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Social Networking Tools for Knowledge Based Action Groups

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1 Introduction

Urban areas are administratively complex, and bureaucrats are often overburdened when they are working at or beyond what Herbert Simon called the bounds of their rationality [1]. Decisions impacting community group members may be based on little genuine knowledge of issues. Groups concerned with particular issues may emerge in the community. Given their focus and interests, group members will collect issue-related knowledge that can be assembled into proposals. However, it is often difficult for people to form such networks and discover what their various interested members know to construct collective knowledge. Also, such community knowledge is often ignored by governing bodies and their bureaucracies. This chapter reviews this situation from deep theoretical, technological and practical points of view and shows how simple to use and freely available social networking tools in the cloud can be applied to effectively support knowledge based community action.

Based on practical [2-17] and theoretical understanding [18-24] of knowledge management in groups and organizations, we consider here some of the knowledge-based roles and dynamics of community groups. We discuss some new cognitive technologies to support the aims of individuals, community groups and governing bodies in urban and regional hierarchies to extend their effectiveness and abilities to communicate across boundaries. Revolutionary Web 2.0 technologies based in the cloud provide action and other social groups with simple yet sophisticated tools to assemble and support social networks; to collect, and assemble personal knowledge; and to transform personal knowledge into community knowledge. Properly implemented in a collaborative environment, Web tools can also be used by bureaucrats and administrators to source local knowledge to support rational decisions about allocation of resources, etc. and to deal with various kinds of emerging situations. The template developed for this project[1] demonstrates cloud computing capabilities of the new tools.

This chapter relates to the sociological concept of "community action". Following Bryant [26], to us, community action means any emergent or externally promoted attempt to involve local people in self help schemes or to participate in policy making and service provision. A community action group is a network of people formed in a local context to promote, guide, or carry out social, political or practical objectives. From theoretical and practical points of view we explore roles of knowledge and information in (a) forming such groups and (b) achieving 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" (CoI) and "communities of practice" (CoP) [12,27,28]. Compared to the well known CoPs, which often are informal subdivisions within the structural hierarchy of one or more existing organizations, action groups are normally independent, self-governed, and are often 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 – often as promoted by community "organizers" [29-32].

The new Web-based "social" technologies provide people with powerful cognitive tools to help form and sustain such groups, and to construct, manage and share knowledge relating to commonly held concerns. The result of combining people with cognitive tools with networking capabilities is the formation of sociotechnical networks with much more power than the people alone would have. The technologies to be discussed here have been tested primarily in community action groups, but provide all kinds of knowledge-based groups with powerful tools for assembling, sharing, and applying knowledge and enabling virtual participation in group activities.

In this chapter we begin with a theoretical framework for community action, then discuss some of the revolutionary cognitive technologies that provide tools for implementing the theory, and conclude by presenting some preliminary observations from ongoing case studies where the technology has been recently implemented. Given that

[1] see "Template for Knowledge-Based Community Organizations" - https://sites.google.com/site/organizingcommunityaction/.

some of the specific Web technologies we are concerned with here have only become fully functional since 2007-2010, there has been no opportunity to study their use over long time scales.

2 Theoretical framework

2.1 Communities and Action Groups

Human social systems are based on fractally complex networks of physical, social, and economic interactions. The networks define complex adaptive systems at different hierarchical levels of organization from local groups, formal organizations and governing bodies. Many of these bodies have properties allowing them to be considered autopoietic (i.e., living [33], see Section 2.3) at a level of hierarchical organization above individual people and below economic or statutory organizations [18-25,33-41].

All activities maintaining the organized fabric of urban and regional districts are to some degree knowledge-based and would not function without the material implementation of that knowledge. Governing bodies make decisions at many different levels of organization, whether by committees, individual bureaucrats or designated workers. All decisions boil down to individual people choosing among 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 [1,8,22,42]. 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 almost always better than no decision, so Simon recommends that decision makers should find tools that can help them make the "best" decision one can in the time available, to help "satisfice".

> [T]he elaborate organizations that human beings have constructed … 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 ([1]: p. 354).

> [W]e … understand today many of the mechanisms of human rational choice. We … know how the information processing system called Man, faced with complexity beyond his ken, uses his information processing capacities to seek out alternatives, to calculate consequences, to resolve uncertainties, and thereby -

> sometimes, not always - to find ways of action that are sufficient unto the day, that satisfice. ([1]: p. 368)

Organizations can make more effective decisions by devolving decisions to people who are closer to the problems and presumably have more knowledge and time to consider the particular problem area [8]. Another is to more effectively filter decision related input to genuinely critical information and tested wisdom [22]. Greiner [45] observed that to grow large, businesses had to survive several revolutionary transformations in management structure to continue growing. We think that successful revolutions represented 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 [8,22].

Individual people can work together in the interface between their physical environment and systems of urban and regional governance to ensure local and personal knowledge is available to guide and constrain activities of administrative juggernauts. Within large social systems, action groups can emerge from networks of people with interests in particular problem areas [12,16,25]. However, there is a large gap between the emergence of an action group and assembling its members' personal knowledge into coherent objective knowledge to support rational decisions by a bureaucrat or functionary. We next look at some theoretical considerations involved in understanding the nature of this gap and bridging it.

2.2 Constructed and tested knowledge

What "knowledge" and "information" mean in the organizational knowledge management discipline is contentious [46-48]. Here we adopt Karl Popper's [49] definition that knowledge is "solutions to problems", where the knowledge may be contained in thoughts, in speech, written on paper, or embodied in the structure of an artifact. For living entities, everything involved with maintaining life in a constantly variable environment is a "problem" [50,51]. In this framework, we consider that "information" refers to variations in the world that may in living things stimulate cognition and add to living entities' knowledge, i.e., Bateson's [52] "differences which make differences". For us, information signifies the content or "meaning" of a message based on its effect on the cognition of the recipient (see Hayles discussion [53: p 55-56]).

