From metaphors to intelligent patterns: milestones on the road to code re-use

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A dissertation submitted in partial fulfillment of the requirements for the degree *Magister Scientia* in the School of Modelling Sciences at the Vaal Triangle Campus of the North-West University

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November 2007

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Acknowledgements

To Marthi, Gustav and Cia – without your love and sacrifice this would not have been possible!

To Hannes and Marietjie, Pete and Gail whose kind ear and gentle interventions enabled this to happen.

To Dawid, under whose auspices incoherent conjecture evolved into meaningful comprehension.

Summary

Computer applications can be described as largely rigid structures within which an information seeker must navigate in search of information – each screen, each transaction having underlying unique code. The larger the application, the higher the number of lines of code and the larger the size of the application executable.

This study suggests an alternative pattern based approach, an approach driven by the information seeker. This alternative approach makes use of value embedded in intelligent patterns to assemble rules and logic constituents, numerous patterns aggregating to form a "virtual screen" based on the need of the information seeker. Once the information need is satisfied, the atomic rules and logic constituents dissipate and return to a base state. These same constituents are available, are reassembled and form the succeeding "virtual screen" to satisfy the following request.

Metaphors are used to introduce current information solutions, where events are initiated and driven by physical constructs built using monolithic instruction sets. The metaphor approach is then expanded, illustrating how metaphors can be used to communicate an understanding between two likeminded intellects – this illustrates how spatial artifacts are used to carry intellectual value across the intellectual divide, from the one (intellectual source) to the other (intellectual target). At this point, the pattern based concept is introduced. This is where value, an intellectual appreciation hidden within spatiality, can be exploited towards the delivery of information.

The pattern based approach makes use of multiple pattern "instances" to deliver functionality – each pattern instance has a specific embedded value. Numbers of these patterns aggregate to drive the formation of a "virtual screen" built using patterns, each pattern referencing and associating (physical) atomic logic and spatial constituents. This is analogous to painting a picture using removable dots. The dots can be used to describe a fish, and then, once appreciation has been completed, the image is destroyed and the

dots are returned to the palette. These same dots can later be reapplied to present the picture of a dog, if that is requested by the information seeker. In both pictures the same "dots" are applied and reused. The form of the fish and dog are retained as value embedded within the patterns, the dots are building blocks aligned using instructions within the patterns.

This study classifies existing application solutions as belonging to the Artifact–Pattern–Artifact (APA) group, and the pattern based approach belonging to the Pattern–Artifact–Pattern (PAP) group. An overview and the characteristics of each are presented.

The document concludes by presenting the results obtained when using a prototype developed using the PAP approach.

Opsomming

Rekenaartoepassings kan beskryf word as hoofsaaklik rigiede strukture waar deur 'n inligtingsoeker moet navigeer opsoek na inligting. Elke skerm, elke verslag en elke transaksie het sy eie onderliggende kode. Hoe groter die toepassing, hoe groter die aantal lyne in die programkode en hoe groter is die uitvoerbare toepassingskode.

Hierdie studie stel 'n alternatiewe patroon–gebaseerde benadering voor – 'n benadering wat deur die inligtingsoeker beheer word. Hierdie alternatiewe benadering maak gebruik van waarde, inherent aan intelligente patrone, om reëls en logiese komponente saam te stel. Veelvoudige patrone word saamgevoeg om 'n "virtuele skerm" te lewer wat gebaseer is op die inligtingsoeker se behoeftes. Sodra die inligtingsoeker se behoefte na inligting bevredig is, verdwyn die atomiese reëls en die logiese komponente keer terug na 'n basis toestand. Dieselfde komponente is weer beskikbaar om die daaropvolgende "virtuele skerm" saam te stel om sodoende die volgende inligtingsversoek te bevredig.

Metafore word gebruik om huidige inligting–oplossings in te voer, waar gebeurtenisse deur monolitiese instruksies geïnisieer en bestuur word. Die metaforiese benadering word dan uitgebrei om te illustreer hoe metafore gebruik kan word om 'n verstandhouding tussen twee enersdenkende intellekte te kommunikeer. Dit illustreer hoe "ruimtelike artefakte" gebruik word om intellektuele waarde oor die intellektuele gaping oor te dra, vanaf die intellektuele bron na die intellektuele teiken. Die patroon–gebaseerde konsep word nou ingevoer. Hierdie konsep toon hoe "waarde", 'n intellektuele waardering, binne "ruimtelikheid" benut kan word om inligting te lewer.

Die patroon–gebaseerde benadering maak gebruik van veelvoudige patroon–voorkomste om funksionaliteit te verskaf. Elke patroon–voorkoms het 'n spesifieke inherente waarde of betekenis. Verskeie van hierdie patrone word versamel om 'n "virtuele skerm" te vorm. Elke patroon besit spesifieke (fisiese) atomiese, logiese en ruimtelike komponente. 'n Analogie is om 'n prent te

teken met verwyderbare kolle. Die kolle kan so geplaas word om 'n vis te vorm. Sodra die waardering van die vis tot 'n einde kom, word die prent vernietig en die kolle word teruggeplaas op die palet. Dieselfde kolle word dan weer gebruik om 'n prent van 'n hond te skep, indien 'n hondebeeld verlang word. In albei gevalle word dieselfde kolle aangewend en hergebruik. Die vorm van die vis en die vorm van die hond word behou as waarde binne-in die "patrone" – die kolle is boustene wat gerangskik word deur die instruksies in die patrone.

Hierdie studie klassifiseer huidige toepassings binne die "Artefak–Patroon–Artefak" (APA) groep, en die patroon benadering hoort aan die "Patroon–Artefak–Patroon" (PAP) groep. 'n Oorsig en kenmerke van elkeen word bespreek.

Die studie sluit af met resultate wat verkry is van 'n prototipe toepassing wat volgens die PAP benadering ontwikkel is.

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Conceptualization of the study

1.1 Introduction

The human mind's thirst for information places a heavy burden on the shoulders of information technology professionals. Not only is the information requirement, the essence of the information need, difficult to define, it changes at the slightest whim, differing from person to person, from one day to the next, from one intellectual need to the next. Capturing the essence (structure) of the information need is an extremely onerous and risky process.

Apart from capturing the essence of the information need, there are many accidental factors which contribute to the difficulty of satisfying the information requirement. One of these is the management of redundancy. Duplication (redundancy) is perhaps the single greatest constraint restricting the optimal delivery of information today. When evaluating the underlying environment within which information delivery must take place, two main pillars within which redundancy exists can be discerned.

- Persistent structures allowing retention of data (rule).
- Algorithmic constructs delivering logic, with which the data can be manipulated (logic).

Normalization of data structures (Codd, 1970) has provided mechanism's to control duplication within the persistent structures. Normalization of logic (Dosen, 2003) remains an enigma. Modern practices suggest that code reuse can be achieved by applying OO principles; however, physical code which is instantiated is still duplicated across similar functions. In elementary terms, registering a Customer Manager Class and registering a Product Manager Class would have two classes, each class instantiating a separate "Registration" object containing duplicated registration logic. The registration code would be duplicated in these objects. The size of the applications executable would be a function of the number of classes – the greater the

number of classes, the larger the binary code of the application. Removal of redundancy within the logical (algorithmic) dimension of computer applications will contribute towards optimizing code use. Optimal code use in turn will be attained when the executable (binaries) size remains constant, irrespective of the magnitude of the information need.

1.2 Problem statement

Development of the accidental aspects supporting information technology solutions today consume significantly more resources than that required to elucidate the essence of the requirement (Brooks, 1987). Duplication within the accidental aspects plays no small role in consuming this effort, not only in duplicating development effort, but also exponentially increasing complexity, forcing a maintenance penalty. The problem statement can be summarized as follows.

> Duplication of logic, rule and structure contribute significantly to the development and maintenance effort of information delivery vehicles.

1.3 Objectives of the study

The objectives of this study are as follows.

1. To determine if the persistent and algorithmic components supporting information delivery can be retained independently and separately during the dormant phase.

2. To investigate how these two constituents can be harnessed towards satisfying an information need on demand.

3. To identify mechanisms which can adroitly react to the ephemeral flow of the information need, dynamically streaming the harnessed constituents towards an appropriate response.

4. To investigate whether it is possible to deliver an executable whose size will remain constant, irrespective of the size of the information need.

5. To determine whether removing duplication from rule (persistent aspects), logic (algorithmic agents) and structure (intellectual appreciation) introduces a meaningful reduction in development and maintenance effort.

1.4 Research methodology

A literature study was conducted and a critical evaluation of current and emerging technologies are presented. A definition of a conceptual alternative is presented. The research is aimed at developing the concept and periodic reevaluation and determination of future effort was undertaken.

An experimental approach was taken. In 1977 the author entered the field of data processing. After two years of Assembler and COBOL programming, he became frustrated at the amount of duplication found within the programming arena. He subsequently spent 8 years developing code generators. This approach was abandoned. The Personal Computer was then introduced to the market, and the author subsequently initiated a project aimed at reskilling himself in application development on Personal Computers. This was the start of the research leading to this document. This research can be broken into two periods – the first ending after 14 years of development in 1999, when the concept initially employed in this concept was proved faulty. Subsequent development, from 1999 to 2003 developed the second prototype, the results are presented in "Table 4: Results from a metaobject based application" in Chapter 7.

The following principles were adopted:

- The "raison d'être" of this research was to remove redundancy in all its forms thereby promoting information delivery.
- No short cuts would be tolerated.
- Time was not an issue.
- Pursue a concept, not a technology.

This study followed an informal protocol, based on qualified, intuitive reasoning pursuing an intellectual objective established at the outset. The instruments were from an accidental perspective, a Personal Computer, a Compiler, and a Database. The essence was the intellectual goal – to find a mechanism to improve the effectivity of information delivery.

The major portion of the study was spent developing the prototype. This development cycled between the following two extremes.

- The definition of a conceptual, theoretical objective and the
- development of the (practical) prototype towards the attainment of that objective.

1.5 Layout of the study

Chapter one defines the research problem and research objectives of the study. The second chapter identifies spatial objects as the persistent constituents of an application and the third chapter introduces temporal agents which deliver the logic aspects. These two constituents form the accidental components of the information delivery solution.

In the fourth chapter, a rational describing how the essence of the requirement is manifested through intellectual reflection (structure), and the internalization and externalization of information is presented. Chapter five evaluates two models, one where intellect is constrained within the corporeal world (Monism) and the APA model is introduced, and a second model where the corporeal world is an instrument of intellect (Dualism) where the PAP model is discussed. Chapter six and chapter seven present the theoretical and practical findings when emulating the dualistic model using a prototype.

