The Metaloger[1]: a toolset to support complex emergent systems

Why a Technology Research Paper?

The Metaloger is an innovation project, based on the work of many in the area this conference addresses. The Complexity Science Conference needs to embrace the spectrum of complexity from its emergence as new thinking, through interdisciplinary science, to delivered artefacts that change the real-world view. The latter end feeds off earlier work and *builds* something from it.

I choose to ground this paper in an examination of a technology research programme. That is not to say that fundamental research is not involved. Nor does it mean the work is non rigorous. But it does mean the starting point and direction is all about delivering a useful artefact to meet some well known need. That encourages funding, and from small beginnings further practical applications will emerge.

This is a working paper about where the work has got to and why we want to take it into much more all embracing directions of application. I hope to show that these will not cause us to fall over though some stumbles on the way are inevitable. By having a few real-world applications, belief in the vision can be turned into results.

The presentation to the Complexity Conference will outline the inter-disciplinary research that will bring the Metaloger to market. It will place this within the EU programme of work on complexity science

What are we pitching a toolset at?

To answer this question we have to start with some of the identified potential areas of interest and go on to show a toolset might be of benefit. The ingredients will be shown to be quite well known areas of endeavour. So a practical basis for believing the project can succeed exists. The crux of the research is the specific application of computerised information handling to the way we *behave.* In short, man-kind has dealt with complexity for a long time but without any specific tool that focuses on the elements of complexity that are embedded in our behaviour.

I draw the analogy with Prof. Deneubourg's work with the mechanisms empirically evident in the behaviour of ants and cockroaches. For humans the mechanisms are already embedded in very real structures of social existence ranging from culture to corporate frameworks. Or, more generally all the complex social models that govern action. These can be studied and built into models, but more importantly applied outside the laboratory that studies them. A toolset uses all this understanding to construct a useful artefact which can both be used in the practicalities of daily life and as a research repository for examining what is going on in 'life'. The study is then on-going, you might say in the university of life. This simple statement is non-trivial. The canvas of this work is all about us. It is about the Transition from Science to Technology.

The Application Area

Complexity Science has the potential to inform how we live, work and manage our existence. It also needs to become a numerate empirical science not just in esoteric applications or the research laboratory, but in the laboratory of everyday life.

This paper is about organisations, management, and the conjunction of complexity science and sociological behaviours. It is a novel area and this paper aims to take its discussion forward. The striking thing in papers on complexity is how the science and technology is tied up with more esoteric factors such as trust, belief, alienation, human concerns about life and its direction.

[1] The term 'Metaloger' is a neologism from meta- and –catalogue, because a catalogue orders and provides access to a set of resources, whether books, or in this case models-in-use. I should add to that the real-time, process control use of the term 'logger', as a device which records control signals for feedback mechanisms and subsequent analysis

These sociological concerns are pervasive. They are examples of key 'meta characteristics' which need to be brought into the frame of any toolset.

The best succinct description of the characteristics of complex emergent systems is Eve Mittleton-Kelly, Director of LSE's Complexity Research Programme (Ref 1).

The Metaloger project (Ref 2) is a research & development proposal for a toolset to address the conditions described in Ref 1. It has cut its teeth on ESS, OSS and BPE support. But its vision is much wider than these (important) applications. Appendix A is an introduction and the full research paper is available on request from the author of this paper.

'Simulating Emerging Properties in Complex Systems', which is a FET proactive initiative funded by the Information Societies Technologies (IST) Programme of the EU (Ref 3) already has identified many of the necessary directions relevant to this work.

The problem: the gap between traditional systems of governance and modern global complex conditions

I use the word governance rather than (say) adaptive behaviour to denote the element of purpose, even moral-purpose. Current complexity science recognises that society is a complex adaptive system but lacks the means to apply it other than by analogy. This is insufficient to make any significant impact. Moreover the truism applies, that "what we cannot measure we cannot know" {Kelvin?].

Every level of modern living, - personal; organisational; commercial; macro-economic; political; - presents difficulties of management of an increasingly complex, alienated, and threatening set of conditions. Far from failures to optimise we increasingly feel we cannot cope.

The problem is current structures of governance are not designed to address either the opportunities or threats inherent in 'global complex emergent systems', i.e. human institutions. The reasons are simple: the field of study is new, its imperative is only now becoming recognised. But, above all the required solutions do not exist yet. In particular, the sociological and the technological domains only work together with difficulty – even if at all! It is not joined-up.

