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Knowledge, Innovation, and Entrepreneurial Systems at HICSS

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Abstract:

This paper presents an overview and history of the knowledge, innovation, and entrepreneurial systems (KIES) track and the knowledge and related systems research community at the Hawaii International Conference on System Sciences (HICSS). This community began as a task force that examined organizational memory in HICSS-27. It has since evolved into a mini-track, a research cluster, and, finally, a full research track that encompasses research knowledge, innovation, and entrepreneurial systems. In this paper, we acquaint knowledge system researchers with a research community that has leveraged HICSS to develop a rich history of high-quality scholastic inquiry in the knowledge system, knowledge management, innovation systems, entrepreneurial systems, organizational memory, and organizational learning research areas.

Keywords: Knowledge Management, Knowledge Systems, Innovation, Entrepreneurship, Crowd Science, Organizational Memory, Organizational Learning.

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1 Introduction

Research in knowledge, innovation, and entrepreneurial systems recognizes the evolving nature of work and the increasingly knowledge-based society that we live in. Competitive pressures force organizations to do more with less and to leverage all they know to succeed. Knowledge systems refer to those systems that foster creativity and innovation by facilitating collaboration and knowledge capture, storage, transfer, flow, and use. The knowledge, innovation, and entrepreneurial systems (KIES) research track at the Hawaii International Conference on System Sciences (HICSS) explores the many factors that influence the development, adoption, use, and success of knowledge systems, such as culture, measurement, governance and management, storage and communication technologies, and process modeling and development. The track also looks at the societal drivers for knowledge systems, such as an aging workforce, the need to distribute knowledge and encourage collaboration in widely dispersed organizations and societies, and competitive forces that require organizations of all types to adapt and change rapidly (Jennex & Croasdell, 2017).

The KIES research track presented forty-one papers in twelve mini-tracks and a special session at the 50th HICSS. The 50th conference marks the twelfth year that the track has focused on knowledge systems but the first year with a name that reflects innovation and entrepreneurial systems. The KIES track focuses on creating, applying, and using knowledge in systems used in areas such as knowledge society, innovation, and entrepreneurship. Knowledge management (KM), organizational learning (OL), knowledge flow/transfer, advanced technologies, economics and metrics, crowd science, security, and social media are at the core of knowledge-based systems. The KIES research community is interdisciplinary, international, and uses multiple research methods. The track was formed to provide a presentation and publication outlet and a discussion forum focused on developing knowledge-based systems.

One problem with focused research communities is that they can become isolated from other like-minded communities and from their disciplines. This paper is part of a special issue in *Communications of the AIS* (CAIS) celebrating the 50th anniversary of HICSS. Among other things, the special issue focuses on publicizing the research communities at HICSS. This paper takes advantage of the special issue to more fully describe and publicize the knowledge systems research community at HICSS to the rest of the information systems (IS) community in order to expand the HICSS community either through expanded submissions, new reviewers, and/or more participation through conference attendance. Additionally, we chronicle the development of the KIES research track from its early days as a mini-track that focused on organizational memory and illustrate the contributions and impact this research track has made on the broader community. Finally, we discuss the HICSS community in terms of its formation, membership, and sustainability.

This paper proceeds as follows. In Section 2, we conceptualize knowledge-based systems based on Riempp's (2004) architecture/framework. In Section 3, we discuss the evolution and composition of the KIES community. In Section 4, we present a short history of the track that traces its roots back through its evolution from an organizational memory mini-track. In Section 5, we analyze KIES from the perspectives of papers, authors, and mini-tracks. In Section 6, we discuss the possible evolution of KIES and the technologies, applications, and processes that we can expect to impact KIES research. Finally, in Section 7, we conclude the paper.

2 Conceptualizing Knowledge-based Systems

We conceptualize knowledge-based systems using a KM framework adapted to knowledge systems as we explain next.

Alavi and Leidner (2001, p. 114) defined a KM system (KMS) as "IT (information technology)-based systems developed to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer, and application". They observed that not all KM initiatives will implement an IT solution but that those initiatives that do not implement an IT solution will use IT as an enabler. Maier (2002) expanded on the IT concept for the KMS by calling it an information and communication technology (ICT) system that allows one to create, construct, identify, capture, acquire, select, valuate, organize, link, structure, formalize, visualize, distribute, retain, maintain, refine, evolve, access, search, and apply knowledge. Stein and Zwass (1995) defined an organizational memory information system (OMS) as the processes and IT components necessary to capture, store, and apply knowledge created in the past to current decision making. Jennex and Olfman (2006) expanded on this definition by incorporating the OMS into the KMS and adding strategy and service components to the KMS. In reviewing the literature, Barros, Ramos, and Perez (2015) viewed an OMIS as an enhancer of the OM, providing effective support and resources for the organization, assisting on decision making, in the solution of problems, as well as in quality and generation of products and services. To summarize, knowledge systems incorporate KM, OM, OL, and each of these initiatives have an information systems and technology basis; as such, a knowledge systems framework has an information systems/technology framework.

Subsequent models have focused on adding process, strategy, and culture components to the knowledge framework. Jennex and Olfman (2003) discussed design considerations for an OMS and included technical, process, and strategy components. Jennex and Olfman (2006) included technical, process, and strategy components in adapting DeLone and McLean's (1992) IS success model into a KM success model. Finally, while studying KM in projects, Jennex (2003) proposed that one needs to capture culture and context to successfully use and store knowledge.

Riempp (2004) proposed an overall architecture for an integrated KMS that included all of the above components. Riempp developed the architecture for the integrated KMS by combining desk research, multiple case studies, and action research. The field research involved a KM initiative at PricewaterhouseCoopers and studies and workshops with ten organizations in the context of the customer knowledge management competence center at the University of St. Gallen (Riempp, 2004). While the literature contains more models, which we do not review as doing so falls outside our purpose here, we chose to adapt Riempp's (2004) architecture to frame KIES research into its various research areas.

Riempp's (2004) architecture for integrated KMS comprises three vertical layers (strategy, process, and system) and five horizontal pillars (knowledge transactions, content, competence, collaboration, and orientation) and the organizational culture that affects all these elements (Palte, Hertlein, Smolnik, & Riempp, 2011). In adapting Riempp's architecture, we use these components but expand on them to focus on knowledge systems. Additionally, while Riempp (2004) focuses on a KMS, we expand the architecture's applicability to knowledge systems, which includes innovation and entrepreneurship systems. We also include knowledge society systems as a subgroup of knowledge systems because these systems uniquely support public initiatives such as electronic government (e-gov), electronic health (e-health), critical infrastructure systems, and so on. Finally, we also realize that many other types of knowledge systems exist, so we do not limit knowledge systems to just these three groups. In the following paragraphs, we describe our adaptations to Riempp's (2004) KMS architecture's layers and pillars. Figure 1 illustrates the adaptation.

The strategy layer comprises the business/organization strategy, the knowledge strategy and goals, and the measurement system. Management expect that the business/organization and knowledge strategies are aligned, which means that the organization has identified how and what knowledge is needed to support the latter. The measurement system identifies metrics that monitor the progress of the KM/knowledge processes (which we describe next) and links these metrics to key performance indicators (KPIs) for the business/organization strategy; the system uses both the metrics and KPIs to measure the effectiveness of knowledge use. This layer also focuses on determining, describing, and measuring knowledge system value generation.

