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A Back-Casting Knowledge Management Vision for a Digital Platform Ecosystem in Support of Thrivable Communities of Knowledge Workers

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Aim/Purpose	This year marks the 75th anniversary of an article titled 'As we may think'. It envisioned the 'Memex' as a personal device affording the productive use of the accumulated human knowledge. It also allowed for the integration of own augmentations able to be effectively shared with the 'Memexes' of others. This article follows up on Vannevar Bush's still unfulfilled aspiration as well as on current unsustainable Knowledge Management states. What would be today's impact and gestalt of such a digital innovation, and how can it be implemented to serve the wellbeing of humanity? To answer these questions, we are drafting a Vision for a 'Memex'-inspired novel decentralized Knowledge Management System. Its aim is to strengthen the capabilities and autonomy of individual knowledge workers to become collaborative contributors to and beneficiaries of institutional and societal performances.
Insights or Findings	The vision elements are rooted in an advanced-stage design science research project and its conceptualization and prototyping of a novel decentralized knowledge management system. The new perspective taken accounts for notions of entropy, generativity, trans-disciplinarity, and sustainability and aims for a digital platform ecosystem which affords clients with highly diverse skills and ambitions to gainfully utilize its resources and generative potential in their personal and local contexts.
Recommendations	With its focus on a sustainable development path to benefit knowledge workers, the back-casting vision methodology applied demonstrates its potential to share the envisaged knowledge management prospects with a wider critical mass of stakeholders as a prerequisite for creating the respective decentralized, more generative knowledge management reality.
Keywords	Knowledge Visions, Knowledge Management, Memex, Personal Knowledge Management, Knowledge Worker, Opportunity Divides, General-Purpose-Technology, Disruptive Innovation.

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AREAS OF CONTRIBUTION

Paper Category		
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Type of Digital Innovation	Industry	Discipline
☒ Radical	☐ Media	☒ Business Technology
☐ Incremental/Enhancing	☐ Telecom	☐ Human Resources
☒ Disruptive	☐ Consumer Financial Services	☐ Management
☐ Breakthrough	☐ Retail	☐ Marketing
☐ Basic Research	☒ Technology	☐ Finance
☒ Sustaining	☐ Insurance	☐ Accounting
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☐ Destroying	☒ Business/Professional Services	☐ Medicine / Healthcare
	☒ Higher Education	☐ Law
	☐ K-12 Education	☐ History
	☐ Training	☐ Philosophy
	☐ Health Care	☐ Religion/Theology
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		☐ Digital Media
		☐ Astrology
		☐ Social Sciences
		☐ Art and Culture
		☐ Psychology/Consciousness
		☐ Astronomy

Human Elements		
☐ Personality Traits	☒ Development	☐ Mental Wellbeing
☐ Behaviour	☐ Environmental	☐ Consciousness
☒ Cognition	☒ Social	☐ Physical Wellbeing

INTRODUCTION TO VISIONEERING AND THRIVABILITY

A system's purpose "gives birth to a vision and is often the most crucial determinant of a system's behavior". As interconnected sets of elements which are coherently organized to serve functions or intentions, system visions are encouraging us to go beyond pursuing individual success for the benefit of a sustainable future. Without visioneering (the engineering of a clear vision), "the purposes of subunits may add up to an overall behavior that devastates the whole system" (Kim & Oki, 2011).

While visioneering incorporates knowledge-creating processes, it may also directly institute a knowledge-related vision as "sets of shared beliefs about how to act and interact to attain some determined idealized future state [by focusing] on the knowledge to be created that goes beyond the existing boundaries" (Nonaka & Toyama, 2005). A collaborative, outreaching, interdisciplinary approach is suggested to promote vision acceptance and sustainability but may seem unattainable in complex and unpredictable settings. '*Wicked' problems* (ill-defined due to incomplete, contradictory, dynamic specifics or interdependencies (Rylander, 2009)), for example, might require pushing for breakthrough innovations where the information needed to understand unfamiliar problem spaces depends on radical ideas and paradigm shifts for solving them.

The design science research (DSR) outcomes – to be repurposed for crafting a '*back-casting' vision* - are fitting this latter category. They refer to the ongoing development of a novel knowledge management (KM) system (KMS) aiming for '*theory effectiveness*[1]' by continually reporting on the adopted methodologies and design theories as well as on the evolving artefact and its envisaged technological impact on users, organizations and society. '*Back-casting*', as one of the "the most effective futuring methods", facilitates knowledge visions by defining a desirable future from which to work backwards to identify conditions and factors that must be addressed for its realization (Ceruti et al., 2019).