Vision and Challenge

I start from the premise that our human intellect, will, and several millennia of endeavour has built up a vast and often impressive structure of ideas, principles, structures, and artefacts for managing life at all the levels referred to above. Governance is a modern generic term. In other words we already handle our complex adaptive system called 'life', but without complexity science. We lack tools to handle this empirically *directly*. There is a disconnect between these, especially from a holistic viewpoint. If they could all be brought into the frame (so to speak) the overlaid dimensions of complexity could usefully inform the bigger picture. There is then the ability to optimise the yield of our human systems, both in the operational scale, and progressively up to the strategic and global level. More importantly we have the possibility to prevent or mitigate down-side problems and catastrophes.

The fantastic vision is to bring together the best of human systems and the capability of large-scale socio-technological support. This is a paradigm change in the way people govern life, challenging many of the current perceptions of what is meaningful and possible. It starts from the premise that ICT is the vital resource to be harnessed.

The outcome could be a ubiquitous toolset to support working with the manifestations of complexity in modern life, rooted in everyone's everyday life, but applying complexity science to *compile* the information, measures, decisions, actions, management and potential outcomes on which optimisation of our fragile ecology depends.

Logistics systems, internet and communications, Business Process Engineering, management and governance are pale portents of the real potential improvements we might target. But they serve to at least point to a realistic trajectory. They will underpin the financial viability of this research.

What needs to be brought about?

The basis for the toolkit thinking is the recognition that the key determinants are the combination of information on which decisions and actions are based AND the dynamics of the systems that require to manipulate this information. The problem is that existing approaches are rooted in the means available pre-computers and complexity science. To change this requires several thrusts:

1. Initial work is to identify the gap in our present thinking and how to close it, recognising the novelty of the project. The science and technology delivery is an immense challenge. The meeting of minds with sociology may be the biggest hurdle.
2. Move the current goal-posts in applying 'complexity' thinking from relevance-by-analogy to embedded involvement, empirical experiment, and especially by developing direct tools
3. Undertake fundamental research into the empirical working of complexity theories in everyday business, organisation, and generically, the domain of sociology, particularly governance
4. Make the connections with current technologies and identify and address their current limitations and therefore required evolution
5. Conduct trials, limited case-work and practical applications to put CES and tools to support them onto the map

What Research Exists or is Required?

1. The key work of the Metaloger project has been to hypothesise that all human systems can be represented as structures of meta-models. The crucial next step is to extrapolate this into a possible combination of fundamental meta-processes, probably embracing socio-cybernetics. This is the beginning of an empirical science of organisation decision making (i.e. management). It will build on work being tackled through bodies such as The Complexity and Emergence Societies.
2. There is a flowering of academic research into complexity and this needs to embrace the technology challenge to deliver actual solutions. We see this as tied in with the above thrust
3. Work on embedded meta-systems, sometimes termed 'culture', is bringing about a wider understanding that such complex systems can be manipulated or even designed to achieve positive results. (The reverse is unfortunately also true.) The sociological and psychological base which is well understood needs to expand to allow for the new thinking, especially to bring in scientific measures and empiricism.
4. Commercial work in Process Engineering is tackling, successfully, specific solutions to various industrial and organisation needs. But this is hard-wired according to a designed-solution. A tool-kit must start as a generic processor of emergent systems
5. Sociology can define how human systems work but this needs also to overlay what it means to describe these as 'meta-systems', (ultimately CES) and how this does or could influence resultant behaviour
6. The ICT challenges are in the fields of large-scale data management, inevitably the HCI demands, and to attain ubiquity, development of pervasive interconnectedness which is also non-intrusive. This will involve advanced computing methods, e.g. Autonomic computing, Agent technologies, genetic algorithms (I am told). The list of topics proposed for CS research (ex Torino) is a useful starter.
7. The area of networked communications embraces both the raw networking and the purposeful interacting between people, and activities, e.g. in COPs/COINs, learning systems, knowledge bases. Meta-modeling enables proliferation of raw information to be organised within a framework of dynamic usage, plus more esoteric structures of meaning such as potential usefulness

Research and Development Directions

This research is grounded in delivering an end-product. This calls for a cooperative venture between a number of bodies to bring an innovation to fruition. This paper is a pitch for this collaboration.

