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A Personal Working Model

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Abstract

This paper builds an abductive argument for the existence of a working model personal to each knowledge worker which it bases on long-established cybernetic principles of control and regulation. The paper demonstrates what a working model needs to encompass, notably the individual herself as she crafts her personal work system PWS and her supporting personal information management system PIMS. The essential characteristics of a PIMS are identified. Conceprocity, concept process reciprocity, models are introduced and the example of the first author is used as a means of illustrating a Working Model. An appendix presents further details of the Conceprocity modelling language.

Keywords: personal knowledge management, personal work management, personal work systems, individual information systems, personal information management systems
[9066 words including 1086 words of references]

1. Introduction

This paper has been written in order to describe the current state of our research into a phenomenon which we call the ***personal working model***. We show the need to model personal working models in order better to understand and learn and from them and subsequently improve them; and to control (regulate) them. This personal working model is the first claimed contribution of this paper.

The model is presented using a new visual and textual concept mapping approach which we dub Conceprocity, concept ↔ process reciprocity. Conceprocity is the second contribution of this paper.

The principal research method used so far in this work-in-progress has been auto ethnography. Our subsequent intention, which we do not yet report upon, is to use the ideas presented here as the basis for mentored action research concerning the personal working model of further individuals.

Table 1 summarises the structure of this paper.

2.	What is already known about Working Models? A review of the literature
3.	Our principal conjecture
4.	What is a Working Model and how can we model it?
5.	How can we investigate the phenomenon of the working model? Research methods
6.	Representing working models: Conceprocity
7.	Initial synthesis (1): The Personal Work System PWS of one of the authors
8.	Personal Information Management Systems PIMS
9.	Initial synthesis (2): The Personal Information Management System PIMS of one of the authors
10.	Giving empirical substance to the Personal Working Model and the Personal Information Management System. This section discusses PIMS, Specks and Nuggets
11.	Future research design
12.	Conclusion
	Appendix 1: Introduction to the Conceprocity notation

Table 1 Structure of this paper

2. What is already known about Working Models? A review of the literature

This conceptual paper suggests, justifies and begins to demonstrate the existence of a phenomenon: that of the ***Working Model*** of the knowledge worker; and introduces ways to recognise and research the phenomenon. We have previously written concerning the phenomenon which (Baskerville, 2011) calls individual information systems and we call personal information

management systems PIMS. We do not here repeat the literature review in those papers: (Gregory et al., 2012) and (Gregory, 2012). Here we concentrate very largely on the cybernetic and systems thinking that underlie the Working Model which is first discussed in this current paper.

What conceptually does this Working Model consist of? And on what basis can we be moderately certain that it exists, even in conceptual terms; and that it has reference to the real world?

The law of requisite variety can be stated thus: "Variety absorbs variety, defines the minimum number of states necessary for a controller to control a system of a given number of states" (albeit in a discrete state controller) (Ashby 1956). If a system is to be stable and / or controlled the number of states of its control mechanism must be greater than or equal to the number of states in the system being controlled. Ashby elsewhere states the Law as "only variety can destroy variety" (Ashby 1956, p.207). In (Ashby, 1958) he sees his approach as introductory to Shannon's Information Theory (Shannon and Weaver, 1949) which deals with the case of "incessant fluctuations" or noise.

Basing their work on Ashby's earlier cybernetic writings and in particular on Shannon's Information Theory (Shannon and Weaver, 1949), (Conant and Ashby, 1970) produced the Good Regulator theorem which required autonomous systems to acquire an internal model of their environment to persist and achieve stability or dynamic equilibrium. (Conant & Ashby 1970, p.89)'s Good Regulator theorem states that ***"every good regulator of a system must be a model of that system".*** The design of a complex regulator thus includes the making or maintenance of a model of the system to be regulated. The theorem shows that "***any regulator that is maximally both successful and simple must be isomorphic with the system being regulated."*** (Conant and Ashby, 1970, p.89). See (Scholten, 2010a) and (Scholten, 2010b) for a recent and accessible introduction to (Conant and Ashby, 1970).

2.1 Controlling variety

A simplistic definition of a system is as a set of interacting or interdependent components which together form an integrated whole. However, some argue that what makes a system viable is its capacity to adapt, that is, to develop increased order (negentropy). Thus Francis Heylighen (Heylighen, 1992)

identifies a number of cybernetic principles. One among these is what he calls blind-variation-and-selective-retention (BVSR). Accepting as another principle that a stable system is to be preferred to one that decays towards higher entropy (disorder), Heylighen goes on to suggest that BVSR processes recursively construct stable systems by the recombination of stable building blocks and by the selective retention of certain higher-order combinations. It is only this higher-order configuration which can now be called a system: stable, self-organising in its configuration and demonstrating a number of emergent constraints and properties. In living systems the selection process is generally evolutionary and what Heylighen characterises as blind. In a work system [see section 2.3 below], the selection mechanism is no longer necessarily blind but can itself be purposeful design, what Archer quoted in (Hevner, 2010) identifies as "designerly enquiry". More generally – but certainly in a non-exhaustive manner – we would identify categorisation, classification, ontology building and "programming" (broadly understood to include "traditional" computer programming and scripting, but also spreadsheet formulae) as among the intelligent behaviours which have the potential to cause the order of a system to increase.

2.2 Checkland's systems thinking

(Stowell and Welch, 2012) advocate Checkland's idea of a system (Checkland, 1981). In (Stowell, 2013), Peter Checkland reemphasised his insistence that a system is not something "out there" whose identification any two dispassionate observers could agree upon. According to Checkland, ***the system is not something in the world; it is the enquiring process.***

(Checkland, 2012, p. 466) states:

"The bare minimum set of concepts needed to express the nature of an adaptive whole is four in number."

We can summarise these as:

1. ***Emergence*** – Checkland calls this the pre-eminent systems idea.
2. ***Hierarchy*** - any entity called a system may also contain within itself functional subsystems and may itself be a part of a wider system.

3. ***Communication*** – in order to achieve adaptation to change, there must be processes of communication both within the system and to and from its environment, and human or intelligent decision-making.

4. ***Control*** – processes which responds to shocks in the environment and to internal failure.

2.3 Information systems from a cybernetic perspective

An excellent framework for initial analysis of information systems requirements is provided by the work systems method of Steven Alter (Alter, 2006). Alter defines a Work System as a system in which people and/or machines perform a business process using resources (e.g., information, technology, raw materials) to create products/services for internal or external customers. Supporting the work system will be a number of Information Systems - although the mapping between information system and work system is many to many; see (Alter, 2002a). Following (Paul, 2010) we define an information system as information and communications technology in use – by people. Simplistically, we can characterise an information system as taking inputs in the form of data, yielding as output information whose purposes may include

- Better visibility / vision of what's happening
- Monitoring and control
- Improved decision making

Generally speaking, information systems are filters on the inward path, amplifiers on the forward path or components of the feedback path used to control a complex system, e.g. business information systems BIS may be used to coordinate and control the work of an enterprise.

Following (Baskerville, 2011), we regard the individual knowledge worker as being the most important component of a personal work system. Following Checkland, we suggest that the only element of an information system – people using information and communications technology – that demonstrates emergent behaviour is the person herself interacting with the technology; the technology itself does not normally adapt. We posit that the controller (that is homeostat or regulator) for a knowledge worker is her personal work system PWS supported by her personal information management system, which we

take to be analogous to her memory extension memex (Bush, 1945) in that it embodies her conceptual data structures CDS and the associated data (Völkel and Haller, 2009). Her knowing brain constitutes the doing (processing) and variety-generating element within the personal work system by which she gets things done. She can increase her requisite and available variety – her ability to cope with complexity (Backlund, 2002) - by information gathering, by learning and by calling upon her network or her mentors. Information here is to be understood as meaningful and true interpretation of data as discussed by (Floridi 2005). The original thinking of the first author on the relationship between data, personal knowledge and information is summarised in (Gregory and Descubes, 2011a). A noteworthy recent paper which treats this issue more holistically is that of (Douglas and Peppard, 2013).

The means by which her knowledge and rule-base is changed is learning. We recognise two kinds of learning: learning existing knowledge as it has already been distilled and published (knowledge diffusion and acquisition); and the discovery of new knowledge (knowledge creation). Learning has the effect of changing the working model that the actor has of her life and purpose. Learning may be achieved, inter alia, via the processes of conventional teaching or with a dialogic mentor (Gregory et al., 2012). The teacher or mentor acts as *deus ex machina* – a source of new purposeful variety. Together and apart the mentor and mentee learn and thus, for a while, survive and thrive.