The process layer comprises the knowledge system's business, support, and knowledge processes. These processes focus on the knowledge identification, capture, search, retrieval, modification, and application processes that specifically support the strategy layer. These processes differ from those in the pillars in that they are integrated processes that use technology, culture, context; focus on the use of knowledge in the organization; and include reporting and measurement processes.

The system layer comprises the information system/technology aspects of the knowledge system. This layer describes the specific technologies that support data acquisition and storage (such as big data, the Internet of things, cloud, KM, and social media). It also includes interface technologies such as portals, mobile devices, wearables, and visualization technologies. Additionally, it includes sensemaking technologies such as data warehouses, data mining, text mining, and WEB mining. Finally, the layer describes any other technologies used in knowledge systems.

Five functional pillars—content, collaboration, competence, orientation, and knowledge transactions—support the three knowledge system layers:

1) Content refers to the management of structured and unstructured data, information, and knowledge objects, the context of these objects, and the management of content itself with respect to lifecycle, quality, and attribution.
2) Collaboration refers to the identification, exchange, development, and use of knowledge. It also includes technologies and processes that support and manage small and large group collaboration.
3) Competence refers to the skill sets and individual and collective competencies in an organization needed to support the knowledge system.
4) Orientation refers to the vision, design, review and management processes, and blueprint/plan/standards used to architect and integrate the knowledge system.
5) Knowledge transactions refer to the interactions between the knowledge base and users. Transactions include security/protection of the actual transactions plus the design of the flow, content, format, and access requirements for the transactions.

The culture layer reflects the organizational and/or national culture(s) of the users and designers of the knowledge system. The culture layer is the bottom layer because culture forms the analytical/interpretation, ethical, and application lenses that influence how the users and designers of the knowledge system view and will use the knowledge in the system. No knowledge system can succeed without incorporating understanding and applying the cultural norms of its users and designers.

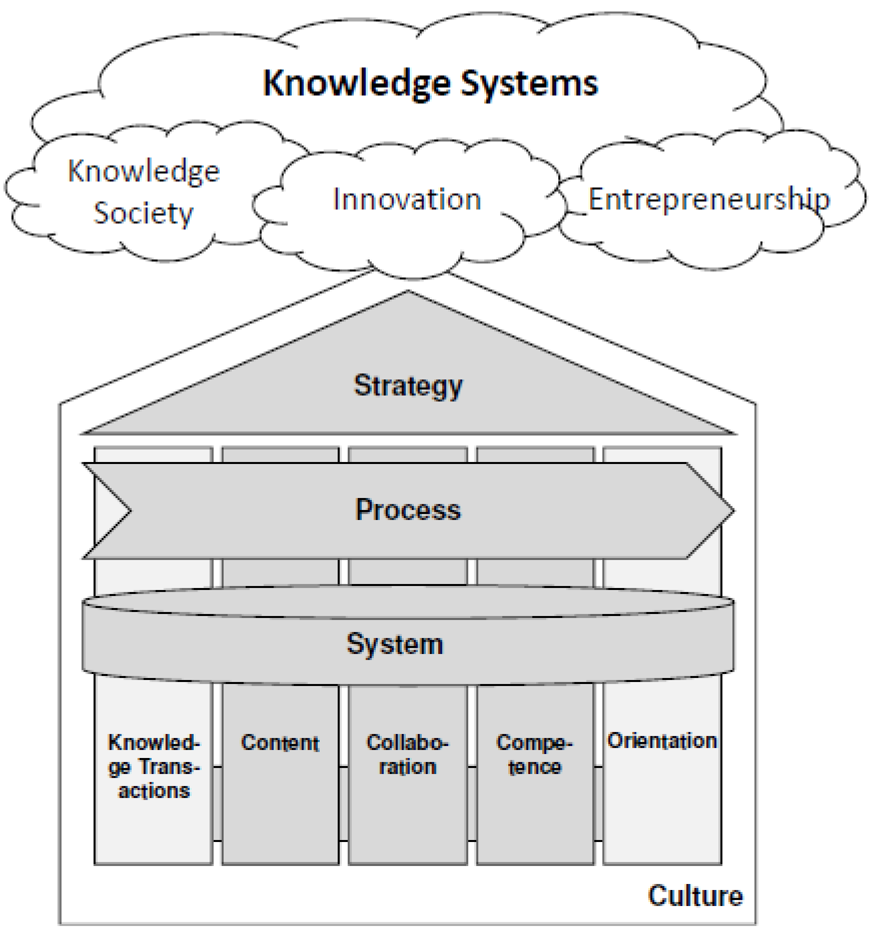

Figure 1. Knowledge Systems Architecture (Riempp, 2004)

3 The KIES Community

The KIES track (and its preceding mini-track and cluster) has, among other things, focused on building a knowledge systems research community. The first five years of the mini-track (from 1993 to 1997)—then titled “organizational memory”, had a small community focused on using technology to help organizations capture and use knowledge. This community was an offshoot of the larger expert systems, knowledge acquisition, and knowledge base community that had grown at HICSS during the 1980s. The small OM community reflected a community disillusioned with the limited scope of expert systems and the limited ability of desktop technology to implement organizational knowledge systems.

However, at HICSS-31 in 1998, two events caused the OM community to rapidly grow. First, a task force formed in 1997 recruited senior OM researchers and new OM researchers to develop a series of position papers to provide a compendium of OM base theory, research methods, and research questions and to provide the state of OM. These researchers presented the position papers in a workshop held at the conference. The senior researchers included Lorne Olfman, Jolene Morrison, George Huber, Thomas Davenport, David King, Jim Courtney, Srinivasan V. Rao, Eric Stein, and Frada Burstein. The junior researchers included Kent Sandoe, David Croasdell, David Paradice, JoAnn Brooks, Munir Mandviwalla, Stefan Eulgem, Carol Mould, Henry Linger, and Murray Jennex. These researchers represented the United States, Australia, Germany, and South Africa. The position papers have not been officially published, but they were circulated to existing and potential OM researchers. Second, Davenport and Prusak (1998) published their book *Working Knowledge*, which introduced the term knowledge management to the general business world. Both events led to an increase in submissions to subsequent HICSS, and the conference’s research community began to rapidly grow. To reflect the changing nature of the community, the mini-track changed its name to KM and OM and then to KM, OM, and OL. Figure 2, The KM, OM, OL model shows the relationships between KM, OM, and OL (Jennex & Olfman, 2002). This model served as the basis for uniting the research community under the mini-track and then mini-track cluster name KM, OM, and OL.