Popper [49,55,56] as interpreted by Hall [18-21] also usefully divided the world into three ontological domains:

- "world 1" – the world of uninterpreted physical systems and dynamics,

- "world 2" – the world of cognitive processes (i.e., cybernetics) together with structural, dispositional and subjective knowledge (i.e., living knowledge), and
- "world 3" – the world of "objective" knowledge (i.e., knowledge that is codified into relatively inert and persistent objects existing in world 1 via printing, computer memories or DNA).

Donald Campbell [54,57] coined the term evolutionary epistemology for the understanding he and Popper had that knowledge was something that was cognitively constructed by living entities from their experiences with the world through fallible processes of trial and error learning [58]. Campbell called the process "blind variation and selective retention", and Popper "conjecture and refutation" [59] or "tentative solutions and error elimination" [49]. In evolutionary epistemology knowledge is constructed via continually iterated cyclical process of cognition resulting in increasingly accurate, although always fallible, understandings of reality. Popper's most detailed exposition what he calls his "general theory of evolution" [49: pp. 241-244]. A more concrete description of the fundamentally cyclic nature of knowledge building in the real world is summarized in John Boyd's OODA Loop process (Fig. 1) [19,20,22,23,60-,62] that is applicable to both personal and organizational levels of analysis.

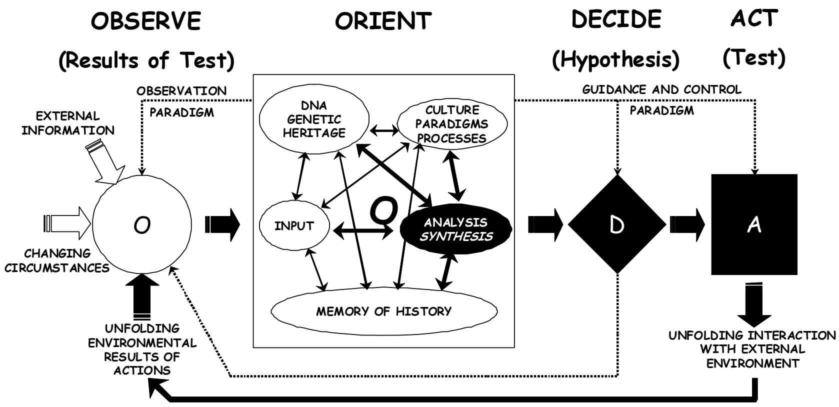

Fig. 1. Boyd's problem solving Observe, Orient, Decide, Act (OODA) Loop. (after [18,60])

This cyclical process of knowledge building involves self-reflection, self-criticism, and self-maintenance that some consider to be viciously circular [e.g., 63-65]. Vollmer argues on philosophical and scientific grounds that such critiques are unfounded as the supposed "circular" processes are "non-vicious, consistent, fertile, self-correcting feedback loops … termed 'virtuous circles'" [66: p. 200]. More simply, knowledge building involves neurological or administrative processing in the physical world [67]. There can be no paradox as the cognitive activities are causally connected to form a 'virtuous spiral' process through time [22,23,] (Fig. 2; see [68] for animations of the concept). Due to time delays in dynamical systems, the world as observed is never the world that is acted upon.

Problem solving entities (people, organizations) seek to understand the world in ways that will enable them to reach particular "intended future" states, but they exist in an unpredictably changing world, where at any time the situation may diverge to any of many possible "divergent" futures [22,62,67-69]. Without continual vigilance, rational orientation and decision, reflected in appropriate action (i.e., via OODA cycles) to converge on intended futures, stochastic divergence is inevitable. It is here that Simon's [1] bounds to rationality are of particular concern. For them to be effective, decisions must be made in the entity's cognitive system close enough to the interface with the problem that processing is informed with enough relevant observational data without being overwhelmed with irrelevant information [22,43,67-69].

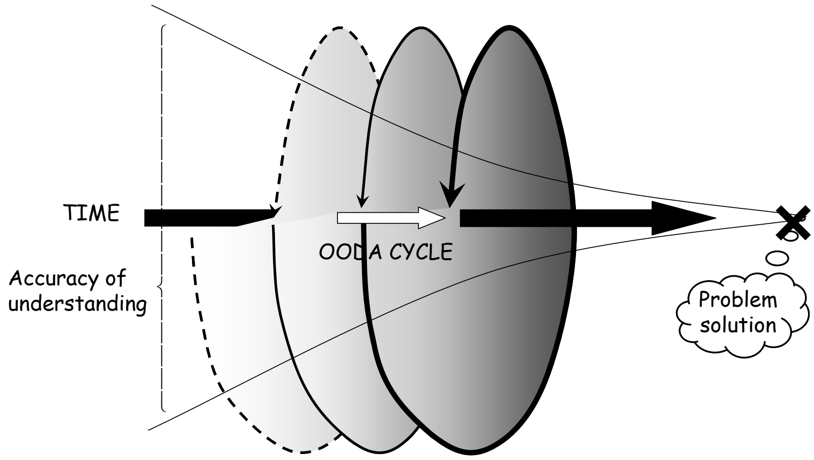

Fig. 2. Spiral construction of knowledge through time converging on a solution to a problem. See [12,22,23,68].

