Systems Dynamics and Activity-Based Modeling to Blueprint Generative Knowledge Management Systems

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***Abstract*—The predicted embracing of thriving knowledge societies is increasingly compromised by threatening perceptions of information overload and attention poverty, opportunity divides and career uncertainties. By integrating system dynamics, discrete-event, and agent-based modeling, this paper traces the roots of these symptoms back to their causes of information entropy and structural holes, invisible private and undiscoverable public knowledge which together characterize the sad state of our current knowledge management (KM) and creation practices. Looking forward, it proposes a decentralized generative KM approach that prioritizes the capacity development of autonomous individual knowledge workers not at the expense but as a viable means to foster a fruitful co-evolution with traditional organizational KM systems. As part of an ongoing design science research and prototyping project, this systems thinking and hybrid model perspective complements a succession of prior multidisciplinary publications on the subject.**

***Index Terms*—Hybrid modelling, knowledge management, personal knowledge management, systems thinking.**

I. Systems Thinking versus Knowledge Management

A novel *Knowledge Management* (KM) perspective follows a decentralizing agenda benefiting knowledge workers. To foster a fruitful co-evolution with traditional organizational KM approaches, KM's renowned *SECI model* (socialize, externalize, combine, internalize) [1] is repurposed and extended to suggest a corresponding complementing SICEE cycle (seize, imbed, collate, encompass, effectuate) embedded in distinct digital ecosystems fully aligned to the notions of generative fit and capacities. The integration of the well-established psycho-social notions of generativity in their technical, informational, and social interpretations have proven well-suited to pursue holistic systemic interventions for confronting opportunity divides "by affording individuals the means for life-long-learning, resourcefulness, creative authorship and teamwork and by supporting their generative role as contributor to and beneficiary of organizational and societal performances" [2] (p.13).

As a *Design Science Research* (DSR) undertaking aiming for a *Personal KM System* (PKMS), the system development and prototyping process aims to comply to the DSR notion of *Theory Effectiveness*, a principle expecting system designs to be incrementally and iteratively designed in order to be purposeful in terms of their utility (largely a matter of content) and their communication (largely a question of presentation) to an audience [3], [4].

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Accordingly, relevant methodologies and practices have been applied in prior publications for continuous thorough design evaluation and knowledge dissemination. This paper aspires to further test the PKMS's utility and theory effectiveness by employing *Systems Thinking* (ST) with its visualization and modeling methodologies to divulge wanting 'as-is' states in favor of sounder 'to-be' scenarios.

As "applied management transdisciplines", *Critical Systems Thinking* (CST) and *KM* are, on the one hand, both "exploring the relationship between theory and practice across the range of managerial concerns [4] centrally concerned with individual and organizational learning", opening-up a rich host of potential synergies. On the other hand, KM has been critiqued (from a CST perspective) as "theoretically impoverished and practically inhibited" due to concerns about its narrowness of underpinning models, its inadequate provision of facilitating tools, its ineffective treatment of complexity, change, conflict, and contradictions, and its insufficient muscle to produce 'systemic individuals' and 'dialectical beings' [5] (p.188, 190-191).

Many of these aspects were touched upon in considerable detail in prior multi-disciplinary publications with over five hundred external references. However, they are also evident in this article whose emphasis is on exploiting the ST's modeling advantages (incl. *System Dynamics Modeling* (SDM), *Agent-Based Modeling* (ABM), and *Discrete-Event and Process-Resource Modelling* (DEM/PRM)) with their idealized representations of key states, objects, and events allowing for presenting the PKMS artefact in the transparent anticipated reality of its most vital features [6] (p.13).

While these modeling types "have traditionally been viewed as mutually exclusive alternatives" prior to 2010 [7], they have - in the meantime - also been increasingly employed in *Hybrid Simulations* (HS) approaches (incl. technology, and innovations, health sector management, construction/infrastructure projects, societal impacts, supply chain and transportation studies) for yielding insights and breakthroughs in support of not only smarter decision making but also of smarter model building and utilization [7] (p.7-9).

To take advantage of these benefits, the objective is to employ HSs for advancing the PKMS/CST theory effectiveness and for exemplifying KM/CST synergies in general. The emphasis, hence, will be shifting from the causal relationships and interactions between the components of the wider *KM System* (KMS) and knowledge economy (section 2: SDM), to the complexities arising from the social dealings of institutional actors and individual knowledge workers (3: ABM), and to the bottleneck and performance risks/potentials associated with suitable, feasible, and acceptable opportunities for change and reengineering (4: DEM/PRM).