The conclusion in chapter eight contains the findings of the study. These findings indicate that a many to many relationship between "Code Fragments" and program modules can be demonstrated. It then presents the findings of the study, each finding matched against the corresponding objective listed in 1.3. Recommendations are presented, after which the conclusion is delivered.

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Spatial Objects

ABSTRACT

Spatiality, from a physical (corporeal) perspective, describes any property relating to or occupying physical space. A second form of spatiality, namely that of intellectual spatiality, called networks of the mind is proposed. Intellectual spatial objects are mental images, constructs of the mind recalled during the process of thinking and dreaming. A parallel between physical spatiality and intellectual spatiality exists. In both cases, structural integrity within the spatial domain remains unchanged in dormant states. This integrity remains true for both the artifacts and the relationships between these artifacts. Attributes of both corporeal and intellectual spatial objects are also contained within this spatiality and thus also retains integrity over the dormant period. Value, an intellectual appreciation of attributes, also retains integrity over the dormant period. The findings of this study indicate that "Value" may share characteristics with and be related to "Essence". "The essence of a software entity is a construct of interlocking concepts: data sets, relationships among data items, algorithms, and invocations of functions. This essence is abstract in that such a conceptual construct is the same under many different representations. It is nonetheless highly precise and richly detailed" (Brooks, 1987).

During periods of change within a given spatial domain, when energy is expended or consumed, the integrity is affected. This amendment affects the "Value" the "Essence", ensconced within and associated with the spatial domain. Attributes and characteristics of spatial domains abide by rules. Energy, which drives the logical aspects, is ensconced in temporal agents.

2.1 An understanding of spatial objects

"Spatial objects" is a term used to describe a collection of related objects. Two categories of spatial objects are suggested, namely physical spatial objects and intellectual spatial objects.

- **Physical spatial objects** display characteristics such as form, shape, texture, and function. Physical spatial objects are built upon underlying sets of physical spatial objects, until the ultimate constituent is found at the atomic level. Physical associations are formed when individual object instances within a relationship exist together with other instances forming a physical hierarchy. A hierarchy exists where one individual object instance is constituted from other object instances. Each object is in turn constituted from other object instances. Physical spatial objects are tangible constituents of the corporeal world (Bongsug & Bloodgood, 2006). Physical spatial objects constitute the "matter" (Williams, 1958) aspect within the corporeal world.

- **Intellectual spatial objects** are persistent "intellectual objects", "mind images", or "memory fragments" collated by the act of thinking and preserved during the formation of memories. It is the "object" aspect of a thought-object (Hooper, 1917). A "memory fragment" is a unique, persistent isolated intellectual spatial object, which can be manipulated using the thought process. Absurdities can be imagined which cannot exist outside the mind. These imaginations form the foundation of intellectual networks of association. Meaning may be encoded in links through the network and patterns of change that may be propagated in the network (McBride, 2006). Patterns are formed by examining spatial objects and the relationships which exist between them. A pin can easily be imagined inside a house. Conversely, it is easy to imagine a house fitting inside a pin head – absurd but imaginable. Spatial constructions of the mind, feeding on persistent memory and driven by the forces of thought are subject to constant reordering. Intellectual associations, for example images of the mind, by allowing virtual associations, are not bound by physical constructs, and are thus not

bound within a hierarchical structure. The relationship between intellectual spatial objects forms an ephemeral network. Intellectual spatial objects are intangible (Bongsug & Bloodgood, 2006). These intellectual associations conform to rules underlying networks. "Information should be represented as networks, where nodes represented information identities and lines represent relationships" (McBride, 2006).

In both the physical and intellectual models, value ensconced within them exhibits characteristics of persistence – a common definitive factor. Persistence, the continuation of an effect after the removal of its cause within a domain exists when the attributes describing an object (physical or intellectual) survive after the object ceases to exist. Persistence is also an attribute of value.

- **Persistence of Physical value**

  Persistence of physical value is observed when morphological characteristics are passed from one biological generation to the next, for example, eye colour (Mendel, 1866).

- **Persistence of Intellectual value**

  Persistence of intellectual value is observed when intellectual value is passed from one intellectual generation to the next, for example, cultural norms. A meme, a term used to refer to any cultural entity such as a song, an idea or a religion (Dawkins, 1976) has two constituents. The first constituent is an intellectual spatial object, and the second, discussed under the heading Temporal Agents below, is a temporal agent. Persistence in the intellectual sense describes an ability to propagate intellectual value across intellectual generations.

2.2 Relationships between spatial objects

Two forms of relationships exist between spatial objects, based on the physical or intellectual nature of the spatial object. Physical spatial objects are

linked hierarchically while intellectual spatial objects are networked intellectually.

- **Physical spatiality**. Everything which exists as corporeal material, which can physically be seen and felt, qualifies as a physical spatial object. A bill-of-materials decomposition where a car has doors, a door has handles; a handle has a plastic cover indicate the physical hierarchical relationships between the physical objects. This relationship forms a physical hierarchy conforming to the typical "bill-of-materials" profile. A universe has constellations, constellation have solar systems, solar systems have planets, planets have continents, continents have territory, territory has trees, trees have leaves, leaves have cells, cells have nucleoli and nucleoli have chromosomes. This decomposition continues until the lowest level, the atomic level, is reached. This is a physical hierarchy. Note that in this physical hierarchy, an atom cannot contain a universe – this is possible within intellectual spatiality.

- **Intellectual spatiality**. The human mind has a capability to imagine, to think, to compare. It reacts to the power of suggestion. If asked to "see an apple", one can immediately build such an image in ones mind. Expanding this, the suggestion "imagine biting an apple" brings an image of lips and teeth, embedded within an apple. Stretching this to the absurd, the suggestion "imagine an apple the size of a house" will readily create an enormous, house sized apple. A house can easily be built inside an imagined apple. An atom can be imagined in which a universe resides. This mental capability, allowing immediate change and unlimited extensibility, however illogical, remains under the control of the individual. This is a characteristic of intellectual spatiality – the ability to manipulate patterns. Higher forms of biological agents have evolved a further, plastic level of structure, instantiated in their nervous systems which allows them a more flexible response to perception. They have compressed and stored patterns as knowledge which they can manipulate to select a suitable response. "... one can say that

knowledgeable agents operate in terms of meta-patterns: patterns which deal with the manipulation of patterns" (MacFarlane, 2003). These exercises of the mind make use of virtual spatiality – mind space, to create, compare and relate intellectual spatial objects. This introduces the networking capability of the mind and of thought – an ability to build multiple intellectual relationships without restriction. The networking relationship between intellectual spatial objects is unique and a fundamental differentiator between physical and intellectual domains.

2.3 Networks of the mind

Intellectual spatiality classifies relationships between intellectual spatial objects as networks and individual intellectual spatial objects are seen as discrete "memory" fragments or images of the mind. "Now the essence of every idea is its relation to some object matter, or thought-object" (Hooper, 1917). The spatial component of Hooper's "thought-object" (Hooper, 1917) and Dawkin's meme (Dawkins, 1976) is an intellectual spatial object. Intellectual spatial objects and their spatial dependencies are retained through memorization and manipulated as a network of associations during the thinking process. They do not exist except if it is wished that they exist. They are not retained unless there is a need for retention. Granularity of intellectual spatial objects is infinite. It can be the finest or roughest, depending on the whim. Extensibility is easily achieved – it can be conjured and included at the behest of the beholder. Intellectual spatiality is one of the prime constituents of the intellectual universe.

2.4 Spatial objects in Information Technology

2.4.1 Physical and electronic structures

Information technology platforms make use of physical and electronic spatiality, both with hierarchical characteristics. The physical spatial objects applied in delivering a physical platform are, for example, hardware devices, CPU's, disks, screens, printers and multiple other peripherals – physical

components of a computer application. These are accidental components contributing to information delivery (Brooks, 1987). These platforms make use of hierarchical combinations of components. Complimenting these physical spatial objects are the electronic spatial objects – files, keys and fields, also spatially related, but with electronic identities – bits and bytes.

2.4.2 Intellectual structures

The act of examining physical patterns (forms, GUI objects, tables on a screen, paper reports) presented by the physical and electronic spatial objects builds and extends intellectual patterns within the mind. These mental images then act as a source from which information is extracted. The value or meaning of underlying information is extracted from the mental imagery conceived from these intellectual patterns. Information can be described as value embedded within patterns; this value is unique to a beholder. Intellect can be described as the ability to impart or extract value from patterns, and thus information, from patterns. Value is a non-corporeal component of the intellectual world delivering intellectual essence. Essence is abstract in that such a conceptual construct is the same under many different representations (Brooks, 1987). Value in patterns (information) varies between intellectual beholders. This ability manifests as a unique ability to appreciate value – a capability residing within the mind of the beholder, accrued cumulatively over the life of the beholder as learning and experience.

2.5 Crossing the intellectual and corporeal divide

Intellectual spatial objects embedded within the mind as mind imagery are retained as memory artifacts, and are persistent, within the capability of the individual to remember. Intellectual spatial objects are modeled, developed, interpreted and stored within a biological (physical) domain of spatial objects (neurons and dendroglia). The mapping of intellectual spatiality to corporeal spatiality is the point where mind meets matter. This is where intellectual structures within the intellectual universe meet physical and electronic structures residing within the corporeal universe.

2.6 Conclusion

The fundamental difference between physical and intellectual spatiality is the nature of the relationships between their nodes or artifacts. Physical and electronic spatiality is hierarchical in nature, whereas intellectual spatiality has a networking capability (MacFarlane, 2003). A dynamic networking mechanism allowing spatial objects to be manipulated independently and communally harnessed towards the resolution of an information requirement must be emulated if information delivery is to reflect and satisfy the future objectives of information seekers. This mechanism must reflect the characteristics of the mind – of intellectual spatiality. Understanding the intellectual nature of intellectual spatiality forces a new look at how physical spatiality needs to be augmented by a virtual, ephemeral spatiality, enabling information delivery solutions with a networking capability.

The contrasting mechanism's enabling persistence, the promoting of biological and intellectual value from one generation to the next must be appreciated before information delivery solutions of the future can be conceived.

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Temporal Agents

ABSTRACT

Temporal agents are change agents which manifest in real time in both a physical and an intellectual sense. Temporal agents are essential to enable change within and between spatial domains. Change is expressed by altering and realigning the relationships between spatial objects. Value, being an intellectual appreciation embedded within patterns, is thus impacted by the influence of temporal agents, in that the order between spatial components within the spatial domain is realigned.