The overarching desire, this article emphasizes, is '*thrivability*'. As a step beyond sustainability, thrivability identifies concepts "in which resilience is achieved within systems and communities" by enabling citizens to "realize their maximal potential and prosperity", by encouraging "collaboration and cocreation", and by facilitating "the cultivation of collective wisdom" and "co-developing communities" (Laszlo et al., 2017). But, as "digital technologies have been spreading, digital dividends have not"; KM technologies can make workers only more productive, when they command the know-how to use it (World Bank Group, 2016) and are motivated by incentives to adopt and accept them.

Whilst also evident in the United Nation's Sustainable Development Goals, the respective gaps are hampering emerging knowledge economies by contributing to widening opportunity divides (Drori, 2010; Giebel, 2013) and are calling for a new educational and knowledge-creation (research) orientation. As just memorizing facts no longer provides individual leverage, today's "limited resource has become the creative combination, integration, and useful application of knowledge into networked production and customization" (Laszlo, 2018).

Neither a vision statement nor a vision-related position paper like this can particularize all the design-related twists and turns considered for the KMS's implementation, nor are they supposed to detail the logics and logistics which shape the overall solution. The back-casting approach adopted, hence, centers on interrelated concise narratives (without in-text citations) but makes the peer-reviewed prior DSR work and external key sources evident in a tabular format at the end of each section with footnotes providing further essential immediate background and definitions.

[1] *Theory Effectiveness* represents a DSR paradigm which expects designs to be purposeful - both in terms of utility (a matter of content) and communication (a question of presentation) to an audience (O'Raghallaigh et al., 2011).

Preceding these vision-related assertions is a visualized bird's-eye view and brief introduction of the decentralized Digital Platform Ecosystem (DPE) which accommodates the novel Personal Knowledge Management System (PKMS) and concept.

DIGITAL PLATFORM ECOSYSTEM & PERSONAL KM CONCEPT

Digital Platform Ecosystems (DPE) are generically defined as meta-artefacts which afford clients with highly diverse skills (*gifts*) and ambitions (*ends*) to gainfully utilize its resources and generative potential (*means*) in their personal and local settings (*contexts*) (Eck & Uebernickel, 2016). An article-in-progress is using the gifts-contexts-means-ends perspective to point out the additional complexities such a DPE faces compared to organizational KMS.

Figure 1 provides a general bird's-eye view with some details to be later referred to (e.g. memes). It depicts a social actor (bottom) with his/her decentralized Personal KMS digital device as a member of the PKMS user community. The clockwise iterative workflow shows that the voluntary shared individual content is centrally synthesized and curated (middle-left) before it is fed back to the community to facilitate continual cycles. It may also be repurposed as learning assets to foster Personal Learning Environments[2] (PLE). Adding to the broader DPE context are further interactions with organizational Knowledge and Learning Management Systems (OKMS, LMS).

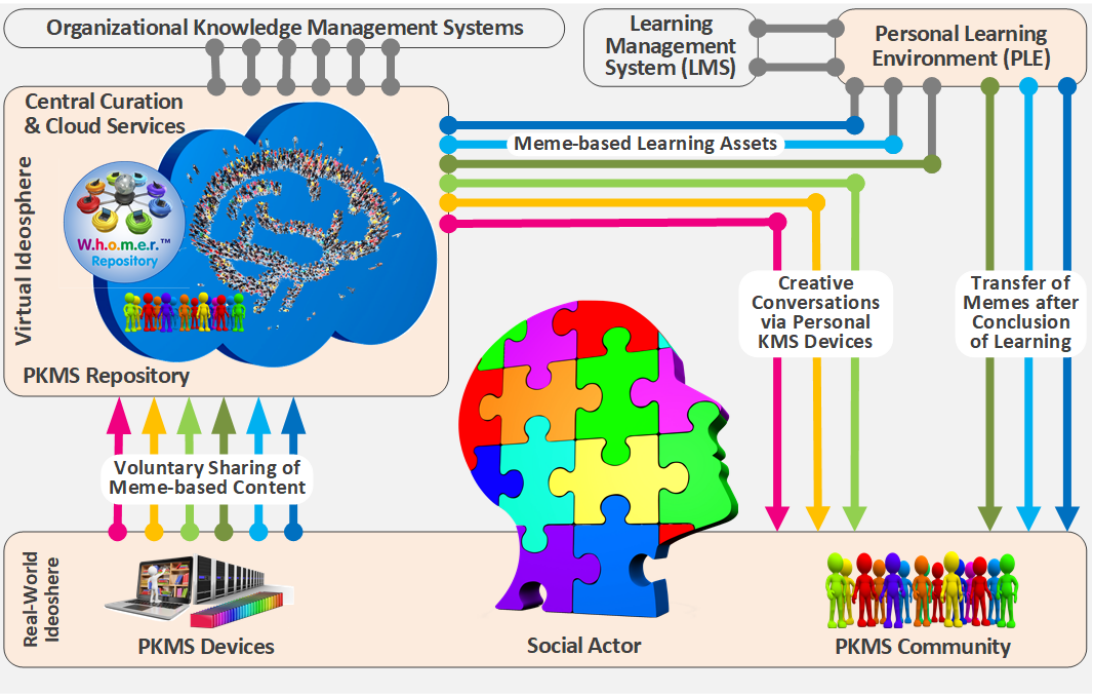

Figure 1. PKMS at the centre of a Digital Platform Ecosystem (DPE) (Schmitt & Gill, 2019).