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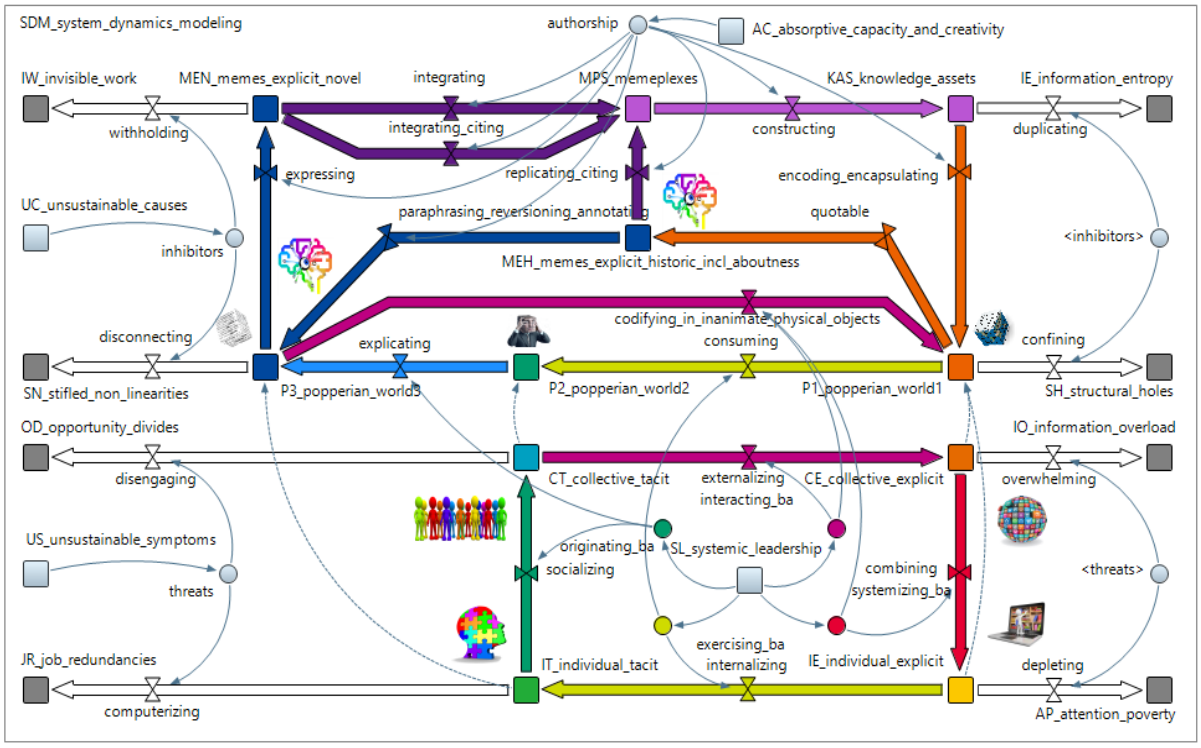

Fig. 1. Nonaka's SECI & Ba model (bottom) and popper's worlds (middle) as SDM Base to analyze 'externalizing' process details (top).

Whereas the HS model to be introduced excludes quantitative simulations (due to the more spontaneous creative nature of knowledge creation), it, nevertheless, demonstrates its applicability in the KM's 'wicked' problem space, characterized as ill-defined, incomplete, contradictory, and by changing requirements and complex interdependencies, where the information needed to understand the challenges depends upon one's idea or concept for solving them [8].

The software tool used (for Fig.1 to 3c) is *AnyLogic* which has been purposely designed to develop practical HS models and has, hence, been a dominant tool applied by models introduced in academic papers [9].

II. System Dynamics and Causes of PKMS Concerns

A. SECI Model, Popper's Three Worlds, and Memes

As an extension to the SECI model's KM-horizon, prior papers have adopted Popper's Three Worlds [4], [10] as a meta-concept for the novel generative KMS design. Fig.1 shows the worlds' integration with the related SECI stocks and flows [to be referenced in square brackets].

As a notion preceding the SECI model, Popper's physical *world:1* [P1] of real concrete objects (plus relations and effects) incorporates the SECI model's explicit collective/individual knowledge types [CE/IE], and his human minds' *world:2* [P2] with its subjective personal knowledge objects of mental thought processes covering the two tacit knowledge types [CT/IT]. Emphasizing his view that the minds' products need to be formulated before they can be shared and criticized, Popper introduced the thoughts' *world:3* [P3] with its abstract objective knowledge objects. As explicated content, any thought stands objectively on its own (judgeable on its own merit) and may be resourcefully combined (independent of its creator) with other content before being physically encoded or encapsulated in concrete physical *world:1* [P1] objects to become accessible and to elicit impact (Fig.1 middle section) [10].

Instead of the current document-centric KM and storage paradigm, the PKMS concept uses memes as more granular basic building blocks whose associative relationships are set and recorded during authoring processes to create higher level memeplexes or documents.

Memes were originally described by Dawkins [11] as units of cultural transmission or imitation (e.g. ideas, tunes, catch-phrases, skills, technologies). They are (cognitive) replicating information-structures that - analogous to genes – evolve over time through a Darwinian process of variation, selection and transmission with their longevity being determined by their environment. As a metaphor of 'living organisms' (as promoted by Memetics), they afford a useful conceptual scheme for knowledge and ideas whose survival depends on enduring in their medium of occupation and on the endurance of the medium itself.