The Working Model needs to be as simple as possible but no simpler. Put another way, it should encourage "requisite complexity" (an updating of Ashby's requisite variety, which is very well introduced by (Stowell, 2013, pp. 118–121)). Since, as Ashby and later Stafford Beer (Beer, 1984) demonstrate, it is in practice almost never possible to create more states of variety in a controller than exist in its environment, the pragmatic necessity is to apply appropriate heuristics which filter and absorb inappropriate variety and permit identification of threatening and friendly variety requiring to be countered and dealt with. Perhaps among other approaches, the creation, maintenance, development and sometimes conscious design of an appropriate personal information management system have the potential to make a major contribution to an effective personal work system.

2.4 The roles of theory and of learning in the Working Model

(Conant and Ashby, 1970) require that a good regulator model be isomorphic with the situation to be regulated. In practice isomorphism is usually not achievable; instead, we achieve various degrees of homomorphism. As we have previously discussed in (Gregory and Descubes, 2011b), the quality of our regulating working model depends critically on two phenomena identified by (Argyris and Schön, 1974, pp. 6–7); these are normally discussed in an organisational context but have applicability also at the individual level. These two phenomena are:

- The difference between espoused theory and theory-in-use
- The desirability of double-loop learning

(Smith, 2001) describes how (Argyris, 1980) makes the case that effectiveness results from developing congruence between theory-in-use and espoused theory. Smith suggests that where there is a mismatch between intention and outcome, organisations and individuals may exhibit either single- or double-loop learning. The latter involves questioning the role of the framing and learning systems which underlie actual goals and strategies in a process which (Argyris 1982, pp.103-4) identifies as deeply reflective.

This double loop learning is a major influence on the Working Model presented below as Figure 1.

2.5 Implications

In this literature review we have demonstrated how W. Ross Ashby's law of requisite variety (Ashby, 1956) and Conant and Ashby's good regulator theorem (Conant and Ashby, 1970) imply that an individual information system is and must be creatively designed, requisitely rich in its variety and that the model for the design should be as far as possible isomorphic with the work system of its use.

This thinking mandates that the individual should:

- Analyse her existing situation by making models of the existing situation and a projected better situation using appropriate modelling techniques.
- Build a solution – directly, or by first making a prototype that at least demonstrates potential improvement then proceeding to a better solution. Building a solution will normally imply using existing tools (perhaps in a mashup), may require new ones, but

certainly requires the user to understand the structure of the information she is processing as she carries out her work.

- Learn to build better solutions (or accommodations) through time.

2.6 The literature of personal information management

We do not here repeat reviews of the specific literature associated with PIM personal information management which we have reported in earlier papers. But note in particular (Jones, 2007), (Jones, 2012), (Jones, 2013), since these books attempt explicitly to summarise the field.

3. Our principal conjecture

Our conjecture - which is not yet a demonstrated thesis – is based generally upon abductive insight and well-established cybernetic theory and specifically upon the good regulator theorem. We conjecture that the effectiveness of the individual knowledge worker depends to a significant degree upon these factors:

1. Each of us has a more or less explicit ***personal working model*** which encapsulates our understanding of how we should organise our personal work. Thus each of us as we work participates in and constructs a personal working model which informs and regulates the personal work system which we as knowledge workers constitute as we work. In most cases, that model is inexplicit.
2. Our further conjectures are that the effectiveness of personal work can be increased for and by individuals who more explicitly model – and thus understand – their personal work system before seeking to design improvements to aspects of that system (particularly the PIMS element); and that in many cases, individuals will benefit from mentoring as they audit, model and redesign their work system (Gregory et al., 2012).

The present paper summarises the current findings of our research and tabulates the steps which remain.

4. What is a Working Model and how can we model it?

4.1 What we need to model

The Working Model has an architecture whose principal components are:

1. The Intelligent User and her knowledge; that knowledge includes her understanding of concepts; her Weltanschauung (world view; see (Checkland and Poulter, 2006)) and her working theories: how the user understands herself as an agent or worker in the world – this is her high-level Good Regulator (Conant and Ashby, 1970). These together constitute her ***answer to the question Why?; they are the product of her learning and of her critical reflection.*** The emphasis here is on enquiry and learning – acquiring and building her personal knowledge.
    a. The user's ***personal work system or PWS****:* her answer to the questions ***What problematical situations do I need to address?*** and ***How can I best address them?*** They correspond approximately to what needs to be done and how should I do them, what (Allen, 2003) calls "getting things done GTD".
2. The user's ***personal information management system, or PIMS****:* the emphasis here is on informing action by means of personal data storage, on ***how the knowledge worker keeps found things found KFTF*** (Jones, 2009, 2007), and on current information, searching and social networking.

4.2 The components of the working model

Knowledge workers typically undertake small tasks, or larger tasks which may give rise to a project. Carrying out a large task or project has a goal and a structure or architecture with components. A particularly important component, previously referred to as working documents, we now call ***nuggets***. The notion of a nugget is a reconceptualization of the working document as a serious knowledge chunk which normally – not exceptionally – comes from the work of others. Then the product of a research task, say a thesis, itself becomes "just another brick in the wall", but a wall of nuggets built by many.

Nuggets, which are broadly similar to the learning objects identified by (Polsani, 2006), are encapsulated chunks of knowledge. Examples might include the various themes in a presentation, the sections in a report and the views or queries in a database application. A nugget may be more than a

document or a collection of resources; it may include the enactment of that knowledge (Maturana and Varela, 1980). As data is used by intelligence (human or programmed), meaning is attributed and the resulting information informs action. Nuggets are further discussed below in section 10.

The essence of the first author's research is to get research volunteers and associates to ***surface*** their working model and then ***improve*** it.

4.3 How to model the working model

We have also needed to model the working model and components such as the PIMS more explicitly, as concepts, their relationships and the procedures which transform concepts. Thus within the context of the current research we have found it necessary to provide a visual modelling language and a supporting web-based toolkit. We have baptised this approach ***Conceprocity*** – concept process reciprocity. ***Conceprocity*** – concept ↔ process reciprocity – is ***a visual and textual language and toolset intended for capturing, expressing, communicating and co-creating models of topic areas of domain knowledge by domain experts or learners.*** Conceprocity has been under development since April 2013. Conceprocity mapping is introduced in section 6 and expanded upon in appendix 1.

4.4 A conceptual model of the Working Model as regulator

Applying Conant and Ashby's Good Regulator theorem, we predict that for every knowledge worker there is always an existing Working Model – since each of us does to some extent get things done and each of us does collect and organise our data and gain the information necessary to get our work done.

The Working Model is intrinsically personal – whence Personal Working Model PWM. It is not therefore unreasonable to take as a starting point for an enquiry into what Working Models (plural) are a conceptual model of the first author's own Working Model.

Figure 1 is a Conceprocity concept process map showing the top level of the conceptual model of the working model of the first author.