3.1 Introduction

Temporal agents exist in the physical world as a form of energy, embedded within spatial objects. Basic manifestations of temporal agents in the physical realm can be observed as energy is released, for example in a wood fire or in the power of the wind. Temporal agents manifest only in the present tense and are a form of combustion between energy and matter. The speed of combustion varies depending on the nature of the constituents. Energy in its pure form can not be observed, rather, its presence is detected by the effect it has within the spatial domain in which it finds itself. In the intellectual world temporal agents exist as logic manifested during the thinking process. Thinking, the act of applying logic, suggests the existence of an intellectual change agent, influencing intellectual spatial objects by rearranging in real time, spatial patterns of memory (intellectual spatial objects) – this is the act of thinking. "Ultimately, thinking is processing of memes: our "mind" is the process of absorbing, understanding, adapting and broadcasting memes" (Scaruffi, 1998).

3.2 Understanding time

Prior (Smith, forthcoming) is often identified as the founder of contemporary presentism. The presentist theory claims that only the present exists – this rational is explored further below.

In the physical world without biological organisms, an interaction between energy and matter is continuously and randomly underway. There is no memory, a prerequisite to recollect the past, and there is no logic, allowing abstraction into the future. In the words of McTaggart "Nothing is really present, past, or future. Nothing is really earlier or later than anything else or temporally simultaneous with it. Nothing really changes. And nothing is really in time" (Mink, 1960:252-263).

Time may be said to possess two aspects, namely, the aspect of measure, which is intellectual, and that of duration, which is perceptual in a specific sense (Rieser, 1946). Both these aspects are intellectual appreciations. Time is an intellectual derivative and originates from the higher order capability to remember and to deduce. Time is suggested to be an intellectual construct understood only within the intellectual universe. "When Bergson limited intellect to the static, to the timeless object of contemplation as in mathematics, he was arguing from the narrow definition: intellect as being logical implications. These are timeless. But what he names the intuition of time is just intellect beholding a real character of the world, a principle of being, for time is a principle governing reality in our universe. Time is just as much a principle, a universal, as number or quantity; it repeats itself constantly. The scientist reasons about time as much as he reasons about space; the one is quite as truly an object of intellect as the other. Bergson's so-called intuition is but intellect beholding a pervasive trait of being, an essential property of reality as given to sense perception. Nor is this to belittle intuition; it is rather to see it as a natural function of man the rational animal" (Sheldon, 1952:129-143).

In the physical (inorganic) world, time does not exist – only combustion, determined by the rate of interaction whenever energy and matter (a physical substance or material in general) interact. "I believe that time is unreal" (McTaggart, 1908:456-473). Aristotle's initially suggested that there was a "before", "now" and "after".

"What is before is in time; for we say 'before' and 'after' with reference to the distance from the 'now', and the 'now' is the boundary of the past and the future; so that since 'nows' are in time, the before and the after will be in time too; for in that in which the 'now' is, the distance from the 'now' will also be. But 'before' is used contrariwise with reference to past and to future time; for in the past we call 'before' what is farther from the 'now', and 'after' what is nearer, but in the future we call the nearer 'before' and the farther 'after'" (Corish, 1978:68-74).

In the intellectual context, the following three broad classifications within time where before is past, now is present, and after is future, are discussed.

3.2.1 Past

Past is a construct of memory driven through an ability to recall and interrogate spatial objects, both of an intellectual and a physical nature. The absolute order is rigid, frozen and permanently recorded as evidence within spatial components within the corporeal and intellectual world. This evidence can be subsequently altered. The past is a complex intellectual construct. The extent of the past is, in unsophisticated higher order organisms, a function of memory, carried orally (the spoken word) from one generation to the next. Sophisticated higher order organisms make use of artifacts (for example the written word or multimedia) to carry memories of events from one generation to the next. Memory in turn is a function, at the one extent of an individual's mental capability, and on the other, the collective memory of a social order or civilization. Past is a function of memory. Conversely, without memory, the past would not exist.

3.2.2 Present

Situational awareness based inputs received from the senses. The present is a buffer between the variable future and the rigid past, where change from the variable to the rigid state takes place. Change takes place when energy is transformed, and spatiality reordered. Neither can occur without the other. The present is a complex intellectual construct. It references the real time flow of events, or it can reflect a status which is recognized as "current". In terms of

this discussion, the present tense is an ongoing awareness of exposure to stimulus experience by intelligent organisms. It is an awareness of "combustion" taking place within and around the organism itself.

3.2.3 Future

A variable construct based on logical capabilities to extrapolate, permutations limited only by the number and type of spatial and temporal constituents within the domain being considered. The future is a complex intellectual construct. Without the capability to apply logic, to deduce, or to abstract, the concept of future would not be possible. Logic, combined with a memory capability has enabled the concept of "future" to be ordained. The extent of the future is, in unsophisticated higher order organisms, an individual's natural capability to apply intellectual logic. Sophisticated higher order organisms make use of artifacts (for example computers, libraries, and sciences) to develop, share and carry logic from one generation to the next. Logic is a function, at the one extent, of an individual's mental capability, and on the other, the collective capability of a social order or civilization, used to promote order. Without logic, the future could not be imagined.

3.3 Understanding temporal agents

Energy and matter are fundamental constituents of the corporeal world, inorganic and biological. The corporeal world includes biological organism's cohabitating within this inorganic foundation. These aspects, together with intellectual consciousness, an intellectual extension, are suggested as three pillars underlying conscious existence. The relationship between the corporeal and intellectual worlds can be rationalized using a number of approaches. Monism postulates a single, universal and homogeneous substance, whereas Dualism affirms that there are two basic substances, fundamentally incommensurate (Miller, 1947). Dualism in turn can have multiple accounts (Okrent, 1997). Temporal agents, embedded in their dormant mode within spatial objects, deliver the energy aspects required to effect change. Temporal agents exhibit a number of characteristics different to those of spatial objects, in that they exist (or manifest) in their pure form only in the

present tense, as part of a "combustion" process. Temporal agents (dormant and potential) are encapsulated in containers of matter (constituted from spatial objects). Descartes held that the two components which constitute man had an independent origin and are of a fundamentally different nature. Though the two realities were of an entirely different nature, they could react upon each other; the soul on the body and the body on the soul (Miller, 1947).

This study has identified the characteristics of temporal agents:

- Instances of temporal agents are autonomous, manifesting only in the present tense and in the physical world (physical temporal agents) and in the intellectual world (intellectual temporal agents), in total isolation of other temporal agents, existing only for the duration of the combustion process. At all other times they are embedded in spatial objects (physical or intellectual).
- Temporal agents cannot interact directly with other temporal agents.
- Temporal agents exist autonomously and independently, and are always totally isolated from other temporal agent instances.
- Temporal agents cannot interact directly with other temporal agents nor can they manifest in their pure form – rather, they must combine with an associated spatial component before they can manifest.
- Temporal agents can spawn future options only when combustion takes place. This combustion requires fusion between the temporal and spatial instances.
- Temporal agents are oblivious of parent or spawned progeny.

During combustion, an instance containing a temporal agent is totally isolated from other instances concurrently combusting. The only means of communicating is through the use of spatial objects exhibiting persistence. Spatial objects act as batons, carrying value from an exhausted temporal agent to a manifesting temporal agent. Manifesting temporal agents utilize

spatial objects to forward value to future temporal agent generations. Combustion is a very lonely affair for a temporal agent.

3.3.1 Early understanding of intellect (Fire, Heat, Wind)

As intellect developed, early man learnt to control and make use of fire. An understanding of the temporal nature of 'raw' energy was gained – the extraction, storage, release and utilization of energy entrapped within matter (Wolpert, 2003).

3.3.2 Modern understanding (Physical appreciation)

Temporal agents in the modern world follow definitions from the physical domain. An understanding of temporal agents, sourced from various energy domains (for example, coal fired power stations, nuclear power, solar power, and wind power), is well understood. This includes storage, utilization and dissipation of energy for each domain. Characteristics of each domain are dictated by the spatiality of the spatial containers (coal, uranium, sunshine, wind) found exclusively within that domain.

3.3.3 Intellectual understanding (Intellectual appreciation)

Temporal agents within the intellectual world have been described largely within the philosophical and human sciences. Applying intellectual temporal agents to intellectual spatial objects is an example of intellectual logic combining with intellectual rules. The act of thinking—applying logic in evaluating intellectual rules—introduces the concept of spatial coherency – an intellectual value, a conscious mental appreciation, the focus of understanding, an output of the thinking process, of intellectual meaning to the beholder. Metaphors illustrate how a spatial source can be intellectually evaluated applying intellect, a generic term combining the act of thinking where an intellectual temporal agent is employed against intellectual spatial object, mind imagery, guided towards a spatial outcome, the spatial target, derived. The metaphorical cycle introduces the accident—essence—accident concept (Copi, 1954) of logical progression. The accident referring to the corporeal world initiating and delivering perspectives of substance, the

essence presenting an intellectual view. Essence and accident are complimentary, but exclusive. Metaphors illustrate how source and target components, reflecting the accident, compliment the intellectual understanding where the essence is interpreted. "We have found, on the contrary, that metaphor is pervasive in everyday life, not just in language, but in thought and action. Our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature. The concepts that govern our thought are not just matters of the intellect. They also govern our everyday functioning, down to the most mundane details. Our concepts structure what we perceive, how we get around in the world, and how we relate to other people. Our conceptual system thus plays a central role in defining our everyday realities. If we are right in suggesting that our conceptual system is largely metaphorical, then the way we think, what we experience, and what we do every day is very much a matter of metaphor" (Lakoff, 1980:453-486).

3.3.4 Observation of the relationship between energy and matter

Matter cannot be created or destroyed without the consumption or release of energy and energy cannot transform outside the presence of matter – energy must pass through matter to be transformed. Conversely, matter transforms energy from one energy form to another – energy transforms matter from one matter form to another. Energy and matter are autonomous and discrete, neither one visible or aware of the presence of the other. Each is involved in a mysterious relationship with the other, with one exception: the mind–body relationship. In this relationship, the body is the slave to the mind – the mind presides. "All that is soul presides, over all that is without soul" (Roberts, 1905:371-389).

These observations imply, that for a given energy-matter artifact (energy-matter conjugate), the following is applicable. Energy cannot interact directly with energy, nor can spatial components interact directly with spatial components. In all interactions, matter and energy combust alternatively. Change, or the sequence of events, can be seen as a spotlight, in one instant the focus is on the energy component, the spotlight then jumps to the matter

component, after which it returns to the energy component and so on. It cannot jump directly from an energy component to a second energy component, nor can it jump directly from a matter component to a second matter component. This introduces the "Energy–Matter" pump principle.