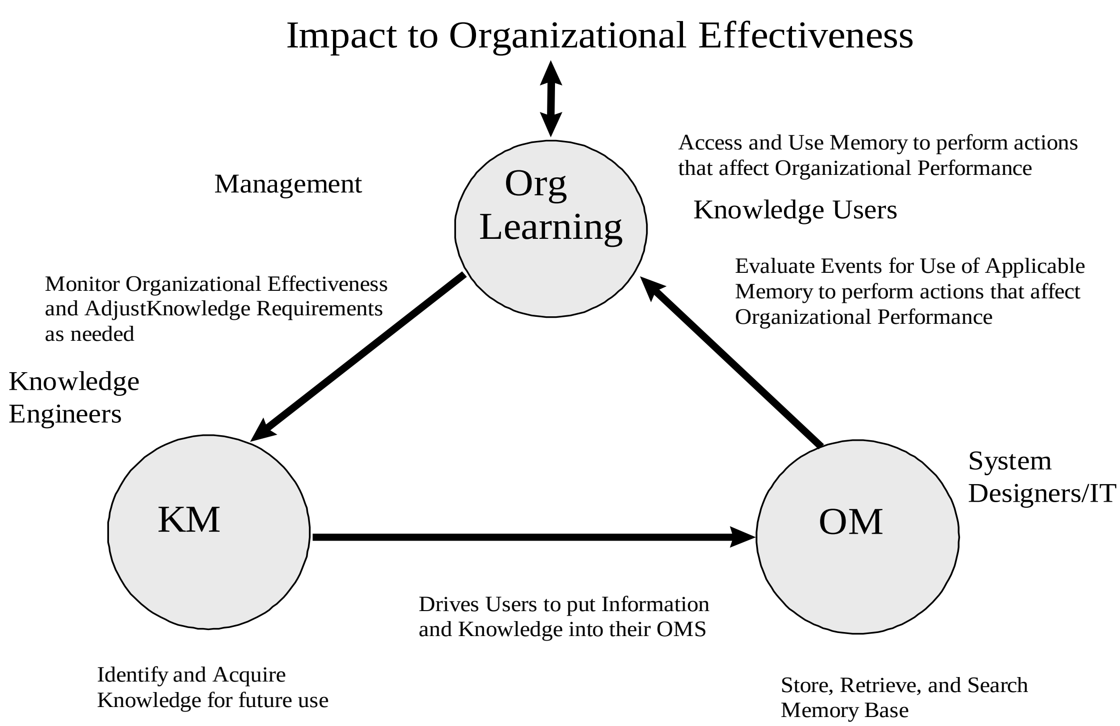

Figure 2. The KM/OM/OL Model (Jennex & Olfman, 2002)

The next growth in the research community occurred in 2005. First, Peter G. W. Keen gave the plenary talk at the 38th HICCS on the fusion of people, process, and technology and the use of knowledge. He also discussed KM, which raised the overall perception of it at HICSS and helped to elevate the cluster to track status for HICSS-39 with a subsequent increase in submissions. Second, the *International Journal of Knowledge Management* (*IJKM*) published its first issue. *IJKM* provided a fast-track outlet for KIES research, which is important to any research community. Murray Jennex is the founding and current editor in chief of this IGI publication, and he heavily recruited the editorial review from the KM, OM, and OL research community at HICSS. Across twelve volumes, 48 issues, and approximately 250 papers, *IJKM* has published 42 papers (approximately 17 percent of the journal's total number of published papers) that their authors first presented at HICSS.

After the KIES track began at the 39th HICCS in 2006, the research community continued to grow and evolve due to the track's ability to create new mini-tracks. The research community grew by proposing new mini-tracks focused on new research areas (Figure 3 shows the development of these new areas and the history of older ones). As we mention above, expert systems, knowledge acquisition, knowledge base, and artificial intelligence were popular research areas in the 1980s. KM was the main theme through the 2000s, but, since then, the community has expanded into more areas focused on knowledge-based systems. The KIES research community currently comprises researchers who investigate knowledge flows, knowledge economics, knowledge society and culture, knowledge system technologies, knowledge analytics, knowledge strategy, advanced knowledge systems, knowledge security, innovation, entrepreneurship, organizational learning, and crowd science. We discuss how the community may further grow in Section 6.

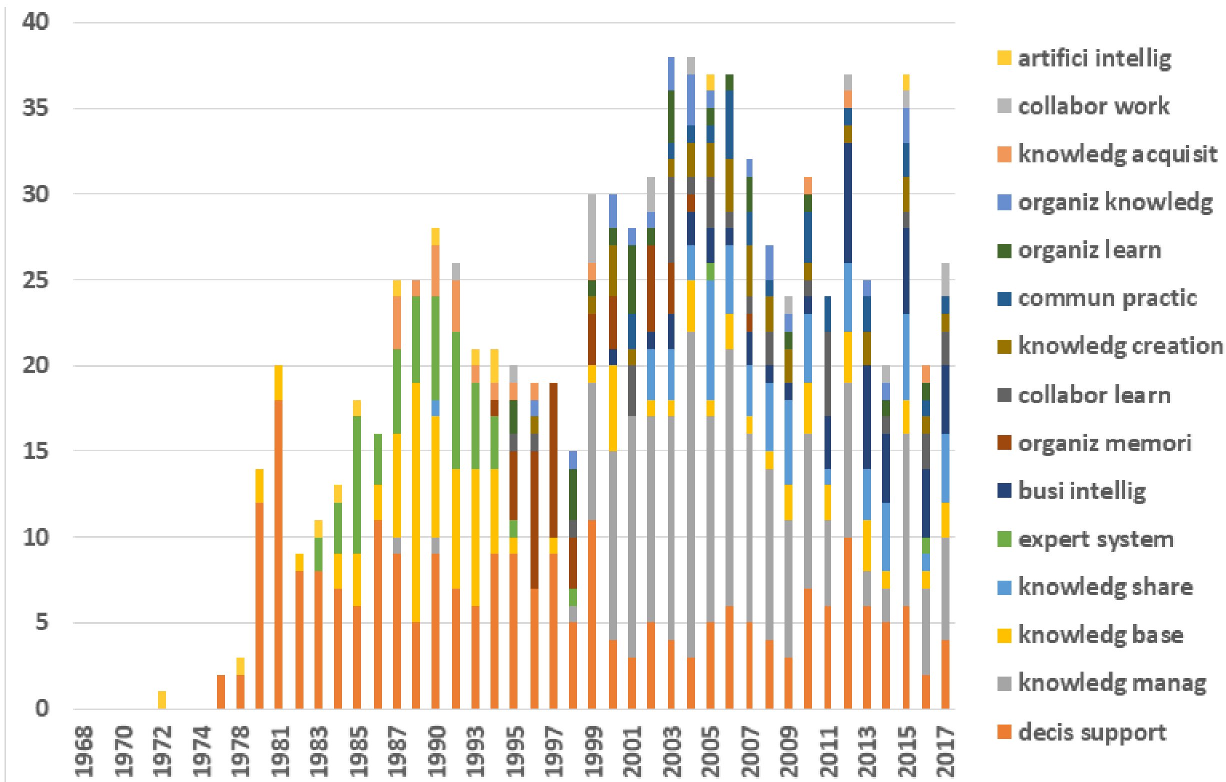

Figure 3. Bigram Plot of KIES Key Terms

The HICSS-51 track title—"knowledge, innovation, and entrepreneurial systems"—represents a broad and inclusive community of researchers and practitioners who have helped to evolve the inquiry and discussion related to continuing efforts to understand knowledge work and innovative systems in organizations. The name changes in track titles reflect the expanding use of knowledge work in organizations—from the development and deployment of knowledge systems that collect, store, organize, and disseminate knowledge to current applications of business intelligence, data analytics, and the Internet of things that feature more ubiquitous knowledge use. Recent manuscripts have also begun to focus on the use of knowledge practices, processes, and artifacts to create more social-oriented systems such as knowledge society, innovation in society, and entrepreneurship.