Commercial Activity

Worldwide activity in developing organisation automation, e.g. logistics, process engineering, call-centres, networked economics is now recognising the downside penalties of not engaging with the sociological dimension. There is likely to be significant support for collaborative ventures to redress this growing problem. ICE^3 Metaloger is indeed a prototype application.

Specialist areas such as security are the biggest growth area, one which is a sub-set of 'normal' process behaviour.

This work will be underpinned by a strong collaboration with a number of major industrial corporations. We hope to be in a position to announce these before the Conference.

Academic Research

Following the last Complexity Conference, a number of potential partners have expressed an interest in exploring the sociology, organisation, process and information aspects of Metaloger research:

- Prof Jeffrey Johnson of the UK Open University is uniquely placed to bring together fundamental science and technological innovation in this field of Complexity Science research
- Prof Corrado Priami of Trento University, who is researching pi-calculus, considered to be an important foundation to process-manipulation (if I have got it right?) (Ref 4)
- Prof Eva Mittleton-Kelly (Director, Complexity Research Programme, LSE) and Prof Patrick Humphries (Director, LSE Social Sciences Institute) have been approached

Themes for Consideration in FP7 ICT

1. Meta-modeling is a problem oriented activity aimed at solving complex management situations by combining existing proprietary 'systems and methods' structures into a rigorous framework of complexity science. This has to be researched
2. Existing technologies such as Knowledge engineering need to be widened to embrace the dynamics of knowledge instantiation, consumption and run-out. This terminology is deliberate to suggest that 'knowledge' is just another *resource* utilised in getting on with living
3. The interface between existing 'non-computer' governance frameworks and a Metaloger toolset is a crucial aspect since currently one of the obstacles to progress is the difficulty of combining human thinking and decision making with computer based systems.

Interdisciplinary activity

The concept that all human activity systems can be modeled as structures of interlinked Met-models begs the question of who and how the initial models might be constructed. Concepts of learning systems will be an ingredient, but an industry is likely to emerge to fashion the building blocks. This is akin to all existing moves towards standards, languages, frameworks and so on. An analagous current activity is all the standardisation initiated by W3C, such as OWL (Ontology

Web Language). We can envisage a lingua-franca for translating between proprietary human systems and their underlying complexity components.

Possible outcomes

By integrating the fundamental underlying rules and processes of CES with existing 'real world' rules and processes, the two worlds of complexity science and organisation behaviour are brought together. Both are held up to scrutiny so as to evolve better ways of managing our existence. This is an on-going and emergent task. We do not know how practice might change given entirely new toolsets. We envisage the outcome for organisation management as being as fundamental as the lever was to engineering.

Links and references

1. Complex Systems & Evolutionary Perspectives of Organisations: Eve Mittleton-Kelly, Director, Complexity Research Programme, London School of Economics and Political Science (LSE)
2. THE METALOGER PROJECT: RESEARCH & DEVELOPMENT PROPOSAL: further details available from the Author
   2.1. "An Investigation into the validity of a Metaloger environment to provide automated support for Business Process *Emergent Engineering* (BP*EE*)"
   2.2. "The Metaloger: an examination of the means of collection, classification, manipulation, and *application* of 'meta' level information using computer based tools and systems"
   2.3. "The design of a generic socio-technocratic modelling environment
3. Simulating Emergent Properties in Complex Systems – 2005 Contact Dr Ralph Dum. http://www.cordis.lu/ist/fet/co.htm email ralph.dum@cec.eu.int
4. Process algebras compositionality to hammer complexity. Torino 2004, Prof Corrado Priami, Department of Computing and Telecommunications, Trento University, Italy

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APPENDIX A iCE^3 Metaloger Platform: A New Computing Paradigm

Background

There is a yawning gap between the ability of computers to support complex but discrete *applications* and their ability to support sociological systems which are the most pervasive and complex structures devised by mankind. They exist in the most diverse and intricate forms across every aspect of human life. This paper argues, starting with the area of business systems, that this must change if we are to make a leap forward in handling modern *complex systems* and ultimately protect the fragile ecology of our existence. This implies a need to examine the way socio-technological solutions to 'life' actually work before trying to build new tools to support them. This is the area of Metaloger research.