[2] *Personal Learning Environments (PLE)* are defined as (1) Activity spaces encompassing appropriate learning resources (tools, content, people) to support and facilitate personal learning experiences, (2) where learners address their own learning requirements and gain control over learning taking advantage of the provided learning resources, and (3) where content is reused and remixed according to the learner's own needs and interests as well as shared with other learners (Rahimi, 2015).

The research methodologies applied to result in this DPE conceptualization are rooted in notions of Design Science Research, Informing Science, and Systems Thinking closely aligned to Knowledge Creation and Human Evolution.

Table 1. Tabular Recapitulation of Key Notions, Contributions, and Sources: *Methodologies applied.*

Primary Emphasis on: Methodologies applied	Key Models & Notions Integrated	Key PKMS Contributions	Sources & PKMS Output
Design Science Research & Informing Science	Theory Effectiveness; Cumulative Synthesis	Meta-Framework with ten Digital Ecosystems integrating PKMS with Popper's/Nonaka's notions.	(Usher, 1954; Hevner et al., 2004; O'Raghallaigh et al., 2011; Schmitt, 2016a)
Systems Thinking	Systems Dynamics; Activity-Based Modeling; Popper's Three Worlds; Briscoe's Digital Ecosystems; Gibson's Affordances/Fixations	Hybrid modeling by fusing system dynamics, discrete-event, and agent-based approaches with leading modeling & visualization tool.	(Dawkins, 1976; Popper, 1978; Briscoe, 2010; Gibson, 2014; Schmitt, 2017a, 2020c)
Knowledge & Human Evolution	Knowledge Types; Memes & Memetics; Co-evolutionary Drivers; Creative Class	Human Civilization as a five-stage-co-evolution between social & physical knowledge technologies with PKMS as next driver.	(Dawkins, 1976; Koch, 2001; Beinhocker, 2006; Florida, 2014; Schmitt, 2014b)

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> *Clutter and confusion are failures of design, not attributes of information.*
>
> *Edward Tuft, American Statistician*

TRANSFORMATIONAL AND DESIRABLE KM VISION

KNOWLEDGE WORKERS AS AUTONOMOUS MEMBERS OF INSTITUTIONS AND SOCIETY

We regard knowledge workers as self-motivated individuals who continually strive to understand the world and take responsibility for driving improvements. To successfully transform their innumerable small 'nano-actions-and-contributions' into viable institutional performances, any thriving knowledge society needs to encourage their knowledge workers' active participation by empowering their capability potentials.

We envisage Personal KM Systems as autonomous but interconnected artefacts (digital devices, tool kits, repositories, and knowledge assets[3]) with six progressing levels of utility:

1. At the most basic level, *access to information and knowledge* is assured via digital networked KMS devices providing effective and affordable connectivity (representing the current emphasis of efforts for sustainable societal ICT for Development (ICT4D) investments).
2. which facilitate *individuals' learning and authorship* and allow for developing and articulating own ideas based on one's personal knowledge, expertise, and contexts and inspired by the digital content from the PKMS community's shared central repository (as a foundation for a

[3] *Knowledge Assets* represent "nonphysical claims to future value or benefits" (Dalkir, 2011).

society pursuing life-long learning and cultural identity based on nurture (e.g. education) or nature (environmental affordances, kinship)).

3. Since knowledge, as part of reality, is socially constructed, each personal artefact affords its user creating and maintaining social ties to *engage with relevant peers of the digital PKMS community* in order to augment his/her creativity (as societal means to foster creative conversations and accumulate social resources/capital).
4. It, moreover, eases voluntary *personal contributions to the world's knowledge heritage and respective discourses* as represented in the shared PKMS central digital repository (as a societal backbone for valuing and sustaining individual freedoms, mastery, and innovativeness).
5. Its digital connectiveness allows for *transcending self-actualizing* foci by furthering causes, ideals, or others' ambitions beyond self. Users are enabled to collaboratively interlink and collectively harvest prior accumulated knowledge subsets for mutual benefits (as a societal opportunity to promote their citizens generative role as contributors to and beneficiaries of organizational and societal performances).
6. Ultimately, its dynamic networked configurations and deployments provide support for professionals and their stakeholders to form and/or support institutions[4] and underpin organizational intelligence and digital extelligence[5] for *exploration and exploitation* (as a knowledge society's enabler/driver for transforming into a knowledge economy).