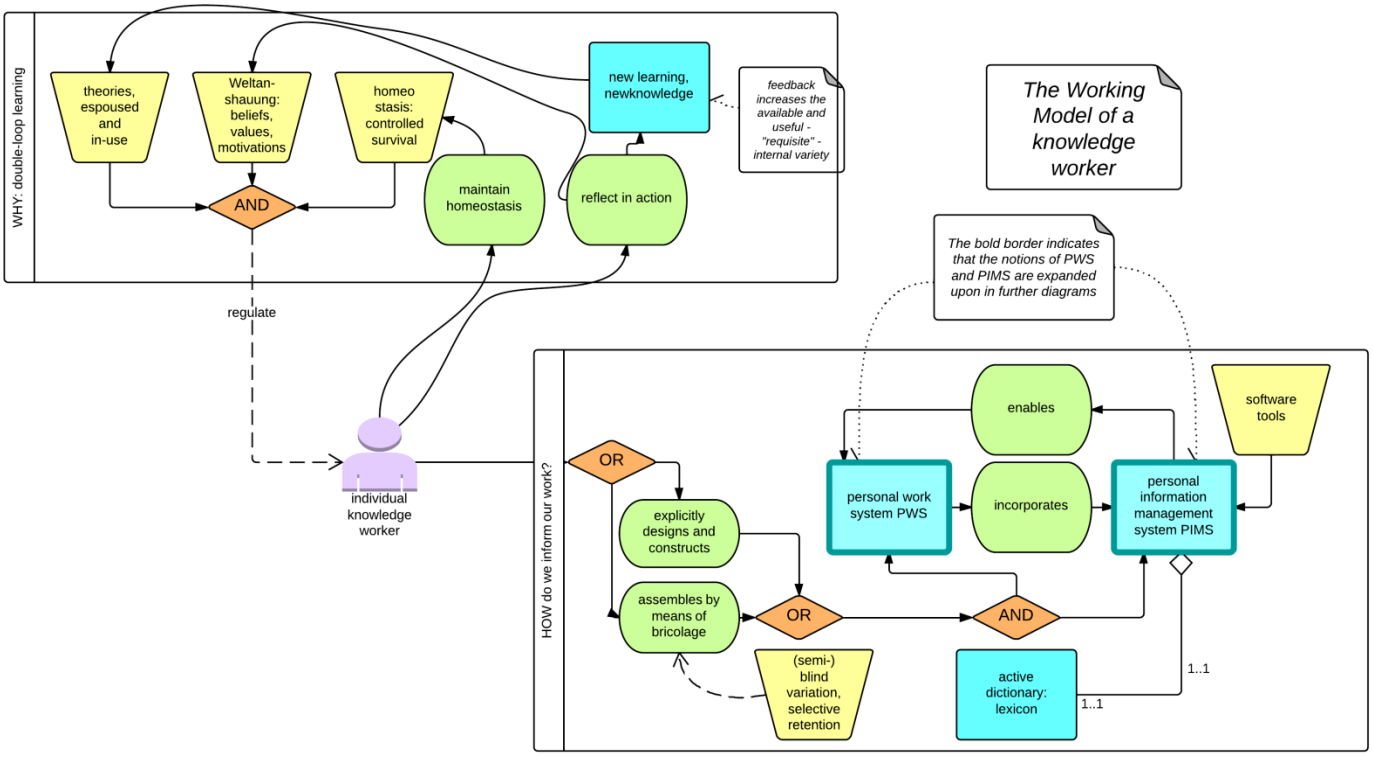


Figure 1 A Personal Working Model: top level diagram

Conceptual models of the sort presented here as Figure 1 have a weak ontological basis in that neither their truth value nor their generalisability can readily be established. They are put forward as plausible conceptual conjectures. Their further identification is the subject of ongoing research. But what research methods are appropriate to working models?

5. How can we investigate the phenomenon of the working model? Research methods

Figure 1 is the result of the application of a research method sometimes referred to as auto-ethnography (Ellis and Bochner, 2000) and sometimes as systematic self observation (Rodriguez and Ryave, 2002). The first author has over a period of 30 months maintained a log of his use and work with personal information management systems.

Of course, what can be dismissed as story-telling (or worse, an abdication of our responsibility to seek objective data, as held by (Delamont, 2007)) has little truth value in isolation. It is therefore essential to submit the conjectures that arise and emerge to some further form of empirical investigation and testing. In the case of this research, that further testing is being carried out in

the context of mentored action research (Gregory et al., 2012); the research is ongoing.

In their discussion of the difficulties associated with action research (Checkland and Poulter, 2006, p. 177) identify a criterion which is necessarily less strong than the repeatability associated with natural science but is stronger than the plausibility which is sometimes all that can be achieved in the social sciences. The intermediate criterion that they identify is that of recoverability. We have insisted upon modelling and on concurrent verbalisation in order as far as possible to operationalise recoverability in this research.

Before the creation of new knowledge, the researcher typically seeks for or stumbles across a knowledge gap. Such a knowledge gap is only recognised once the researcher has successfully scoped an area of enquiry and established the existing knowledge within that area. The researcher makes use of methods of enquiry which may include abduction. Abduction is one of three generally-recognised modes of enquiry, these being abduction, deduction and induction (Potter, 2006). Van de Ven holds that this logic of discovery or creativity was identified by Charles Peirce as the abduction logic of enquiry:

> "This form of reasoning begins when some surprising anomaly or unexpected phenomenon is encountered. This anomaly would not be surprising if a new hypothesis or conjecture was proposed… I argue that researchers and practitioners create or discover theories through a process of abduction." (Van de Ven 2007)

It is a surprising fact that "most" people have effective personal work systems by means of which they get things done, but "most" people do not have explicit personal information management systems PIMS to support their work. A plausible abductive explanation is that in fact ALL knowledge workers have a personal work system and that ALL make use of one or more personal information management systems – but that for "most" people these systems are not perceived, planned or explicitly improved. There is rarely a single unified PIMS. Instead there are a number of more or less integrated elements or separate IIS (that is, PIMS), many of them shared with other individuals. Thus the issue is not (necessarily) to create a PWS or some PIMS,

it is rather to ***recognise what already exists*** and thereby to ***facilitate its improvement by evolution or by revolution*** (replacement).

We propose abductively that ***there exists for each individual what it is convenient to term a Working Model.*** This deliberately ambiguously named conceptual system refers both to the ways in which the individual gets things done and the ways in which she structures, manages and exploits the data that she needs to get that work done. That working model includes conceptualisations of projects and tasks which the individual needs to undertake, an identification of individual actions or processes which the individual needs to follow as she gets her work done and a more or less explicit conceptualisation of the information needs that those projects and tasks engender.

5.1 Complementary approaches to concept mapping as part of a mixed-methods research design

The first author's current research is at heart a multi-methodology – cf. (Avison et al., 1998) - mixed-methods and initially exploratory approach to a research question which can be simplified to:

> ***"What is the contribution of personal information management systems PIMS to the working model and personal work system of knowledge workers?"***

Mixed methods research is often taken to refer to quantitative and qualitative research in differing mixes. For an introduction to the philosophical issues, see (Ågerfalk 2013). (Goldkuhl 1995) presents a Habermasian view of information and action which is in contrast both to pragmatism as seen in (Ågerfalk 2010) and critical realism as seen in (Mingers et al. 2013) and (Zachariadis et al. 2013). The current paper uses as mixed methods (i) auto ethnography; (ii) designerly enquiry and (iii) content (textual) analysis by emergent fuzzy concept maps. In the later stages of this research programme we are employing (iv) action learning and (v) mentored action research; we will report this later work in a forthcoming paper.

Concerning textual analysis, and particularly the Leximancer software used in the creation of the subsequent Figure 2: (Smith and Humphreys, 2006) report that the Leximancer system is a relatively new method for transforming lexical

co-occurrence information from natural language into semantic patterns in an unsupervised manner.

Thus what we term Leximancer "fuzzy" concept maps emerge from unsupervised (or, better in practice, semi-supervised) semantic mapping of natural language text. The word fuzzy in this context is our own.

5.2 Fuzzy concept mapping: concepts emerging from a research journal

Figure 2 shows the result of a semi-supervised Leximancer analysis of the first author's research journal (circa 130,000 words written over 30 months).

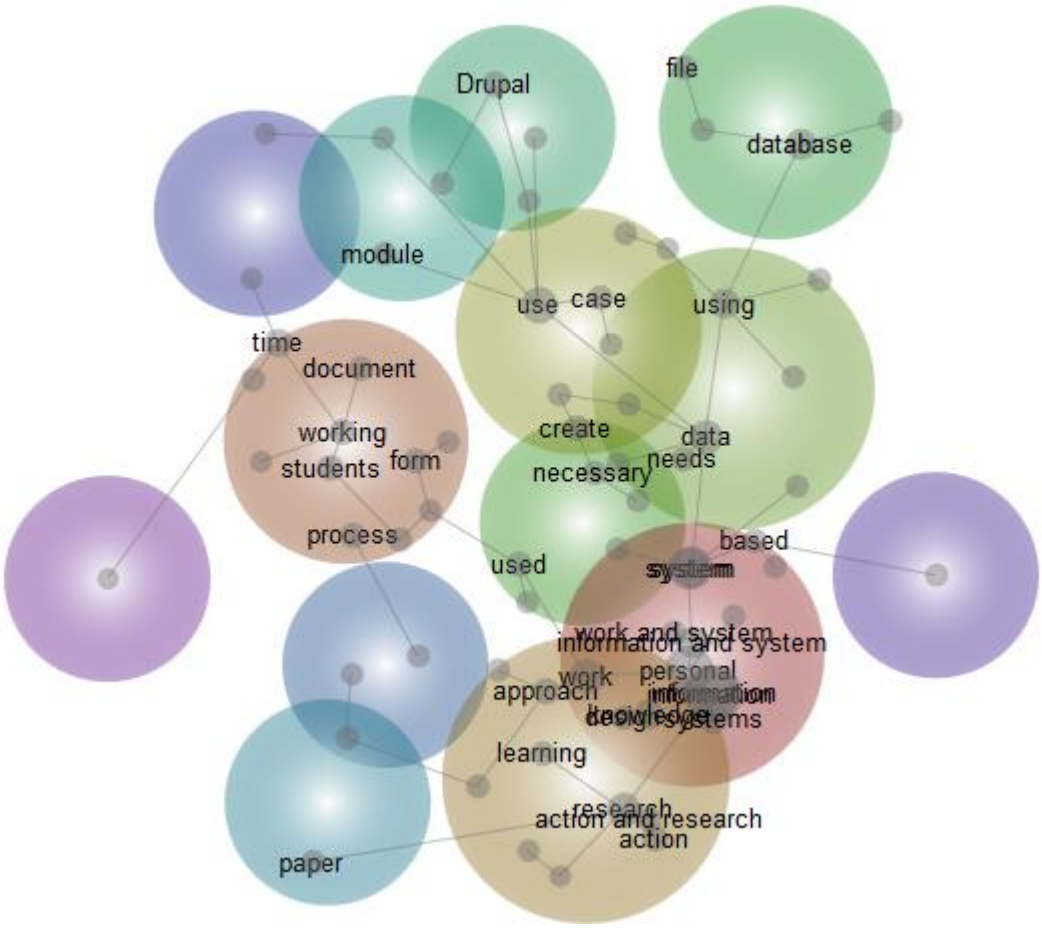


Figure 2 Fuzzy concept map of the first author's research journal produced using Leximancer