4 KIES Roots: The Road from a Mini-track to a Full Research Track

The beginnings of the KIES track trace back to HICSS-27 in 1994 when Jolene Morrison and Lorne Olfman conducted a mini-track on organizational memory (OM) to "provide a forum for information systems and other related researchers and practitioners to share ideas and theories about organizational memory and organizational memory systems" (Morrison & Olfman, 2000). Like so many mini-tracks at HICSS, the OM mini-track brought together like-minded researchers to share their ideas and their research in a thoughtful and collaborative venue in order to generate, nurture, and advance their research. Neither Morrison or Olfman likely envisioned that a full-fledged research track would grow out of their early efforts to foster and promote a community devoted to conducting research on the use of information systems to support organizational memory and organizational learning; however, the mini-track continued to evolve. The mini-track was renamed organizational memory (OM) and knowledge management (KM) in 1998 for HICSS-32. The name was further revised one year later to knowledge management, organizational memory, and organizational learning (KM, OM & OL) for HICSS-33. The name changes reflect the changing nature of the submissions along with the evolution of the community's research interests. In documenting this evolution, Jennex, Croasdell, Olfman, and Morrison (2005) found that the focus of research changed from organizational memory and organizational learning to knowledge management between 1998 and 2004 probably due to the release and popularity of "Davenport and Prusak's (1998) paper. While the mini-track had a roughly equal number of KM, OM, and OL papers in 1998, three times as many papers focused on KM than either OM or OL by 2004 (Jennex et al., 2005). Additionally, Jennex and Olfman (2002) (see Figure 2) identified the relationship between KM, OM, and OL: KM refers to what an organization does with respect to identifying and using knowledge, OM refers to what the organization's information systems group does to support KM by creating and maintaining the infrastructure and repositories necessary for the organization to use knowledge, and OL refers to the result in the organization from using knowledge. The relationships are circular in that KM is the initiating activity that identifies the knowledge needs that guide the information systems group in creating the necessary infrastructure and repositories for knowledge use (i.e., organizational memories that results in the organization using knowledge with the resulting organizational learning resulting in feedback to the KM activity for adjusting knowledge needs). Figure 4 shows the evolving history of submissions to the mini-track from 1998 through 2004.

Changes in mini-track leadership occurred as Murray Jennex succeeded Jolene Morrison in 2001 for HICSS-34 and Dave Croasdell succeeded Lorne Olfman in 2002 for HICSS-35. Further, during this time, the mini-track moved from the collaboration systems track to the digital media track. It moved again a few years later in 2004 to the organizational systems track.

The mini-track saw steady growth from its inception. The first three years yielded less than ten submissions per year. The mini-track grew to 15 submissions per year between HICSS-30 in 1997 and HICSS-33 in 1999. HICSS-34 had 26 submissions, and HICSS-35 had 22. To summarize, in the first decade or so of the mini-track's existence, it had a small but highly engaged community of practice who congregated to discuss and explore the application of ideas that authors such as Huber, Davenport, Nonaka and Takeuchi (KM), Senge (OL), and Stein, Zwass, Walsh, and Ungson (OM) had articulated. The KM/OM/OL mini-track at HICSS-36 in 2003 received 47 submissions—almost double the number in previous high years. While we cannot pinpoint why the mini-track received such a high growth in interest in 2003, it most likely arose due to growth in KM in the practitioner world in the late 1990s, to the rise of the Internet, and to the rapidly improving capabilities of desktop computers. Whatever the reason, 2002 proved to be a tipping point for submissions. At HICSS-37 in 2003, the increased interest in the mini-track led to the creation of the knowledge management, organizational memory, and organizational learning "cluster", which featured four mini-tracks. The newly formed cluster received a total of 65 submissions. In 2004, the cluster's now six mini-tracks received 83 submissions among them. At HICSS-39 in 2005, the cluster became a full track called the knowledge management systems track.

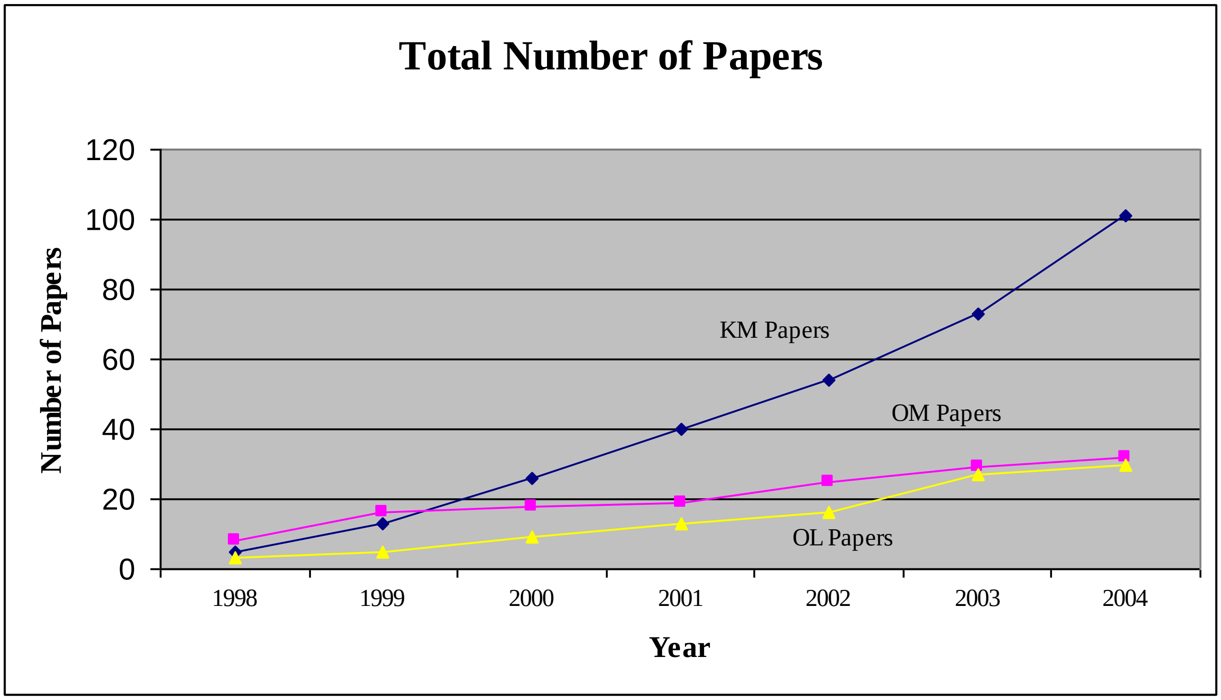

Figure 4. Distribution of Papers by Topic (Jennex et al., 2005)

Though initially called the knowledge management systems track, its name and scope continued to evolve: in 2012, the track dropped the “management” to reflect a broader research community. The track changed its name again in 2015 (to the knowledge and innovation systems track) for the 48th HICSS for a similar reason. Hind Benbya, Lynne Cooper, and Nassim Belbaly proposed adding an innovation-focused mini-track in 2007 for HICSS-41. This mini-track did well with submissions. Further, Gloet and Samson (2013, 2016) (mini-track chairs since HICSS-48) and several other authors wrote papers in which they linked innovation and knowledge and demonstrated them as being necessary for sustained competitive advantage. In addition, these authors presented how one can use KM in innovation management to help in managing and applying knowledge for innovation. The track chairs and members of the KIES community considered this research a sufficient basis to consider innovation systems a constituent of knowledge systems.