2.3 Life, cognition and living knowledge

We have argued elsewhere that cells, people, organizations and other entities in the complex systems hierarchy of the biological world are all autopoietic or living [18-25]. Autopoiesis (= "self" + "production") is a condition of a complex dynamical system at any level of structural organization that gives it the autonomous ability within its environment to self-produce and maintain its dynamic state of organization. As defined by Maturana and Varela [33-35], 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 [35: p. 192-193]:

- *Bounded* ("the unity [i.e., an entity] has identifiable boundaries"). Varela et al. {35} were concerned that the entity could be discriminated by an external observer. To us this criterion should read, "the entity has *self*-identifiable boundaries".
- *Complex* ("there are constitutive elements of the unity, that is, components"). Biological systems are more than complicated.
- *Mechanistic* ("the component properties are capable of satisfying certain relations that determine in the unity the interactions and transformations of these components"). In other words, the complex entity is a dynamical system, such that components show causal interactions as detailed by Urrestarazu 70.
- *Self-referential or self-differentiated* ("the components that constitute the boundaries of the unity constitute these boundaries through preferential neighbourhood relations and interactions between themselves, as determined by their properties in the space of their interactions"). That is, the boundaries of the system are structurally determined.
- *Self-producing* ("the boundaries of the unity are produced by the interactions of the components of the unity, either by transformations of previously produced components, or by transformations and/or coupling of non-component elements that enter the unity through its boundaries").
- *Autonomous* ("all the other components of the unity are also produced by interactions of its components as in [the statement above], and … those which are not produced by the interactions of other components participate as necessary permanent constitutive components in the production of other components")

Maturana and Varela [33] consider that cognition begins with the self-defining, self-regulating and self-producing spiral processes that define and dynamically maintain the autopoietic condition. In other words, autopoiesis cannot exist or continue without cognitive processes able to build, maintain, and act on knowledge to solve the problems of life. See Popper, [49] and "All life is problem solving" [51] for a similar understanding developed completely independently from Maturana and Varela's (or conversely).

Unifying the paradigms of evolutionary epistemology and autopoiesis [33-23,71], we recognize three categories of knowledge:

- *Structural* knowledge is embodied in the organized physical structure of a causal network responsible for maintaining autopoiesis in a dynamical system in an instant of time. At one instant the structure is such that it ensures that the causal network maintains autopoiesis in the next instant. In other words, most adjacent possible [71-74] states of the system in the next instant will be states that also propagate the autopoietic organization of the system. Thus, autopoiesis continues as long as the system remains in the basin of a "'strange' or 'chaotic' attractor" [75: p 178-179]. Loss of autopoiesis is equivalent to disintegration of the system. Natural selection builds increasingly reliable knowledge by eliminating entities unable to maintain themselves in the basin of attraction where autopoiesis is maintained.

- *Dispositional* and *subjective*: Using Popper's terms [49] (and as informed by the theory of autopoiesis [33]) this is knowledge held in the nervous system. Dispositional knowledge relates to dispositions or instincts to act in certain ways, i.e., as built into the inherited or habituated structure of the nervous system; subjective knowledge is the living or conscious knowledge of the individual "subject", readily available to be criticized or improved by learning. All of this is more or less comparable to Polanyi's [76,77] "tacit" knowledge.
- *Objective* or "*explicit*": encoded forms of knowledge (e.g., in the form of letters on paper, sequences of bits in a computer memory, or sequences of nucleotides in a DNA molecule). Objective knowledge is inert and persistent. As such it can be preserved through time and exchanged across time and the space between living individuals.

Structural, dispositional and subjective knowledge, together with the cybernetic (cognitive) processes for building, maintaining and acting on this knowledge are encompassed within world 2. Popper [49] places articulated (but not codified) speech in world 3 together with all kinds of persistently codified knowledge. We (following Hall [71] and Ong [78]) place speech in world 2 because sound vanishes from the physical world in an instant and its content persists only through its impact on cognitive processes of living people (world 2).

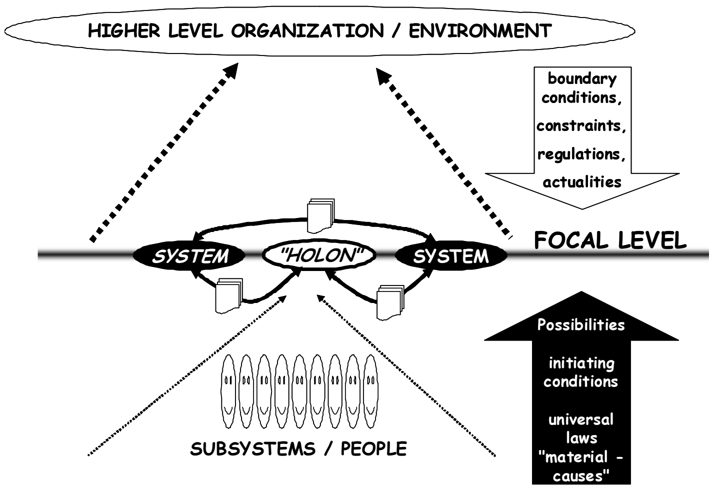

Fig. 3. Action groups in the hierarchical structure (after 21, 37)

Living systems emerge and can exist at several different levels of organization in a complex systems hierarchy [25,19-21,36-40,79,80].

The hierarchy containing living systems ranges from fundamental particles; through cells, multicellular organisms, and various kinds and levels of social systems involving organisms; to planets, solar systems, galaxies and the universe [37,80]. What we see is determined by level of the hierarchy on which we focus (Fig. 3). If we focus on, e.g., human organizations, we see organizational systems comprised of components ("subsystems" such as people that may be recognized as systems in their own right if studied at a lower level in the hierarchy). The focal system also exists within an environment (e.g., a national economy) that may also be seen as a system in its own right when examined at a higher level. Koestler [81,82] (following Simon [38-40]) wrote that a focal system ("holon") formed a triad of the system itself and its component subsystems, within the higher level organization that formed its environment. Focal levels containing living enties are self-identified. Causal networks of subsystems and components constrain what the holon is capable to do (upward causation), while downward causation from the higher level system constrains what the holon is possible to do.