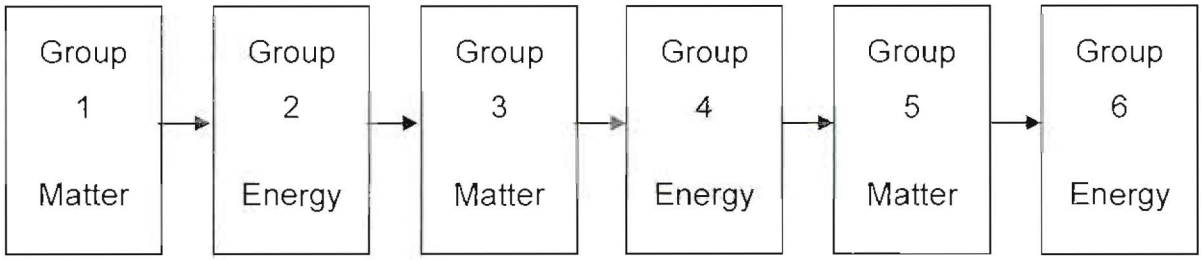


Figure 1: Overview of energy and matter interrelationships

The relationship between energy and matter can be regarded as a chain reaction. An initial introduction of energy into a stable domain of spatiality introduces instability. The energy is absorbed, and spatial reorientation takes place. This spatial reorientation releases a second quantum of energy, after which the initial spatial domain stabilizes. The second 'quantum' of energy then migrates to a subsequent stable spatial domain, where its introduction introduces instability, and the cycle repeats. A stable spatial domain cannot be destabilized without the introduction of energy, and conversely, energy cannot be released without destabilizing a spatial domain. This 'flip-flopping' between spatial stability and the flow of energy underlies the principle found in passing attributes across generations. The spatial value carried across generations must pass through an "Essence" status for the second (biological) generation to be totally independent of the first (this will be discussed later under the APA cycle). Conversely, intellectual essence (a form of relational energy) must pass through a spatial domain before the second intellectual generation can appreciate that value (this will be discussed later under the PAP cycle). In the one case, the perspective is a Matter–Energy–Matter relationship, in the other an Energy–Matter–Energy relationship.

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3.4 Utilization of temporal agents within information delivery

Within computer programs, logic is manifested inside algorithms. "There are many sort algorithms with fairly complex internal logic" (Cockburn, 1993). Each program contains a physical sequence of instructions, each instruction by way of its relationship to the previous and the next forming a unique pattern of instruction. This pattern lends the unique value embedded as logic – a rigid, spatial coherency between statements within that particular module. The logic, released by sequentially processing these instructions, is the temporal agent, which reorders the spatiality of persistent electronic bits residing on the hard disk or within the computers memory. These individual electronic bits are absolute, and form the fundamental building block of data within information systems. These are electronic spatial objects. For information delivery vehicles to be optimized, algorithms delivering logic required for information processing need to be reduced to an absolute non–redundant level of atomicity. These individual algorithm containing a single temporal agent, encapsulated within 'physical code fragments', independent and autonomous of other code fragments, need to be dynamically associated with a set of qualifying spatial object rules using metaobjects. Each metaobject initiates a single event, networks of metaobjects building networks of events. "Complex information structures are built up from networks of simpler structures and hence form networks of elementary particles held together by relationships which create connectivity. Complex structures are hence aggregates of simpler structures" (McBride, 2006). The sequential order is manifested at the latest possible moment, during the processing process. Conjugating an electronic temporal agent construct with an electronic spatial object (manifested by fusing an absolute code fragment dynamically with the spatial component) in response to an intellectual information need (for example, the selection of a query button), dynamically initiates a sequential stream of metaobjects, each delivering the exact computer logic, in concert underlying the information delivery need. This is a point where intellectual information needs and physical worlds (streamed logic from concatenated code fragments) meet. This conjunction is a point of consciousness; a deliberate

decided milestone in the delivery of information. It is realized when the information seeker initiates information delivery at the point in time the information is required.

3.5 Conclusion

Information needs are constantly being reconstituted using intellectual temporal agents. In essence intellectual logic driven by the conscious thoughts of the information seeker. This flexible application of intellectual temporal agents, driven deliberately by human intellectual needs provides an understanding of how logic, within the boundaries of information delivery vehicles, must be addressed. The dynamic and independent manner in which logic ebbs and flows, changes direction and reforms itself as the changing dynamics of information need manifest themselves provide a parallel which must be emulated. The patterns constantly rearrange themselves as influenced by the needs of the information seeker. Aspects to be emphasized and which distinguish the intellectual approach to information delivery from the current information delivery approach (physical) is the capability to exhibit extensibility, the networking flow of logic emulating the short-lived independence of intellectual abstraction and the indirect nature of one temporal agent to the other.

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Intellectual Reflection

ABSTRACT

Reflection is an intellectual phenomenon observed in biological organisms. In the lower forms, it exists as instinct and in higher forms it manifests as consciousness. It is an ability to coherently demand and consume information (by extracting value from patterns), and to conceptualize and deliver information (imparting value into patterns). Levels of reflection are suggested, from instinctive reflection through intellectual reflection to philosophical reflection. Intellectual reflection allows a beholder to structure thought by applying a subjective, relational value, an interpretation, unique and meaningful to information received.

4.1 Introduction

Intellectual reflection, both the process and the product of conscious and unconscious thinking, is a cycle of understanding, and feeding on information. From the physical environment, a stimulus is received (this can be in the form of sensory patterns) (Van Beveren, 2002) and by conscious and subliminal learning, extract value from these patterns, turning it into information unique to the beholder, internalizing the information as knowledge, and directing intellectual focus. In the consciousness state it manifests explicitly as thinking, and implicitly as intuition. In the unconscious state it manifests as dreaming (O'Shaughnessy, 1991).

4.2 Intellectual reflection in information delivery solutions

Information consumption is driven by an information need. This need is a response to a conscious deliberate thought born from an information thirst. "We learn to recognize cause and effect, a concept which David Hume called 'the cement of the universe' " (Mackie, 1974).

Ideally information delivery should accommodate and compliment the changing demand for information, reflecting information delivery dynamically against the intellectual need. Current information delivery solutions (applications) fail dismally at this. "We argue that current attempts within software engineering to respond to the software crisis have not been adequate and that a new, more humble, approach to software development is required" (Robinson, et al. 1998).

There is a need to find a more effective and efficient way to deliver information to an information seeker. The following criteria, using inorganic and organic perspectives, are intended to provide a holistic understanding of intellectual reflection.

4.2.1 Reflection in nature

4.2.1.1 Inorganic world – no reflection

Hypothetically, a universe without biological organic organisms would be in a state of interaction, consuming and releasing energy in a constant cycle of spatial reorientation, driving spatial transformations of matter from the smallest to the largest of configurations, and back. This interaction has been underway since the fiery birth of the Cosmos (Seife, 2001). This is a state where energy and matter randomly and dynamically interact. Past and future do not exist – only the present tense (McTaggart, 1908); energy and matter exist in a constant state of combustion, energy into matter, and vice versa. The nature of this causality is based on randomness "Causality is weak – arbitrary" (Wolpert, 2003). This causality takes place outside human intellect. The consequence of this interaction is a spatial reordering of matter, from one state to the next, from one spatial pattern to the next, and energy transforming from one energy form to another. Simple independent elements aggregate towards singular composites, singular composites decomposing (losing their identities and ceasing to exist) reduced to an absolute simplicity of finest atomicity, elements of the initial composite with no implicit relationship to one another – the relationships, a form of spatial or relational value between the elements, have been destroyed. Granularity refers to a level of coarseness; atomicity refers to the miniscule elements which are the final output of

decomposition. This is the perpetual cycle, one of consolidation and growth, of degradation and dispersion.

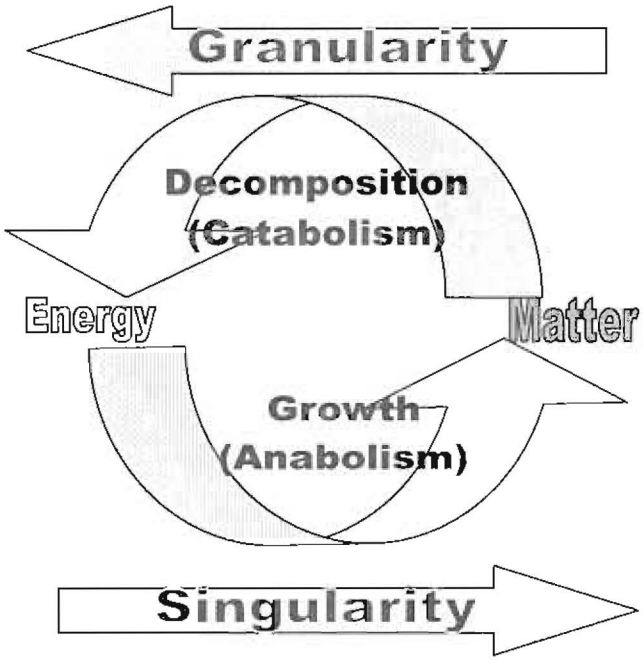


Figure 2: Energy matter cycle

4.2.2 Unicellular organisms – basic reflection

Unicellular organisms, when reacting to stimuli, exhibit a reflective capability (Allen, 1998, Fenchel, 2002). This reaction is explicit and direct, based on the characteristics of the stimulus and the nature of the organism. The role of time is limited – the action–reaction cycle takes place within the constraints of the physiological reaction time required once the stimulus has been triggered. The action is a simple reflex action.

4.2.3 Lower vertebrates—instinctive reflection

As life forms evolved, these unicellular organisms opportunistically evolved to embed a capability to influence behavior in their progeny. This behavior, carried forward and inherited by the progeny, is a basic form of learning propagated from one generation to the next. This capability is a persistent form of instinctive behavior, passed from one generation to the next, driven from within the organism, and influenced by a reaction to environmental and

other stimuli. Experience plays a minor role. Adaptive responses are more significant (Sargent, 1965). Time is unconscious and oblivious to them, indirectly encapsulated within these behavior patterns, driven by a primordial mechanism established during the evolution of the organism. In this scenario, the role of time is basic – no conscious awareness of it can be discerned, rather, frenetic activities are wantonly triggered by external stimuli, for example, seasonal changes elicit the building of nests (Sargent, 1965).

4.2.4 Higher vertebrates – intellectual reflection

Higher vertebrates have developed an understanding of the concept of time. The evolution of a capacity to remember (memory) has introduced an understanding of yesterday. A capacity to understand (logic) has introduced an understanding of the future. Causality is strong or human. "The other (causality), which is uniquely human is strong or 'natural' causality, and is programmed into our brains so that we develop a concept of forces acting on objects" (Wolpert, 2003:1709-1719). These aspects (memory and logic) introduce the capacity to consciously understand and comprehend time. This understanding of the concept of time is an intellectual exercise, a manifestation of logic and memory (Prior, 1967). In the physical world, the past and future do not exist. The present tense is an ongoing combustion, an interaction between matter and energy. However, intellectually speaking, past, present and future do exist (Tooley, 1997). Memory and logic support an intellectual capability to remember and anticipate. The speed of combustion determines the pace of time – this can only be appreciated intellectually.

