Free technology for the support of community action groups: Theory, technology and practice

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[1] Although styled as a formal journal paper, this document is written as a hypertext intended to be read on a computer screen connected to the Internet; in itself demonstrating some of the Web technologies it discusses. References in the text are linked to the full bibliographic citation. In turn, most citations link with a single click to the full text of the item referred to via the TinyURL link. The URLs are provided, not for bibliographic detail, but as simple one-click connectors to the full content of the referenced item. All URLs are valid as at 22 September 2010.

Structured Abstract

Purpose – Urban areas are administratively complex, and bureaucrats are often overburdened, which means they are often working at what Herbert Simon called the bounds of their rationality. Thus, responsible bureaucrats may have little genuine knowledge of issues within their briefs that impact community members. Groups concerned with such issues may emerge in the community. Given their focus, members of such groups will have issue-related local knowledge; and probably also the time and effort to share and assemble such personal knowledge into practical and informative group proposals. This paper reviews this situation and demonstrates how simple to use and freely available socio-technical tools can be applied to support knowledge based community action.

Design/methodology/approach – The paper provides a theoretical framework for community action, discusses some of the revolutionary cognitive technologies that provide tools for implementing the framework, and presents a template based on two of Google's cloud computing applications: Google Sites and Google Docs to demonstrate how the technology can be used (see "Template for Knowledge-Based Community Organizations" - https://sites.google.com/site/organizingcommunityaction/)

Originality/value – The theoretical framework is new, and we are unaware that such an approach towards the support of community action groups has been previously documented.

Practical implications – The generic tools demonstrated are free and may be used by anyone with an internet connection and a Web browser. They provide action and other social groups with simple yet sophisticated tools to collect, and assemble personal knowledge; and to transform it into community knowledge. Properly used, the tools can provide bureaucrats with the necessary background knowledge to make rational decisions about allocation of resources, etc. to deal with various kinds of situations. The template developed for this project demonstrates capabilities of the cloud computing tools.

Keywords – Social technology; Community knowledge management, Cloud computing; Organization theory; Bounded rationality

Paper type – Theory, Technology and Practice

1 Introduction

This work relates to the sociological concept of "community action". Somewhat following Bryant (1972), community action denotes any emergent or external attempt to form or involve local groups in voluntary self help schemes or as participants in the process of statutory policy making and service implementation. Thus, a community action group is a group of people formed in the community to promote, guide, or carry out social, political or practical objectives of interest to the community. We are particularly concerned to explore the roles of knowledge and information in the formation of such groups and the achievement of their goals within the governance frameworks of urban and regional environments. Action groups are at the far end of the spectrum of knowledge based communities including communities of interest and communities of practice (Brown & Duguid 1991; Wenger & Snyder 2000; Nousala 2006). Compared to communities of practice, which often are informal subdivisions within the structural hierarchy of existing organizations, action groups are normally independent, self-governed and usually formally constituted groups of people with their own self-determined goals. Historically, action groups have emerged in local areas from the face-to-face social interactions and collective work of people sharing common concerns and interests. The new Web-based technologies demonstrated here have been tested in community action groups, but provide all kinds of knowledge-based groups with powerful tools for assembling, sharing, and applying knowledge and enable virtual participation in group activities.

We present here a theoretical framework for community action, discuss some of the revolutionary cognitive technologies that provide tools for implementing the theory, link to a working template demonstrating how the technology can be used, and make some very preliminary observations from ongoing case studies where the technology has been recently implemented. Given that the specific technologies we are concerned with here have only become fully functional this year, there has been no opportunity to study their use over long time scales.

Urban districts are complex adaptive systems comprised of hierarchically dynamic networks of social, physical and economic interactions among their inhabitants. Such systems have many of the properties allowing them to be considered autopoietic (i.e., living) at a level of hierarchical organization above people and below economic or statutory organizations comprised of people (Simon 1962, 1973; Miller 1978; Maturana and Varela 1980; Salthe 1985, 1993; Hall 2003, 2006; Hall et al. 2007). All the activities involved in maintaining the organized urban fabric of the district are to some degree knowledge-based and would not function without the material and structural implementation of that knowledge. Here we consider how individual people can work together in the interface between the complex systems of urban and regional governance and the physical environment to ensure local and personal knowledge is available to guide and constrain activities of administrative juggernauts.

Governing bodies make decisions to do things in the world at many different levels of organization, whether by committees, individual bureaucrats or designated workers. All decisions involve boil down to individual people choosing among various alternatives based on available knowledge. Under the label, "bounded rationality", Herbert Simon explained that the rationality of decisions is limited by the amount of information that can be held in the mind, processed and understood (Simon 1955, 1979; Else 2004; Hall et al. 2007, 2009). If these limits are breached by lack of pertinent information that can be found in the available time or an overload of irrelevant information, decisions become increasingly irrational. However, suboptimal decisions are still often better than no decision, so Simon recommends developing means for "satisficing", i.e., to provide tools to make the "best" decision one can in the time available.

> [T]he elaborate organizations that human beings have constructed in the modern world to carry out the work of production and government can only be understood as machinery for coping with the limits of man's abilities to comprehend and compute in the face of complexity and uncertainty (Simon 1979: p. 354).