Simon [38-40] noted that individual systems and levels of complexity can be discriminated by intrinsic interaction frequencies. Systems at a focal level are discriminated by lower frequencies of interactions across their boundaries than between components within them. Simon [39: p. 33] called this "loose coupling". (Maturana [83: p. 54] similarly noted that boundaries of autopoietic system are "surfaces of thermodynamic cleavage"). Hierarchical levels in a holonic triad are discriminated by interaction speeds. Interactions of components in subsystems are generally so fast that (seen from the focal level) they appear to be in internal equilibrium and interact as particles in law-like ways to form the focal system. Similarly, interactions of components forming the supersystem will generally be so slow that the supersystem forms a relatively constant environment for the focal system [39: pp. 10-11, 40]. Simon calls hierarchically complex systems conforming to this situation "nearly decomposable".

For humans, networks of "social" interactions interconnect people via the exchange of knowledge or "content" in worlds 2 and 3 (see Section 2.2) to form higher order social systems (organizations). In people, faster networks of interaction interconnect their nerve cells to carry out cognitive processes. In organizations, (1) structural knowledge for autopoiesis is held in dynamically changing logical and physical networks of interactions amongst members, layout of plant and equipment, etc., (2) dispositional and subjective knowledge in the minds and behaviors of its members – especially as reflected in organizational routines and jargons ("organizational tacit knowledge" in Nelson & Winter's term [84]), and (3) explicit documentation produced and shared among organizational members [19,20,41].

2.4 Emergence and sustainment of knowledge-based community groups

We seek to understand the emergence of knowledge-based entities in the hierarchy between individual people and local and regional authorities and governments. Salthe [79] argues that self-sustaining systems can emerge at intermediate levels of organization in the complex systems hierarchy where there are major inefficiencies in the dissipation of potential between existing levels. This corresponds to situations where there is a gap between what people in a local area need and want in terms of affordances from their environment and what the social supersystem is providing. This is often due to gaps in resources and knowledge.

Where individual people form groups to construct, share and apply knowledge relating to problem situations, Nousala and Hall [25] suggest that they coalesce around a "human attractor" who has a public reputation for interest in that type of problem. People recognize that they share this interest with the attractor and begin to exchange knowledge with her/him, and having been brought together by the attractor, they also begin to network amongst themselves in various knowledge transfer processes, as illustrated in Fig. 4 that shows early stages in the emergence of an autopoietic organization..

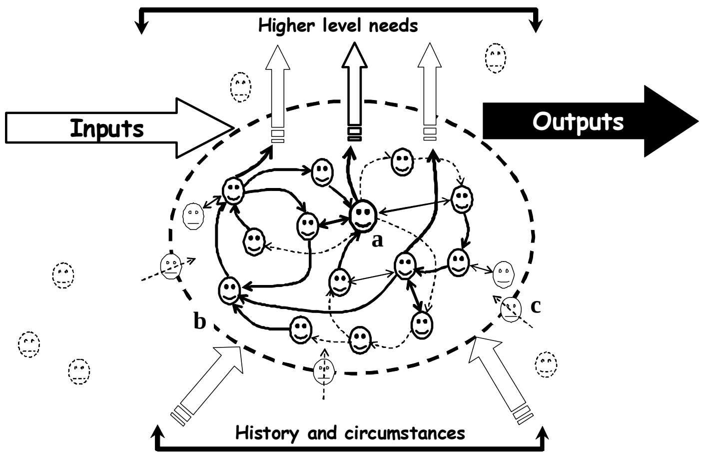

Fig. 4. Early stages in the emergence of a knowledge-based community [after 25].

"Faces" in Fig. 4 are subsystems/people in the emerging group or organization. ('**a**') is a human attractor. ('**b**') is the emerging boundary separating "insiders" who identify themselves as participants for community purposes from "outsiders" in the neighborhood. Faces crossing the boundary ('**c**') are people being recruited and inducted into the community. Bright smiley faces represent people/actors receiving organizational/social rewards for their involvement with the collective need. Open arrows at the top indicate the value/importance of the assembled knowledge as this is ordered and directed to address higher level organizational needs, while arrows at the bottom indicate the importance and roles of historical circumstances in constraining what is possible ("adjacent possible"). Directed lines connecting faces show knowledge transfer between individual actors. Line weights show strengths of the connections. Note that the connections are beginning to form cyclical knowledge processing routines able to be mapped and improved [2,85].

Fig. 5 combines the concepts introduced in the previous four figures to illustrate the virtuous knowledge building spiral of an emergent organization responding to environmental imperatives and its internal goals. Each OODA cycle responds to fresh observations where the organizational understanding is analyzed and criticized via orientation processes and tested via selective decisions and actions in the world. On balance, the organization's understanding of the world should be improved with each turn of the spiral.

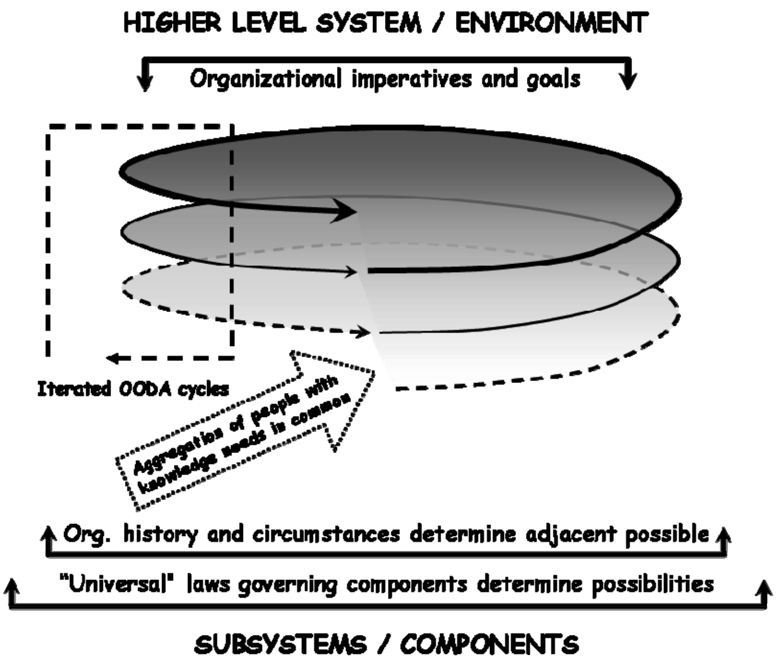

Fig. 5. Building organizational knowledge [after 12].