A Research paper in 1999 addressed the fundamentals of a Metaloger[2] under the title: "an examination of the means of collection, classification, manipulation, and *application* of 'meta' level information using computer based tools and systems". It analysed the pervasive dynamics of meta-information in human life and the benefits of constructing new ways to handle these dynamics. The subsequent MBA Thesis in 2001 focused on one area of this phenomenon, under the title: "An Investigation into the validity of a Metaloger environment to provide automated support for Business Process *Emergent Engineering* (BP*EE*)". This work was sponsored by ipulsys iCE BV. This white paper necessarily omits the detailed academic research and evidence justifying the central thesis of the Metaloger. That is available from the Author. This report does include many of the diagrams and pictures which are used in that thesis to encapsulate detailed analytical argument, even though they cannot be given a full exposition here. They are offered as a way of whetting the appetite to learn more about the potential of the Metaloger

The Metaloger

The iCE^3 Metaloger platform is a tool-set for processing real-world activity systems typified by advanced logistics, but also potentially any structured organisational environment. It does this by combining advanced modeling, principles of emergence, and all this using familiar modes of engagement that people are familiar with in their professional, working, and group lives.

The Paradigm

This paper argues that a universal 'methodology' is a method for life and describes a current research programme into how computing lies at the heart of such a methodology of 'life'. Both an immediate practical example is given as well as a projection of the ultimate goal of the research.

The above statement is philosophical, theoretical, practical and technological. This parallels much of complexity science thinking. Study of Life, the Universe and Everything [Douglas Adams] tends to lack focus through trying to be all embracing. It becomes all things to all men and ends up getting nowhere. So this research starts from the immensely practical: it has *process engineering* as its practical focus, and is *technology driven* because that is the means and the driver. The extent to which *complexity science* will result in a Kondratiev paradigm shift remains to be established.

At the heart of this uncertainty lies not so much the ability of technology to deliver (though the challenge is immense), but our readiness to contemplate bringing such technology based support – I will not affect hubris by using the term 'solution' – to bear on the most fundamental of human activity. By this I mean principally how we think and form our view of the world. But, more especially, a view that leads to decisions, action, and validated conclusions. The latter can be understood in the realm of academic research, as well as the more immediate practicalities of how we conduct our globalised endeavours. 'Governance' is the overall aspect. Exploiting capability within a framework that is directed by potential, by responsibility, by knowing and acting is both powerful and critically necessary. However these statements skirt round the fundamental problem area, which is to bring together the disconnected worlds of those who ponder the affairs of mankind, and the technologists who can directly change the playing field in such matters.

The two words that epitomise the philosophical challenge of complexity science are 'universal' and 'disconnected'. The former tries to bring more into the frame. The latter reflects our inability to deal with more than we can handle with the tools at our disposal. Sufficity (Simon) versus the absolutes of thought itself. The Metaloger, a computing and a sociological platform, engages with this dilemma and challenge.

[2] The term 'Metaloger' is a neologism from meta- and –catalogue, because a catalogue orders and provides access to a set of resources, whether books, or in this case models-in-use. I should add to that the real-time, process control use of the term 'logger', as a device which records control signals for feedback mechanisms and subsequent analysis. (Ref.M0)

Its aim is to deliver a new automated toolset for meta-modelling.

The Vision

Meta-modelling offers the ability to support complex dynamic human systems, going beyond current decision support which aims (ineffectively) to programme-out the human dynamic. It does this by extending the ideas behind business modeling and process automation to the way people think and manage in today's global emergent conditions. We have got to the conceptual design stage and worked out how to apply this to advanced virtual operations support systems. Current pattern recognition technologies, such as are used in large search engines, work on huge databases which are essentially *static* data. The Metaloger works on the dynamic processes that cause the data to exist and make it meaningful. The fundamental technologies required are in the research stage, and involve leading edge computing algorithms, complexity theory, and knowledge codification. The unique feature is to process the structures of meta-models that give significance to gathered knowledge by showing usage, preference and trends. The search for 'meaning' is the basic human quest that this technology supports.

The Metaloger computerises the dynamics of management behaviour, and thereby adds the leverage of ICT to management. The dynamics consist of the complex frames of reference embodied in the multiplicity of management models, and the organisational context in which they are applied. The concept behind the Metaloger is that these complex models can be systematised. The leap of the imagination is the realisation that these models are the equivalent of the properties of materials in applied science or the Human Body in the medical sciences. Their study leads to empirically derivable laws and validated management. Provided models can be made to deliver their potential, we shall see a reversal of management action as the pre-eminent plaudit, and a reinstatement of reflection as the pre-eminent skill of the manager; action will remain skilled and technically complex but essentially subservient to thinking. Models are superior to real-life as experience for determining action because they are not limited to one partial set of 'events'. At least modelling must be in the loop of how action occurs.