To add detail to the SECI's [externalizing] flow, *world:3* [P3] integrates a small-big-theories-knowledge-scheme [3], [12] which particularizes the meme transformation process between tacit and explicit (collective) knowledge [CT-CE] and between *world:2* and *world:1* [P2-P1] (fig.1 top section).

B. Transforming Memes in the Popperian Third World

An individual cumulatively synthesizes and [expresses] his/her memes and ideas with his/her learnt knowledge over time [13] which occupy - once explicated – a personal virtual slice [MEN] of the abstract *world:3* [P3] only accessible and interrogatable via the individual's own memories or cues.

Whenever an already explicated and accessible meme from historic content [MEH] is paraphrased, re-versioned, or annotated (or an original idea is expressed), a novel meme is created [MEN]. In contrast to the latter, scholarly practice requires citing the original source of the former. Authors integrate both types together with quoting and citing explicit

memes directly [MEH] from their physical container (e.g. document, file, web page) into increasingly complex (but foremost linear) memeplexes [MPS] or knowledge assets [KAS] (defined as "nonphysical claims to future value or benefits" [14] (p.335). The output, once shared or published, adds to Popper's *world:1* [P1] with its collective explicit knowledge.

Rather than focusing on today's negative effects mentioned in the abstract (overload [IO], poverty [AP], divides [OD], and job losses due to technological progress [JR]), the extended model allows the pinpointing of some of the underlying causes:

- Digital authoring still compels us to provide linear accounts of knowable nonlinear realities and contexts [SN] preventing the effective sharing of knowledge already understood in holistic transdisciplinary ways (undiscoverable private knowledge).
- Current reviewing and publishing practices prevent the sharing of "magnitudes of invisible work" (as gaps between formal representations and unreported 'back stage' work [15] (p.606-607) termed by Bush [16] as the "scaffolding" of research output (undiscoverable private knowledge) [IW].
- The "modelling of digital documents as monolithic blocks of linear content [is] unnecessarily replicating content via copy and paste operations, instead of digitally embedding and reusing parts of digital documents via structural references" [17] (p.391) contributing progressively to the information entropy experienced as abundance or overload (entropic discoverable public knowledge) [IE].
- The share of growing non-redundant explicit knowledge suffers from proliferating and expanding "structural holes" [18], referring to the potentially beneficial but unrecorded ties between knowledge clusters (e.g. approaches, specializations, or disciplines). The lack of connectivity bolsters knowledge islands and silos (undiscoverable public knowledge) [SH].

The consequences are dire by inhibiting methodological interdisciplinary approaches, by threatening the finite attention individuals' cognitive capabilities are able to master, or by forcing others to re-spend energies to start over. Current online realities ([OR] excluded in fig.1) add to the woes by inhibiting engagement in a wider sharing, faster diffusion, and more rapid iterative improvement of ideas, sources, data, work-in-progress, preprints, and/or code [19].

'Extelligence' has been termed as the externally stored counterpart to the intelligence of the human brain/mind tasked with understanding (driving each other in a complicit process of accelerating interactive co-evolution). Deficient awareness and education as well as inadequate tools, however, amplifies the ineffective utilization [IU] of the world's accumulated world record. As pointed out by Stewart and Cohen [20]: Extelligence only generates competitive advantage if it is accessible and augmentable by individuals who know how.

III. Agent-Based Modeling and PKMS

While SDM (Fig.1) has exploited the method's capacity to study its continuous aggregated processes and properties by transparently targeting and mapping the underlying causes (rather than just their effects), the dynamics encountered suggest following up with an ABM approach in order to allow for taking account of the decentralized micro-level (re-)actions of diverse related entities engaged over time in discrete events as well as potentially resulting emerging macro-level outcomes and macro-micro feedbacks [7].

Possible model architectures for hybrid SDM-ABM have been classified as sequential (outcome of each module forms input for the next module), interfaced (independent non-sequential modules contributed to a combined outcome), and integrated (modules and outcomes provide feedback to each other) [7] (p.7).

In following the latter, Fig. 2 reconfigures Nonaka's and Popper's notions (fig.1) within a regular decagon (ten-sided polygon) where each side aligns to one of ten pentagons representing digital ecosystems (forming an iterative cycle depicted as a color-wheel). While each of the four SDM-stocks/flows correlate to four ABM-nodes/paths (nodes depicted as dotted-line-pentagon, paths as conveyors), a further node and path is added to complement the SECI/Ba spiral with Popper's *world:3*. Additional paths (depicted as roads) are linking some of the ecosystems to nodes residing outside the novel iterative cycle which account for external (re-)sources (Institutional/Organizational KMS, Learning Management Systems (LMS), 'Shoebox' (to temporarily store external information prior to further processing), and field/desk-research (to search/collect information from real world environments). The process-resource-modeling in the next section presents further detail. But, first, a further correlated knowledge creation model needs to be addressed.