In 2016, the track expanded once again to include work in entrepreneurship. Bandera, Bartolacci, and Passerini (2016) discussed how entrepreneurship incorporates knowledge creation and innovation in smaller organizations, and, once again, the track chairs and the KIES community considered this research a sufficient basis to consider entrepreneurial systems a constituent of knowledge and innovation systems.

While we trace the track’s lineage above, it does not show the importance of knowledge and other topics featured in the track to HICSS. To illustrate the importance of KIES topics to HICSS, we generated a list of key terms associated with KIES and analyzed all HICSS papers. We generated Figure 3 using these terms. The figure shows that, from 1980, HICSS papers have featured the topics that define KIES.

5 Analysis of the Track

In this section, we analyze the research published at the KIES track at HICSS (from 2006 to 2017). We analyzed all 433 published papers in the track from three perspectives: the papers themselves, their authors, and the track’s mini-tracks.

5.1 Analysis of Papers

HICSS papers may have up to only 10 pages. The conference allows all research methods (quantitative, qualitative, action research, design theory, etc.) and conceptual papers. All papers go through a blind review process with three reviewers in most cases. The track has generally focused on achieving a 50 percent acceptance rate. Table 1 shows the number of accepted papers and acceptance rate for each year of the track. The acceptance rate has averaged approximately 52 percent for the track's history with the highest acceptance rate (59%) in 2008 and the lowest (48%) in 2006 and 2007. As its acceptance philosophy, the track accepts all quality papers and does not accept low-quality papers just to meet an acceptance rate goal. Overall, the acceptance rate per year is at a stable level and, thus, serves as an indicator for sustained high quality in terms of submissions and presentations.

Table 1. Number of Accepted Papers per Year

Year	Number of accepted papers	Acceptance rate (%)
2006/HICSS-39	37	48%
2007/HICSS-40	44	48%
2008/HICSS-41	37	59%
2009/HICSS-42	25	51%
2010/HICSS-43	30	52%
2011/HICSS-44	35	50%
2012/HICSS-45	46	53%
2013/HICSS-46	34	53%
2014/HICSS-47	30	55%
2015/HICSS-48	35	52%
2016/HICSS-49	40	52%
2017/HICSS-50	37	49%
Average values	36.08 (5.8 std. dev.)	52%

The KIES track has strived to present at least 36 papers at each conference because that number of papers supports a full schedule for each session of the conference and, thus, ensures that the KIES community can participate in a wide variety of stimulating paper presentations. Given that the track has accepted 36.08 papers per conference (5.8 std. dev.), the track has met this goal in most years.

The mini-tracks drive what particular topics the KIES papers have, and the track chairs select the mini-tracks based on the topics' popularity and their tie to supporting an aspect of the knowledge systems framework adapted from Riempp's (2004) architecture (see Section 5.3 for more information). The KIES track has published 433 papers in 99 mini-tracks. The top paper topics include knowledge transfer/sharing/flow, knowledge system design/technologies, knowledge measurements/metrics/ success, innovation, knowledge economics, knowledge society/culture, knowledge process modeling, and knowledge security. The KEIS track has continuously evolved but has been the home of new technologies: in fact, the track presented some of the first HICSS papers on big data, analytics, social media, cloud, security, and so on. These topics grew in importance and popularity to the point they became their own cluster. While some have expressed concern that the track loses topics to other tracks, which stops it from growing even larger, it also means that it encourages new ideas, grows them, and then lets them evolve to their own core groups.

Khiste, Maske, and Deshmukh (2018) assess the importance of the KIES track papers in assessing KM output in SCOPUS from 2007 through 2016 more generally. They list HICSS as the sixth most important source of KM papers.

5.2 Analysis of Authorship

The KIES track supports a collaborative and multinational research community. We looked at several statistics to analyze these authors. First, we looked at the number of authors per paper. Many authors have looked at increased research collaboration as a function of the number of authors with mixed results on the resulting papers' quality. However, the KIES research community and KM researchers in general accept that increased collaboration is good and that the number of authors on research papers can reflect increased collaboration in research. The trend at HICSS has been towards papers having more authors. Portenoy and West (2017) found the general trend on the number of authors for HICSS papers to be increasing and that the number of authors per paper averaged 1.5 in 1968, two in 1989-90, 2.5 in 2006, and three in 2016-17. KIES papers tend to reflect this trend with the median number of authors per paper being approximately 2.52 over the life of the track (King, 2017). A further review of authorship found only

68 out of the 433 papers that the track published had one author. Of the remaining 365 papers, 169 had two authors, 120 had three authors, and 76 had four or more authors. Further, Table 2 lists the winners of the best paper award for each track year. Only one winning paper had a single author; four had two authors, one had three authors, four had four authors, one had five authors, and one had six authors. This suggests that having collaborative teams improves the quality of the research and subsequent paper.

Table 2. KIES Best Paper Winners

Paper
O'Callaghan, R., & Andreu, R. (2006). Knowledge dynamics in regional economies: A research framework. In *Proceedings of the 39th Hawaii International Conference on Hawaii System Sciences.*
Haynes, S. R., Schafer, W. A., & Carroll, J. M. (2007). Leveraging and limiting practical drift in emergency response planning. In *Proceedings of the 40th Hawaii International Conference on Hawaii System Sciences.*
Holsapple, C., & Wu, J. (2008). Does knowledge management pay off? In *Proceedings of the 41st Hawaii International Conference on Hawaii System Sciences.*
Christian Hirsch, John Hosking, John Grundy, Tim Chaffe, David MacDonald, Yuriy Halytskyy (2009). The visual wiki: A new metaphor for knowledge access and management. In *Proceedings of the 42nd Hawaii International Conference on Hawaii System Sciences.*
Durcikova, A., & Fadel, K. J. (2010). Knowledge sourcing from repositories: The role of system characteristics and autonomy. In *Proceedings of the 43rd Hawaii International Conference on Hawaii System Sciences.*
Stanoevska-Slabeva, K., Hoyer, V., Kramer, S., & Giessmann, A. (2011). What are the business benefits of enterprise mashups? In *Proceedings of the 44th Hawaii International Conference on Hawaii System Sciences.*
Seebach, C. (2012). Searching for answers —knowledge exchange through social media in organizations. In *Proceedings of the 45th Hawaii International Conference on Hawaii System Sciences.*
Gloet, M., & Samson, D. (2013). Knowledge management to support systematic innovation capability. In *Proceedings of the 46th Hawaii International Conference on Hawaii System Sciences.*
Min, J., Lee, J., Ryu, S., & Lee, H. (2014). Individuals' interaction with organizational knowledge under innovative and affective team climates: A multilevel approach to knowledge adoption and transformation. In *Proceedings of the 47th Hawaii International Conference on Hawaii System Sciences.*
Raymond, R., Bergeron, F., & St-Pierre, A.-M. C. J. (2015). Entrepreneurial orientation and e-business capabilities of manufacturing SMEs: An absorptive capacity lens. In *Proceedings of the 48th Hawaii International Conference on Hawaii System Sciences.*
Richter, A., Hetmank, C., Klier, J., Klier, M., & Müller, M. (2016). Enterprise social networks from a manager's perspective. In *Proceedings of the 49th Hawaii International Conference on Hawaii System Sciences.*
Seeber, I., Zantedeschi, D., Bhattacherjee, A., & Füller, J. (2017). The more the merrier? The effects of community feedback on idea quality in innovation contests. In *Proceedings of the 50th Hawaii International Conference on Hawaii System Sciences.*