Table 2. Tabular Recapitulation of Key Notions, Contributions, and Sources: *Knowledge Workers & Societies*.

Primary Emphasis on: Knowledge Workers	**Key Models & Notions Integrated**	**Key PKMS Contributions**	**Sources & PKMS Output**
Sustainable Development, ICT4D, and SDGs	Maslow's Hierarchy of Needs; Johri's ICT4D-Design Framework; Giebel's Opportunity Divides; Computerization of non-routine tasks	PKM for Development Framework (PKM4D) with progressing individual development states & societal intervention levels.	(Koltko-Rivera, 2006; Johri & Pal, 2012; Giebel, 2013; Frey & Osborne, 2013; Schmitt, 2016b)
Capacity Building; Exploration, Exploitation, & Ambidexterity	Attention Management; Extended Ignorance Model Map; Snowden's Cynefin Model; Experiential Learning; Experience Management	PKM for Empowerment Framework (PKM4E) incl. unknown-known-dynamics & interventions.	(Simon, 1971; Kerwin & Witte, 1983; Snowden, 2002; Kolb, 2014; Schmitt, 2017c, 2018a)
Participation in Network Community-Building, Collaboration, and Social Knowledge Sharing	Affordances of Past and Next Community-oriented Technologies	Repurposing, restructuring, and extension of prior affordances frames to accommodate PKMS needs.	(Mynatt et al., 1998; Cabitza et al., 2015; Schmitt, 2017a, 2017d)

[4] *Institutions* are defined as "snapshots of a subset of the ideational field that persevere while the network itself continues to fluctuate" (Kanengisser, 2014).

[5] *Extelligence* refers to the world's externally stored information; it represents any cumulative archive of human cultural experience and know-how. As the external counterpart to the intelligence of human brains/minds, it provides information for the intelligences' understanding in a complicit process of accelerating interactive co-evolution to be accessible and augmentable by any individual who knows how (Stewart & Cohen, 1999).

> *That's been one of my mantras – focus and simplicity. Simple can be harder than complex. You have to work hard to get your thinking clean to make it simple. But it's worth it in the end because once you get there, you can move mountains.*
>
> *Steve Jobs, American Business Magnate*

AFFORDANCES CONFERRED TO PKMS COMMUNITY MEMBERS AND STAKEHOLDERS

We envisage KMSs to be at the center of a Digital Platform Ecosystem (DPE) serving a diverse community in respect to skills and experiences, contexts and means, ambitions and ends (figure 1). Aligned to the six levels of utility presented in the previous sub-section, these affordances include:

1. *Effective Digital Technologies*: The provision of affordable autonomous decentralized 'grass-roots' PKMS digital devices for personal knowledge management and retention, of interconnectivity for creative conversations and cooperative work, of centralized cloud-based storage and curation services for access to the voluntarily shared community's content repositories.
2. *Shielded Extelligence*: The confidence that one's personal digitized knowledge stays always in the possession and at the personal disposal of its owner or eligible co-worker independent of changes in one's social, educational, professional or technological environment. Moving from one project or responsibility to another embodies one's actualized PKMS device and finally renders the notion of knowledge and skills as mobile and portable a reality for individuals.
3. *Productive Collaboration*: The universality of the standardized, consistent, transparent, flexible, secure and non-redundant formatting of digitized information structures for easing authoring, retrieval, expansion, sharing, pooling, re-use, or migration (based on meme-based repositories instead of document-centric knowledge bases to be referred later).
4. *Systemic Development*: The coherency and plausibility of the PKMS concept and design for allowing transparent interventions and systematic informing options and for lowering any entry barriers regarding participating in and contributing to the community.
5. *Professional Relevance*: The across-the-board applicability for continuous life-cycle support from trainee, student, novice, or mentee to professional, expert, coach or leader independent of space (e.g. developed/developing countries), time (e.g. study or career phase), discipline or economic sector (e.g. science, academia, industry, entrepreneurs, or public service).
6. *Co-evolutionary Synergies*: Shared KM concepts and methodologies, common interest in the world record and in staying current and resilient present strong incentives for fruitfully co-evolving organizational and personal KMS. Motivating knowledge workers by serving their PKMS self-interests also raises the acceptance of institutional KM objectives as well as organizational capabilities of purposefully creating, extending, or modifying its absorptive capacity[6] and resource base[7]. Similar synergies also exist between PKMS and Learning Management Systems (LMS).

[6] *Absorptive Capacity* has been defined as the "ability to recognize the value of new information, assimilate it, and apply it to commercial ends" (Cohen & Levinthal, 1990).

[7] *Resource Base*, in the context of this article, includes tacit (attitude and leadership), explicit (knowledge bases, rules and strategies), and encapsulated knowledge (products and services) as well as its wider ecosystem (involvement with the community).