A. Sensemaking Loop for Intelligence Analysis

The Notional Model of the Sensemaking Loop for Intelligence Analysis [21] correlates with the following components of the novel generative KM concept (fig.2):

External data sources [Knowledge K0] are identified, verified, contacted, and evaluated [Action A0] according to (initial or subsequently adapted) information needs [Task T2] and interrogated during field and desk research. The data collected is filtered for relevance [A1] and temporarily stored in a shoebox or case file [K3] for further screening, reading, sorting, and extraction [A4].

Experiences gained allows for re-assessing and revising related sources and content [T5] and for adjusting evidence [K6] or support requirements [T8] in order to continually improve the value of information subsets passed on from the shoebox [K3] to the evidence or memes file [K6] and, after schematizing (e.g. classifying, contextualizing, interpreting, annotating, summarizing, or formatting) [A7] to the topics/schema or memeplexes file [K9]. Once sufficient content is available, the analyst/author may start building his/her case [A10] which may need some support [T11] but, if finalized after some potential re-evaluation [T14], results in, for example, presentations, conclusions, new meanings and/or knowledge assets [K12] which may be shared or published [A13].

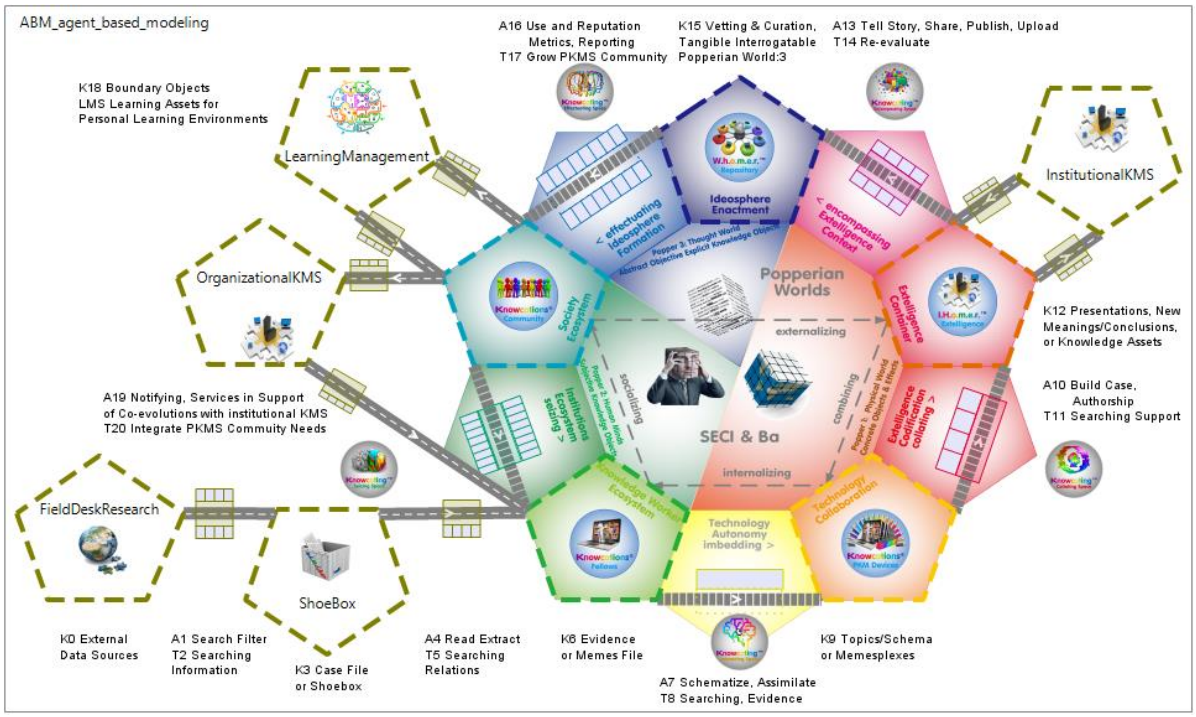

Fig. 2. Integrating SDM (SECI/Ba & Popperian worlds) with novel generative KMS design and supporting digital ecosystem.

Pirolli and Card [21] present their cognitive-task-related model as an integrated foraging loop (KATs 0-7) and sensemaking loop (KATs8-14) to be controlled by a reality/policy loop. It correlates – as indicated by the numbered legends – only partially to the ecosystems (six out of ten). The remaining (labeled KATs15-20) apply strictly to the novel design to be covered in the next section.

The foraging and sensemaking loops extend the SDM perspective of the SECI's 'externalizing' flow (Fig.1 top). As collections of explicated data, information, and knowledge objects are differing in origin and format, they are progressing along a value chain in relevance, cohesion, and purpose. They present the agent (analyst/author) as a resource who may also have further resources/tools at his/her disposal. As the work/actions performed agree with the SDM's practices, all symptoms/causes alluded to (Fig. 1) also apply.