We also found interesting results concerning authors' nationalities. For the 365 papers that had more than one researcher, 289 of those author teams had the same nationality, 72 papers had authors from two different nations (based on university affiliation), and four papers had authors from three different nations. However, we also found that knowledge system research is being done in many countries. We found that researchers based in a total of 38 countries participated at the KEIS track at HICSS and, thus, that the track contributes to multinationalism of the conference. Table 3 overviews the countries with the most number of authors at the track. Since HICSS is one of the largest and most important IS conferences that take place in the US, one should not find it surprising that the biggest share of authors have come from that country. The second biggest share has come from Germany (164 authors). Jennex and Zakharova (2006) discussed the impact of national culture on knowledge and KM perspectives. That KIES has had papers from 38 countries demonstrates that KIES and knowledge systems are a multicultural concept and that KIES provides various perspectives and research methodologies. It also shows that KIES focuses on a globally important topic, it would be expected to attract authors from the Pacific Rim countries, and it does, however, it also attracts significant numbers of authors from outside the pacific rim with authors from all continents supporting the global importance of the track topics.

Table 3. Countries with 10 or More HICSS KIES Authors

Country	Number of authorships	Country	# of Authorships
USA	408	New Zealand	22
Germany	159	Sweden	20
Canada	71	Switzerland	19
Australia	60	Brazil	18
Finland	44	UK	15
China	34	Spain	13
Austria	33	Hong Kong	11
Taiwan	30	Netherlands	10
South Korea	24	Belgium	10

As part of the anniversary celebration for HICSS-50, Portenoy and West (2017) prepared a list of the 74 most impactful authors based on HICSS papers. While the KIES track is relatively young, some of the track authors made the list. Table 4 lists the five KIES authors that made the list of 74 most impactful HICSS authors. Additionally, Table 5 lists the top and most impactful KIES authors based on the number of papers they have presented in the KIES track.

Table 4. KIES Authors on Most Impactful HICSS Authors List (Portenoy and West, 2017)

Name	Number of papers in HICSS	Sum of eigenfactor	Eigenfactor per paper	Rank
Murray E. Jennex	33	17.157	0.52	20
Stefan Smolnik	27	6.237	0.231	36
Timo Kakola	26	3.384	0.13	38
Lorne Olfman	25	13.3	0.532	44
David Croasdell	23	4.249	0.185	52

Table 5. KIES Authors with Most KIES HICSS Papers (Minimum of Four)

Name	# of papers	Name	# of papers	Name	# of papers
Stefan Smolnik	16	Julee Hafner	6	Ronald Freeze	4
Murray E. Jennex	15	Suzanne Zyngier	6	Timothy J. Ellis	4
Alexandra Durcikova	10	Carsten Brockmann	5	Eugenia Y. Huang	4
David T. Croasdell	9	Susan A. Brown	5	Kelly Fadel	4
Daniel Samson	7	W. David Holford	5	Maurice Kügler	4
Lynne Cooper	6	Alexander Kaiser	5	Bernhard Moos	4
Marianne Gloet	6	Christian Wagner	5	Travis K. Huang	4

One may not find the lead entries in Tables 4 and 5 to be surprising: they are past/current track chairs and/or have participated in HICSS since the 1990s. Further, the fact that a decent number of authors have published four or more papers in HICSS reflects the longevity and continuity of the KIES research community.

One may note that the authors in Table 4 are all men; indeed, Portenoy and West's (2017) full list has only six females out of 74 authors listed. In contrast, one can see seven female authors in the 21 listed in Table 5 While there has been much discussion in the IS discipline on the issue of female underrepresentation, the KIES track community has enjoyed a more balanced gender participation. We support this statement through Table 5: 10 of the 28 mini-track co-chairs for HICSS-50 were female, and eight of 12 best paper winners listed in Table 2 had at least one female author. We expect that KIES will continue to attract female participation.

5.3 Analysis of Mini-Tracks

Mini-tracks at HICSS are subgroups that represent particular communities of practice or “birds of a feather” groupings in the track. Prospective mini-track chairs submit their proposals that outline the topic area for the mini-track to the track chairs. The track chairs select the mini-tracks that each year’s conference will explore. Once selected, mini-tracks solicit submissions, coordinate the review process, and select papers for conference presentation and publication. Track chairs select mini-tracks based on what topics they believe are important to KM/knowledge systems. The number of mini-tracks for each conference year varies, but the track chairs focus on ensuring the conference covers core research areas (see Figure 1)) and new/cutting edge research areas. Table 6 shows the number of mini-tracks for each year of the track. As one can see, the number of mini-tracks went from six in 2006 up to 12 in 2017 to include the core areas of innovation and entrepreneurship (hence the name change to KIES) and a broad range of cutting-edge topics.

Table 6. Number of Mini-tracks per Year

Year/ HICSS	Number of mini-tracks
2006/HICSS-39	6
2007/HICSS-40	7
2008/HICSS-41	7
2009/HICSS-42	5
2010/HICSS-43	8
2011/HICSS-44	6
2012/HICSS-45	10
2013/HICSS-46	9
2014/HICSS-47	8
2015/HICSS-48	8
2016/HICSS-49	13
2017/HICSS-50	12
Total	**99**

Additionally, we looked at the main topics that each mini-track has covered since 2006 using the mini-track descriptions and assigning the mini-tracks to one or more layers and functional pillars from the knowledge systems adaptation of Riempp’s (2004) architecture (see Figure 1). Figure 4 shows the result of assigning the mini-tracks. We recognize that some papers presented in those mini-tracks might have a focus that differs somewhat from their mini-track, which one should consider when reviewing the data.

The KIES track has had 99 mini-tracks. Figure 5 includes numbers in the various layers and pillars of the knowledge systems adaptation of the Riempp’s (2004) architecture that indicate the number of mini-tracks that relate to the layer or pillar. Many mini-tracks relate to multiple layers or pillars, so the numbers on Figure 5 do not add to 99.

Figure A1 in Appendix A illustrates the timeline for the mini-tracks. The first row shows the evolution in the track name. The second row lists the years of the track. Each year column lists the mini-tracks for that year’s HICSS. Some mini-tracks occurred over multiple years, which the figure shows with a bar over the relevant years below the relevant mini-track names. The numbers below the bar line for each mini-track represent the number of papers presented in the mini-track for that year. We list mini-tracks with different names but similar themes in the same row to show how mini-track chairs have modified their programs to reflect the evolution and fluctuating interests of their research communities. One can see that the names and chairs for mini-tracks have changed over time but that a few prominent themes have emerged. The most prominent themes represented in the KIES manuscripts at HICSS have examined KM implementations, knowledge flows and transfer, technology and tools to conduct knowledge work, and ways to conduct knowledge work to be creative and innovative. Entrepreneurship and crowd science only show up late in the timeline, which reflects their infancy and current trending status. Reports from the field constitutes another fairly recent mini-track. This mini-track provides an opportunity for practitioners and researchers to report on newer knowledge system applications and case studies. It focuses on building a bridge between practitioners and researchers and providing a forum for presenters and attendees to discuss issues important to practitioners and for researchers to explore the relevance of their research with practitioners. Time will tell if these themes remain relevant for KM researchers. As a whole, however, Figure 1 provides potentially useful information for those considering research projects associated with knowledge work.

