day and people use the convenient features social webs like Facebook, Twitter, and LinkedIn to create interactions with many people. These connections create the chance for information exchange between crowds. Such information exchange leads to knowledge creation, transfer, repository and hence knowledge management. Social webs with the intent of supporting PKM have a remarkable number of users like Wiki's and social bookmarking [38]. Connectivitism creates a more favorable platform for learning, where Connectivitism is the integration of rules as a result of the brainstorming of multitudes. Learning in turn favors PKM through a process of experiencing socially accepted beliefs, 'the justified truth'. PKM involves three basic things 'create, organize and share' these will be enabled through Connectivitism and social software will make true the realm of Connectivitism. Hence social-software enables PKM indirectly Social – software → Connectivitism → learning → PKM [39].

Web 3.0 (semantic web), the future of PKM highly depends on Semantic technology. Semantic PKM (SPKM) is defined by Völkel [32] as an enabler for PKM by providing the codified semantic, rather than presenting a huge amount of files. SPKM tools encompass semantic information retrieval, personal knowledge creation as of the Nonaka SECI [6] model from a different format (ex. Tabular format), by combining more semantics (Sematic wiki's, Blogs and Mind-maps), and finally serves as a personal knowledge repository. There is a need for SPKM tools which meet the requirement of PKM to be affordable, personalized, flexible, linked, contextual, printable, simple and continual. The current SPKM tools lack some of these requirements [40]. Semantic technology will be supportive for PKM by presenting semantic applications, which underlies the semantics of the business and the semantics of procedural knowledge. In the current PKM model, the problem is the difficulty in having an individual data-model and their intellectual asset, which is currently better presented by Web 2.0 (social media) but may be more effective through Web 3.0 (semantic web) and semantic technology [41]. Semantic desktop is the implementation of the semantic web to personal use to manage personal knowledge. Integration is the basics of a semantic desktop. Integrating PKM tools like wiki's, mind-map and topic map and integrating the data from all sources like emails, documents, address book, SQL databases and office applications. There are three steps for integration (1) identifying all resources through a URI →(2) structuring all the resource through RDF →(3) complying the ontological representation of the RDF. Semantic desktop can be one of the potential enablers for PKM [42]. To learn individuals need to interact with the community, and this will be helped through technology [36].

Table III provides the summary for the tools in enabling PKM.

TABLE III
TOOLS TO ENABLE PKM IN PRIOR STUDIES

Tools	Findings
Web 1.0 (WWW, search engines and other technologies supported online, e.g. cloud computing)	The skills and processes encompassed by PKM can be enabled through WWW and search engines [35], [36], [25]
Web 2.0 (Social Media)	Convenience of the features of the social webs to interact with many people became a potential enabler for PKM [37]-[39].
Web 3.0 (Semantic Web)	Semantic Web will be a future of PKM which gives a more enabling capability for PKM [40]-[42].

D. Research Gaps of PKM

PKM benefits, as presented through the searched articles, focuses only on two dimensions: individual and organizational. The third dimension societal advantage of PKM is missed. Obviously, society can be benefited by PKM, assisting individuals indirectly assists society. Researches regarding the societal wing of PKM are in demand to show the entire perspective of PKM benefits.

Certain factors which matter for individuals while using PKM systems are expected. Identifying those factors and acting accordingly, will result in a more profitable PKM. Unfortunately, these factors are seemingly an afterthought under PKM studies. Personal Interest, Personal Skill, Ease of use, Ease of accessibility, Dependability, Organizational politics, Managerial styles, the Norms and Trends of the society towards encouraging knowledge creation and other personal, organizational and societal facilitators and barriers for utilizing PKMs, need to be investigated.

Semantic technologies are presented as the future of PKM and there are a few studies [40]-[42] in modeling and indicating how to implement semantic technology. Yet more studies are still required to enrich the area and to make practical semantic PKMs.

Knowledge will be favorable only through collaboration. Knowledge cannot be created and used by originating from a single individual mind. It needs connection and collaboration, connection with others, nature and the surrounding. Collaboration is the nuclei of knowledge creation. However, only a few studies talked about it and how to model collaborative PKMs [20] and [27], and therefore, more studies are required.

Research Gaps:

- Societal benefits/value of PKM.
- Facilitators and Barriers of PKM.
- Semantic PKMs features.
- Collaborative PKMs.

IV. FUTURE DIRECTION

Future PKM research needs to include two broad subject areas: (1) semantic PKMs and (2) collaborative PKM. The enabling power of third generation Webs, Web 3.0 (Semantic Web) is much better than the current trends and technologies. PKMs semantic applications are preferred due to their fitness with high technologies and enabling capability. On the other hand, open PKMs as a catalyst of collaboration is a second research area. It is only through real collaboration that knowledge can be created as defined in this study, knowledge which helps in problem solving, decision making, competence improving and innovating. In order to create a platform for collaboration there are certain behaviors which an individual seeks, both from the knowledge producer and the consumer side. By identifying the behaviors which facilitate or hinder PKM, creating a collaborative platform for PKMs with semantic features will be remarkable in the field of knowledge management.

V. CONCLUSION

In this paper a systematic review of PKM studies is conveyed. Accordingly, the definition, benefit and enablers of PKM were clarified and future direction is indicated. PKM is defined as the process of creating, sharing, and storing knowledge acquired by the individual for the sake of improving the self-ability of problem solving, decision making, competence and innovation. PKM is of benefit for individuals and organizations. Individuals will benefit from learning, working on knowledge and generally in managing their knowledge by overcoming information overload and creating, transferring and using knowledge. Organizations will benefit indirectly from their employees benefit and directly by having an easy way of spanning the knowledge management approach from the individual level to the organizational level in a bottom-up approach. Obviously, society will also benefit indirectly from having such individuals who manage their knowledge. Technology is an enabler for PKM, and Web 1.0, 2.0 and 3.0 are tools that provide remarkable support for PKM. Under Web 1.0 (the WWW), search engines and other web-based technologies like Cloud computing, will have a positive impact towards helping PKM. Web 2.0 (social media) will greatly facilitate the connection of people where information dissemination will be at its peak, the creation of knowledge will be possible and PKM will be enabled. Web 3.0 (the semantic technology) is expected to be the future of PKM because of the features available within semantic technology. Indicating the future direction and finding research gaps in PKM studies was one of the major research questions of this study. In relation to this, the research gaps are identified to be: the benefit of PKM for society, factors affecting PKM and semantic and collaborative PKM. The future direction of PKM is indicated to have a better effective PKM which encompasses an open-collaborative semantic framework of PKM with identified factors for assisting individuals in managing their career, personal and social knowledge.

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