Table 3. Tabular Recapitulation of Key Notions, Contributions, and Sources: *Affordances and Education*.

Primary Emphasis on: Affordances, Education	Key Models & Notions Integrated	Key PKMS Contributions	Sources & PKMS Output
Information Entropy Digital Threats & Interventions	SVIDT-Framework; Negentropy & Syntropy	Cohesive rationalization of current KMS's neglect of personal, generative, & negentropic needs with consequences & remedies.	(Scholz, 2017; Schmitt, 2018b; Schmitt & Gill, 2020)
Higher Education (HE)	Qualification Frameworks; Bloom's Taxonomy; Academic Value Chain	Making the Case for revising HE Program & Services Portfolios and Commitments via PKMSs.	(Blass & Hayward, 2014; Schmitt & Butchart, 2014)
e-Learning & e-Skills	Digital Scholarship & Curation	PKM for Learning Framework (PKM4L-in-progress) to promote non-linear e-Learning approach as a spin-off of novel PKMS concept.	(Schmitt, 2015b, 2015c, 2014a)
Learning Management Systems (LMS) & Learning Assets	Smart Education Concepts; Interoperability		(Schmitt, 2016c; Schmitt & Saadé, 2017; Schmitt, 2019c)

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> *Making the simple complicated is commonplace; making the complicated simple, awesomely simple, that's creativity.*
>
> *Charles Mingus, American Jazz Pianist*

Enabling Technologies and Generative Knowledge Bases

We envisage, as briefly alluded to, a paradigm shift from today's document-centric 'book-age' storage tradition to *meme*[8]*-based 'digital-age' repositories*. By digitally embedding and reusing parts of digital documents via structural references, the meme-based approach abandons 'book-age' copy-and-paste digital document creation practices and the underlying knowledge heritage model which generates unsustainable attention-and-resource-consuming entropy (e.g. replication, fragmentation, inconsistency, untraceability, corruption, decay, obsolescence, or falsification) at an accelerating scale.

PKMS community members are, accordingly, guided in digitally capturing, creating, modifying, classifying, combining, and accessing textual and visual memes and their relationships to be stored in personal and – if voluntarily shared - centralized repositories. The associatively interlinked content comprises subject matter (e.g., parts of this paragraph, citations, or visuals), aboutness (e.g., article review, wordcount, or author's profile), structural connections (e.g., links between authors, papers, publishers, and references), intent (e.g., tasks to do), and monitoring (e.g., schedules, to-do-lists, progress made).

[8] *Memes* present a scheme of (atomic) cognitive information-structures that evolve over time through a Darwinian process of variation, selection and transmission. By employing the metaphor of living organisms, they self-replicate utilizing mental storage in human hosts by influencing their hosts' behavior to promote further replication. Memes are virtual, and have no intentions of their own, they are merely pieces of information in a feedback loop which are encoded in vehicles for transmission between human hosts; this loop facilitates their continued replication as mental copies with their longevity being determined by their environ-ment (Dawkins, 1976; Bjarneskans et al., 1999; Collis, 2003).

Table 4. Tabular Recapitulation of Key Notions, Contributions, and Sources: *Undesired Entropy Clusters*.

Primary Emphasis on: Entropy Clusters	Key Models & Notions Integrated	Key PKMS Contributions	Sources & PKMS Output
Public Knowledge Discoverable	Information Entropy[9], Copy-&-Paste Redundancy, Traceability	- Information Overload, - Attention Poverty, + Compromised Mobility	(Bush, 1945; Simon, 1971; Pinheiro, 2004; Schmitt, 2020a)
Public Knowledge Undiscoverable	Structural Holes, Islands and Siloes[10]	- Opportunity Divides + Effective Utilization, + Awareness & Education,	(Burt, 2004; Levy, 2011; Giebel, 2013; Szostak et al., 2016; Schmitt, 2020a)
Private Knowledge Undiscoverable	Invisible Work, Unreported Scaffolding[11]	- Unproductive Rework, + Holistic Understandings	(Bush, 1945; Star, 2010; Schmitt, 2020a)
Private Knowledge Discoverable	Generative Potential, Online and Publishing Realities[12], Non-Linear Relationships	+ Iterative Improvement + Innovativeness + Reputation Systems	(Bush, 1945; Mintzberg, 2005; Nielsen, 2012; Bratianu, 2019; Schmitt, 2019b)

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> *Everything should be made as simple as possible, but not simpler.*
>
> *Albert Einstein, Theoretical Physicist*

Due to the PKMS's standardized memetic format, content is stored in a flat-file WHOMER-repository (World Heritage of MEmes Repository (figure 1)) allowing for scaling by enabling the use of noSQL technologies. Curation services merge identical memes (reducing entropy), conserve and consolidate their bi-directional relationships (enriching traceability) and assure self-referential associative integrity (emulating as-built-genealogies[13]). Accordingly, we expect to overcome the inherent shortcomings of the 'book-age' paradigm resulting in reducing negative (-) effects and encouraging positive (+) advances (Table 4).