One solution is to devolve organizational decisions closer to the problems. Another is to more effectively filter decision related input to genuinely critical information and tested wisdom (Hall et al. 2007). Greiner (1998) observed that growing businesses had to survive several revolutionary transformations in management structure to achieve success. The successful revolutions represent changes that kept operational decisions within the limits of rational decision making. In other words, decisions need to be made by people who are close to and well informed about the issues being decided (Hall et al 2009).

Within large social systems, action groups can emerge from networks of people with interests in particular problem areas (Nousala 2006; Nousala & Hall 2008; Nousala et al. 2009). However, there is a large gap between the emergence of an action group; and assembling their personal knowledge into coherent explicit structures to support rational decisions by a bureaucrat or functionary. We next look at some theoretical considerations involved in understanding and bridging this gap.

2 Theory of knowledge-based organizations

2.1 Theory of knowledge

What "knowledge" and "information" mean in the organizational knowledge management discipline is contentious (Hildreth & Kimble 2002; Stenmark 2002; Wilson 2002; Miller 2002; Land 2009. Here we adopt Karl Popper's (1972) definition that knowledge is "solutions to problems", whether this knowledge is contained in someone's thoughts, articulated in speech, written on paper or embodied in the structure of an artefact. In this framework, "information" refers to variations and uninterpreted codes that may store and transmit knowledge, i.e., Bateson's (1972): "differences which make differences".

Donald Campell (1960, 1974) coined the term evolutionary epistemology for the understanding he and Popper had that knowledge was something that grew from living entities' experiences with the world through trial and error learning, "blind variation and selective retention" (Campbell 1960) or "tentative solutions and error elimination" (Popper 1972).

One of Popper's concerns was to differentiate between fantasy and belief on one side and "scientific" knowledge, i.e., knowledge that could be trusted to be reasonably reliable (Popper 1959, 1963, 1972). Such knowledge is built over time through fallible cyclical processes beginning with speculation based on "general" knowledge and observation, and progressing through trial, error-elimination and sharing of results, followed by subsequent rounds of further speculation based on shared knowledge (Osinga 2005; Hall et al. 2007).

Understanding how this cyclical process can work most effectively in an increasingly socio-technical environment is crucial to making the most effective use of knowledge-based activities in the urban systems environment.

What makes knowledge reliable from a Popperian point of view? Scientists and others may claim to know something reliably. However, no matter how many tests a knowledge claim has survived; it can never be equated to truth (where truth is the complete correctness of a claim about the real world - Popper 1959, 1963). However, something about the conduct of science still contributes more to the growth of knowledge than do fantasy and belief. To clarify his thinking about the evolution and growth of knowledge, Popper (1972) introduced an ontology of three worlds, as extended by (Hall 2005, 2006; Hall et al. 2007; Vines et al. 2007, 2010; Hall & Nousala 2010):

- *World 1* (W1 - physical events and processes) is dynamic physical reality and everything in it, including physiology.
- *World 2* (W2 – cognition and living knowledge) is the domain of embodied behavior of agents, mental states and processes, and structural (i.e., tacit) knowledge. Embodied knowledge is the system's propensities to act in certain ways in response to particular situations. By extension, W2 includes the embodiment of all kinds of cybernetically self-defined and self-regulated dynamic processes. In other words, W2 contains the semantic significance or meaning of cognitive processes and their results in living systems, while the physical dynamics of the matter remain in W1.
- *World 3* ("W3" - objectively persistent products of knowledge) is the domain of persistently codified knowledge, where encoded content can exist objectively and independent from a knowing entity. Popper defined W3 to include "the world of the logical contents of books, libraries, computer memories, and suchlike" (Popper 1972: p. 74) and "our theories, conjectures, guesses (and, if we like, the logical content of our genetic code)" (Popper 1972: p. 73), while the physical structure of the codified content remains always in W1. W2 mediates between W1 and W3.

Knowledge evolves and grows as claims in W2 are shared via social expression and codification in W3, and strenuously tested against W1. Claims that survive personal criticism and intersubjective testing are clearly better than those that fail such tests.

Popper (1972) summarized his ideas in what he called his "tetradic schema", or more boldly, his "evolutionary theory of knowledge" (Figure 1). Popper developed his evolutionary epistemology primarily in the context of human cognition. We argue that knowledge is formulated and applied by living systems (Hall 2003, 2005, 2006; Hall et al. 2005) across several hierarchical levels of organization (Miller 1978; Salthe 1985, 1993) including living cells, multicellular organisms including people, and social and economic organizations (Nousala and Hall 2008; Hall and Nousala 2010).

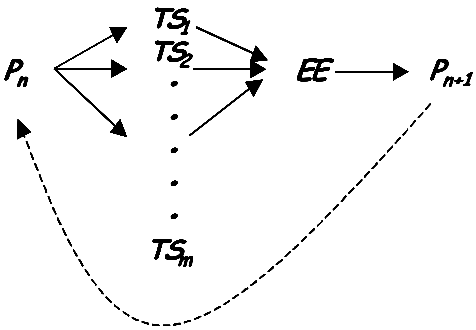

Figure 1. Popper's "general theory of evolution" (**1972**: p. 243). $\boldsymbol{P_n}$ is a problem in the real world, $\boldsymbol{TS_m}$ are tentative solutions (or theories) the entity may embody or propose in W2 to solve the problem. ***EE*** represents a process of selection imposed by W1 on the entity applying the tentative solution, or a process of criticism and error elimination in W2 that selectively removes those solutions that don't work in practice. $\boldsymbol{P_{n+1}}$ represents the now changed problem situation remaining after $\boldsymbol{P_n}$ is solved. As the entity iterates and reiterates the process, it constructs an increasingly accurate representation of external reality.