Different categories of knowledge may serve different functions in a knowledge-based group. Structural and other kinds of knowledge contributing to forming and maintaining the autopoietically functioning network structure of the organization are what makes the functioning group something more than the arithmetic sum of its individual members. Especially in the case of community action groups, knowledge may also be generated for export to the world as products of the groups activities.

Fig. 6 illustrates this in a fully formed knowledge-based group, where the practices to form and maintain the community have been objectified as structural procedures (indicated by the records icons). Grey faces: those using codified knowledge (‘**a**’) about how to manage internal and external monitoring processes providing overall feedback control. White faces: those using codified knowledge (‘**b**’) about processes for producing and exporting knowledge to the external world. Black faces: those using codified knowledge (‘**c**’) about the product quality control cycle. (‘**d**’) codified knowledge about induction process recruiting new individuals into the community to satisfy new needs and to replace attrition. For the community to persist beyond the memberships of particular people, new members need to be recruited and “inducted” into the group to replace those leaving. In this context involves inductees adopt the group’s interests and aims, accept affiliation, and learn to carry out tasks contributing to the group’s overall survival and success. (‘**e**’) codified knowledge about environmental monitoring processes. (‘**f**’) codified and structural knowledge about how to establish and sustain the community itself.

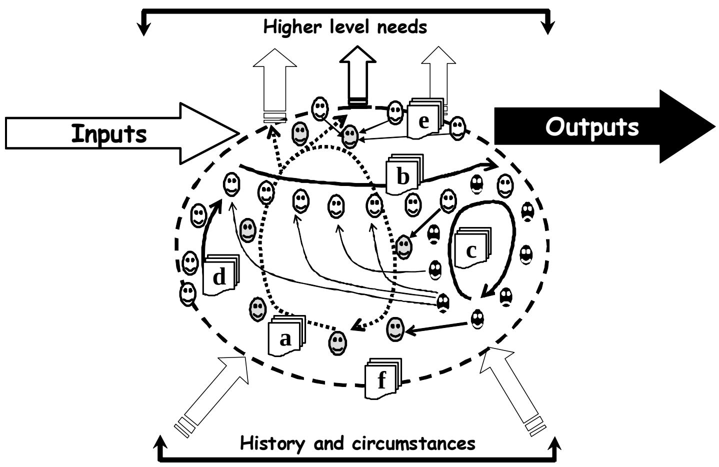

Fig. 6. A mature community (after 25).

2.5 Application of actionable community knowledge in a governance framework

We now consider how emergent knowledge-based community groups fit into and function in the hierarchical complexity of the knowledge ecology [86] of their environments. Urban/regional councils, other administrative bodies 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.

Fig. 7 applies the theoretical framework presented in the previous sections and [7] to knowledge acquisition, building and acting in the urban environment. We recognize at least three nested epicycles of knowledge-based autopoietic systems that we have also seen in other hierarchical knowledge-based systems, i.e., large engineering organizations [8,12,15,16], industry clusters [5,6], and academic and scientific research communities [24,88]:

The levels in these hierarchical structures are defined as follows:

- *Individual people* (”**I**”). Individuals concerned by particular problems may assembler explicit knowledge in the form of documents, photographs, maps, records of measurements, etc; as well as developing his/her personal knowledge. Following Popper [49] this knowledge building may involve cycles of **O**bserving, **O**rienting, constructing **T**entative **T**heories, and acting to **E**liminate **E**rrors.

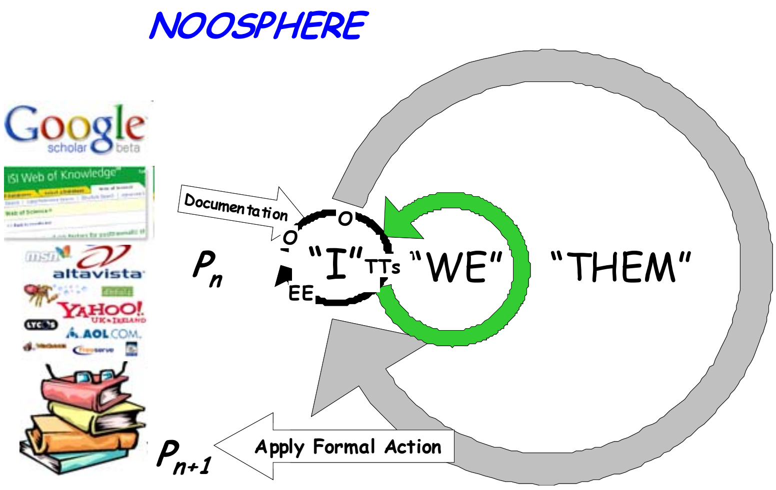

Fig. 7. Putting community knowledge into its hierarchical context (from [7]).

- *Community action groups* (“**WE**”). Where several people face similar problems, they may share concerns and knowledge leading to emergence of a community group [25]. This may involve sharing personal knowledge and documents to build a group repository. Group success and sustainability will depend on the success of the personal interactions in assembling useful knowledge and action plans.
- *Councils and other governing bodies* (“**THEM**”). Councils are complex bureaucracies, organized into departments responsible for problem areas. Decisions to act tend to be centralized, where the bounds to

rational decision making are likely to be the greatest [8,22]. Those making decisions often know little about specific problems. Groups close to the problems can collect, organize and present their collective knowledge in formats easily used by functionaries. Ideally, action groups can function as knowledge building epicycles connecting councils' knowledge building activities with reality.