[9] The complexity of navigating and utilizing the *mounting explicit accumulated world record* is accelerating and is overwhelming traditional top-down KM approaches (developed in a time of information scarcity). Advice to prevent today's shortcomings were voiced but ignored, for example, Bush suggesting associative indexing to build the 'Memex' (Bush, 1945) or Simon calling to extract the redundancy and to exploit the patterns of the world record ensuring that considerable less needs to be read, written, and stored (Simon, 1971).

[10] *Structural Holes* refer to unrecorded, potentially beneficial ties between knowledge clusters resulting in disconnected undiscoverable public knowledge (islands and silos) inhibiting, especially, the tackling of 'wicked' transdisciplinary spaces (Burt, 2004; Szostak et al., 2016).

[11] *Reviewing and publishing practices* currently prevent the sharing of "magnitudes of invisible work" (defined as the "gap between formal representations, including publications, and unreported 'back stage' work" (Star, 2010) also referred to as "scaffolding" (Bush, 1945). As undiscoverable private content knowledge, others are forced to re-spend the energy and to start over.

[12] *On-line publishing realities* currently inhibit engaging in a wider sharing, faster diffusion, and more rapid iterative improvement of ideas, sources, data, work-in-progress, preprints, and/or code (Nielsen, 2012).

[13] *As-built-genealogies* form already the heart of modern manufacturing systems which define and trace the technical interrelatedness of discrete parts, ingredients, and labor with their intermediate and final products, services, and/or utilizations (Pinheiro, 2004)).

PKMS-DPE as Scalable General-Purpose Technology

Table 5. Tabular Recapitulation of Key Notions, Contributions, and Sources: *Knowledge Creation & Management*

Primary Emphasis on: Knowledge Creation	Key Models & Notions Integrated	Key PKMS Contributions	Sources & PKMS Output
PKM versus Traditional Dynamic Knowledge Creation Models	Nonaka's SECI Model & Ba; Pirolli's Sensemaking Model; Boisot's 3D-Information Space; and others	PKM for Action Framework (PKM4E) as a three-dimensional dynamic 'public-transport-like' map holistically portraying complementing KM workflows.	(Popper, 1978; Nonaka et al., 2000; Boisot, 2004; Pirolli & Card, 2005; Wierzbicki & Nakamori, 2007; Schmitt, 2017b, 2019a)
PKMS-OKMS-Co-evolution; Individual & Institutional Absorptive Capacities; Entrepreneurship	KM System Generations; Earl's Schools of KM; Wiig's Nano-Contributions; Growth-Stage Models; Dynamic State Matrix	PKM for Management Framework (PKM4M) for integrating the PKMS with Earl's seven Schools and operative ERM Systems.	(Garnsey, 1998; Earl, 2001; Pollard, 2008; Levie & Lichtenstein, 2009; Pasher & Ronen, 2011; Wiig, 2011; Schmitt, 2015a, 2016d, 2018c)
Heritage Knowledge & Generativity; Knowledge Assets & Intellectual, Social, & Emotional Capital; Scaling	Memex & Associative Indexing; Decentralizing KM Revolution; Reinventing Discovery; C-K-Design Theory; Culinary Knowledge Heritage; Scaling Innovation	Development of a PKMS prototype based on rapid development platform, cloud-based no-SQL database, and networked decentralized personal PKMS devices.	(Bush, 1945; Erikson, 1950; Bush, 1991; Gratton, 2011; Levy, 2011; Nielsen, 2012; Eck, 2018; Carvajal-Pérez et al., 2018; Schmitt & Gill, 2019; Schmitt, 2019b, 2020b)
Disruptive Innovation & Sustainability Vision* ** currently under review*	General-Purpose Technologies GPT; Desirable Sustainability Vision; Development & Visioneering	PKM for Innovation Framework (PKM4I) fusing GPT & Vision Criteria to project PKMS potential in marketplace.	(Garon, 2011; Cantner & Vannuccini, 2012; Wiek & Iwaniec, 2014; Kaiser, 2017; Schmitt, 2019d)

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> *If you want to find new ways, and everything seems barred, take things deemed very simple, and make them very smart.*
>
> *Adapted from one of my former professors, Exkart Zwicker, TU Berlin*

We, consequently, envision the transformation of Popper's abstract, intangible, inaccessible World Three[14] into a steadily growing (expanding community sharing existent and novel content), single

[14] *Popper* applied his three-world-metaphor to depict knowledge creation flows between the physical *world:1* (concrete related knowledge objects and effects) and the human minds' *world:2* (subjective 'mental thought' knowledge objects). He introduced *world:3* (abstract objective 'explicit thought' knowledge objects) to serve his conviction that thoughts—in or-der to be shared or critiqued—need to be explicated, so that the formulated content stands objectively on its own (independent of its creators and able to be judged on its own merit). As a mere philosophical construct, Popperian *world:3* content still needs to be resourcefully combined and physically encapsulated (or encoded) in concrete physical objects to transform the concrete *world:1* environment (or other *world:2* minds) in order to activate its generative potential (Popper, 1978).