The knowledge management literature provides many different learning cycles (e.g., SECI - Nonaka 1991; "knowledge life cycle" - Firestone & McElroy 2003; double-loop learning - Blackman et al. 2004, etc.). We prefer the terminology associated with John Boyd's OODA loop process (Boyd 1996). Not only does this have a very robust derivation from multiple disciplines in the worlds of history, philosophy, physical and biological sciences, complexity theory, (Simon 1962, 1973; Salthe 1985, 1993) and military affairs (e.g., Grant 2005; Grant & Kooter 2004; Osinga 2005), but it directly applies Popper's evolutionary epistemology to building knowledge about real world situations (Hall 2003, 2005, 2006; Hall et al. 2007; Vines et al. 2010). The OODA loop involves iterated processes of:

- **O**bserving (i.e., collecting sense impressions of the world),
- **O**rienting (sense-making, relating observations to prior knowledge, generating tentative solutions, logic testing, planning, etc. – Grant & Kooter 2004),
- **D**eciding (selecting a tentative solution),
- **A**cting (applying the selected solution/plan to the real world). The next iteration repeats, beginning with observations of the world – including effects of the action.

OODA or knowledge building cycles generally involve interactions of the three worlds (Figure 2). In a social context, W2 knowledge may be exchanged among individuals tacitly or by articulating and exchanging explicit claims via W3. In a community environment we are particularly interested in tacit exchanges between the W2's of different individuals (that may involve the articulation of ideas via speech) and capturing and sharing such knowledge explicitly via W3. With iterated cycles of knowledge building and testing, knowledge of the world grows more reliable with time, and thus becomes more trustworthy.

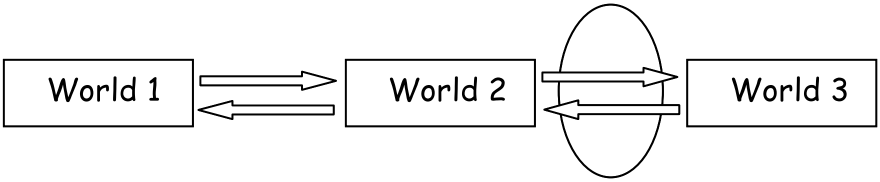

Figure 2. Cyclic interactions of knowledge and control between Popper's three worlds. W1 impinges on the living entity in W2 to create sense data. The W2 entity constructs an understanding of W1 that may be made explicit for preservation and sharing via W3, based on sense data and prior knowledge sourced from W3. Based on its growing knowledge of W1, W2 attempts to control W1. The circle emphasizes cyclic exchanges between world 2 and world 3 as world 2 attempts to represent and interact with world 1. (Nousala 2006).

Boyd (1996) also emphasized the importance of time in the observing, orienting, deciding and acting cycle. Speed of decision is often a factor in solving real world problems that can escalate if not dealt with in good time. However, it is important to consider the impact of time and the quantity and quality of knowledge on decision makers (Simon 1947; 1957; 1969).

Basically, in the real world there is never enough knowledge and time to fully understand and assess a problem and alternative solutions in order to make the perfect decision (Simon 1955, 1957, 1979; Else 2004, Hall et al. 2007). These limitations prevent decision makers from knowing and understanding everything they would have to have in their minds to make perfect decisions. Thus, organizational systems should be constructed to facilitate the time-consuming tasks of information gathering and the creation and assessment of alternative (i.e., "tentative") solutions. Those making decisions must "satisfice", i.e., to try to optimize their information gathering and thinking strategy to make the best decisions they can within the bounds of time and the knowledge that is available when and where it is needed.

Thus, "knowledge" is solutions to problems, the value of which depends on the degree to which it has actually been tested against the real world. In this context, "information" is a "difference which makes a difference" (Bateson 1972) or a significant arrangement in the structure of a system that could have been different without any different expenditure of energy (after Salthe 1993).

2.2 Hierarchically complex organizational systems and epicyclic knowledge growth

In seeking to understand how organizational knowledge grows and can be managed in large multi-level organizations, we have studied a variety cases, such as:

- commercial organizations (Hall 2003a; Hall et al. 2002; 2009; Nousala 2006; Nousala et al. 2005, 2009; Nousala et al. 2009; Nousala & Jamsai-Whyte 2010; Nousala et al. 2010),
- industry clusters (Hall 2006a; Hall & Nousala 2007), and
- the knowledge society (Vines et al. 2010; Hall & Nousala 2010a).

In conjunction with the casework cited above, we are constructing a theory of organizational knowledge combining the evolutionary theory of knowledge discussed above with Maturana and Varela's (1980) autopoietic theory of life (Hall 2003, 2005, 2006; Nousala & Hall 2008; Hall & Nousala 2010) and the theory of hierarchical systems.

Where a complex dynamic system at any level of organization is autonomously able to act within its environment to self-produce and maintain its dynamic state of organization, it may be "autopoietic" (= "self" + "production") or living. As defined by Maturana and Varela (1980), systems are autopoietic when they meet six criteria considered necessary and sufficient to recognize when a complex system could be considered to be autopoietic, and thus living (Varela et al., 1974 – paraphrased here):

- *Bounded* (demarcated from the environment),
- *Complex* (different components within the boundary),
- *Mechanistic* (system driven by energy dissipation),
- *Self-differentiated* (system boundary intrinsically produced),
- *Self-producing* (system produces own components),
- *Autonomous* (self-produced components are necessary and sufficient to produce the system).