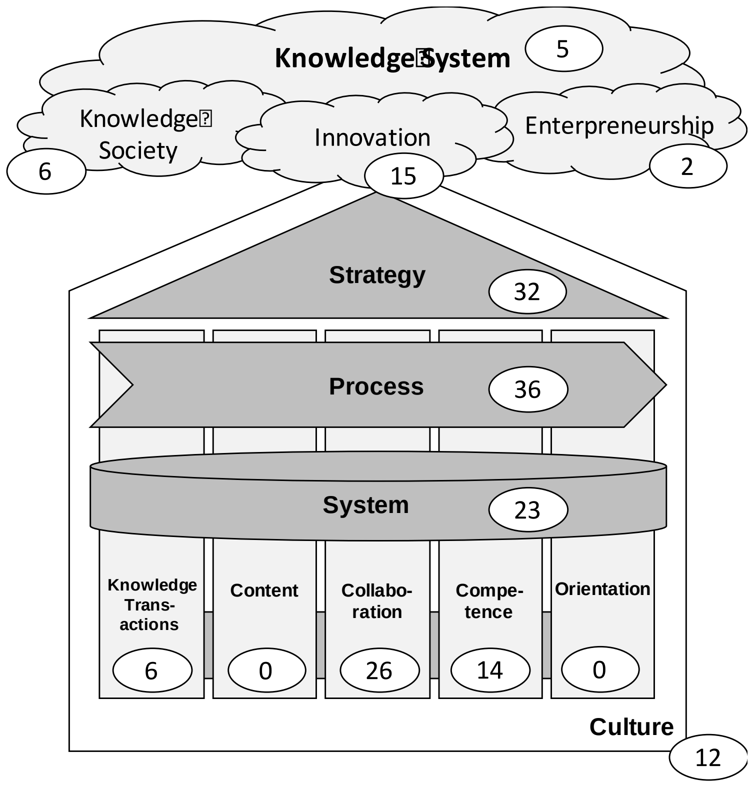

Figure 5. Number of Mini-tracks in Each Component of the Knowledge Systems Adaptation of Reimpp (2004)

6 Future Expectations/Trends/Expansion

In this paper thus far, we discuss the history of the KIES track and its community of researchers. In this section, we discuss where we expect the KIES track to go by analyzing how we expect knowledge systems to evolve. Figure 1 shows the architecture for knowledge systems and includes the entrepreneurship mini-track. Additionally, another new expansion is the minitrack on crowd science. Both these mini-tracks are the current expansion of KIES and both are expected to grow for the next several years with the crowd science minitrack being the most cutting edge technology and entrepreneurship being the most cutting edge business application. Figure 6—the revised knowledge pyramid with big data and IoT (see Jennex (2017) for a full discussion on the model, highlights are discussed as follows)—is a new interpretation on the traditional knowledge pyramid that incorporates many new technologies and initiatives into knowledge systems, and I use it to discuss KIES's future evolution. Figure 6 shows that the traditional knowledge pyramid represents knowledge in action in society (and, as such, is called the societal knowledge pyramid) and is inverted, which implies there is more wisdom than data (for why, see Jennex, 2017). It also shows that KM is still a traditional pyramid that is a subset of the societal knowledge pyramid (the KM pyramid is based on the use of organizational knowledge) that focuses on the creation of actionable intelligence. Both pyramids have double-ended arrows at their frame that indicate that knowledge/data creation flows both up and down the pyramid with traditional learning processes being used to transform between layers with societal knowledge and organizational learning processes being used to transform between layers in the KM pyramid. Both learning and organizational learning rely on the use of insight, analytical, and sensemaking processes to guide the learning process. These insight, analytical, and sensemaking processes are implemented in the form of filters to aid the transformation between layers. KM has strong filters because these filters focus on very specific transformations that lead to actionable intelligence, while societal knowledge uses weak filters or filters based more on general understanding rather than specific transformations. One can implement both strong and weak filters as processes and using technologies such as machine learning, data analytics, artificial intelligence, and so on. Finally, Figure 6 also integrates two newer sources of data—big data and the Internet of Things, IoT—into KM. Big data are massive databases that require automated tools to fully analyze and use their contents. IoT are smart sensors being incorporated into many aspects of business and society that generate massive amounts of data that were previously not available. Figure 6 implies that big data is a subset of IoT.

Looking at, Figure 6, we realize that the KIES track has focused on the KM pyramid inside the overall societal knowledge pyramid resulting in Figure 6 showing two possible areas for KIES expansion. The first is into knowledge society areas represented by the societal knowledge pyramid. Knowledge society systems focus on the application of societal knowledge to assist society by creating systems focused on areas such as e-health, crisis response and management, smart grid, e-learning, belief management, and wisdom systems. Wisdom and belief management systems are new approaches in the IS field and are analogous to KM systems focused on actionable intelligence. We expect that the KIES track might evolve to the knowledge, innovation, entrepreneurship, and wisdom systems (or KIEWS) track.