Leximancer automatically recognises only single-word concepts. Most of the current research concerns compound concepts; Table 2 presents the multi-word list used when producing Figure 2:

Compound concept
information system (alias: IS)
personal information management system (alias: PIMS)

work system
personal work system (alias: PWS)
action research
knowledge management (alias: KM)
knowledge representation (alias: KR)
personal knowledge management (alias: PKM)
Personal Information Management (alias: PIM)

Table 2 Compound concept seeds

6. Representing working models: Conceprocity

Conceprocity - concept <-> process reciprocity - is a visual and textual ***language*** and ***toolset*** intended for capturing, expressing, communicating and co-creating ***models of topic areas*** of domain ***knowledge*** by domain ***experts*** or ***learners.*** The modeller decides the vocabulary as she follows grammar rules in the somewhat complex (and therefore expressive) CAPRILOPE dialect. CAPRILOPE stands for Concept, Actor, Procedure, Relationship, Image, Logical Operation, Principle and Event. Conceprocity is based on but substantially extends G-MOT (Paquette, 2010).

Conceprocity has been under development for about one year. It has been implemented using Lucidchart (www.lucidchart.com) for the visual elements together with a dictionary element which is currently built using Microsoft Excel.

We first recognised the need for Conceprocity when seeking to model knowledge such as the structure of a complex journal article and when modelling work systems and information systems. Concept maps appeal to both left and right brain thinking; (Sperry, 1975) discovered that the human brain has two very different ways of thinking:

- Right brain is visual and processes information in an intuitive and simultaneous way, looking first at the whole picture then the details
- Left brain is verbal and processes information in an analytical and sequential way, looking first at the pieces then putting them together to get the whole

6.1 Illustrating Concepts

Concepts may be held both visually and linguistically, as has been recognised by (Novak and Cañas, 2008) following David Ausubel (Ausubel, 1963); (Ausubel, 2000)

- Concept maps with typed concepts and relationships: LICEF G-MOT (Paquette, 2010); (Basque, 2013)
- Concept ↔ Process maps: Conceprocity: Mark Gregory – please see the website http://www.markrogergregory.net

Using both the visual and the linguistic (written and spoken language) stimulates better understanding of a situation and – later – better learning. We

summarise this by saying that we model to understand, then to learn, and possibly to communicate.

If we consider a simple requirement such as doing the shopping, we might create a Conceprocity map something like:

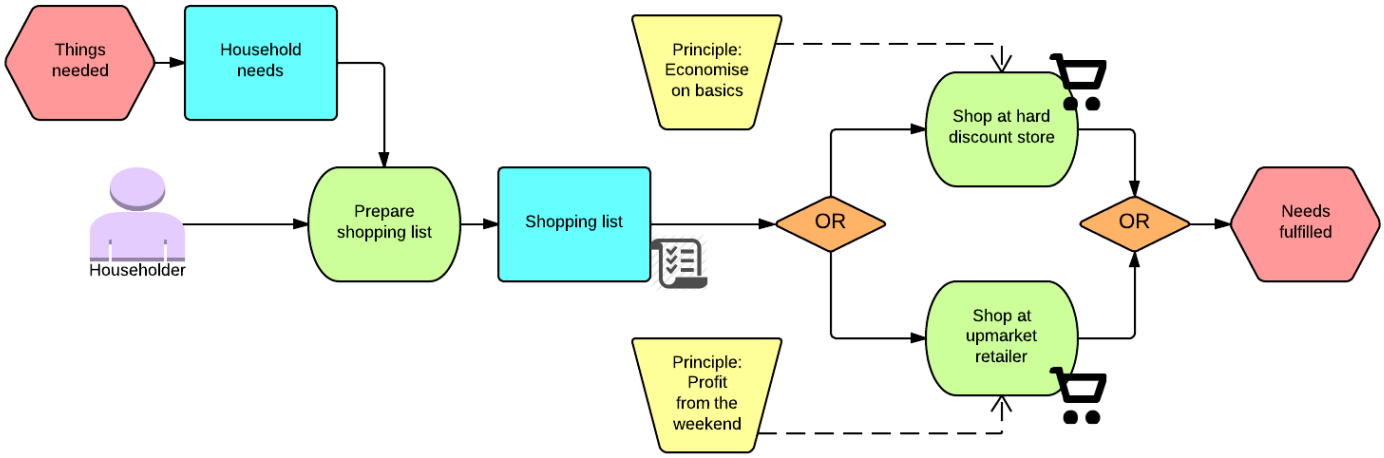


Figure 3 An example nugget signature model for the nugget "Do the Shopping"

Please see appendix 1 for further information concerning the notation used in Conceprocity.

6.2 Other uses of Conceprocity

Conceprocity has already been used, primarily by students, in the following contexts:

1. ***IS analysis – Who; What***: Creating ***usage models***. Usage models are an extended use case notation which adds to actors and use cases the notion of interactions, such as web forms.
2. ***IS analysis – Who; What; How; When:*** Creating ***extended event process chain diagrams***.
3. Student use in mapping the content of academic journal articles concerning e-commerce, improvements to their personal information management systems and analysing the applications portfolio of companies.

These further uses will be the subject of a later paper which positions Conceprocity as a "knowledge organisation system", cf. (Friedman and Smiraglia, 2013; Friedman and Thellefsen, 2011).

7. Initial synthesis (1): The Personal Work System PWS of one of the authors

A plausible conceptualisation of a knowledge worker's work system is suggested as Figure 4. This model is the result of conscious design (Hevner, 2010); it and the models which follow synthesise auto ethnographic insight, but are dominantly based on a rereading of existing research findings.

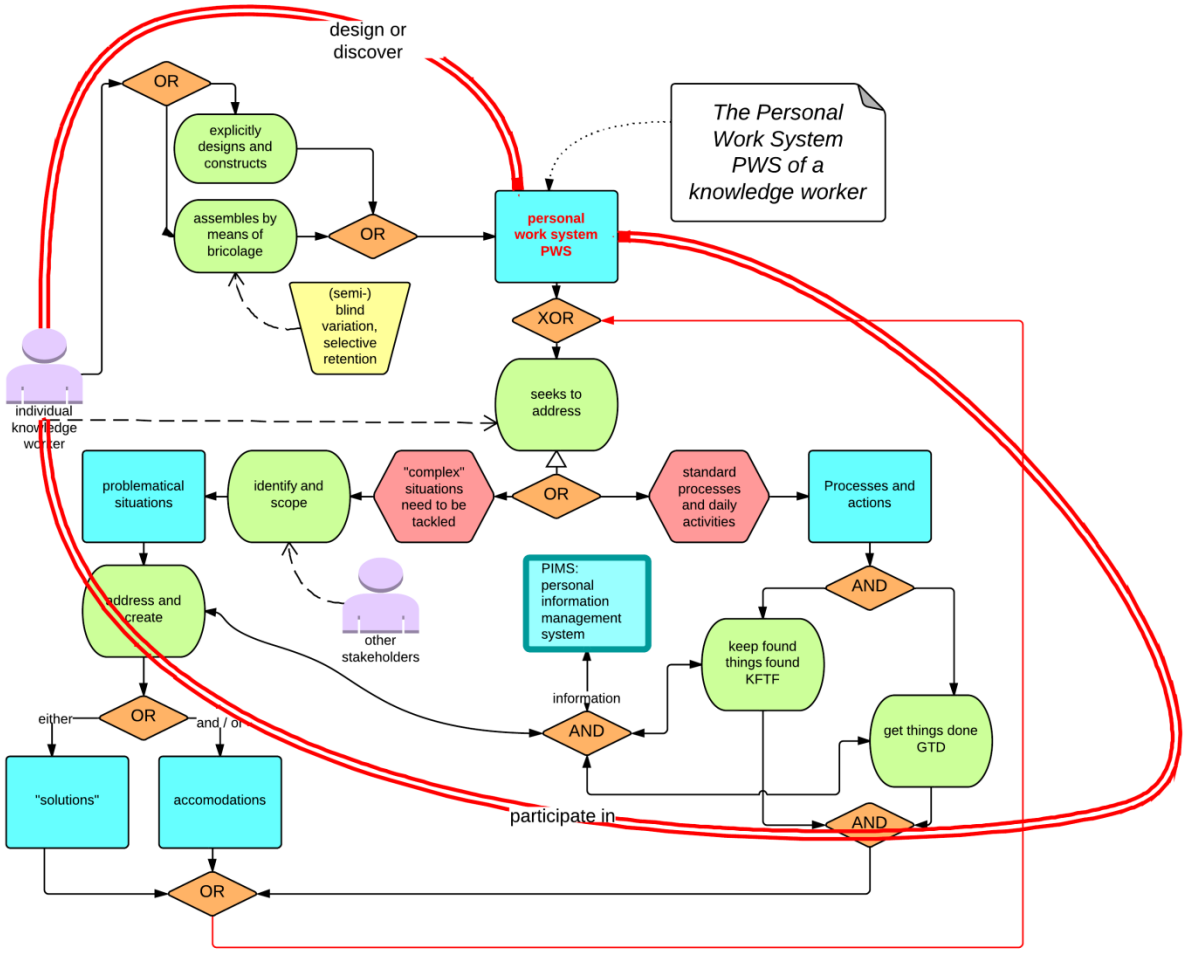


Figure 4 The Personal Work System PWS of a knowledge worker

In Figure 4, which is an expansion and specialisation of the concept of working model introduced in Figure 1, we suggest:

1. The need to address daily activities; this is introduced by the event "standard processes and daily activities".
2. The need to tackle larger problem situations in conjunction with others; this is introduced by the event "'complex' situations need to be

tackled". Such "messes" (Ackoff, 1997) or "problematical situations" (Checkland and Poulter, 2006) inevitably involve other stakeholders and may indicate the necessity for soft systems approaches.