- ***Noosphere*** [87]. This is (a) the totality of human knowledge available to man and (b) the cybernetic processes operating in this space (without any teleological or mystical connotations that might be inferred from Pierte Teilhard de Chardan's writings). This includes knowledge ecologies [86,89] and all kinds of knowledge artefacts in world 3 and the collective personal knowledge of humanity in world 2. With appropriate tools, **I**, **WE** and **THEM** can all draw on the collective knowledge and wisdom of the "Noosphere".

The emergence of groups networking around common causes within larger social or ecological systems is probably as old as the origins of human language [78], depending mainly on tacit and verbal knowledge exchange [8,12,13,14,15,16]. However, as will be discussed in the next section, the development in the last ~30 years of cognitive technologies able to exchange massive amounts of explicit knowledge in a variety of formats has revolutionized the environment for and potential capabilities of knowledge-based groups

3 Technologies for socially constructing and sharing knowledge

In less than a lifetime, the integration of new cognitive tools and knowledge production technologies has extended human cognition far beyond the bounds of human brains. Humans have become "post human", where people and their machines now act as symbiotic super-organisms (53,90-93). Similarly, human networks have become "socio-technical", i.e., comprised of people, plus tools, machines and technologically mediated processes [94]. Over the last 30 years, tools such as personal computers and the internet are radically revolutionizing people's interactions to organize. Today's organizations potentially command vastly more knowledge to support their actions than was the case three decades earlier.

3.1 The importance of "free" applications for the support of emergent action

Genuine community action begins with individual people at the grass-roots level, who desire (and need) to combine their knowledge with the knowledge of other individuals in the community who have similar concerns and interests to act. The essential consideration in this emergent situation is that whatever is initially done to establish an organized action must be done within the personal household budgets of interested and motivated individuals. Institutions, governments and industrial organizations can spend millions of dollars on integrated knowledge management applications for licensing, implementation, training and support (3,4,10). Individuals need access to user friendly applications they can readily implement for no cost other than time and labor. In the remainder of this paper we consider only applications that are available "free to the web" for no license costs to individuals and community groups.

3.2 A caveat

However, there are important caveats regarding the use of "free applications". Genuinely useful tools are created only through the investment of major intellectual effort either by altruistic groups or commercial organizations hoping to use them as vehicles for paid advertising or for marketing paid services. Where products provided by altruistic groups are concerned, there is no guarantee that the group will survive to provide continuing maintenance of the application. Where tools developed by commercial organizations are concerned, the free service may be withdrawn or changed at any time on the whim of the provider.

Although our demonstration below is based on Google's applications as they existed in the latter half of 2010, it should be noted that in February 2011, with no warning, Google (1) made major modifications to the user interface of their flagship document management ("Docs") application. These substantially impaired the functionality of its user interface (even for paid users - Google Help Forum: "The New Refreshed Documents List is DREADFUL" - http://www.google.com/support/forum/p/Google+Docs/thread?tid=327b78beafe120ba&hl=en; and (2) changed the licensing of their application suite ("Apps") that now requires paid licensing for use by more than 10 members ("Update on changes to Google Apps" – email to existing users dated 29 April 2011). The advertised cost for commercial licensing of Google Apps is $50 per user/per year (http://www.google.com/apps/intl/en/group/index.html) or $30 per user/per year for "nonprofits" having US IRS 501(c)(3) status with more than 3000 users or a free Google Apps for Education license for those qualifying organizations with fewer than 3000 users (http://www.google.com/nonprofits/eligibility.html) or non-US, although we could find nothing on Google's web pages explaining how such smaller organizations could obtain licenses. These changes may offer insurmountable obstacles to those attempting to implement Google's tools for at the level of community groups. At the time of writing this, it is still unclear how these changes impact the "sharing" capabilities of sites maintained by a single person – as is the case for the implementations documented below.

3.3 Social, semantic 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. As personal computing technologies have vastly extended and revolutionized the cognitive capacities of individual humans [53,92,93] is turning emergent human social organizations on the borderline of autopoiesis, that to now have been predominantly organized via tacit knowledge exchanges, into much more powerful and robustly sustainable "sociotechnical" organizations. Three new 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 significance of components of text to be marked up in ways that computers can understand semantically for further processing [3,95], with the first "Recommendation" for XML released in 1998 [96]. However, the full potential of the semantic web hoped for by Berners-Lee et al. [95] has still not been realized because of difficulties reconciling logical and dialectical differences between the implementations of XML on different sites [88,97].
- *Web 2.0*. Web 2.0 or "social computing" does not refer to specific technology developments but rather to the development of aspects of the web that favour virtual collaboration and sharing of electronically delivered content. The term Web 2.0 was invented by O'Reilly in 2001 to cover the whole range of social computing activities [98,99] Following Miller [100], Web 2.0 thinking seeks to:

  - Free data (e.g., 'freedom of information', minimize constraints on data access),
  - Enable virtual applications (e.g., aggregate data & functions from different sources),
  - Facilitate two way participation (e.g., peer to peer)
  - Focus on user needs not provider wants
  - Build modular applications (facilitate 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 Web 2.0 qualities is Wikipedia [101]. A wiki is a collaborative website where users can easily add to, modify and comment on content using only a Web browser. Wikis facilitate collaborative 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 [102].

- *Cloud computing*. The concept first appeared in 2007 [103-105] to cover the idea that data storage and processing will be offloaded onto external repositories and data processing centers [106,107] users can access the data and control the processing with little more than a web browser and internet connection. A wide range of applications (apps) are available that can be more-or-less readily integrated to meet most knowledge management needs for knowledge-based groups.