Key areas in which the Metaloger will deliver fundamental change are quality; the *amelioration* of pathological management; handling of complexity; proactive management of the dynamics of change; incorporation of the sociological dimension; managing larger programmes; and making people more creative in their organisational life. The benefits accruing from developing the Metaloger are: firstly, in the support of a new science of management, and, secondly, it will be the knowledge repository which provides the only means to control and harness technology so as to achieve Taguchi's vision of quality as 'inversely proportionate to the sum total of loss to mankind'.

The Metaloger will make it routine to surround data and decisions with recorded and verifiable audit-trail of their aetiology so that pathological misuse of data and wilful mal-practice becomes more visible. Where real-time handling of such data and decisions is enabled it will be much more difficult to engage in mal-practice, to hide it, and escape from its consequences. The Metaloger also makes such processes available for future decision making and learning.

Historical Context

Computers and organisations have achieved much over the sixty years since they first undertook the complex calculations of weapons trajectories. They have evolved from calculating machines, carrying out tedious repetitive administrative jobs, to supporting sophisticated integration of human activity systems – typified by supply chain logistics. They have also been harnessed to complex physical systems as in robotic manufacture and automatic flight control. The one area that has largely eluded the industry is the support of complex functioning human systems, whose characteristics defy analysis into finite computational steps. Artificial Intelligence has tried to replicate the way we think, and has even succeeded with relatively simple expert task support – in effect by isolating the complex phenomena of human intelligence into things that can be ascribed finite computable attributes. Current research is looking at both what happens in complex human systems – we call this 'process analysis', and what it represents as an information handling and decision-making problem. We can refer to this as process automation, though computer supported human processes might convey the idea better. This is the area of computing that our group is working in.

Envisioned Trajectory

The Metaloger project concerns research and development of socio-cybernetic systems that model complex systems of human behaviour. The word 'model' has many connotations, of which the most fundamental is that we perceive our world entirely through the models we construct in the mind. The notion that these can be supported by automation challenges current thinking and also the prejudices that seek to limit the sphere of computing's involvement.

The Metaloger seeks to extend computer support to the complex, dynamic, and interlinked models we choose to apply to our world. Put another way, currently the technology of information handling stops at the point where people get on with using what the system provides. They then determine the real-world processes by which it is put to use. The Metaloger supports the people world with automation of the processes plus the knowledge that puts flesh on them (indeed this is a vital two-way thing). Thus the dynamics begin to be directly processed in the automated environment. In the real-world as in the modelled world, the connections between models and behaviour are one. The connections reside in exceedingly complex structures of meta-models, that can be modelled by complexity theory. Processing these extend current thinking and practice in some novel and radical directions.

Further research which is on-going, under the title: "The design of a generic socio-technocratic modelling environment", will expand the canvas on which the Metaloger will paint tapestries of current, historical and emergent scenarios of *life*. This work addresses the dynamics of the management of human affairs, especially the sociological dimension, the Knowledge processing involved, and how this leads to better systems for decision-making.

Researching the operation of meta-models and how these can be codified and modelled dynamically is the goal of the current stage of this research. Two concepts show the capability to address the fundamental science. They are General Systems Theory, and the specific working of this into the Viable Systems Model (first developed by Stafford Beer). These enable basic mapping of what we can term 'the basic processes of *organizational* life'.

Translating this into a processable (and itself emergent) computing platform requires basic research going beyond current human-technology interface management. The continuous configuring of the Metaloger requires a seamless language of emergence which is applied to people, process, platform and performance within the ecology of the world we inhabit.