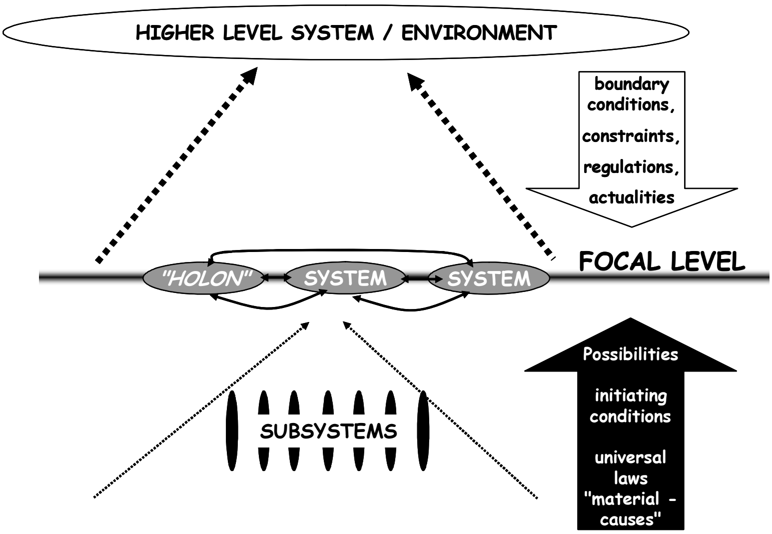

Figure 3. A hierarchically complex system examined from a specified focal level (From Hall et al. 2005)

Based on the theory of hierarchically complex systems (Simon 1962, 1973; Koestler 1967, 1978; Miller 1978; Salthe 1985, 1993, 2004 - Figure 3), systems at the focal level are components of a single higher level system functioning as an environment for the focal systems. Subsystems below the focal level are components of focal level systems. In this model, large organizational structures involve several hierarchical levels or epicycles of knowledge building and testing. In each epicycle there are continuous exchanges between the personal or tacit knowledge of individual people and articulated and explicit forms of knowledge that can be shared among people involved (Hall & Nousala 2010a; Vines et al 2010).

Hall and Nousala (2003, 2005, 2006; Hall et al 2007; Vines et al 2007; Nousala and Hall 2008; Hall & Nousala 2010) combine autopoiesis, hierarchy theory and evolutionary epistemology to argue that knowledge-based autopoietic (living) entities can emerge and evolve at several levels of organization:

- *single-celled organisms* where knowledge is embodied in the dynamics of cellular structures (W2) and codified in DNA (W3),
- multicellular organisms where knowledge is embodied in the dynamics of cellular interactions, epigenetic structure and socially transmitted knowledge (all W2) and as codified in sexually exchanged DNA codes (W3) – Jablonka and Lamb 2005, 2007), and
- *social and economic organizations* such as companies comprised of people and their technologies where knowledge is embodied in the dynamics of human interaction, the structures of organizational routines, plant and equipment layout and tacitly accepted organizational jargons (all W2) that Nelson and Winter (1982) called organizational tacit knowledge; and as explicitly codified in organizational documentation.

Based on the complexities of human interactions in organizations comprised of humans, it is also likely that other autopoietic entities can emerge at intermediate levels of organization between individual people and large socio-economic organizations (e.g., communities of practice and other kinds of communities – Nousala & Hall 2008; Nousala & Jamsai-White 2010; Nousala et al. 2010) or at higher levels yet than single organizations (e.g,, nation states – Wendt 2004; and industry clusters – Hall 2006a; Hall and Nousala 2007). Urban and regional councils are organized entities existing between people and the state, while community organizations such as we are considering here emerge between people and councils.

The properties of autopoiesis are embodied in the persistent organization of the dynamic network of interactions among the components of a system; whereby autopoiesis is perpetuated as its structure changes continually from one adjacent possible state to the next as matter and energy pass through it. Kauffman (2000, 2003) and Kauffman et al (2008) define the "adjacent possible" as all possible configurations of system components *that could be reached in the next instant from the present configuration*. For any system with many components, the adjacent possible is a vanishing small fraction of all configurations that are physically possible. A living system remains living as long as aspects of this favourable structure persist through time; e.g., as the system progresses from one instant to the next, most of the adjacent possible states fall within an attractor basin affording the properties of autopoiesis. Where the system lacks capabilities to compensate for perturbations to the structure such that the next state falls outside of the attractor, it disintegrates and any knowledge it held is thus selectively eliminated (Popper's 1972 "error elimination"). What remains in surviving autopoietic systems after error elimination are those structures embodying structural or codified knowledge that has survived the test. Thus, the *history of problems survived as embodied in its structure* in the present instant represents "structural" knowledge in W2.