Homo sapiens have evolved to a point where the level of intellectual reflection is advanced. Our understanding of time has expanded from a simple view of yesterday, today and tomorrow, to a capacity to comprehend the implications of these phases – that a universal complexity of cycles, within and adjacent to each other, is continually interacting and playing out.

Homo sapiens individuals are formed from millions of atomic elements; it is a generic construct reflecting the combined relational value of its elements. The millions of elements, biological cells, by themselves – the material (Hartman, 1976) would weigh the same as the composite, but are without value. The

composite, once formed from the millions of elements, differs only in that the relationships between the elements have taken on a value – the structure (Hartman, 1976). The aggregated value is indirectly orchestrated by the form (Hartman, 1976) contained within the genetic material. On top of this, consciousness has identified an even higher, totally matter independent manifestation – the soul. As Socrates writes "...know well, Glaucon, that in my opinion, we'll never get a precise grasp of it [i.e., the question of the soul's unity and diversity, or perhaps simply the soul] on the basis of procedures such as we're now using in the argument. There is another longer and further road leading to it" (Cooper, 2001:341-371). Built on top of a simple cluster of cells, consciousness and the soul are non-corporeal elements – the essence (Hartman, 1976) greater than the sum of the cells constituting the physical organism.

Without human interventions, the order within which these cycles act and interact would be random. With the intervention of human intelligence, the order is manipulated. "We have learned to recognize cause and effect, a concept which David Hume called 'the cement of the universe'" (MacFarlane, 2003:1581-1616). Not only do we understand the implications of specific spatial ordering, we can manipulate it. Spatial reordering, previously a random phenomenon, has become understood. Intellectual reflection enables mankind, in a limited way to understand, intervene and manipulate spatial reordering. Intellectual reflection has a source, the input to intellectual processing and the output is the target – the consequence of intellectual processing. A parallel is found in the structure of metaphors. "In short, the locus of metaphor is not in language at all, but in the way we conceptualize one mental domain in terms of another" (Lakoff, 1992).

What was random is now largely controlled, within the constraints of human understanding. Man has learnt that yesterdays seeds, planted today, give tomorrow's fruit.

Intellectual reflection provides the structure against which information (being value embedded within patterns), is internalized, appreciated and

externalized. This structure is dynamic, and evolves as fast as the information can be assimilated.

From a corporeal perspective, information can be seen as a stream of sensory stimuli or patterns continuously bombarding and being reflected from the information seeker within the limitations of the physiological reaction taken from the point when a stimulus is administered, to the point where a reaction can be measured (Miller & Glickstein, 1964).

From an intellectual perspective, intellectual reflection can be seen as an internal intellectual exercise of extracting, appreciating and imparting value embedded within these patterns. Each cycle begets a succeeding cycle – information needs of the information seeker continuously being fed, and new sources of information consequently being requested – a continuous cycle.

4.3 Patterns, information, intellect and knowledge

4.3.1 Patterns: relationships between spatial objects

A single spatial object, in isolation, has attributes and these attributes can contain meaning. If there is no relationship with other spatial objects, no relational pattern exists and no meaning or value can be interpreted. Two spatial objects may have a single relationship or pattern. Intellectually, this single association can be interpreted differently. For example, two people talking can be interpreted differently, depending if the beholder is deaf or blind. Multiple spatial objects will have multiple relationship types and each relationship type is determined by the nature of the value sought. Compound relationships are complex both in the number of relationships and the number of meanings which each relationship can be accorded. These compound relationships form what can be described as dense logical spider webs, reflecting the essence (Copi, 1954) within these spatial components. These logical spider webs are rich in meaning, each meaning being seen differently as each observer applies a different frame of reference. These logical spider webs illustrate the complex nature of patterns, and thus value, embedded in relationships.

4.3.2 Information: value embedded within patterns

"Information is any represented pattern" (Wikepedia, 2007). Information is value embedded within patterns of meaning to the beholder. Meaning or value within relationships is invisible until the value is interpreted and released. This release is triggered by an intellectual ability to derive value from the relationships. Information locked within patterns will remain hidden until an appreciation unlocks it. It is implicit "value" (not information) while hidden in this dormant state.

4.3.3 Intellect: the ability to derive, extract or perceive value

Intellect is an ability to extract or impart value using patterns. Release of value is triggered when a capability in search of that value examines and detects the value within patterns constituted by the spatial object and its relationships. This capability (or intellect) then extracts the value. Information locked within patterns will remain hidden until an appreciation unlocks it, either accidentally, or deliberately. Patterns are the conduit through which value or essence is communicated between the intellectual and the physical world. The intellectual view experiences only value, the physical world sees only the spatiality. Patterns have two identities – each identity hidden from the other in a "Jekyll and Hyde" relationship. "But if the mental cannot be understood scientifically, how is it to be understood? There is another kind of explanation, I shall argue, which may be called 'personalistic' explanation. This is an entirely respectable kind of explanation; it works, however, in a certain sense, in the opposite direction to scientific explanation. As things become increasingly personalistically intelligible, they become, roughly, increasingly scientifically unintelligible, and vice versa. As the contents of a conscious person's head come increasingly into focus scientifically, as a brain or physical system, inevitably the mental aspects seem to disappear; as the contents of the person's head come increasingly into focus pesonalistically, as a mind, so the brain, the neurons, the physical system seem to disappear. The key to solving this important part of the philosophical or conceptual mind–body problem is to recognize a dualism, not of kinds of entity, but of kinds of explanation" (Maxwell, 2000:49-71).

4.3.4 Knowledge: an intellectual construct

Our behavior is determined by a vast, and varied, repertoire of pattern–processing structures in our brains. These are associated with physical states of the brain, which we will call mental states (MacFarlane, 2003). Human knowledge is a mental state (Williamson, 2000).

Knowledge is an internal intellectual construct, locked in the mind of the recipient, indirectly accessed by others. It is internalized and externalized through patterns (retained as value embedded in the pattern). These patterns in turn pass value to the next beholder using the patterns within a physical spatial object as a container. These patterns, once interpreted, are then internalized as information by the recipient beholder, and retained as knowledge. "Human knowledge is distinguished from belief on the following grounds: rationality and coherence: continuity and persistence: reliability and effectiveness: and factivity" (MacFarlane, 2003:1581-1616).

- Rationality and coherence – the ability to apply logic, achieved using temporal agents (application of logic).
- Continuity and persistence – intellectual spatial objects carrying the persistent aspects (memory items).
- Factivity – intellectual reflection (the conscious need to absorb and/or dissipate value using patterns.

Knowledge of one individual is an ephemeral association of intellectual spatial objects containing patterns with embedded value. Transferring this knowledge converts it, through physical artifacts into information patterns, which are then internalized by other information (knowledge) seekers. Knowledge, when transferred between two individuals, passes through an information state before once again becoming knowledge (Van Beveren, 2002).

4.4 The need to understand intellectual reflection

Intellectual reflection is a mechanism which receives and delivers the conscious stimulus underlying structured thought. The structure of intellectual

reflection is volatile, amorphous and transient. It can be seen as a dynamic, ephemeral abstraction within which an information thirst is quenched and a subsequent need formed. Understanding this allows a response to be designed which reacts fluently and dynamically realigning with the changing information need supporting the intellectual thirst. Intellectual reflection provides the structure or the highway along which information (equivalent to delivering patterns containing value) can be identified, anticipated, delivered and released.

Separating intellectual reflection ("essence" (Hartman, 1976, Copi, 1954)) from the physical material aspects ("accident" (Brooks, 1987, Hartman, 1976, Copi, 1954)), delivers an understanding of the independent, autonomous ephemeral controlling mechanism required for information delivery; free of the constraints found within today's information delivery vehicles. "We contend that software engineering exhibits symptoms of breakdown, with an acceptance amongst leading advocates that it has failed to deliver the promises of high rationality" (Robinson, et al. 1998; Copi, 1954). A contributing reason is the difficulty of transferring an understanding of the "essence" of the requirement into a working information delivery solution – the "accidental" aspect.

"I believe the hard part of building software to be the specification, design, and testing of this conceptual construct, not the labor of representing it and testing the fidelity of the representation" (Brooks, 1987).

Examining Brook's statements reveals that the "essence" referred to is embedded "value" hidden in the identified relationships of the patterns (for example, the GUI's) presented when delivering the accidental components to the information seeker. These relationships are between characters, words and figures found within data sets, in which spatial rules (keys) are contained algorithms – the batons containing the temporal agents and invocations – an instrument of order. Metaobjects are instruments which manipulate both the essence and the accident towards the delivery of patterns presented for intellectual examination by the information seeker. A metaobject has two identities, one allowing essence to be presented to the intellectual world and

one where the aspects supporting what will later be instantiated in the physical world, the accidental aspects (Copi, 1954) are initiated. "The view I offer does not demand that there be such kinds in nature; each object could be unique. But our world seems to be characterized by multitudes of objects closely similar to one another, and it is fortunate for empirical science that it is of this nature, else no transfer of information gained from a study of one object to other objects would be justified. The need to justify such transfers (generalization) calls into play another variety of accidental and essential attributes. That set of objects to which conclusions derived from the study of a limited number of samples can be tentatively transferred must be identifiable. Since it has been assumed that the same objects display different characteristics under different conditions, the required means must be supplied by the discovery of characteristics that are invariant in a given set under a wide variety of conditions. These are identification characteristics and can be called "essential" as opposed to those which vary with environing conditions, which would then be termed 'accidental.'" (Donald Oliver, 1954:719-730).

The text above illustrates the need to indirectly access the material aspects (Novak, 1963) forming the object to be instantiated. These material aspects are structurally described in metaobjects, indirectly referencing both the temporal objects containing logic, and the spatial objects defining rules. Relative order is controlled using essence embedded in the patterns. Metaobject make use of patterns to allow the "essence" or value embedded within the patterns to manipulate the temporal and spatial aspects.

Knowledge of the essence of a thing is said to be more important than knowledge of its other attributes (Copi, 1954).

The essence must be separated from the accident. The structure delivering intellectual reflection is a fundamental corporeal pillar required for the optimization of information delivery, together with an understanding of how the intellectual rules (intellectual spatial objects) and intellectual logic (intellectual temporal agents) interact.

4.5 Conclusion

This chapter defines intellectual reflection as an ephemeral structure, a mechanism around which an information requirement can be formulated and satisfied. This structure is used to harness intellectual logic and intellectual rules to dynamically constitute an intellectual information delivery vehicle appropriate for the consumption and delivery of relevant information. Computational information delivery must evolve and ultimately emulate the structures underlying and supporting intellectual reflection if flexible and unrestricted delivery of computational information is to be attained.