  The best known cloud-based tool is probably MediaWiki (http://www.mediawiki.org/), that provides the basis for Wikipedia. From the point of implementiation by individual users at the community level, its user interface is non-intuitive and does not provide for the easy embedding of tables, calendars and non HTML content such as videos and forms that are useful to community groups. On the other hand, Although free and useful cloud-based tools are offered by many providers, the major tools we personally experimented with and integrated in 2010 for community use are Google's cloud "Apps" (see caveat in Section 3.2, above) with social capabilities [9]. These include:

- *Google Account* (a "single-sign-on" server that identifies a user for access to other Google Apps – see Wikipedia: "Google Account"),
- *Gmail* (a cloud-based email server launched as a beta in 2004, and fully released in 2007 – Wikipedia: "Gmail").
- *Docs* (authoring and repository). Text documents, spreadsheets and presentations can all be authored and edited in the HTML-based browser environment. Any document type may be stored and managed in the repository (but only Google formatted documents may be edited in the browser rather than using a dedicated application – e.g., MS Word for .doc formats). Docs supports document sharing and collaborative authoring with version tracking. Documents may be shared or not (controlled either at file

or folder level and sharing may be limited to specified account holders or may be open to the public). Docs was released to Google Apps users in February 2007. Currently, each Google Account user is automatically granted more than a gigabyte of free repository storage in the cloud. Additional storage can be purchased in increments of 20 GB for (currently) $5.00 per year, electronically payable via Google Account. (Wikipedia: "Google Docs"). Note 1: free tools such as Zotero (http://www.zotero.org/) and Dropbox (http://www.dropbox.com) are substantially better stand-alone tools for managing shared document repositories than Docs, but offer less free storage and connectivity with other tools. As for Google, additional Zotero or Dropbox storage can be purchased - at substantially greater costs than Google charges. Note 2: changes made to the user interface in Feb. 2011 make Docs less user-friendly than it was in 2010)

- *Sites* is a flexible wiki-like collaborative authoring tool for assembling and managing complete web sites based on collections of HTML Web pages. Sites, launched in 2008 has similar access controls to Docs, and (e.g., compared to MediaWiki) will embed and provide access to files held within (and controlled by) Docs. It is ideal for hosting community-based wikis. Usage notes for Google Sites are provided by [108,109]. (Wikipedia: "Google Sites").
- *Groups*, acquired in 2001, offers a discussion forum format allowing threaded conversations comparable to several other group hosting applications, except that it relies on the members' single-sign-ons maintained in Google Accounts. Groups may be based on controlled subscriptions or open to the public, and may be used to manage sharing for Docs and Sites (Wikipedia: "Google Groups").
- *Translator Toolkit* is Google's multilingual collaborative translation tool hidden behind its normal machine translation function. It facilitates interactive human collaboration and lexicon development around machine generated texts (Wikipedia "Google translator toolkit").
- *Other Google social computing tools integrating with Sites*. There are a variety of other social computing tools in addition to those mentioned above that can be integrated into a Google Sites environment to assist the assembly and management of group knowledge, and to produce knowledge-based products to influence decisions of larger organizations [9,108]. These include: Google Maps, Picasa Web Albums, Google Calendar, and You Tube.

4 Constructing a Template for Community Groups

For community problem solutions to be successful, they need to meet community content management requirements and be supportable. For several years Hall has supported collaboration environments for an informal research group, TOMOK, interested in the theory, ontology and management of organizational knowledge. After testing several free wiki tools and collaboration environments, the group's first collaboration environment was established on a product called BSCW and marketed by OrbiTeam (http://www.bscw.de/english/product.html). This provided full content management requirements for source references and versioning, tracking and discussion requirements for several coauthored papers, to meet all TOMOK's requirents Although BSCW was available free on trial or for longer periods to unfunded academic groups, TOMOK found the server maintenance and frequent re-licensing requirements beyond our capacity to support.

From January to mid May 2010 Hall constructed a collaboration environment for the TOMOK group using Google Apps, and based on this experience, began experimenting with implementing these tools in community action scenarios.

4.1 Initial usability testing in a community action scenario

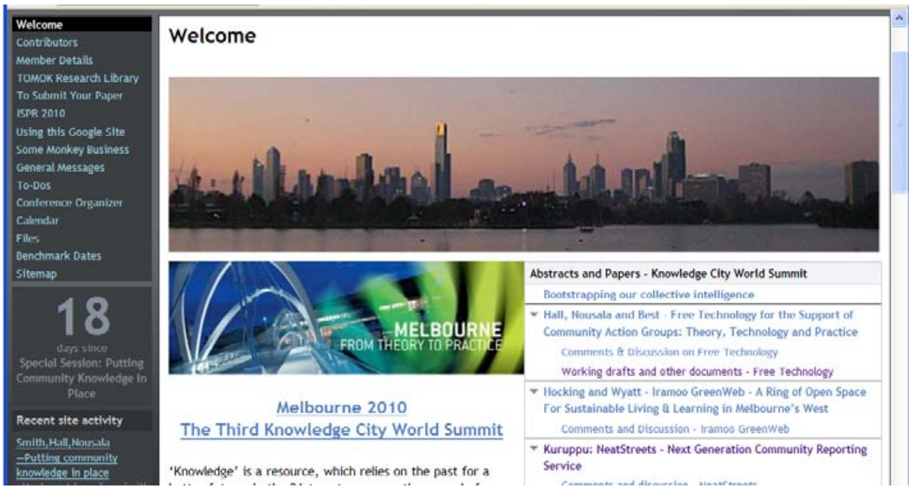

Fig. 8. Test 1: wiki site constructed for a particular group project

Our assumption that the technology would be useable by people with few computer skills has been tested in four new implementations (note: these test that the technology meets theoretical requirements discussed above, and are not studies of the knowledge lifecycles in the groups concerned):

- *Test 1* (Fig. 8): Hall established a collaboration site for authors contributing to a special session of Knowledge Cities World Summit, "Putting Community Knowledge in Place", beginning with Google's

Wiki template (https://sites.google.com/site/projectwikitemplate_en/). Implementation began 17 May and was complete and shared with other contributors by 26 May.
- *Test 2* (Fig. 9): 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 [108]. 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.