(cloud-based), unified (transdisciplinary), negentropic (redundancy-eliminating), concrete, tangible, accessible, and interrogatable archive of an up-to-date knowledge heritage.

DISCUSSION & CONCLUSIONS

Facilitating fruitful knowledge sharing to gainfully utilize digital dividends, as alluded to, does not depend on technological means alone but on a range of affordances which are currently sadly missing. Accommodated by a series of prior publications supporting an ongoing design-science-research and KMS-prototyping-project, this article has presented the back-casting vision of a novel decentralized, generative, negentropic KM concept. It substantially departs from conventional centralized institutional KM solutions by strengthening individuals' developmental and collaborative means.

As 'digital-age' knowledge workers with their distinct contexts and ambitions are not only striving to develop unique artefacts (knowledge assets) but are also inclined to voluntarily and freely reveal them to others to use, a new culture of open access and open science is taking hold. A growing PKMS community can significantly add to such a 'thrivable' culture through *actionable transparency*. While "the emerging artefacts can be easily understood (are *transparent*) by other contributors and allow real-time iteration due to rapid generate-test cycles[15] (are *actionable*)", users are growing in sophistication, and innovation "starts to be dispersed among many creative and entrepreneurial individuals" enabled by opportunities to provide incremental as well as radical advances (Roszkowska-Menkes, 2017).

These outcomes also benefit institutional interests and offer synergies for a fruitful co-evolution between the novel PKMS and conventional organizational KMS. As a structural confirmatory factor analysis model has shown, knowledge sharing excels with higher job satisfaction (depending on an enabling collaborative culture) which, in turn, promotes knowledge distribution, with, both, becoming strong mediators between facets of organizational culture and institutional performances (Kucharska & Bedford, 2019). Empirical proof also confirms that a collaborative culture forms a mutually beneficially strong bond with trust (Kucharska, 2017).

Both, a compelling culture and thriving trust, are also vital for successfully growing a PKMS community. However, *trust* (defined as a "bet about the future contingent actions of others" (Sztompka, 2019) "cannot be afforded directly but has to be earned by acquiring a reputation of, for example, expertise, professionalism, reliability," or high-quality services/content supplied which may all be within the reach of the envisioned PKMS-DPE affordances (Schmitt, 2017a). This position paper's early draft of a back-casting vision with its 'thrivability' context aims to initiate a suitable informing strategy to address a wider audience as well as to steadily build the vital trust which may come with it. The key aim of the curated repository adds to this endeavor by "providing the PKMS community with non-redundant multi-and-trans-disciplinary memes and knowledge assets which can be trusted and can be traced and accessed through the captured and shared path trajectories just like components, ingredients, or batches in modern manufacturing enterprise resource systems" (Schmitt, 2018c).

Currently, many are not even aware of the dire and unsustainable extent to which knowledge workers and societies are missing out on the full potential of the digital revolution by suffering from lock-in

[15] Rapid generate-test cycles in the PKMS context mean that any user-authored meme/content voluntarily shared with the PKMS community afford other members the opportunity to annotate, redeploy, reclassify, or revise it while any new links or versions created in this process feed back to the original author/modifier (assured by the PKMS's central curation services of their associative integrity). Termed 'creative conversations' (Levy, 2011), these functionality allows for rapid iterative improvement among peers based on the interlinked PKMS-managed memeplex versions.

effects, self-centered business interests, and solutions providing objectionable cost-benefits to individuals, entrepreneurs, and employers. Initially faced with these kinds of 'emerging complexities[16]', the DSR knowledge base and multi-disciplinary publications have been progressing on cumulatively synthesizing over 600 referenced external sources (as of October 2020). The approach allows for verifying new conceptual or design elements comprehensively, since any effective change process needs to holistically consider its potential interdependencies[17].