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Physical, biological and intellectual lifecycles

ABSTRACT

Within the world around us, three distinct categorizations, physical, biological and human can be discerned (Bawden, 2007). Splitting the human into biological and intellectual aspects, refines this categorization into physical, biological and intellectual. An artifact within each of these three categories has a lifecycle in which the artifact is formed, exists and ultimately perishes. In the case of the physical (inorganic) category, no propagation of attributes with persistence is observed. In the case of biological and intellectual lifecycles, persistence, the propagation of attributes containing value from one generation to the next is observed. In summary:

- A physical lifecycle is without persistence – no inheritance of attributes exists allowing attributes from a previous physical generation to be carried forward to a succeeding generation is found in the physical world.
- A biological lifecycle with persistence – inheritance of attributes exists, where biological organisms are propagated and persistence of biological attributes from one biological generation to the next takes place.
- An intellectual lifecycle with persistence – inheritance of attributes exists, where intellectual values are propagated and persistence of intellectual attributes from one intellectual generation to the next takes place.

NOTE: A fourth non-persistent example is also mentioned for completeness. This is knowledge of an individual – it is internalized within the intellectual armory of an individual – when the individual dies, the knowledge is lost. It is possible that the knowledge can be externalized, but then it assumes the identity of value embedded within spatial objects – this is latent information, awaiting intellectual inspection and discovery.

Biological persistence is where characteristics (for example, morphology, hair colour, eye colour) are carried across from one generation to the next. Intellectual persistence is where intellectual value is carried from one intellectual generation to the next.

Characteristics that differentiate the persistence mechanism found in the biological lifecycle from the persistence mechanism found in the intellectual lifecycle are introduced, and an approach, emulating the intellectual lifecycle, applied towards the delivery of information is proposed. In both the biological and the intellectual propagation lifecycles, a common mechanism to carry embedded value or "essence" (Copi, 1954) within a spatial container is observed.

5.1 Introduction

Bawden (Bawden, 2007) proposes that a unified concept of information as a form of self-organized complexity may be equally applicable to the physical, biological and human domains. He suggests that information can be expressed as organized complexity, meaning and understanding in each domain respectively. When inverting this approach by defining information as value embedded in patterns (spatiality), the appreciation across these dimensions becomes partitioned. The physical world has value contained in it (information) which can be released by applying skills and expertise learned through the geological and archeological sciences, biological value can be released through examination using an understanding of the biological natural sciences, and finally, the sum total of intellectual value accrued through the ages by mankind contained, released and propagated using learning institutions and libraries. These domains can be categorized into three distinct groups:

- Physical (inorganic world) with no persistence.
- Biological world (organic) with persistence of physical attributes.
- Intellectual world with persistence of intellectual characteristics.

Aristolian "structure" and "material" (Hartman, 1976; Williams, 1958) exist in all these domains. "Form" and "essence" (Hartman, 1976; Williams, 1958) are found only where persistence can be demonstrated.

5.1.1 Physical lifecycle

"Modern big bang theory states that a massive explosion created all the mass and energy in the universe" (Seife, 2001:2236-2238). Within this inorganic world of mass and energy, forces constantly release and absorb energy, constantly recycling matter, constantly forming and eroding. Characteristics are unique for each artifact, formed independently and randomly. These artifacts are brutally physical, no persistence of attributes exists, and no inheritance of attributes is found. No parent or child generation exists within this world. In this world, time is a single dimension – the present tense, in which energy and matter constantly interact in an ongoing sequence of random combustion.

5.1.2 Biological lifecycle

Within the organic world, biological organism's reproduce from the one generation to the next. Each generation receives attributes from their parents, and in turn, these children become parents, passing these same attributes to their children. Morphological characteristics are passed from one generation to the next. A genetic pattern, containing persistent value, is used to pass physical characteristics from parent to progeny (Mendel, 1866). These physical characteristics are retained as "value" within the genetic code. This enables persistency of attributes (characteristics) to be carried across generations. The pattern carries the persistent characteristics, embedded as 'value' equivalent to "essence" from the parent generation to the sibling generation – the genetic material is purely a vehicle, the "form" (Hartman, 1976) soon to be discarded, whereas the value or "essence" (Hartman, 1976) is carried from one generation to the next. These characteristics are passed using value embedded in the genetic patterns, a spatial coherency, found in the relationship between DNA amino acids (Watson & Crick, 1953). This introduces the parent–genetic pattern–sibling cycle otherwise called the artifact–pattern–artifact (APA) cycle. Note that the complex intellectual construct of time is not recognized within the biological world.

Figure 3: Persistance of biological attributes across biological generations is schematically illustrated below. As individuals within a generation mature, propagate and die, so a particular attribute – in the case of this example, an eye colour, persists from one generation to the next. The genetic pattern is reproduced using genetic material, but the constituents, the particular amino acids are newly created spatial components within the genetic material containing the pattern are formed from different instances of amino acids. The pattern remains constant over the generations, the pattern has embedded in it the "value" which is manifested as a physical characteristic – blue eyes.

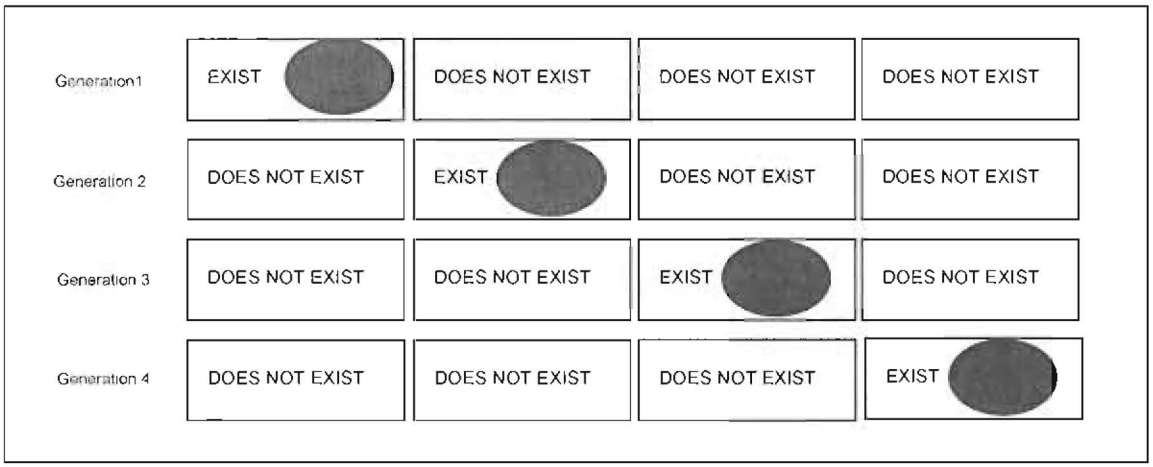


Figure 3: Persistance of biological attributes across biological generations

The biological world is unaware of the complex nature of time – it experiences time as a two state construct (exist / does not exist) when promoting persistence. As generations step through the roles, as children become parents and in turn reproduce, so the persistent value is carried forward, establishing a permanent (persistent biological) attribute within a biological community.

5.1.3 Intellectual lifecycle

Intellectual phenomena, for example, knowledge and cultural values, can be described as an abstraction of spatial coherency; value embedded in patterns

formed by intellectual spatial objects similar to memes (Dawkins, 1976), retained as intellectual spatial objects. Organizational culture is a "bundle of knowledge repositories with storing and information processing capabilities" (Lemon & Sahota, 2004:483-498). Culture is in terms of this definition carried forward as an intangible intellectual construction of memory and logic. An intellectual form of spatial coherency propagates intangible intellectual characteristics from one intellectual generation to the next (Dawkins, 1976). Examples of these intellectual characteristics include knowledge and cultural values. This is implemented using a physical, spatial medium as a baton, passing the cultural values from the one intellectual generation to the next. The physical medium can be the biological progeny themselves, or a physical artifact, for example, a book containing writing, or a stone tablet with hieroglyphics. The propagation of intellectual phenomena (value embedded in intellectual "mind" patterns manifested through individual intellectual meme collections, of cultural values, knowledge, customs or folklore) is undertaken by using a physical artifact (either organic or inorganic) as a baton, these intellectual values passing from one intellectual generation to the next. The artifacts used in the intellectual lifecycle to transfer these attributes are the individuals, biological spatial objects, educated in these values, propagating the values to the following intellectual generation. Information, being value extracted or imparted using patterns, is an individual intellectual abstraction. The intellectual subjectivity of the beholder interprets value embedded within patterns using an initial physical permutation (Lemon & Sahota, 2004; Wolpert, 2003) of stimuli (sight, touch, smell and taste), augmented by an intellectual memory and logic capability. This provides a framework to understand and interpret information which ultimately becomes internalized to become part of the experience and skills set of the individual. The mind-body interaction (McGinn, 1989; McLaughlin, 1993) can be described as a portal linking the intellectual universe to the corporeal world. It demonstrates dichotomic characteristics – an ability to extract the essence of value from the corporeal world, and an ability to impart and manipulate the corporeal world based on value derived intellectually (McLaughlin, 1993). These two universes appear to be invisible to one another, although they are engaged in a permanent, real time intimate alternating pulsed relationship. This can be

described as the mind-body relationship (McLaughlin, 1993), the essence–accident relationship (Copi, 1954), or as an energy–matter (Intellect–Corporeal) cycle when evaluating metaobjects. Metaobjects as described in this document are information delivery instruments which emulate the mind–body portal.

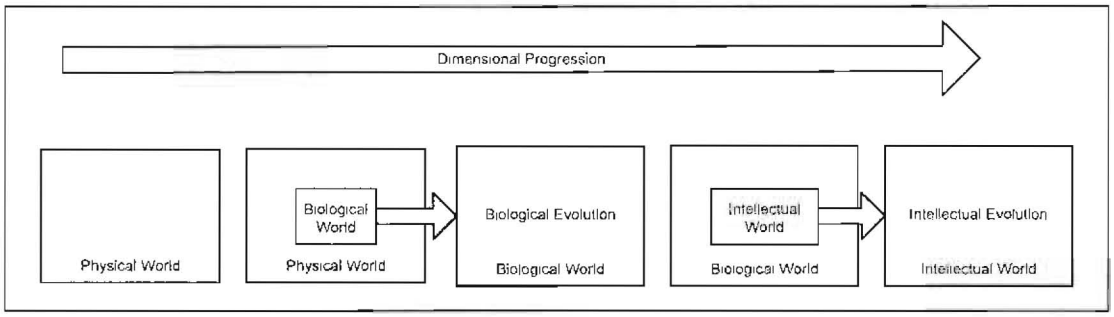


Figure 4: Relationship between physical, biological and intellectual worlds

"What I wish to focus on instead is a positive feature of modem natural philosophy, common to both of these seminal thinkers and sometimes viewed as the product of their negative stance on substantial forms, viz., a corpuscular matter theory and mind-body dualism. Early modern thinkers developed theories of the hierarchical composition of compound bodies from such simpler substances as primitive corpuscles and molecules, and theories of a human mind that is a really distinct, self-conscious, and purely intellective substance. We might take the following as conditions fundamental to early modem theories of natural philosophy, the former subverting Aristotelian physics, the latter subverting Aristotelian psychology: all material things are composed of simple bodies, which are primitive corpuscles or atoms, and each human being is a composite of two distinct substances, a body composed of atoms and an immaterial self conscious substance, the human mind" (Michael, 2003:343-360).