3. Both to deal with daily activities and to tackle larger problems, the knowledge worker creates and evolves an approach to work which we have identified as the overall personal work system which the knowledge worker designs or discovers and then participates in and uses.

8. Personal Information Management Systems PIMS

The authors hold that a very significant component of each such personal work system is an individual and personal information management system (PIMS). That PIMS may from time to time be the consequence of an explicit design act on the part of the individual who constructs and uses it. Perhaps more often it will arise from a process of more-or-less serendipitous bricolage (Ciborra and Jelassi, 1994), (Verjans, 2005) – tinkering until by some happy chance we have a temporarily stable but useful personal information management approach. Thus we suggest the emergence and (sometimes) design of a personal information management system PIMS, which is an information system specific and personal to an individual knowledge worker.

A personal information management system PIMS is posited as an information system which stores data used by an individual to yield information which she requires (inter alia) so as to be able to control her own activities. Her aim is to get work done more efficiently or effectively by more closely achieving desirable goals or outcomes. The achievement of this aim is embodied in a personal work system (where work is to be understood very generally so as to embrace play rather than to contrast with it). Thus:

- An engineer designs and constructs a "better future", that is she looks at an existing messy situation and identifies problems and problem owners - the latter may be or become the clients for possible solutions – realisable improvements to the messy situation (Ackoff, 1997). In such a way an engineer might construct improved personal information management tools.
- A do-it-yourselfer, what the French call un bricoleur, makes something that is useful but typically in a less systematic manner than the engineer.

- The motivations for bricolage, a French word meaning do-it-yourself or "muddling through" (Levi-Strauss, 1966), include inadequate access to expertise or cost saving. As (DesAutels, 2011) suggests, individuals have frequently to mash together various components so as to address their personal information management needs by means of what he calls user generated information systems UGIS. When the scope of the required system extends beyond the individual, we suggest that a UGIS becomes a situational application (Gregory and Norbis, 2009).
- A worker progressively assembles together, more or less consciously, a "mashup" of components which are together useful as her personal information management system. Knowledge workers work within (a) work system(s) (Alter, 2008, 2006, 2002b).
- A player is similar to a worker, since we here treat play as work much as some people treat work as play. For both worker and player the emphasis is on creatively finding a solution to an immediate problem while always seeking to learn how to solve that problem or others like it better next time.

What do the engineer, the bricoleur and the knowledge worker / player have in common?

- They are all involved in everyday task identification and management, and in problem-solving.
- They are all part of a work system and have some limited or constrained ability to improve the system of which they are a part.
- They all understand something of the systemic nature of the situation, which is that any improvement will change the problem situation but will rarely completely "solve" it, since unanticipated systemic effects – sometimes positive, often negative – will emerge and then in their turn need to be addressed.
- They work best, that is, they get more done more quickly, if they have:
    - ❑ a good problem-solving framework
    - ❑ competences, perhaps including modelling and design skills
    - ❑ they learn by doing and from doing (the latter being the fruit of reflection).
- They sometimes see the need for, and either acquire or make, a new tool in order to amplify their competences.

However, information systems researchers have not as yet contributed much to the study and practice of personal information management. Thus Baskerville

(Baskerville, 2011) as editor of a leading information systems journal has recently identified what he calls “individual information systems IIS” as a new subject of enquiry. PIM is not a new field of enquiry. Studying PIM systems or individual information systems as information systems is arguably novel; we will furnish evidence concerning the extent of this novelty later.

What are the essential characteristics of the PIMS that supports the PWM? Here are just sketches of an answer:

1. Conceptual data structures which are adapted to the data to be stored and the information to be derived. These structure the specks and nuggets which are the data. Specks and nuggets are discussed below, section 10. Nuggets will take concrete form as for example data tables, data views and multimedia documents; specks are either specific items (e.g. rows) in tables, or standalone information items such as contact details or bibliographic references. It is convenient to distinguish between so-called structured and unstructured data, although these may not be as distinct as some seem to think.
2. In so far as the Working Model is a model of a way of working, it is as much a set of activities, sometimes repeated in accordance with a template and thus distinguishable as processes; as it is a set of concepts, data tables and data views.
3. We still need to model the use of a PIMS while at the same time recognising the necessity for higher-level “processes” such as planning and delivering a new course, writing a paper or book – found in the personal work system PWS - and also reflection-in-action – part of the overall working model.
4. It then becomes necessary to model a PIMS. We have devised Conceprocity for this purpose and for others. Conceprocity permits the construction of visual concept-process knowledge models – the significance of the visual component being that it resonates with a large part of the brain’s variety-absorbing and learning capacity.
5. We suggest the use of a dictionary / lexicon to store the metadata / semantics associated with named things; we suggest that the dictionary

be an active component (Zahran, 1981) which can also support the taxonomic classification and tagging of information items.

6. An implication is that the model of a personal information management system, the meta information about that system, is itself a part of the personal information management system. Here we can draw a parallel to those data management systems which incorporate a data dictionary as an active component of the database management system itself. Just as an active data dictionary is a vital component of a really effective data management system (Zahran, 1981), so an active working model dictionary is a vital component of a well-defined personal information management system. By active, we mean that the model not only describes the system but is a vital (living and growing) component of the system.

9. Initial synthesis (2): The Personal Information Management System PIMS of one of the authors

The next phase of the research is to seek to identify, distil and make explicit this model as it exists in the working lives of other research subjects by means of action learning (Revans, 1998) with students and mentored action research (Gregory et al., 2012) with professional knowledge workers.

In Figure 5, we suggest the basic architecture of a personal information management approach.