Figure 4 illustrates our concept of a knowledge-based autopoietic system at a selected focal level within the complex systems hierarchy (Hall et al., 2005; Nousala and Hall 2008). Autopoietic systems are comprised of many coupled cyclic processes (i.e., epicycles) driven by the dissipation of energy between high potential sources and low potential sinks coupled to the transformation and transport of other inputs from sources to products and waste ("other outputs"). Subsystems and processes comprising the entity are indicated by looped arrows to indicate their largely cyclic nature. Some of the flow through the system is fed back into the system itself to maintain system integrity against entropic tendencies to decay. Some subsystems are fully determined aspects of the focal system, while others may be autopoietically cooperating subsystems. Ultimately, all cycles and epicycles within the system are driven by the dissipation of high potential energy transported from sources to sinks (Prigogine 1955; Morowitz 1968; Salthe 1985, 1993; 2004; Chaisson 2001; Hall 2006). The capabilities of the focal system are determined by those of its components and their possible interactions, and the focal system's activities are constrained by selective processes to meet its problems or imperatives for survival, such as maintaining an internal environment where its subsystems can function within the environment created by the higher level supersystem. The higher level supersystem provides the focal system with its external environment that constrains its behaviour to stay within the bounds of what is possible within that environment. Further constraints are provided by prior history and knowledge that determine what is possible for it to do in the next adjacent possible.

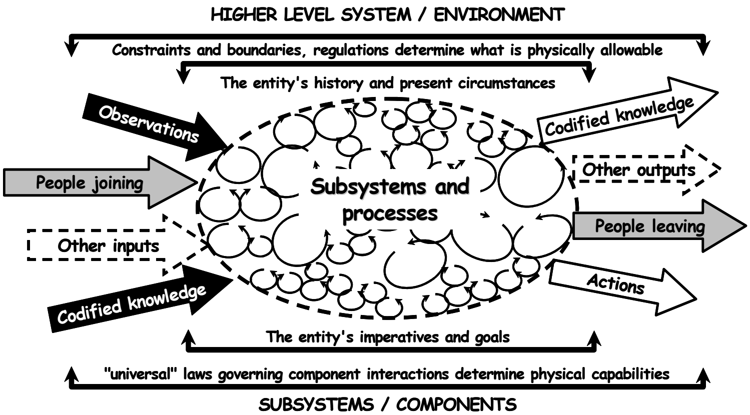

Figure 4. The knowledge based autopoietic system in its environment within a higher level system (from Hall et al. 2005).

Urban councils and their delegates are responsible to provide services necessary for civil life and for maintaining peoples' health and amenities. To do this functionaries need to know who, what, where, when, why and how-to relating to problem areas.

Based on ideas from Hall (2003, 2005), Nousala (2006), Vines et al. (2007), Vines et al. (2010), Hall and Nousala (2010a). Figure 5 illustrates the application of this theoretical framework to epicyclic knowledge acquisition, building and acting in the urban environment. We recognize knowledge-based autopoietic systems in at least three nested levels of organization:

- *Individual people ("**I**")*. When concerned about a particular problem area, individuals may go to considerable lengths to gather explicit knowledge in the form of existing documents, photography, maps, records of measurements, etc; as well as developing his/her personal knowledge. This knowledge building may involve cycles of **O**bserving, **O**rienting, constructing **T**entative **T**heories, and acting to **E**liminate **E**rrors.

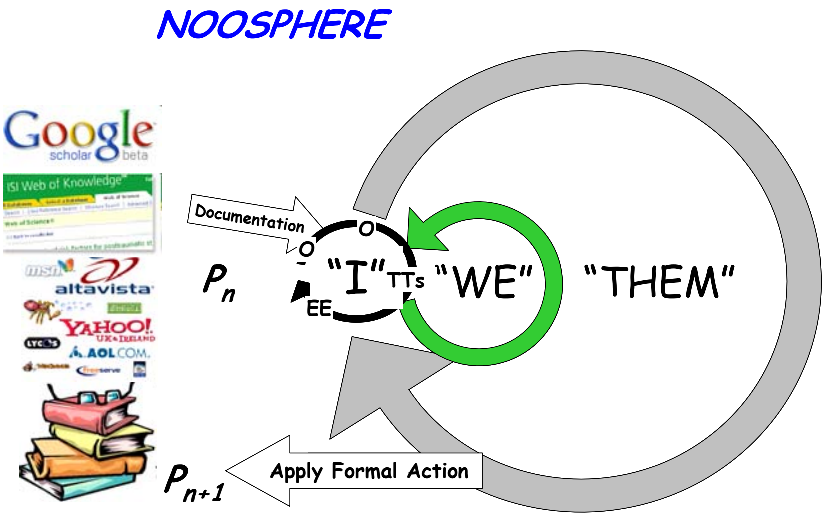

Figure 5. Knowledge cycles in urban governance (derived from Vines et al. 2010). Noosphere is the sum of human knowledge. Individuals, groups and councils all draw from and add to this store of knowledge as consequences of their activities.

- *Community action groups ("**WE**").* Where individuals in the community face similar problems, they may share concerns and knowledge to stimulate the emergence of a community group (Nousala and Hall 2008) to resolve the problem. Group knowledge building may involve sharing personal knowledge and building a group repository of documentation and observations. The success and sustainability of the group will depend to a considerable degree on the success of the personal interactions in assembling useful knowledge and action plans.
- *Councils ("**THEM**").* Councils are complex bureaucracies, organized into departments responsible for problem areas. Decisions to formalize actions tend to be centralized, where the bounds to rational decision making are likely to be the greatest (Hall et al. 2009). Committees or officers making decisions often have little or no personal knowledge of specific problems. Groups close to the problems can play important roles by collecting, organizing and presenting their collective knowledge in formats easily used by functionaries. Ideally, action groups can function as knowledge building epicycles supporting councils' own knowledge building activities.
- ***Noosphere*** (Krippendorff 1986). (a) The space occupied by the totality of information and human knowledge collectively available to man and (b) the cybernetic processes operating in this space. This includes all kinds of knowledge artifacts in W3 and the collective personal knowledge of humanity in W2. **I**, **WE** and **THEM** can all draw on the collective knowledge and wisdom of the "Noosphere".