5.1.4 Physical, biological and intellectual worlds

The creation of the physical world was the first step in a three step progression towards the modern world (Bawden, 2007) as experienced today. The physical, inorganic world was initially free of organic biological organisms.

As conditions became conducive, a new dimension, the biological world, containing biological organism's emerged, initially as primitive organism's, ultimately evolving into the complex organisms which exist today. The emergence of the biological world introduced a capability to pass physical attributes - persistence of characteristics such as eye colour and physical shape (Mendel, 1866) – from a parent biological generation instance to sibling generation instances. The nature of this relationship is hierarchical. A parent instance spawns a child instance – a child instance cannot give birth to the parent instance from whom he / she was spawned. Characteristics found in the biological parents are passed to the sibling through the use of genetic material. As the biological world consolidated, so the ability to remember and to apply logic emerged. This capability allowed the concept of time to be formulated. As this understanding grew, and mechanism's to carry intellectual capital across intellectual generations developed – initially orally, and later using physical instruments (writing, stone, paper), so the sciences, arts and philosophies emerged. This marked the introduction of the intellectual dimension. The emergence of the intellectual world introduced an ability to pass intellectual capital across intellectual generations. The emergence of the intellectual world introduced a capability to pass intellectual attributes – persistence of intellectual value – from a parent intellectual generation[1] to a sibling intellectual generation. Characteristics found in the intellectual parent are passed to the intellectual sibling through the use of persistent spatial objects. Conversely, an intellectual parent for one item of intellectual capital can be the recipient of intellectual capital from another. Note that the nature of this relationship is of a networking nature – intellectual capital from one intellectual source can be assimilated by 'n number of sibling generations. Evolution describes the progression of biological species, initially absent, then evolving from unicellular organisms to complex higher order organism's (Darwin, 1859). Intellectual capabilities appear to follow a similar progression. Initially instinctive and reflective, evolving to the various societies applying, in

[1] Note that an intellectual parent has no relationship to a biological parent – a biological sibling can be an intellectual parent to his / her own biological parent

natural societies the physical governances and in modern societies, intellectual governances observed throughout human society today.

The propagation of persistent physical biological attributes from biological parent to biological sibling follows the APA cycle (Please refer to 5.8.2.1 Introducing the Artifact Pattern Artifact cycle (APA)). In this case, physical attributes, e.g. blue eyes, are embedded as value within genetic patterns, constituted using genetic material, and manifested in the progeny. Physical attributes are carried from the one generation to the next generation using value embedded within chromosomes.

In the case of propagation of intellectual values, the PAP cycle is followed (Please refer to 5.8.4.1 Introducing the Pattern-Artifact-Pattern (PAP) cycle). In this cycle, intellectual value is carried (using spatial artifacts as a container) from one intellectual generation to the next.

Both cases propagate persistence of value from one generation to the next – in both cases, value, embedded as patterns, moves from a parent generation to a sibling generation. Note that in both situations, the perception and illusion of two states of is created (present and future, parent and sibling) – the propagation mechanisms support this.

In terms of non-intellectual reality, both these cycles exist in a single dimension state of real time combustion. Persistence across generations, emulating time, is attained by passing through the artifact–pattern–artifact (physical persistence) or the pattern–artifact–pattern channel (Intellectual persistence).

5.2 Monism

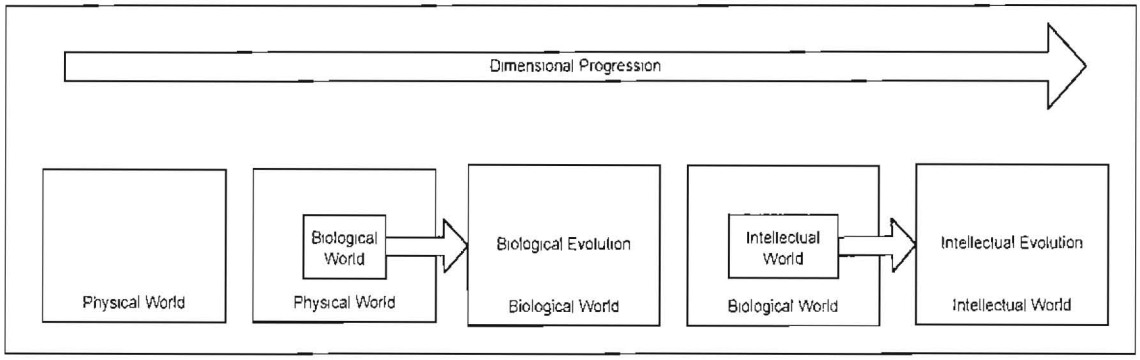


Figure 5: Monism

"Aristotle's theory of the psuchê was firmly rooted in his broader metaphysics–hylomorphism – according to which all things are a combination of matter (hulê) and form (morphê). To put things very crudely, his theory of the psuchê went like this: take a human body, combine it with the "form" of life and you have a living human. In this particular case, the form in question is that of the organization of the body's normal biological functioning. Aristotle argued that the psuchê is nothing more than the "form" that was said to turn a body into a living human" (Green, 1997).

Monism suggests the mind and body both form part of the corporeal world (Miller, 1947). Intellect and biology form part of a cohesive single unit. Intellectual appreciation is limited by the environment of which it is aware. Intellect is trapped within the corporeal world. The need to introduce Monism will become clearer once the discussion of the Artifact–Pattern–Artifact model in 5.8.2.1 has been completed. The Artefact–Pattern–Artefact (APA) model reflects the Monism perspective.

5.3 Dualism

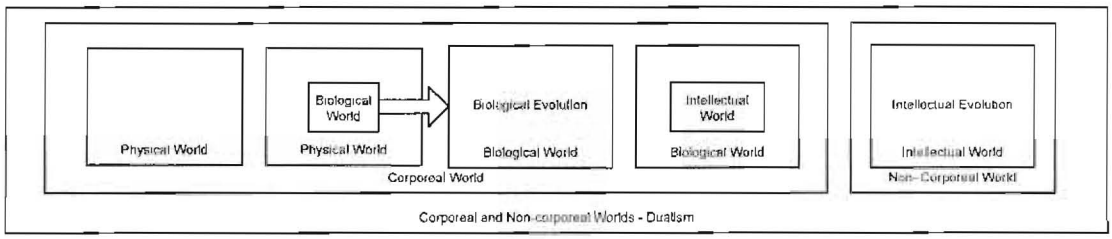


Figure 6: Dualism

Cartesian Dualism suggests the body and mind are distinct from one another, the body within the corporeal world, and the mind outside (Miller, 1947). Where Monism has an arrow, an umbilical cord connecting the Corporeal World with the Non-Corporeal World, in Dualism, this arrow has disappeared, and the intellectual world is autonomous.

Parallels between Dualism and the Pattern–Artifact–Pattern model exist and are discussed in 5.8.4.1.

5.4 Understanding Matter, Structure, Form and Essence

Aristotle's (Hartman, 1976; Williams, 1958) poses a question: "Can a man step into the same river twice?" This is a precursor he uses to introduce a debate around four main categories – "Matter", "Structure", "Form" and "Essence". During the course of this study, parallels have arisen with these categories, for later discussion. The following understanding of these categories is necessary for this discussion.

Material

"All material things are composed of simple bodies, which are primitive corpuscles or atoms" (Michael, 2003:343-360).

Physical components are constituted from physical (corporeal) artifacts. An analogy using an atom is presented for explanatory purposes. Imagine an atom, labeled "A1" with two material parts – a single electron labeled "E1",

and a single proton labeled "P1". P1 and E1 describe the material, instances of the physical components constituting the atom, not the atom itself.

Substance

"Reflection on matter convinces Aristotle that a substance is not simply whatever happens to be occupying a particular place at a particular time; for matter fits that description, and matter is not substance" (Hartman, 1976:545-561).

Given there is an atom "A1", and the electron "E1" is replaced with electron "E2", and the proton "P1" replaced with proton "P2", Atom "A1" appears to be unchanged. The "Substance" remains unchanged, whereas the "Material" has been swapped. The substance describes the composite atom "P1". The "Substance" is different to "Material" (Hartman, 1976).

Form

"What sort of similarity between these entities counts as identity? The only answer he gives is sameness in form, and that does not tell us which of these mighty oaks is identical to the sapling we planted many years ago. Each is identical in form to the sapling; neither, probably, is identical in matter to it. For an oak to survive from seed through sapling to maturity requires the persistence of an individual form, but how are we to know which of these oaks has or is the right individual form? The most natural way might be to seek some connection through time that holds in one case and not the other" (Hartman, 1976:545-561).

In the biological world, "Form" is contained in spatial components (genetic material) used to establish persistence – to pass attributes from one generation to the next: In biology this is the genetic material containing the genetic code. In the intellectual world, persistence of intellectual value is carried using spatial objects, either physical specifications or blueprints (expressed as hieroglyphics, diagrams, written word) or intellectually (intellectual spatial objects). This study suggests that intellectual spatial objects can be emulated in computer systems using metaobjects. This study suggests that "Form" is found only in the biological and intellectual Universe,

where persistence across generations exists. Metaobjects can be considered to be the "Form" equivalent within information technology when emulating the intellectual lifecycle.

Essence

"Metaphysics Z4 countenances individual essences. "To be you," Aristotle writes, "is not to be musical, for you are not musical in virtue of yourself". The locution "to-be-something or other" is frequently used for an essence. In this case it is clear that the essence is primarily attached to an individual person rather than to a species, for you is singular. Each person has his own essence, as he has his own musical talent" (Hartman, 1976:545-561).

"Essence" is a non-tangible individual intellectual appreciation, a value available for inspection, embedded within a pattern (it is NOT the pattern). It is the non–corporeal compliment of "Form". This value is not visible outside the intellectual world. The greater the intellectual capability, the more significant the "Essence". "Essence" is not a temporal component. It is persistent, the persistence a function of the stability of the container containing it. "Essence" can be unlocked intellectually, using the direct application of energy as a catalyst, during the real time process of combustion. In the corporeal world this energy is presented as metabolic energy and in the intellectual world it presents as an intellectual temporal agent. At all other times essence remains invisible. It resides as a higher intellectual order of information, where information is an intellectual appreciation embedded in patterns.