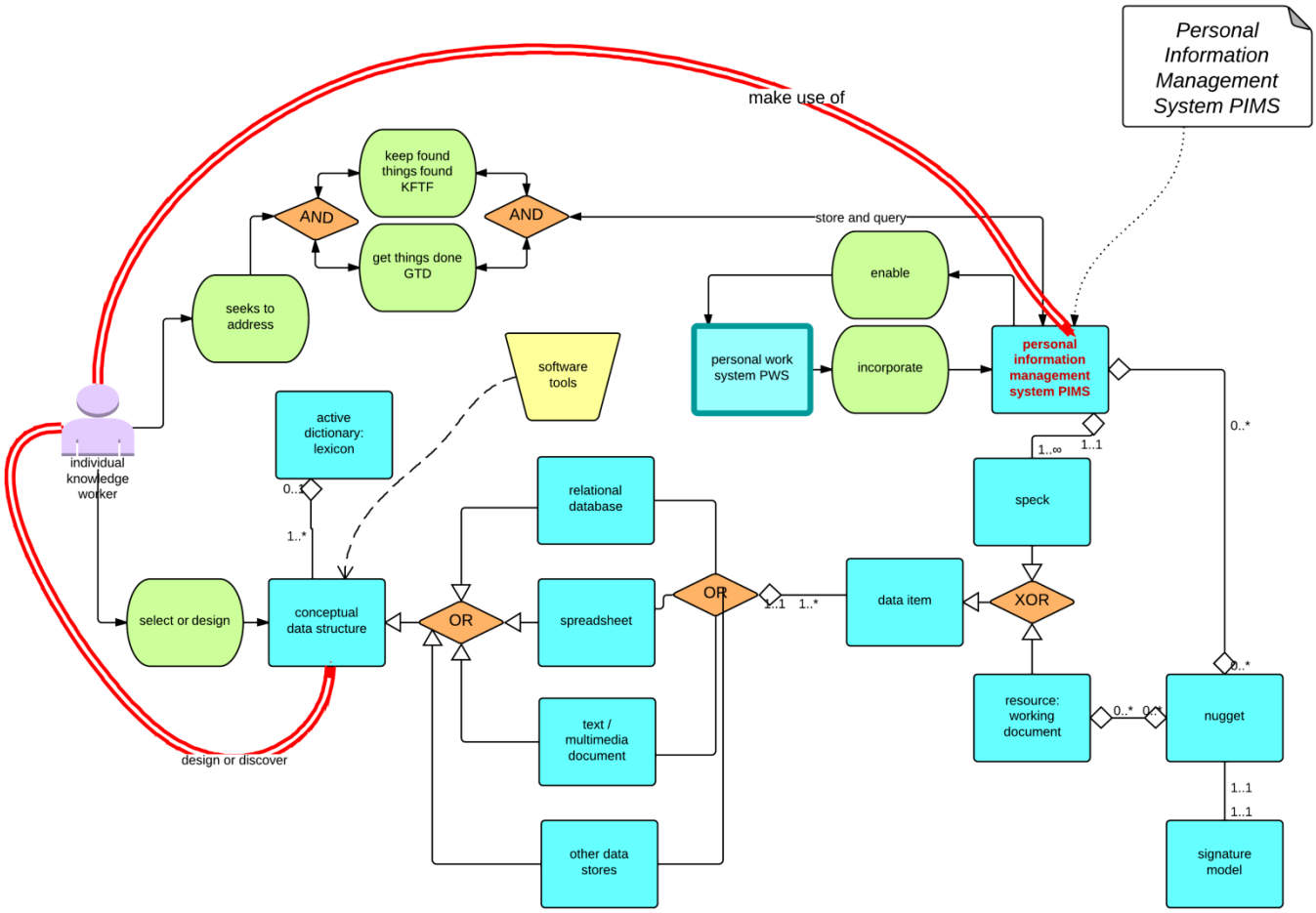


Figure 5 Components of a personal information management system PIMS

10. Giving empirical substance to the Personal Working Model and the Personal Information Management System

10.1 PIMS, Specks and Nuggets

Richard Baskerville defines an Individual Information System IIS thus:

> "An IIS is a system in which individual persons, according to idiosyncratic needs and preferences, perform processes and activities using information, technology, and other resources to produce informational products and/or services for themselves or others." (Baskerville & Lee 2013, p.3).

We suggest as a complementary definition that a personal information management system PIMS is:

> "The emergent individually-generated information system which each person creates and maintains as she uses ICT to create or derive or record data, structured and semi-structured, that she needs in order to support her personal work system."

The data may consist of facts or observations that are more or less independent of one another - little snippets of data that we refer to as ***specks*** – whose common characteristic is that they are of significance to the individual who keeps them. Or the data may take the form of what we have named ***nuggets*** of information that coalesce in a single recognisable form – a section of a Word document, for example, a sequence of PowerPoint slides or an Excel table. Although conceptually singular, a nugget may comprise a set of separate elements. Thus a sequence of PowerPoint slides might contain references. It may pragmatically be necessary or desirable to keep the references in a Word file that is thus also a part of the same nugget as the slides.

"Little" snippets of data can be referred to as ***specks*** – being smaller than nuggets of gold! A bibliographic reference is an example of a speck, as are contact details for an individual or organisation.

Nuggets link to and may use other nuggets. The use may imply a copy or a link or the execution or provision of a method (that is, nuggets can be executable program code or scripts). Nuggets are assembled; the resultant compositions can be published and used by others to inform their actions or to enhance their knowledge.

10.2 The significance and nature of nuggets

The pragmatic significance of information nuggets for a PIMS is that it is one of the fundamental information-conveying items or things that need to be stored in a personal information management system.

A nugget may be smaller than a complete document. Thus a single PowerPoint presentation is often a composition of parts of several or even of many nuggets. Pragmatically, it would be extremely useful to be able to store compositions as a collection of references to nuggets, such that when a nugget is improved, it will automatically be incorporated into the various compositions that make use of it. This requires that the references be links, and not embedded.

Conversely, a nugget is often a collection of files (or parts of files). Thus for example a nugget might include a presentation, a supporting descriptive Word document, another Word document containing the references used in the

presentation and perhaps some test / evaluation materials. The presentation might include audio or video elements.

The exploitation of nuggets may require the decomposition of large, compound documents into discrete nuggets. Such a discrete nugget perhaps corresponds to Jones' information thing (Jones, 2007); (Jones, 2012); (Jones, 2013)– see also (Catarci et al., 2007).

10.3 The nugget signature model

A nugget has, or should have, a signature model by which it advertises itself to the world. This signature model defines its "interface" – its visible and usable characteristics.

By visible is meant described textually, modelled and characterised by properties.

By usable is meant understandable as an item of discrete and learnable knowledge. A nugget may also be capable of enaction, as a process, project or other enactable form of knowledge. A nugget encapsulates its data and, where appropriate, its enactable procedures or methods.

Conceprocity is suggested as a useful mechanism for creating nugget signature models. An example nugget signature model has been presented as Figure 3 above.

10.4 The content of nuggets

By way of illustration, we present Table 3, a partial list of an author's nuggets:

Nugget name	**Implementation notes**
Administer Lucidchart	
Administer MSDN Academic Alliance - Microsoft DreamSpark	
Business Process Analysis using Use Case Analysis	
Business Process Modelling using event process chain EPC notation	
Categorisation and classification	
Classifying websites	
Conceprocity	Primarily Lucidchart
Create a WordPress.com website	
Create an ER diagram using Chen's notation	
Create and maintain Event Process Chain EPC using Lucidchart	
Creating Use Case Diagrams UCDs	
Define a light process	
Demonstrate Simpleton	
Design Thinking	
Designing PIMS	
Excel techniques	
How to assess fairly	

How to assess team course works on IS505E Principles of E-Commerce 2013-4	
How to assess team projects on IS402E EBM - 2012-3	
How to assess team projects on IS402E EBM - 2013-4	
How to evaluate students on IS443E Management of Information Systems	
How to mark exams on IS402E EBM	
Index of Learning Styles	
Information and Databases	
Introducing personal information management systems PIMS	
Knowledge organisation by means of concept process mapping	
Learn dataflow diagrams	
Learn how to use Lucidchart	
Leximancer	
Maintain MAIB projects IS	
Maintain my PhD journal	
Maintain nuggets	
Nominate students to partner universities	
Operate IS minor - IS443E MIS and IS444E IBIS	
Operate IS505E PEC	
PIMS Design	
Referencing and citing	
Semantic modelling	
Semiotics, data and information	
Set IS strategy	
Setting exams	
STOIC	
Teece on business models	
Understand the Internet and the World Wide Web	
Use Acquis - Academic quality information system - database	Microsoft Access database; 77 tables, 125 Mb data
Use Camtasia Studio	
Use Zotero and ZotFile	
Using a CMS	
Using Alter's Work Systems Method	
Value creation in e-business – business value	
What are systems	
What is an information system and why should we study them	
Working Model	
YAWL - Yet Another Workflow Language	

Table 3 A list of some of one of the first-named author's nuggets

10.5 PIMS Components

Among the significant components in the PIMS of the first author are the items identified in Figure 6:

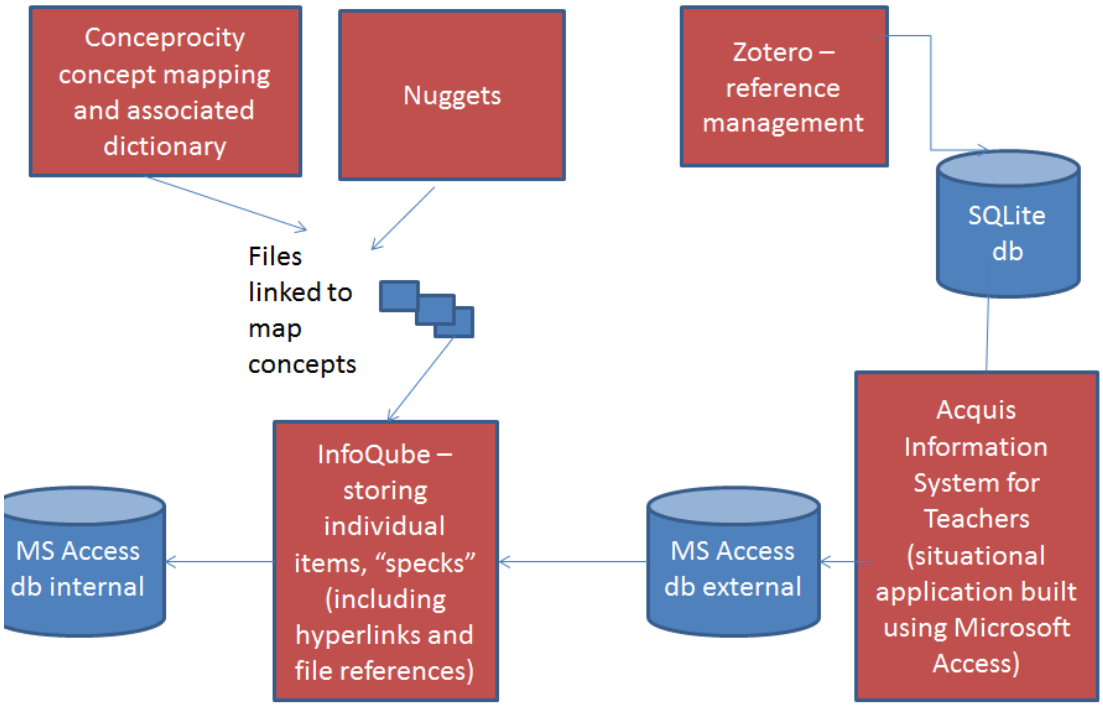


Figure 6 Personal information management architecture (or lash-up)

11. Future research design

Table 4 summarises the research experiments and methods being used in the first author's current research. In particular, it indicates how two contrasting forms of concept mapping are used in complementary experiments which are already underway. These two forms of concept mapping are:

(1) Conceprocity concept-process maps. Conceprocity models are the result of conscious analysis and specific design by Conceprocity modellers.