The idea of the Noosphere derives originally from discussions among Valadimir Vernadsky (who also coined the term "biosphere"), Teilhard de Chardin, and Edouard Le Roy, that initially had mystical and vitalistic connotations (Turner 2005). Turner reviews and updates the concept in a way that corresponds with our usage here. The noosphere is the net product of the global diversity of knowledge ecologies like those shown here in Figure 4 and described by Hall and Nousala (2010a) for peer-reviewed journals and Vines et al. (2010). The knowledge ecosystem comprises all of the living and cybernetic entities using and contributing the knowledge forming the noosphere (e.g., see Pallaris & Costigan 2010)

3. Technologies for socially constructing and sharing knowledge

In less than a lifetime, the invention and integration of various cognitive tools and production technologies have extended human mental capacities far beyond the bounds of human brains. Humans have become "post human", where people and their machines are now symbiotic (Licklider 1960; Pepperell 1995; Hayles 1999; Hall 2006b; Yakhlef 2008). Organizations have become "socio-technical", i.e., comprised of people plus their tools, machines and technologically mediated processes (Harvey 1968). Over the last 30 years, tools such as personal computers and the internet have extended human cognition to radically revolutionize people's interactions in organizations so that people in today's organizations are cognitively knitted together with a wide variety of technologies extending cognition beyond the mental bounds of human bodies.

3.1 Technological revolutions change the nature of human cognition

Progress towards these post-human capabilities involved four revolutions in technology enabling major cognitive revolutions, each supporting huge changes in the biological nature of the human species in terms of their abilities to solve problems in their interactions with the world (Hall 2006b):

- *Speech and teaching* transfer articulated knowledge from one human memory to another perhaps 100,000 - 200,000 years ago.
- *Writing and reading* record and transmit knowledge external to human memory >5,000 years ago.
- *Printing technology and near universal literacy* vastly extended human memory 560 years ago.
- *Electronic content creating and processing technologies* (i.e., word processing, spreadsheets) *and the Internet* for individuals extended cognitive processes beyond limitsof human brains around 30 years ago.

Since Hall's (2006b) paper, a fifth major revolution is expanding post-human cognitive capabilities at a still increasing pace.

- *Semantic, social and cloud computing technologies* (i.e., "Web 2.0") support the emergence of collective cognitive processes at group and organizational levels (Hall et al. 2008, 2010; Vines et al. 2010; Hall and Nousala 2010a).

3.2 Computers externalize aspects of personal cognition

Microelectronic technology able to support the personal computing revolution had its origin around 1971 when Intel launched its first large-scale silicon chip-based microprocessor, the 4 bit 4004 (Aspray 1997). This was followed in 1972 by the 8 bit 8008 processor which powered the first personal microcomputers (Stachniak 2003). Since then Moore's Law (Intel 2007) has led to exponentially increasing computing power. Today, processing power, transmission speed and storage capacity per dollar are increasing exponentially at rates approximating 37, 19, and 26 percent per year, respectively – with no evidence that technological limits will be met soon (Koh & Magee

2006; Chang & Baek 2010). The physical communications backbone connecting these computers at light speed is provided by Internet that began its development in the 1960's as a project of the US Defense Advance Research Projects Agency to provide backup communication in case of nuclear war, with the first implementation in 1969 (Leiner et al. undated). Sets of processes and software tools have emerged in three domains using personal computers and the Internet that serve to externalize and connect aspects of the knowledge building cycle:

- *Content creation* (word processing, spreadsheets, databases) were all introduced around 1980.
- *The World Wide Web* ("Web") using hypertext technology linking servers and browsers were developed from 1989 to around 1993. These provided basic infrastructure for viewing hyperlinked HTML texts.
- *Web search engines.* To close the knowledge growth cycle between creating and viewing; indexing, "search" and retrieval tools were needed for finding relevant texts. These were developed by around 1995. Google was launched in 1998 with underlying technology (Brin & Page 1998) able to keep pace with the exponentially increasing volume of content on the Web, and by 2001 was well on the way to dominating the market (Gasser 2006). By 2006 Google had probably indexed more than 20 billion pages (Notess 2006). by July 25, 2008 they claim to have registered over 1 trillion (1 x 10^9) web pages (and that is after removing duplicate URLs! – Alpert & Hajaj 2008). Today Google has indexed most of the academic, scientific and professional literature (via Google Scholar) and many millions of books that have been scanned from America's major research libraries (partially available via Google Books and Amazon). Any of these pages that are relevant to a problem at hand can be discovered in seconds using keyword or string searches or citation indexing concepts (Hall et al. 2010; Hall and Nousala 2010a).