B. Process-Resource Perspective Supporting ABM Approach

Guided by the ten digital ecosystems forming the iterative cycle (Fig. 2), the perspectives and opportunities presented in this Process-Resource Modeling (PRM) section differ. The agent role is shifting to a single meme or to their interconnected collections (memeplexes). As memes share a common digital structure and their relations are either integrated in it or represented by other discrete memes (self-referential), the format (as compared to the sensemaking model) is standardized, and an actor at any stage in the progressing value chain (meme, memeplex, knowledge or learning asset, tangible Popperian *world:3* database) represents a unique subset of the accumulated flat-file knowledge repository.

The PRM description starts at the bottom-left pentagon of the iterative cycle [K6] termed knowledge worker ecosystem. In the SECI model, it stocks individual tacit knowledge which then need to be socialized in the first step/flow of the (socializing-externalizing-combining-internalizing) spiral in the clockwise direction depicted (fig.2). The novel concept reverses this order in the anti-clockwise SICE(E) sequence displayed with (E) being the added flow/path prompted by the *world:3* extension. To emphasize the inherent synergies of this integration, the SICEE acronym has been kept but – due to the different nature of the activities - with modified semantics: seizing [Path A19], imbedding [A7], collating [A10], encompassing [A13], and effectuating [A16]).

Synergies also extend to the affordances of the metaphor (memes as living organisms) in communicating the parallel but reverse SECI flow descriptions: For survival, memes "either need to be encoded in inanimate durable *world:1* vectors (such as buildings, machines, products, software, storage devices, books, great art, or major myths) spreading at times unchanged for millennia, or to succeed in competing for a living host's *world:2* attention span (such as people, teams, corporations, or economies) to be [subjectively and tacitly] memorized (internalization) until forgotten, codified (externalization) in further [concrete] *world:1* objects [(via objective abstract *world:3* objects)] or spread by the spoken word to other hosts' *world:2* brains (socialization) with the potential to mutate into new variants or form symbiotic relationships (combination) with other memes (memeplexes) to mutually support each other's fitness and to replicate together" [2].

IV. Discrete-Event and Process-Resource Modelling

The following PRM charts (Fig. 3a: knowledge capturing, 3b: decentralized devices, and 3c: centralized repository and curation) present a more detailed break-down of the higher-level SICEE states (Fig. 1, 2) with the iterative value chain cycle shown as a sequence of three subsections and a set of icons.

The icons' and connectors' formats adhere to AnyLogic's specification and process modeling library [23] (pp. 139-141). They are labelled by up-to-four-part-acronyms (see Table I).

TABLE I: LEGEND USED FOR THE DESCRIPTORS IN FIG.1 TO 5

Part	Legend
1	Capital letter refers to type, e.g. Action, Meme, Task, Value-added-proposition, or (in case of a Resource) Curation-protocols, Device, Person;
2	Correlating to the numbering (0-20) of the extended foraging/sensemaking loop (fig.2);
3	Qualifying small letter; for As: author, bond, capture, deconstruct, fitting, ignore, join, merge, privatize, remove, select; for Ms: fused, globalized, in, localized, kept, merged, out, revised, shared, updated, vetted; for Rs: back-feed, forward-feed, revise; for Ts: release, seize; for Vs: boundary, lms-modules, metrics, notifying, organizational-kms, reporting;
4	Capital letter indicating relevant object: Device, Shoebox, Task, World Heritage Of Memes Repository (WHOMER).

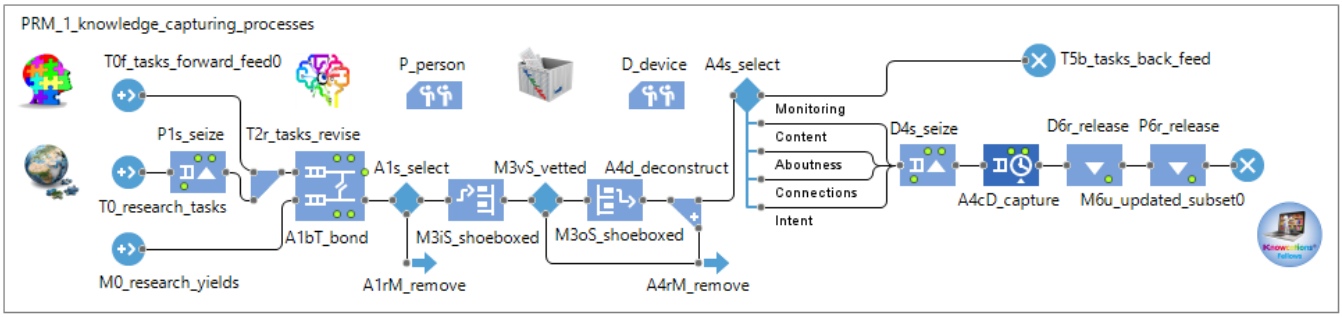

Fig. 3a. Detailing the ABM/PRM perspective of the knowledge capturing processes (with memes representing the agent).