The five tables complementing the interrelated vision narratives exemplify some of these peer-reviewed prior publications with some of their integrated notions and cited primary sources. They are presented in eighteen distinct key clusters to support the higher-level vision-related assertions made with access to further detail, evidence, and ample visualizations:

- Table 1 focusses on the methodologies applied covering design science research, informing science, systems thinking, and knowledge evolution. It also references the efforts made to transform the progressing six levels referred to into a PKMS meta-framework of digital ecosystems interlinked with Popper's three Worlds and Nonaka's SECI & Ba Model.
- Table 2 digs deeper into issues affecting knowledge workers and knowledge societies, including capacity-and-community-building, sustainable development, and key challenges. It also relates the PKMS ecosystems and SICEE model to Maslow's Extended Hierarchy of Needs.
- Table 3 describes sustainability-related efforts to re-purpose the publications and multiple visualized frameworks (already captured in their meme-based representations in the PKMS) to become learning assets (to exemplify opportunities for other content). It builds upon synergies with established learning management systems and proposes extensions to facilitate non-linear learning and novel ways of extelligence transfer and retention.
- Table 4 summarizes the entropy-and-generativity-related key rationales of the PKMS.
- Table 5 emphasizes the huge synergetic potential between traditional organizational KM and the personal KM concept and system in terms of, for example, human capital and organizational learning differentiations, heritage and innovation management, for example: the complementing workflows and prospects of twelve renowned dynamic knowledge creation models with the PKMS have also been mapped in a 'public transport-like' three-dimensional map; and the envisaged impact has been evaluated against sets of disruptive-innovation-criteria which demonstrates the PKMS's potential to become a general-purpose-technology.

Since the envisaged PKMS is still in its prototype-development stage, further empirical testing is necessary. Further research is in progress to determine how the PKMS concept compares to, can make use of and add to the advancing semantic web and AI technologies; this includes verifying the PKMS potential to generate ontologies and RDF-statements (resource description framework for knowledge modeling) straight from its content and relations repository. Publications are also planned to consider how the memetic PKMS storage compares to traditional document-centric approaches (e.g., Google Scholar, ResearchGate) and what kind of complementing, mutually beneficial synergies exist with current software and social platform or service-oriented computing providers, for example:

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[16] *Emerging Complexity* describes states where "the solution to a problem is unknown, the problem statement itself is still unfolding, and the key stakeholders are not yet identified" (Kaiser et al., 2013).

[17] *Isolated changes* - as a KM Framework Cluster Analysis (Heisig, 2009) and the Change-Equilibrium Model (Leavitt, 1962) suggest – are likely to affect more than just one of four clusters (*technologies*: artefacts including storage devices; *human factors*: people, culture, leadership; *organizational aspects*: structures & processes; *tasks and management*: operations and controlling).

- The use of as-build-genealogies for authoring (but with resources not being depleted with use) correlates with the logics and logistics of Enterprise Resource and Supply Chain Management Systems.
- The storing, tracing, and repurposing of granular limited-size memes would fit well with Twitter functionalities.
- The more granular and transdisciplinary meme-to-meme traceabilities would greatly enhance reference management software and services (e.g. Google Scholar or ResearchGate) to save users precious time and efforts.
- The content stored in Google Books could be effectively used to validate the content, source, and location of memes uploaded by the PKMS community.
- Facebook users used to contribute content and chatter as social capital may appreciate to channel their energies (analogue to citizen science endeavors) into contributing to their own and others' heritage and novel knowledge.
- The professional world of Microsoft's LinkedIn would likewise profit but with the added community-related value of benefitting from and serving fellow knowledge workers representing diverse sets of gifts, contexts, means, and ends.
- LMSs and eLearning Portals offering traditional linear courses would profit from more flexible and exciting non-linear options where meme-based learning assets can be reused in other courses or transferred into the PKMS devices of participants or alumni for knowledge as well as customer retention.

This KM-related position paper has followed up on a typical Design Science Research project with multiple diverse milestones and publications along longitudinal streams of research with continually evolving design concepts and artefacts. It has applied the logic of a back-casting vision to frame prior findings and prospective work in a novel way in order to provide a comprehensive but concise overview to rationalize the need for a new generation of decentralized knowledge management systems. Developing knowledge by cumulative synthesis and by assessing the role of artefacts matters but also suffers from a lack of respective academic publications in the DSR as well as the KM domain[18]. This and the prior PKMS-related articles contribute to these underrepresented fields and to a research tradition of cumulative knowledge development. They aim is to inform designers and knowledge workers alike as well as to share the envisaged PKMS prospects with a wider critical mass of stakeholders as a prerequisite for creating the respective decentralized, more generative digital knowledge management reality.

[18] An exploratory study focusing on Information Science (IS) and design theories refers to the lack of similar research and is also alarmed about the paucity of follow-up research that test or extend the IS design theories investigated which prevents the further evolution of the DSR field within and beyond the IS discipline (Schuster et al., 2018). An assessment of the role of KM artifacts (1997-2015) found that empirical works outnumbered conceptual contributions by two to one and, similarly, lacked cumulativeness and consistency in current KM debates (Mariano & Awazu, 2016).

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