3.3 Semantic, social and cloud computing externalize aspects of community cognition

Since 2000 the Web's revolutionary capabilities for extending cognition have continued to evolve at a still increasing pace. Three trends of technological understanding and development are coming together to externalize and support cognitive processes at the community level:

- *Semantic Web*, where specialized markup languages allow the semantic significance of components of text to be marked up in ways that computers can understand for further processing (Berners-Lee et al. 2001; Hall 2001), with the first "Recommendation" for XML released in 1998 (W3C 2010). However, the full potential of the semantic web hoped for by Berners-Lee et al. (2001) has still not been realized because of difficulties reconciling logical and dialectical differences between the implementations of XML on different sites (Vines et al. 2010, Vines & Firestone 2008).
- *Web 2.0*. Web 2.0 or "social computing" does not refer to any specific technological developments but rather to the development of aspects of the web that favor collaboration and the sharing of web content. The term Web 2.0 was invented by O'Reilly in 2001 to cover the whole range of social computing activities (O'Reilly 2007; Gruber 2008). Following Miller (2005), Web 2.0 thinking seeks to:
  - *Free data* (e.g., 'freedom of information', minimize constraints on data access),

- *Enable virtual applications* (e.g., aggregating data & functions from different sources),
- *Facilitate two way participation* (e.g., peer to peer)
- *Focus on user needs not provider wants*
- *Build modular applications* (enabling construction of hierarchically complex systems)
- *Share* (code, content, ideas)
- *Facilitate communication and community building*
- *Facilitate remix and mashup*
- *Become smarter* (e.g., Amazon's recommendation engines, Google's Page Ranking)
- Open up the "long tail" *(make it cost effective to service small requirements of large number of individuals)*
- Build trust *(in individuals, assertions, data and its reuse)*

For community knowledge management, probably the best known and most successful application exemplifying many of these qualities is the community constructed Wikipedia (Wikipedia 2010). A wiki is a collaborative website where users can easily add to, modify and comment on content using web-based tools (usually only a Web browser. Wikis facilitate collaboration in the collection, generation, review and distribution of content. They typically allow users to add new content, link to other content within and outside the wiki environment, edit content, organize and structure content, view content and access a history of changes to contributions. Contributions may be authored within the environment or brought in from outside (O'Leary 2008).

- *Cloud computing.* The concept first appeared in 2007 (Markoff 2007; Lohr 2007; Lohr & Helft 2007) to cover the idea that data storage and processing will be offloaded onto external repositories and data processing centers (Baker 2007; Raman 2008) users can access the data and control the processing with little more than a web browser and internet connection. The major tools involved here are mostly Google's cloud "Apps" (Wikipedia – "Google Apps")[1] as described by Hall et al. (2010).

4. Building a template for knowledge based community organizations

For community actions to be successful, they need to be based on tested knowledge of the problems being confronted. From early experience with Google's Apps from January through mid May 2010 (Hall et al. 2010), it seemed that Google's cloud Apps could meet all requirements for managing community knowledge.

4.1 Usability tests

The assumption that the technology would be useable in practice has been tested in four new implementations (note: these are tests/demonstrations that the technology meets

[1] Google's cloud applications have been released and are evolving so rapidly, recently and pervasively that there has been little time for them to be properly digested and documented in the formal literature. The most accessible reviews I have found of their histories and capabilities are those in the cloud computing tool, Wikipedia. References to these articles are cited: Wikipedia "link").

theoretical requirements discussed above, not studies of the knowledge lifecycles in the groups concerned):

- *Test 1*: Hall established a wiki style collaboration site for authors contributing to the Knowledge Cities Summit special session, “Putting Community Knowledge in Place”, beginning with Google’s own Project Wiki template (Google 2009). Implementation started 17 May and was completed and shared with others on the contributor list by 26 May.
- *Test 2*: Selected components of Putting Community Knowledge in Place were used as the starting template for a demonstration linked to the present paper that has been shared with the world (Hall and Best 2010). Work began 27 June 2010, with the page structure complete by 29 June. Page contents were modified July 5, 8, and 22 as inclusions and linked documents were refined.
- *Test 3*: Starting with a blank Google Site, Best created a new site for the Riddells Creek Landcare Group (RCL) and transferred content into it from the existing RCL Web page hosted on conventional server-based web technologies. The new RCL site includes public pages as well as private pages accessible only to Committee members. The Google Site version will be released to public access via the existing Riddells Creek Landcare URL in the near future. Beginning with the blank site opened around June 1, Best and other members of the RCL Committee transferred most historical documents, project records, financial accounts, and membership list details before the 24 July 2010 AGM. All RCL people who have tested it have found the Google technology intuitively easy to work with, *much easier* than the existing server-based technology that requires specialist skills to administer.
- *Test 4*: Google Sites was trialed in a committee meeting of an umbrella group of 11 landcare groups to see how easily a group naïve people with modest computing skills could come to grips with it. The Secretary (representing one group) and representatives of two other groups attended the meeting. Sitting around a kitchen table and networking wirelessly via their notebook computers, participants soon understood the Google Sites’ logic. Led by one of us, and starting with a blank site, the basic structure for the umbrella group’s Web page was built within an hour. This explains the group’s aims, describes joint projects and stream observations, establishes a private committee area, and provides links to each of the 11 component groups. This site is also currently undergoing further development, but has not yet been published.

The conclusion from all of these tests is that anyone able to use an internet browser on a home computer should be able to work within a Google Site to make their personal knowledge explicit. As a final comment, we note that Google provides only very limited documentation to explain how to use the sophisticated functionality and multiple add-in functions (i.e., “gadgets”) they provide. To partially fill this gap we developed the Template for Knowledge Based Community Organizations (Hall & Best, 2010) that also includes some detailed usage notes (Hall, 2010).