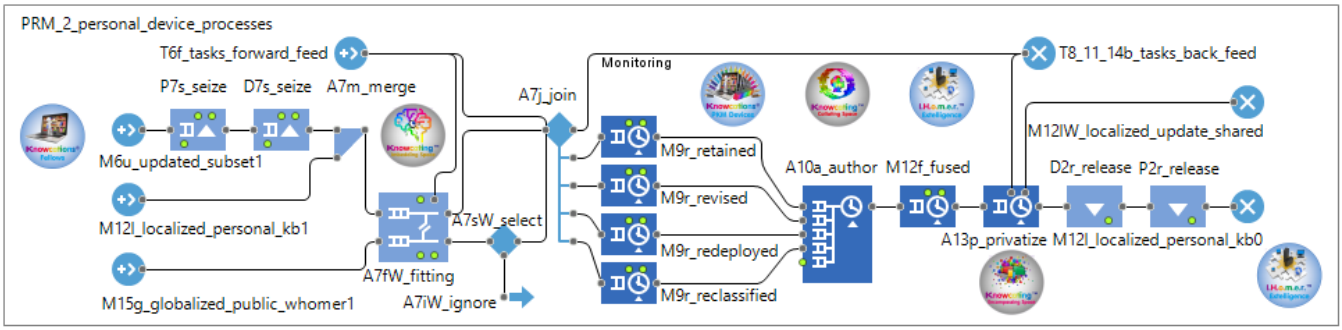

Fig. 3b. Detailing the ABM/PRM perspective of the decentralized autonomous bottom-up personal device processes.

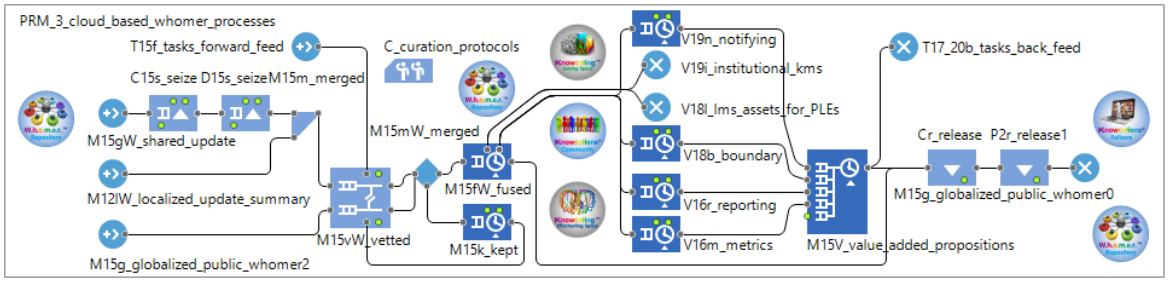

Fig. 3c. Detailing the ABM/PRM perspective of the centralized WHOMER cloud-services (with memes representing the agent).

A. Knowledge Capturing (Fig.3a)

Memes are initially modelled as 'living organisms' (agents) inhabiting the field-desk-research-space (real-world ideosphere) by residing in knowledge objects of differing granularity and complexity. They are affording potential yields [M0] by symbiotically bonding [A1bT] with a person's [P] already internalized 'research task' memes [T0] (continually revised by task-related feedbacks [T0f, T2r]).

They are competing against other memes to seize the person's attention [P] aiming for being preliminary selected [A1s] and 'shoeboxed' [M3iS] for further later processing instead of being discarded/removed [A1rM, A4rM].

Periodically, the 'shoebox' is examined, selected knowledge objects are vetted [M3vS] and deconstructed to harvest particular memes of interest [A4d, A4s] for capturing them digitally [A4cD]. Memes may comprise of content (e.g. this paragraph or visuals), aboutness (e.g. article review, wordcount, or author's profile), connections (e.g. link to author, paper, publisher, or reference), intent (e.g. tasks to do), and monitoring (e.g. schedules or to-do-lists) which may all be captured based on the PKMS's standardized memetic format and associative indexing structures.

B. Decentralized Devices (Fig. 3b)

A meme capturing session always results in a small subset of potentially interlinked new memes [M6u] (depicted as end point in Fig.3a). As one of the starting points in Fig. 3b, it is immediately immersed in any – by now cumulatively synthesized - prior captured subsets which form the local knowledge base [M12l left, A7m]. The PKMS device support (Fig. 3b) affords the integration of the new subset within the historical personal repository; accordingly, an updated version of the knowledge base emerges as a result [M12l right bottom]. Analog to an any eager student keen to better retain newly acquired knowledge by embedding it into his/her prior learning and experiences, the steps shown as icons bridge the two initially disconnected meme sets (the session-by-session and step-by-step mode described only applies in this explanatory context, while the iterative reality

affords instant access to all modes). There are three ways to accomplish the bridging task: (1) Additional external content may be captured, or newly created memes are added as the user's own intellectual contributions (change of M6u); (2) suitably related information from the global public WHOMER repository may fit any respective structural hole (defined as non-existent but potentially promising ties between current knowledge islands) to be selected or ignored [M15g, A7fW, A7s, A7i]; and (3) the original state of any of the memes (including the ones joining from options 1 and 2 [A7j]) may be modified by altering any combination of its attributes [M9r] [24]: its symbols and codification (revising), meaning and context (reclassifying), and/or application and container/asset (redeploying). If a meme is revised, the original is retained, and a new link is created to its new version.