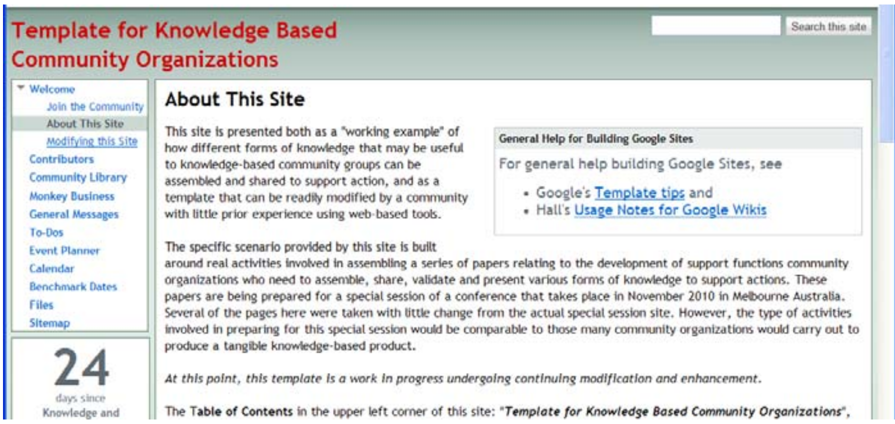

Fig. 9. Test 2: Template for Knowledge Based Community Organizations.

- *Test 3*: Starting with a blank Google Site, a new site was created by the Riddells Creek Landcare Group (RCL) with content transferred 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(http://www.riddellscreeklandcare.org.au/). Beginning with the blank site opened around June 1, 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 prior server-based technology that requires specialist skills to administer.
- *Test 4*: Google Sites was trialled 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. 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. For the live site see http://www.jcen.org.au/.

The conclusion from these tests is that anyone able to use an internet browser on a personal 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 limited documentation to explain use of sophisticated functions and multiple ‘add-ins’ (i.e., “gadgets”). To partially fill this gap we developed the Template for Knowledge Based Community Organizations [108] that also includes some detailed usage notes [109].

4.2 Knowledge management capabilities to support community action

For community actions in the real world to successfully achieve 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, testing and criticism of knowledge following a Popperian knowledge development cycle as illustrated in Fig. 1 and Fig. 5. An appropriately implemented wiki should meet most knowledge-related requirements for a community action group. In our personal experience, Google Sites (together with other Google Apps) meets several knowledge management requirements beyond content management for community action groups, all as illustrated in [108]:

- *Observation*: Hall [109] describes 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” in 108).
- *Orientation and development of tentative theories/solutions*: Web pages offer provisions for people to comment, discuss and attach additional document files. 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) and at the bottom of the “Free Technology for the Support of Community Action Groups” page (specific).
- *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 councillors 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.
- *Recruitment functions*: The site may be shared with "everyone" so it is indexed and discoverable by anyone interested in the group's activities.
- *Membership 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, membership dues 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 mail out function other than change notifications specifically associated with a Google Site. Group members can nominate to be notified of changes to the site as a whole or to designated pages within the site. However a parallel Google Group (see http://groups.google.com/) can be established and linked to the site to manage a fully functional discussion list.
- *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 for Government" have been certified for government use under the US Federal Information Security Management Act [110].
- *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.

4.3 Higher levels of organization

Although our own studies have focused on the potential uses of cloud computing social technologies at the level of communities emerging at levels of organization between that of individual people and the larger governing organizations such as urban and regional councils and states, such technologies are also being adopted at these higher levels in the USA, at city, county, state and federal levels. Documented examples implementations are Department of Defense, Social Security Administration, State of Wisconsin, Prince Georges

County MD, and the City of Los Angeles amongst several others [111]. The next step in our explorations of the social dynamics of this technology will be to see if we can build connections between the "WE" and "THEM" epicycles (Fig. 7) social knowledge building.

5 Conclusions and looking to the future

Even before the Web was established, it was recognized that interpersonal networking supported by computer systems could help form and sustain community groups [112,113,114]. As elaborated above, in 2010 no cost and easy to use social technologies appeared that offer extraordinary capabilities for socially constructing, managing and delivering content for knowledge based community groups. The tools can easily be used by a single human attractor to create a socio-technical environment advertizing a problem situation and inviting like-minded people to join together to form a community of interest/practice/action. The community and its membership can be easily formalized in the environment that then offers its members an array of powerful tools helping group members to capture observations and existing knowledge to build, criticize and propose solutions to the identified problems.

Once established, the site and its contents persist as an underlying and evolving structure (a) linking the changing network of community members and (b) containing knowledge relating to the community's imperatives as individual members come and go. Individual humans are dynamic actors in the organizational system, but the evolving knowledge persists to guide and inform members' individual actions relating to the system's goals and to sustain its organization. The sociotechnical knowledge management system can thus contribute greatly to the formation and continuity of the community as an autopoietic organization.

The small organizational networks that tested the technology described here are all components of emerging umbrella groups concerned with monitoring, maintaining and improving the ecological health of the urban fringe of the Melbourne metropolitan area. These super-organizations are emerging from the overlapping interests of (1) several individual landcare groups (e.g., Riddells Creek Landcare – *loc. cit.*) combined into umbrella groups covering drainage basins crossing the northern and western suburbs of Melbourne (e.g., Jacksons Creek Econetwork – *loc. cit.*), (2) native plant and animal societies (e.g., the Keilor Plains Group of the Australian Plants Society - http://www.apskeilorplains.org.au/), and (3) an emerging grant-supported group called NatureShare (http://natureshare.org.au/) that is seeking to observe, photograph and map all Victorian flora and fauna. These last two sites are at least partially implemented on paid applications and servers, and were also reasonably costly to implement by comparison to the Google sites reviewed above.

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 [115,116]).

Finally, we seek to understand how the knowledge building and sharing capabilities of the action groups can be integrated with local and regional governments that are themselves implementing similar social technologies in their own organizations (Fig. 7).

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