The Initial Killer Application

The business world has reached a stage of complexity that calls for radical new approaches and tools for its management. This thesis is about modelling, what this means as a fundamental human activity, what it is as part of the practice of business professionals (managers and process engineers), and the automation of this activity. It derives a new synthesis of understanding about the nature of business development and improvement, called 'Business Process *Emergent Engineering'* (BP*EE*). and shows this is a particularly important case of modelling which can only be enabled with a new kind of automated environment. A conceptual automated solution for this is the Metaloger, which this project describes and validates. The Metaloger can be said to process the information concerning emergence, BP*EE* being one application of this phenomenon. The phenomenon labelled emergence is more fundamental than merely being a characteristic of the business world. It encompasses the whole gamut of purposeful human existence. Taking the BP*EE* example, it embraces the entirety of how business activity is brought into being and to fruition, to deliver the aspirations of the people involved. I use those terms rather than the more conventional ones of innovation, change, strategic development, and operational delivery. But the all encompassing term is the *socio-technocratic* society (first coined by Galbraith). The Metaloger is an automation support system for a socio-technocratic environment. Thus the Metaloger is a generic tool for processing emergence, viewed as the evolving thought and purposeful activity of communities, organisations, society, and mankind globally. To bring this grandiose claim down to earth, the Metaloger is however only a tool-set; it is not the thing itself. This thesis shows how the concept called 'meta-modelling' forms the basis for the fundamental processes of human thought, and in turn can be supported by an automated environment. It goes without saying that this takes computing into areas of information processing that are at the leading edge of current computability. However this rigorous view forms the coherent science and practical basis for development of automation solutions for the business world.

Harnessing computer technologies dynamically to this world is an extension of current practice but already in early form being done in virtual operations support systems. These Operations Support Systems (OSS) are the business area we have cut our teeth on. The iCE^3 platform is at the prototype stage[3]. Typical future applications are in anticipating and meeting individual customer preferences (a key business imperative across most industries and services). More advanced applications are the reverse of this where the chosen customer preference is not the outwardly manifested process, but some covert one, which is a cover for the real aims. Here the 'conforming' behaviour is scrutinised for hints and patterns that suggest the tie-in with the codified meta-structures that we define even though their proponents try to conceal them, (this includes forensic investigation, forensic accounting, security, organised crime, and above all counter

[3] iCE^3 iCE cubed stands for interactive customer engagement, empowerment & engineering to *transform* business performance

terrorism. This is reverse customer preference). The generalized potential of this product is as a core component of every kind of system that supports the way people work, behave, and live.

The goal of this work is a partnership between the best of automation and that of human systems that extends their reach and effectiveness. This is the area of behaviour, decision making, and above all goal-oriented activity. To achieve this we need to evolve new paradigms of human-computer working. These embrace worlds that traditionally do not meet or share common ground. A new research space has to be created and populated. Fortunately much of its needs have already been prefigured in existing ideas and research work. We can support business process engineering, knowledge management, and suchlike by existing technologies. Present limitations arise because human behaviour is richer, more complex and creative - even idiosyncratic. Our brains plus organisational structures enable us to manage the world we create, but it is perceived wisdom that all the above is getting more complex, dynamic and difficult to control against the goals we strive to attain.

The Prototype

This white paper summarises the development point reached so far in implementing a Metaloger solution as part of an iCE Toolkit for business process and service automation. The toolkit adds to the prototype iCE solution the ability to dynamically configure business change. The significance of this is far reaching and the business application is simply the first use of such an environment.

The automation of service processes as in a Virtual Operations Support Services (V)OSS has one big Achilles Heel. The service does not stand still. Moreover the customers want more and the shareholders want to supply this but for less money, and fast.

ipulsys iCE is an automated web-enabled platform, initially built for a telco environment, but applicable to any customer environment. The ability to automate the reconfiguring to suit any kind of business is called the ‘toolkit’ . The customer engages with the platform to design their own way of working!

The further advance the Metaloger brings to this is to engage with the fundamental business management planning process. Although this can be termed Business Process Engineering automation, the Metaloger goes beneath the surface which is the operational business processes to the conceptual thinking that business strategists and managers undertake all the time in the *Emergent Business.* A BP*EE* Toolkit widens the scope of service automation to embrace continuous business change.

Commercial Positioning

This work is ready for exploitation. It will become a core intelligent component of all knowledge management and business processing solutions. We have a virtual team of highly original thinkers, most of whom have worked on the earlier (V)OSS prototype. Academic research is on-going. The business plan has immediate practical potential, while positioning a world informatics leader as the leading practitioner of process automation. We still seek a world-class technology partner with the vision and ambition to exploit this work. They will bring their own leading-edge research and facilities as well as providing the means to bring the Metaloger to the market. This work is ready for exploitation. It will become a core intelligent component of all knowledge management and business processing solutions.
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