(2) Leximancer "fuzzy" concept maps. These emerge from textual content analysis.

Experiment and research methodology	Concept mapping approach	Current status and significance
1. Analyse own auto-ethnography using Leximancer emergent or fuzzy concept maps. The specific auto-ethnographic approach is based on systematic self-observation (Rodriguez and Ryave, 2002).	Leximancer. We seed Leximancer with compound concepts (e.g. information system, personal information management, personal information management system) and thus to refine and focus the resultant concept map. An early attempt at this analysis is reproduced as Figure 2	Largely complete. This exploratory research has helped to identify key concepts. This has in turn helped to enable subsequent action research to focus on probably significant issues.
2. Building various text corpora and then analysing them • Recognised writing concerning personal information management • Key literature concerning the epistemology and ontology of personal information management and personal knowledge management	Leximancer; seeking the emergence of significant vocabulary as a fuzzy concept map Seeking evidence of a systems approach in the PIM literature; expecting the null hypothesis Seeking an emergent vocabulary and (counter-) evidence for the concept of personal information management systems	Underway. Few authors have discussed personal information management systems. But see (Barreau, 1995) for an exception.
3. Analyse own auto-ethnography using Conceprocity; the outcome is a directed and synthetic concept map	Conceprocity; the outcome is a developed definition of a Working Model	See Figure 4 for current results.
4. Observing the usability and usefulness of Conceprocity mapping used by postgraduate students as a means of understanding and elucidating research articles	Conceprocity. The outcomes expected are (1) a better understanding of the extent to which various usage profiles are used and useful to students and (2) refinements to the Conceprocity mapping approach	The first experiment is complete; initial analysis indicates a very poor level of conceptual understanding by some students; however, others produce very well structured maps and simultaneously report considerable satisfaction with the method. In a second experiment, students are being more tightly directed in their use – an instance of mentored action learning. Results will be available when this paper is presented.
5. Mentored action research with a small number of research volunteers. We aim to get RVs to surface their working model and then to improve it. This requires, inter alia, mentored Conceprocity modelling informed by a prior PIM audit.	Evaluation will make some use of Conceprocity and (where volunteers have written concerning their personal information management) Leximancer	Underway with a small number of research volunteers.

Table 4 Experiments underway in first author's current research

12. Conclusion

As Table 4 shows, there is more to be done before we have a fuller understanding of the nature of the working model. However, this paper has demonstrated an abductive justification for the existence of a personal working model as the regulator of the personal work system constituted by an individual knowledge worker as she undertakes her work. It has introduced Conceprocity, Concept ↔ Process Reciprocity, and demonstrated its pragmatic usefulness in modelling a working model. We have suggested that the working model has as its principal components the individual knowledge worker, her personal work system and a supporting personal information management system. We have used Conceprocity to model an example personal working model and its constituent PWS and PIMS. Finally, we have set out a research design which we are now following as we seek substantive empirical justification for the personal working model and as we and others learn how to exploit an increased understanding of it.

1. Appendix: Introduction to the Conceprocity notation

The main symbols used include:

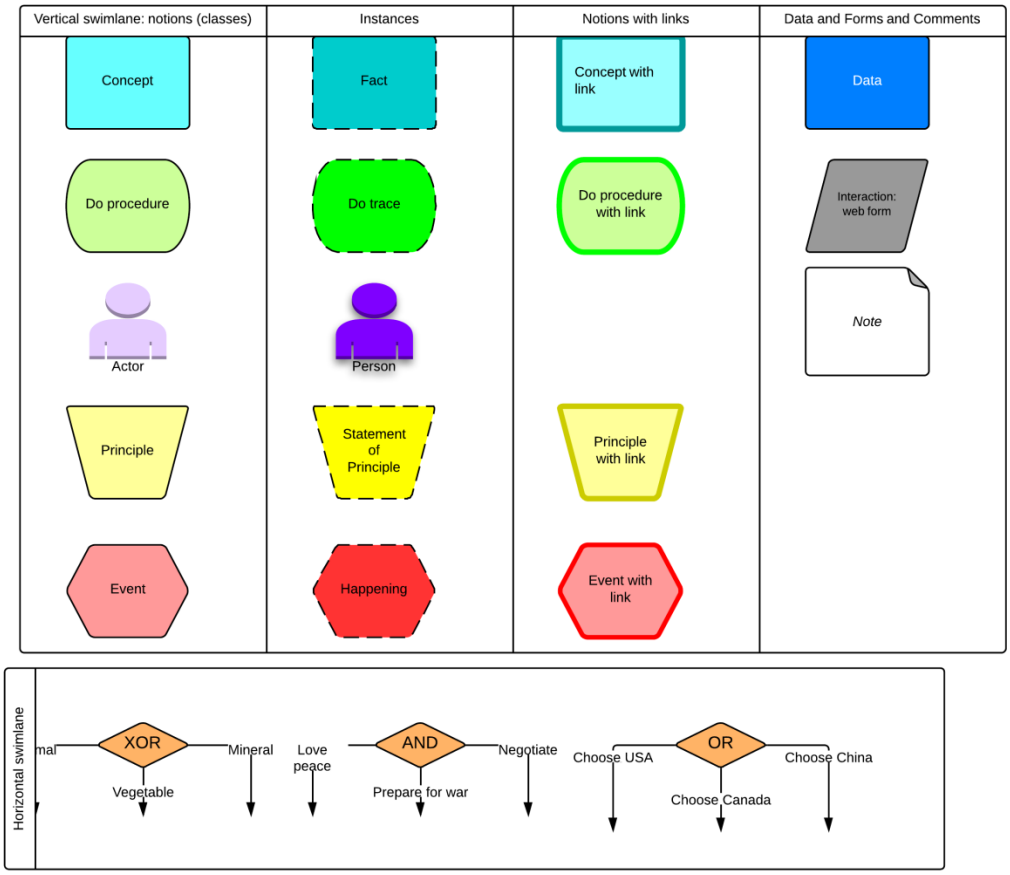


Figure 7 Principal symbols used in Conceprocity

Different kinds of arrow are used to represent the various relationships; we start with the most basic:

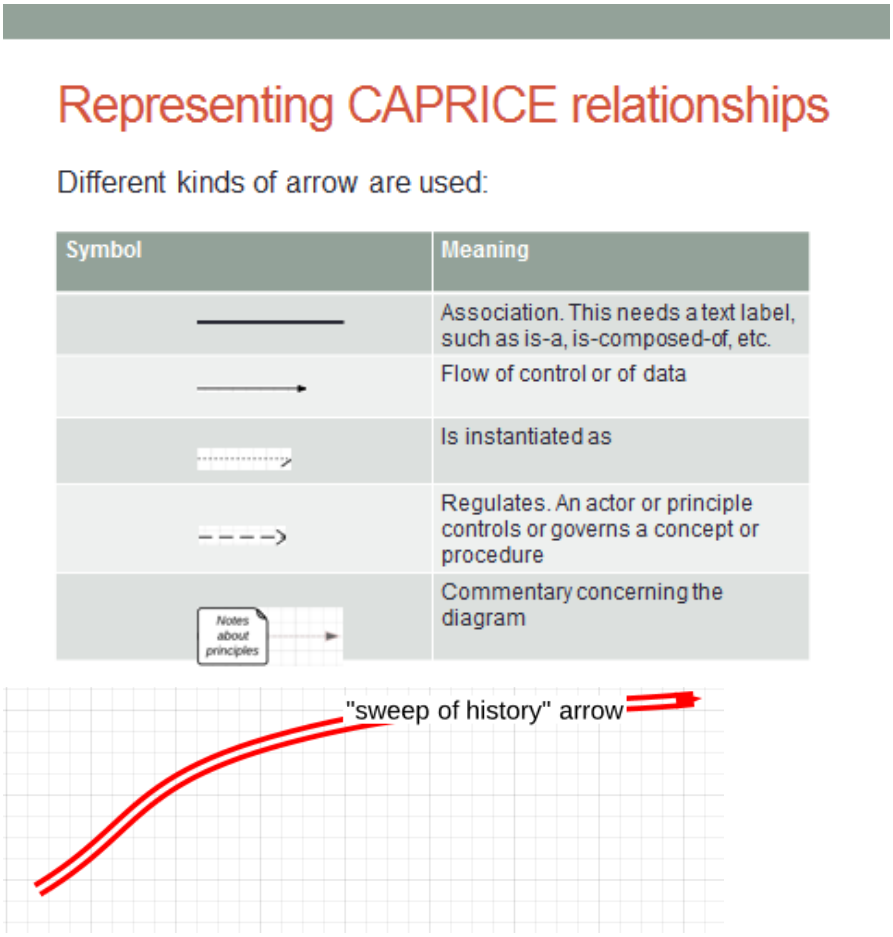


Figure 8 Types of arrows used in basic Conceprocity relationships

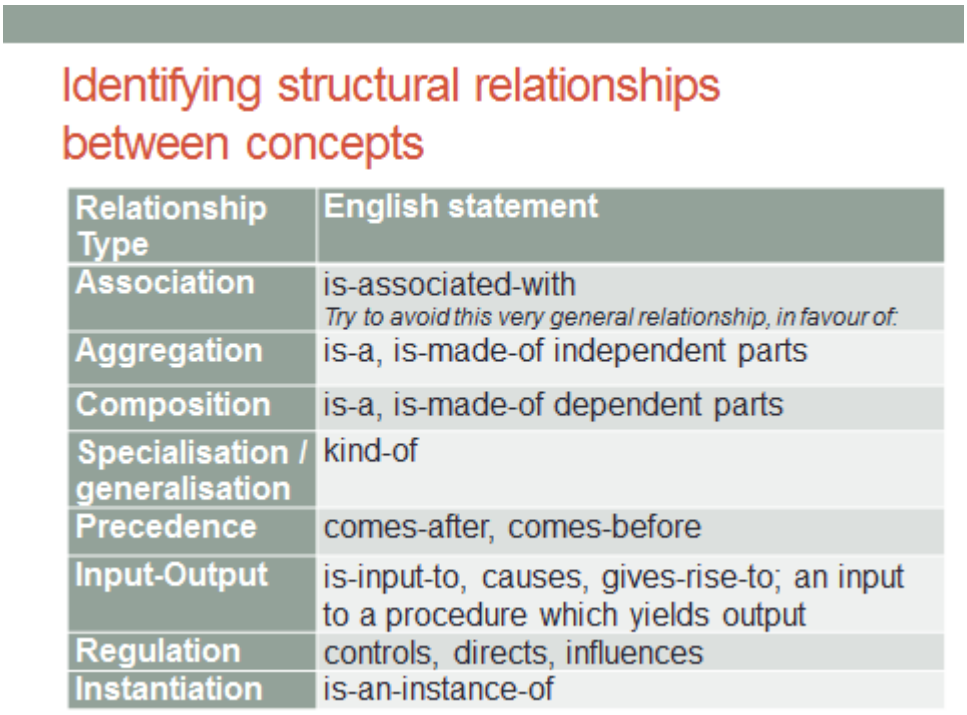
The method for building a Conceprocity model is as follows:

- Define a focus question to which your model will be a (partial) answer, or at least delimit a clear topic area
- Decide the type of model which you wish to build
    - ❑ Conceptual
    - ❑ Procedural
    - ❑ Prescriptive
    - ❑ Methods and processes
- Decide the usage profile which is appropriate to you and to the situation you are modelling
- Create a Google Drive directory (folder) to contain the files that will constitute the model
- Begin to build a Conceprocity dictionary and glossary containing initial lists of:
    - ❑ Concepts (and specific instances: facts)
    - ❑ Actors (and specific instances: e.g. named persons)

- Processes

- Create some examples for each notion
- Think about the relationships between the concepts, actors and processes
- Can you identify structural relationships between concepts?
    - Or are concepts related only by processes?
- Can you identify principles (rules) which affect the modelled situation? Include constraints
- Start to sketch out the initial Conceprocity model
    - It's often necessary then to go back, reconsider and refine the initial lists in the dictionary
    - This stage also typically requires further research around the original question
- Add principles, events and logical operators to the model
- Create, refine and use the model in Lucidchart

Structural relationships



Identifying structural relationships between concepts

Relationship Type	English statement
Association	is-associated-with *Try to avoid this very general relationship, in favour of:*
Aggregation	is-a, is-made-of independent parts
Composition	is-a, is-made-of dependent parts
Specialisation / generalisation	kind-of
Precedence	comes-after, comes-before
Input-Output	is-input-to, causes, gives-rise-to; an input to a procedure which yields output
Regulation	controls, directs, influences
Instantiation	is-an-instance-of

Figure 9 Conceprocity structural relationships

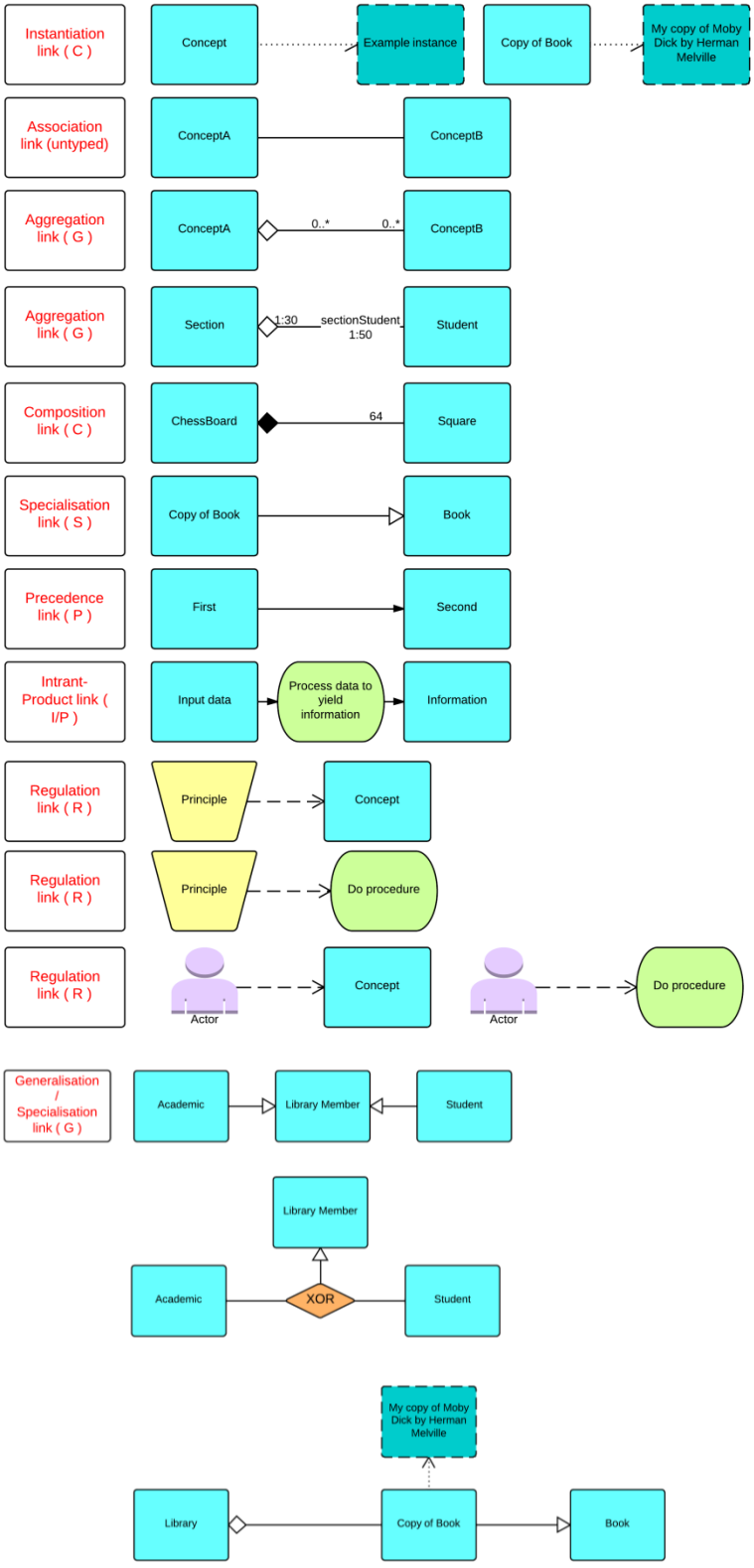


Figure 10 Conceprocity relationship types

Where to find out more concerning Conceprocity

Further information concerning the Conceprocity approach can be found at the website www.markrogergregory.net

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