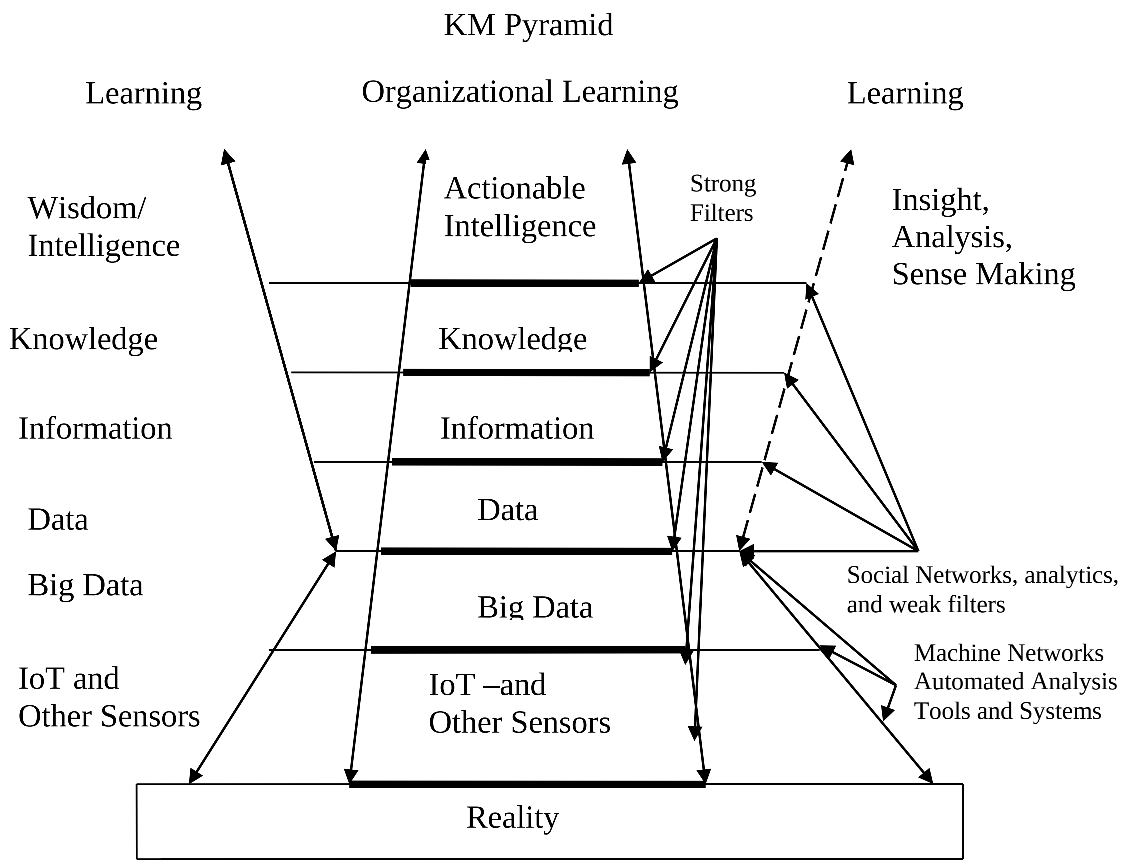

Figure 6. The Revised Knowledge Pyramid with KM, Big Data, and IoT (Jennex, 2017)

The second area of expansion comes from the addition of and overall impact of big data and IoT on both the societal and organizational knowledge pyramids as follows:

- Autonomous knowledge generation and use that we already have begun to see in autonomous vehicles, smart grids, and large-scale control systems. We expect this research area to be a vibrant one as researchers investigate technologies and the ethical implications of these systems. We also expect that these systems will grow in importance to both knowledge and wisdom systems.

- Determination, construction, and implementation of filters to make massive data sets manageable. These tools are also coming into play as part of sensemaking and it is expected that researchers will have many design and implementation issues to address.
- Application of newer technologies such as artificial intelligence, AI, machine learning, social network analysis, text and Web mining, and visual analytics to identify and capture knowledge, actionable intelligence, and wisdom. These tools are already cutting-edge technologies that many disciplines have begun to apply. We anticipate that current knowledge/wisdom/actionable intelligence systems will incorporate these tools to create stronger, faster, and more integrated advanced knowledge/wisdom/actionable intelligence systems and that researchers will have many application areas to study and technical issues to resolve.
- New human-centered processes such as knowledge/wisdom/actionable intelligence governance, strategy, management, content management, and flow processes and impacts on the valuation of knowledge/wisdom/actionable intelligence. These new human-centered processes will provide new research questions for many current KIES mini-tracks and potential new areas for new mini-tracks.
- Finally, we expect to see new methods for representing, organizing, and presenting knowledge/wisdom/ actionable intelligence to support decision making and users. We expect this research area to be a vibrant one as researchers determine how to optimize knowledge/wisdom/actionable intelligence utilization.

We see many rich research areas that will continue to sustain the KIES track as a cutting-edge track at HICSS.

7 Conclusion

As the knowledge, innovation, and entrepreneurial systems track's current name implies, the track is an innovative track that focuses on evolving research that creates knowledge systems. While it has KM at its core, the track is expanding to embrace additional aspects of knowledge systems. We see the track as leading the research community that focuses on creating systems that use knowledge to create value and benefit society. Our history has been one of innovation and cutting-edge research. We adapt Riempp's (2004) architecture to be a knowledge systems architecture that one can use to create successful knowledge systems. We define the pillars and layers of this model to fit knowledge systems, and we show that the mini-tracks in the KIES track support the architecture.

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Appendix A

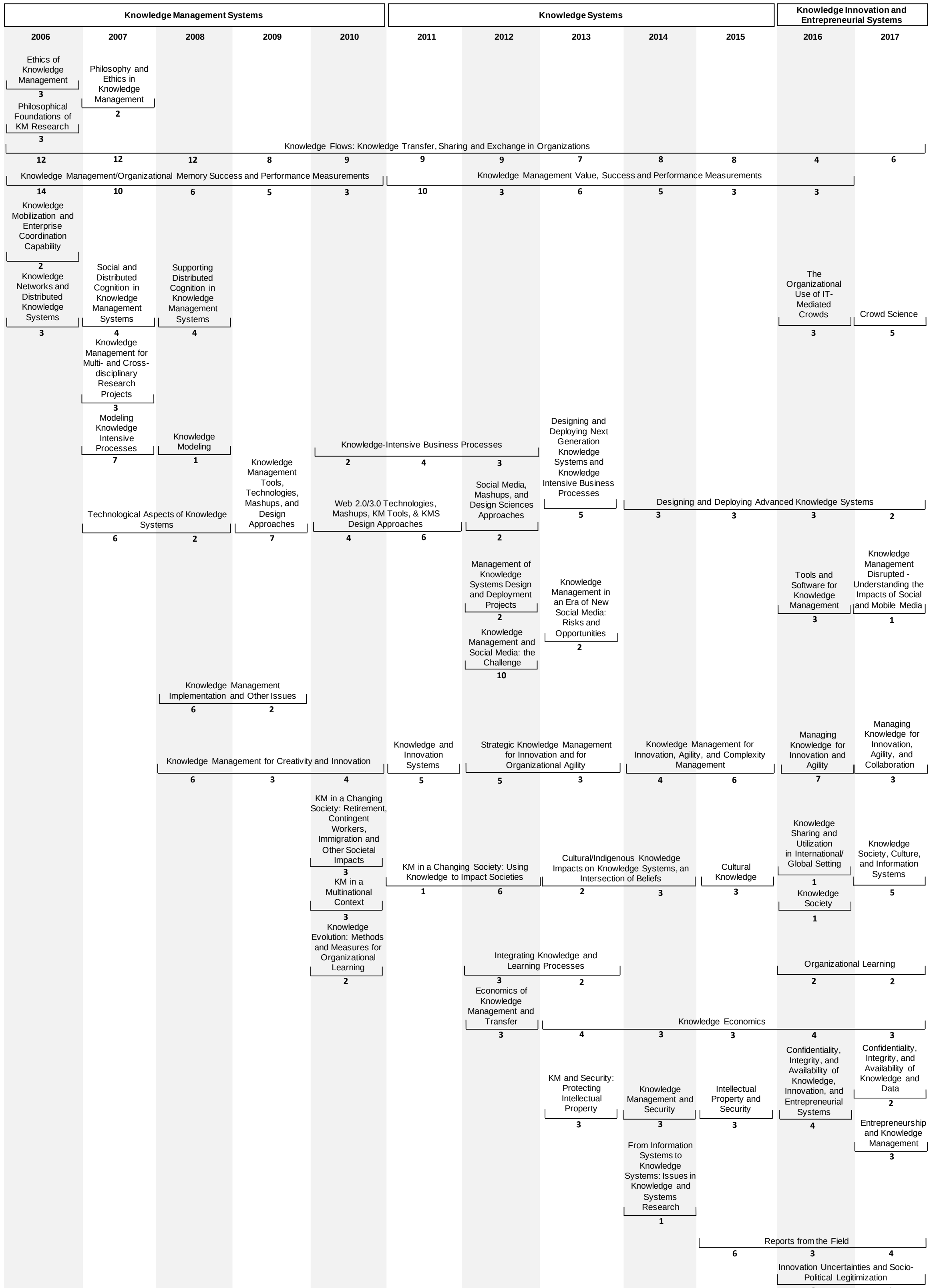

Figure A1. Mini-track Timeline

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