Thus, by digitally capturing, creating, and modifying memes and their relationships, they are preserved as basic information units and building blocks able to be recalled, referenced, combined, and sequenced for any authoring and sharing activity one would like to pursue.

However, unlike physical items, memes are not expended when used or disbursed. As virtual agents, their infinite usage potential via associative structural links supports trans-disciplinary employment without setting off unmaintainable attention-consuming redundancy. This constructivist feature affords developing and authoring varied sets of virtual memes into memeplexes and knowledge assets [A10a] whose fusion generates the associative information-richness referred to by Bush [16] as "scaffolding" [M12f], a missing feature in the still dominating book-age paradigm approaches.

If the user decides to voluntarily share parts of his/her content [A13p], these personal content-based affordabilities are scaled to benefit the wider PKMS community [M12lW]. 'Always confidential' meme categories enable the monitoring of projects in progress [T6f, T8_11_14b]: Forethoughts focus on longer-term objectives, plans, and related responses; Intentions on shorter-term tasks and diaries, and Evaluations on feedbacks and personal assets and reflections.

As a result, a PKMS affords its user a self-reflecting monologue with former states of retainable non-redundant digitalized personal knowledge over lifelong learning and productive periods. Moreover, the cumulatively synthesized personal extelligence is biographically self-determined, meets demands for the mobility and portability of a knowledge worker's skills and capacities, and provides the autonomy of how one's expertise may be shared with personal and professional acquaintances for mutual benefit.

C. Centralized Repository and Curation (Fig.3c)

The last sequential cluster hosts the centralized WHOMER services as well as the Ideosphere Ecosystems (enactment & formation) complementing the SECI model by adding a 'cumulative' heritage knowledge stock as well as an effectuating space/flow (the fifth E in the SICEE accronym).

It receives the aggregated shared local updates from the decentralized personal devices [M12lW left as consolidation of M12lW top right in Fig. 3b] which are merged [M15m] with any global content updates contributed by WHOMER's own or partner services [M15gW]. WHOMER integrates these records within its historical global repository [M15g right] in a series of steps resulting in an updated version [M15g left] to be subsequently shared with the PKMS community.

While the decentralized content-specific, relational, and contextual updates [M12lW] need to fit a knowledge base conceivable as a complex entity-relationship-model, every meme and connection also just represents a distinctly structured generic record which can be intercompared allowing for vetting to identify and eliminate any duplicates [M15vW]. In such case, identical memes from different sources are merged while their relationships with diverse meme sets and usage histories are fused to keep all information [M15fW]. Also, a reference record of every meme shared is kept [M15k] even if it might be blocked from dissemination due to, for example, legal, ethical, or falsification reasons. Any identical meme uploaded in the future is, hence, identifiable [M15vW informed by M15k] to trigger appropriate actions.

The consolidation and curation of this interrelated, associatively indexed, multi-disciplinary content is envisaged to steadily mature - with a growing community and meme base – into a single unified digital knowledge repository [M15fW] representing the tangible interrogatable equivalent of the philosophical notion of Popper's abstract intangible inaccessible Third World. All the interventions alluded to, so far, aim for the associative integrity of the WHOMER knowledge base (analogous to the relational integrity of relational databases). Once this state is secured, the updated repository [M15g] can be accessed by the PKMS community.

Additional value-adding services include the reporting of emerging trends [V16r], superior usage and reputational metrics [V16m], provision of boundary objects [V18b], learning assets to afford personal learning environments (PLE), collaboration with learning management systems (LMS) [V18l] and institutional KMS [V19i], and personalized notifying services [V19n]. They assist in tackling the entropic problem areas alluded to and have been further detailed [25].

V. Digital Platform Ecosystem (DPE)

Digital Platform Ecosystems (DPE) are meant to accommodate social actors with highly diverse ambitions and skills as well as expectations to gainfully utilize the DPEs' resources and generative potential in their personal and local contexts [26]. For rounding up this article, Fig. 4 depicts the higher-level DPE of the envisaged PKMS which affords a central service structure for an iterative decentralized workflow cycle: "PKMS Community Members [knowledge worker] through their PKMS devices [technology] are capturing, exploring, or creating specifically formatted content (memes) at various levels of granularity (memeplexes) to be voluntarily shared and centrally curated in a repository [ideosphere] from where it feeds back in the form of accessible conversations, resources, or assets [extelligence] to the PKMS community [society] to be (potentially generatively) utilized in personal and local contexts. Synergetic interactions with external Organizational Knowledge Management Systems (OKMS)

and Learning Management Systems (LMS) complete the broader technological ecosystems" [2] (p.6).