4.2 Demonstrating knowledge management capabilities to support community action

For community actions in the real world to be successful in terms of having their intended effects, they need to be based on tested knowledge of the reality being confronted. As noted above, a wiki provides a framework for the social construction and testing of knowledge following a Popperian OODA knowledge development cycle as illustrated in Figure 1 and Figure 5. An appropriately implemented wiki should meet most knowledge-related requirements for a community action group. Google Sites (together with other (Google Apps) meets several knowledge management requirements for community action groups, as illustrated in Hall and Best (2010):

- *Observation*: Hall (2010) explains how individual users can insert a wide range of materials ranging from original observations to links and embedded documents, or even a "file cabinet" into a web page, ranging from textual notes and observations, individual photographs, photo albums, maps, and even videos (as illustrated by "Monkey Business").
- *Orientation and development of tentative theories/solutions*: Web pages allow people to add comments and attach additional document files, e.g., as shown at the bottom of William P. Hall's contributor page. Message functions can be used for either general discussions at the site level, or discussions related to specific project pages, etc., shown on the bottom right of the Welcome page (general discussion) and at the bottom of the Free Technology for the Support of Community Action Groups page.
- *Decision*: Decisions can be developed via topic page-related discussions or polls based on spreadsheet forms.
- *Action*: Google Sites provides excellent facilities for multilayered presentations. Inviting councilors to join the site may be a deliverable in its own right, as this would give them full access to a submission and layers of supporting information.
- *Monitoring results of actions*: The full capabilities of the observing functions can be used.
- *Member administrative functions*: New member records can be generated automatically using a Google Spreadsheet form in a web page (as illustrated on the Join the Community page).
- *Financial management*: Financial records, contracts, funding proposals and all other matters of financial interest can be kept in a linked Site accessible only to group officers and committee members.
- *Communication, coordination and tracking*: There is no mailout function specifically associated with a Google Site. However a parallel Google Group can readily be established to manage a mailing list (see http://groups.google.com/). Group members can nominate to be notified of changes to the site as a whole or to designated pages within the site.
- *Facilitate internal trust and outside security*: As can be seen from the Join the Community page and various Contributors pages, e.g., Susu Nousala, the Template provides ample possibilities to create a trust-worthy persona within the site community. Secure materials can easily be established in linked Sites where the access is password protected and fully controlled. Google's cloud computing Apps have been certified for government use under the US Federal Information Security Management Act (Krishnan 2010).
- *Provide epistemic structure*: Pages within a Google Site can be readily established in a logical hierarchy reflecting the group's aims and purposes. Documents and cross-links within pages provide additional cognitive associations. If desired linked document libraries can also be established within Google Docs, organized within a hierarchical folder structure (e.g., click the Community Library link). As amply demonstrated in the Template, hyperlinks can be used throughout the site structure to link associated knowledge objects.

5. **Discussion and conclusions**

Even before the Web was established, it was recognized that computer systems could help form and sustain community groups (Licklider & Taylor 1968; Rheingold 1993; Schuler 1994). As elaborated above, in the last year or so, free and easy to use social technologies have appeared that offer all the capabilities required for building social knowledge management environments for knowledge based community groups. Once established, the site and its contents persists as an underlying and evolving structure containing the knowledge relating to the community's imperatives as individual members come and go. Individual humans are the dynamic actors in the organizational system, but it is largely the evolving knowledge contained in the organizational system that guides and informs members' individual actions to sustain the goals and structure of the community beyond the memberships of any particular individuals in the organization.

Although this is the only paper in the special session "Putting Community Knowledge in Place" to focus on Google's social technologies for community groups, several other papers in the session illustrate similar features.

- *Iramoo Green Web* (Hocking & Wyatt 2010), establishes a web of partnerships among a variety of institutions and community action groups to facilitate "deliberative community engagement through a range of methods that legitimizes local community knowledge and practices".
- *NeatStreets* (Kuruppu 2010) demonstrates the use of smart phones with cameras and geotagging to collect observational data on community problems (e.g., leaking water mains, lost shopping trolleys, potholed streets, etc) for reporting to councils or other relevant authorities.
- *Tacit knowledge network support* (Nousala et al. 2010) describes the emergence of tacit networks for knowledge exchange in small organizations that transform personal knowledge into community knowledge.
- *Out of the heads and bottom drawers of non-traditional owners* (Smith and Nair 2010) documents the existence in most communities of large volumes of personal knowledge and documentation relating to local environments and planning issues that is essential to support council decisions that councils generally do not know about.
- *The trails of two cities* (Smith 2010) looks at the development of community action to support the retention and landscape preservation of unused rail reserves established in the late 19^{th} Century.

Except for the company described by Nousala et al. (2010) the small organizations represented in this special section are all components of an emerging umbrella group concerned with monitoring and maintaining or even improving the ecological health of Melbourne's urban fringe. This super-organization is emerging from the overlapping interests of (1) individual landcare groups combined into umbrella groups covering drainage basins crossing the northern and western suburbs of Melbourne, (2) native plant and animal societies (e.g., the Keilor Plains Group of the Australian Plants Society), and (3) an emerging group called NatureShare that is seeking to observe, photograph and map all Victorian flora and fauna). It is possible that the social technology described here may powerfully help coordinate all of these group and umbrella interests into a powerful autopoietic supersystem. Over the next years we will be following the development of selected community action groups, the impacts of new technologies on their knowledge lifecycles and successes/failures in achieving their aims, and changes in their knowledge ecologies (e.g., along the lines of Lanzara & Morner 2003 and Sowe et al. 2008).

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