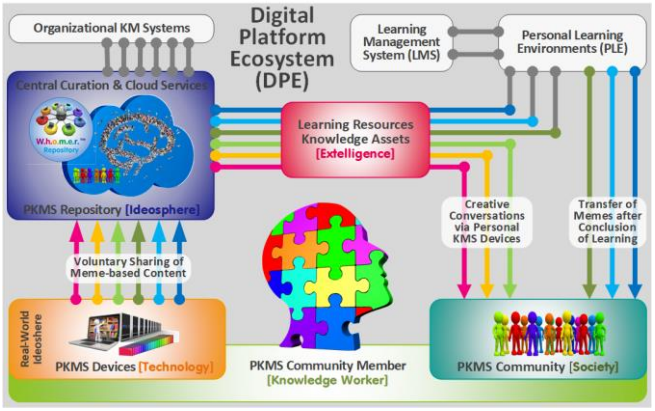

Fig. 4. PKMS as a digital platform ecosystem (DPE) [2].

VI. Discussion and Conclusion

Any sustainable KM intervention depends itself on the diffusion of credible knowledge. On the one hand, it presents "a challenge of such enormous magnitude that it needs to [convince and] attract the best talent across the world, including human resources in areas not now in a position to be well-informed about needs, alternatives, and opportunities to develop better options than those currently available."

On the other hand, it "rests considerably on bottom-up, grassroots-based actions, reflecting local contexts that differ so greatly that what makes sense in one situation is seldom what makes sense for most situations." Hence, "realizing the full potential of distributed talent in all parts of the world depends fundamentally on assuring that the talent knows the current state of science and technology", so the talent is thoroughly aware of his/her actions, avoids wasting time reinventing the wheel, and more talent is attracted by posing interesting puzzles and offering opportunities for learning [27] (p.994).

As the viability of the envisaged PKMS concept and application depends on the transparency of its features and affordances, the multi-disciplinary rationales put forward in this, previous[1], and prospective publications is intended to be three-fold: (1) To inform relevant stakeholders about the status quo by using a systems thinking and entropic perspective (to advance further evidence based on the hybrid models presented); (2) To convince a progressing part of their critical mass that a viable remedial option exists (as a prerequisite for creating the respective future generative KM reality); and (3) To propose the decentralized personal KMS technology which not only details a sustainable solution but – at the same time – brings with it the generative affordances to evolve into a prospective general-purpose technology [28], [29] for realizing the potential of the distributed talent referred to.

This article, accordingly, contributes a novel CST perspective by fusing SDM, ABM, DEM, and PRM modeling approaches in order to demonstrate the potential value and rich host of potential synergies alluded to in the introduction based on a qualitative hybrid simulation of the KM field.

Since the prototype development is still in progress, the envisaged features require further implementation, testing, and validation. Although this implies certain obvious limitations, compliance with guidelines of DSR (as typically longitudinal research streams with "continually evolving artefacts and design theories") necessitates informing about early visions of technology impact on users, organizations and society [30] which also refers to and reflects on aspects of feasibility, suitability, acceptability, and theory effectiveness.

The SCT/KM synergies demonstrated in this article further extends to CST/DSR contexts since creating solutions to 'wicked' KM problem spaces (1) prohibits to "claim to know the answer in advance or peddle" some existing solution (although Bush's inspiring, never realized vision of the 'Memex' [16] may be considered as the PKMS's closest ancestor), (2) calls for seeking "to be holistic and to ensure that theory both underpins practice and is [to be] tested in practice", and (3) expects clarity of "who benefits from the knowledge and advice provided" [31] (p.138).

Moreover, the PKMS's SICEE-cycle (with its digital ecosystems further explicated and visualized) also presents a novel knowledge creation model which specifically reflects on today's never-before experienced ever-increasing attention-consuming information abundance and its entropic effects. It has recently been compared against twelve dynamic knowledge creation models (all introduced during the still familiar period of information scarcity) and resulted in an integrated three-dimensional dynamic 'public-transport-like' map [32]. But, in the former scarcity era and its book-age paradigm, redundant content helped to find scarce information more easily and, hence, negentropic considerations were not prioritized.

Accordingly, previously fragmented and ignored warnings have now been integrated into the novel PKMS approach, including Bush's 'Memex' [16], Nelson's 'Xanadu' [33], Simon's attention management [34], Pollard's bottom-up rationale [35], and Levy's decentralizing KM revolution [36], all enveloped in a concept to transform the Popperian abstract *world:3* into a negentropic, tangible, accessible, and inter-rogatable one with wide-ranging generative potentials [2].

Conflict of Interest

The author declares no conflict of interest other than to deliver a viable PKMS termed 'Knowcations®'.

Author Contributions

Sole Authorship: 100% Contributions by Ulrich Schmitt.

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[1] Prior peer-reviewed conference and journal publications have been disseminated to and received feedback from a wide range of disciplines covering Knowledge Management and Information Science, Technologies and Innovation, Social Sciences and Management, Human Resource Development and Organizational Change, Higher Education, Sustainable Development, Creativity, Cybernetics, Systems Thinking, and Future Foresight. The scope of language and knowledge have been further broadened by integrating transdisciplinary concepts of evolution, memetics, and entropy as well as by engaging in KM's extensive use of analogies, metaphors, frameworks, and visualizations.

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