"Form" and "Essence" are complimentary. "Form" is the corporeal pattern complimenting the non-corporeal "Essence". "Form" is the corporeal constituent, "Essence" the intellectual constituent. "Essence" is invisible to the corporeal (non-intellectual) world; conversely, "Form" is visible to the intellectual world.

5.5 Physical, biological and intellectual lifecycles

In the physical (non-biological) world, there is no propagation of attributes across generations. In both biological and intellectual dimensions, a capacity

to retain persistent attributes across generations has developed. Organic life forms make use of sophisticated physical (biological) mechanism's to propagate. The objective is twofold – to provide both survival and to ensure biological characteristics of the parent are carried forward into the following generation. Organic life forms succeed in both cases, not only do they continue their lineage; they also carry biological attributes from the parent to the progeny (Mendel, 1866). These characteristics include, for example, the colour of eyes and hair. The mechanism to carry forward these differences uses a genetic mechanism, linking parent and progeny indirectly, by passing genetic patterns, embedded within genetic material. These genetic patterns deliver a form of spatial coherence. Spatial coherence is a pattern found within genetic material. It delivers the physical differences within individuals in a species, making use of the same basic constituents – their differentiator being the relationships between the constituents, a hidden 'value' within the material and not the material itself.

5.5.1 Understanding information

MacFarlane (2003) offers the following definition of information:

Information: the currency of agency is a pattern, physically instantiated in matter or energy that corresponds to events in the world (MacFarlane, 2003:1581-1616).

A pattern can be described as a corporeal entity. Intellectually speaking, the value (a non-corporeal understanding) within this corporeal container is the essence (Copi, 1954), awaiting release through intellectual inspection. Once inspected, the essence extracted becomes information to the beholder.

With this as background, Information can be described as a private intellectual appreciation which differs from one beholder to the other. Information is value embedded in patterns, intellectually appreciated.

Intellect is the ability to extract value from patterns or to impart value into patterns.

5.6 A Metaphor based approach to Information

Metaphors are intellectual instruments which contrive the future using the past – the essence of time is encapsulated within a metaphor. Outside intellectual appreciation, metaphors reflect a frozen snapshot in time, mapping a spatially based, historical, conceptual frieze against a seemingly unrelated target, also a spatial construct. The relationship between the two reflects an intellectual understanding spawned by the author, and frozen at the point in time when the metaphor is conceived. Lakoff quotes Reddy as follows: "The metaphor then acts as an instrument in propagating this meaning for future inspection by succeeding intellectual generations" (Lakoff, 1992:453-486).

Conversely, metaphors are mechanisms which link the intellectual universe with the physical universe – real, physical experiences of the corporeal world are spatially recorded in metaphors, forming the objects in the source and target domains. Intellect, an ability to extract and impart value using patterns, is harnessed in search of the meaning ensconced within these two icons.

These mappings, in essence patterns, frozen in this snapshot include implicitly the intellectual understanding which existed to the originator of the metaphor. This intellectual understanding, implicit and initially invisible to others, links two spatial domains and by implication, also freezes the intellectual effort, the intelligence, manifested in creating the association at that point in time. Revisiting a metaphor is an act of intellectual rebirth, in which an instant of time past is revitalized – the nature of intelligence being such that this input in itself can propagate a second metaphor, built upon the experience of the first. Visibility of internalized metaphors is achieved once a conceived metaphor is publicly published in the corporeal world – either verbally, or through some other physical medium. Intellectual capital can only be shared using a physical medium as a baton. Conversely, two intelligent minds cannot interact directly without the employment of a physical artifact (this illustrates the energy–matter pump principle).

Metaphors provide the following mechanisms.

- Used as a private bridging instrument connecting a private individual intellectual capacity to the physical world.

- As a public, bridging, physical instrument, it is a container used to share intellectual constructs between multiple intellectual capacities across a physical divide.

The physical artifact used to communicate between the two individuals carries the meaning, the value, as patterns frozen during the transition. This value is mirrored through the relationships found between the physical artifacts forming the baton. This meaning, a value embedded within the patterns can only be realized when logic is applied, in the present tense – at all other times it remains embedded within the spatiality of the artifacts.

In the physical world, the rate of combustion is the single metronome – the rate of combustion differing, based on the particular combination of energy and matter being displaced and transformed. The physical world combusts within a single dimension. Time does not exist in the physical world.

In the intellectual world, metaphors are instruments which allow time to be emulated in that the past (source) and future (target) are linked intellectually, using internalized intellectual logic.

Persistence, where attributes are carried from one generation to the next, from the past, through the present to the future can only be transferred as value embedded in patterns.

It is not possible for persistence of intellectual attributes to be passed from one generation to the next without embedding the inherited value as patterns within spatial objects, nor can physical attributes be passed from one biological generation to the next without becoming value embedded within a pattern.

In the corporeal world, biological attributes are carried forward as value using patterns embedded within the genetic material – these patterns reflect the value which is manifested later as a physical attribute.

In the intellectual world intellectual material (value embedded within the intellectual domain of the individual) is transferred from the one intellectual domain to the next using spatial artifacts in which the value is embedded in the pattern. The following intellectual generation inspects these patterns, and transfers the value into their own intellectual domain.

Time is an intellectual construct, and persistence is a mechanism used to carry characteristics across generations – enabling attributes to span time and jump across generations. Emulating persistence requires that time be emulated. It is emulated using physical patterns within spatial components, these physical patterns containing the value transferred to the following generation.

Value within patterns is only visible intellectually; manipulation of patterns (and thus the value embedded therein) is only possible within the physical realm – with one exception.

The conjugation of the human mind (and thus the intellectual universe) and the physical body[2] allow the intellectual mind to interact with the corporeal world. The human mind as an intelligent agent stands alone with the capability to interact intellectually within the corporeal world. The human body is the single known portal linking the intellectual and corporeal universes.

The intellectual world without the senses is lightless, soundless, touchless, smellless, and tasteless. The intellectual world does have a capacity to conceptualize time, to remember past experiences and to reason future consequences. Sensors of the body continually provide electrical and chemical patterns to the physical brain. The intellectual mind exposes the value within these patterns, and freezes this value as memory fragments (virtual spatial objects). These memory fragments, as they accrue and multiply, ultimately provide the intellectual spatiality so necessary to compliment intellectual logic. The human mind is limited only by knowledge

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[2] Although restricted to human intellect in this discussion, varying degrees of intellectual appreciation do exist amongst other higher biological organism's

and experience of the senses (for example, sight sound, touch) known to it. It may be that other corporeal manifestations do exist, but as there is no equivalent sensory mechanism, humankind is oblivious to it. These unknown senses will need to be discovered indirectly using artifacts and intellect. (Wolpert, 2003).

5.7 Ontogeny of Metaphors

Metaphors form the essence of communication between the intellectual universe embedded within the mind, and the corporeal universe – the material world around us. Initially developing higher order embryos are without a sense of sensory reflection and no metaphoric capacity exists – as the sensory system evolves, a point is reached when the sensory impulses are recorded neurologically, becoming persistent as memory. Physical stimuli originating in the material world are transferred through the senses, internalized and frozen neurologically as a single intellectually meaningless "kaleidoscope of sensorial recognition" or metaphorical "Source". This kaleidoscope is labeled intellectually, the internal mental label becoming the "Target" aspect of the metaphor under construction (Gentner, 1988; Lakof, 1980). The label, unique to the individual is added to the database of memories, and becomes a component of an internalized intellectual metaphor in the experience armory of that person. The intellectual conclusion constructed during the act of thinking, of applying logic and manifested as an intellectual image of the mind, is then retained as a persistent neurological pattern "image" which then forms the experience component of a simple basic personalized metaphor. A number of target images may be constructed based on a single source metaphoric trigger – a single source metaphoric stimulus can lead to a number of mental conclusions – each a target component of a metaphor. Each target metaphor constitutes an intellectual window into the world within the mind and when concretized, outside the mind. Physical input is interpreted as patterns and stored inside the mind using intelligent labels. Metaphors are containers containing embedded patterns – these patterns are the instruments of the intellectual world and used to communicate intellectually with the physical world.

Simple metaphors are formed early in life – the ringing of the pavlovian bell illustrates the impact of the physical environment on the behavior of trained animals. These metaphors revolve around simple spatial objects. As intelligence develops, so intellectual metaphors become more sophisticated, metaphors then including direct references to the relationships between objects. Advanced metaphors are composed from indirect references to the relational aspects binding objects. Compound metaphors where meaning embedded in various metaphors forms source and target spatial components represent complex permutations of this concept (Gentner, 1988) – this is the world of intellectual constructs, embedded value, patterns innuendos and indirect references. This sophisticated instrument is applied when sharing intellectual capital.

A Metaphor, when viewed internally, is constructed around a source / target framework (Lakoff, 1980). The source, a spatial image is linked intellectually to the target, a spatial image. This artifact–intellectual–artifact construct has parallels with the APA cycle discussed later.

A metaphor when viewed externally can be seen as an independent construct used to bridge the intellectual divide between two intellectuals. It is a spatial component layered between two intellectual domains. This intellectual–artifact–intellectual construct has parallels to the PAP cycle.

5.8 The Maze - Mist analogy

Differentiating between approaches and capabilities between the intellectual and physical universes is illustrated using the Maze–Mist analogy. In both the Maze and Mist scenario's described below, a challenge is given to an unsighted individual with a hearing capability to retrieve a ringing bell. These two scenarios are discussed in 5.8.1 and 5.8.3.

5.8.1 The Maze Scenario

Illustrates how the corporeal world constrains the intellect. In this situation, an individual finds himself in a physical maze – the individual can listen and hear a bell ringing – he can only follow passages available to him – he must abide

by the constraints of the maze to ultimately find an exit. The success of the search will be determined by the proximity of the exit to the bell – all exits will need to be tested before the closest to the bell is found. In this model, the intellect is surrounded by physical artifacts constraining the individual from achieving the objective. This situation introduces the artifact–pattern–artifact cycle. The individual is guided and *restricted* by the physical domain within which it finds itself when executing the exercise.

A metaphor based approach uses a spatial construct – the source, to guide intellectual thought towards a conclusion, built around a target spatial construct. The physically induced model abides by the maze analogy, and restricts the intellectual capacity within the influence of the source and target domains.

5.8.2 Physically Induced Events (APA)

When the physical universe triggers an event, it is characterized by the presentation of an artifact for intellectual evaluation. This artifact is subjected to intellectual scrutiny, and the intellectual output in turn is manifested using an artifact. In Figure 7 the source of the metaphor is "thunderstorm", a figure of a cloud, and the target of the metaphor is "shelter".

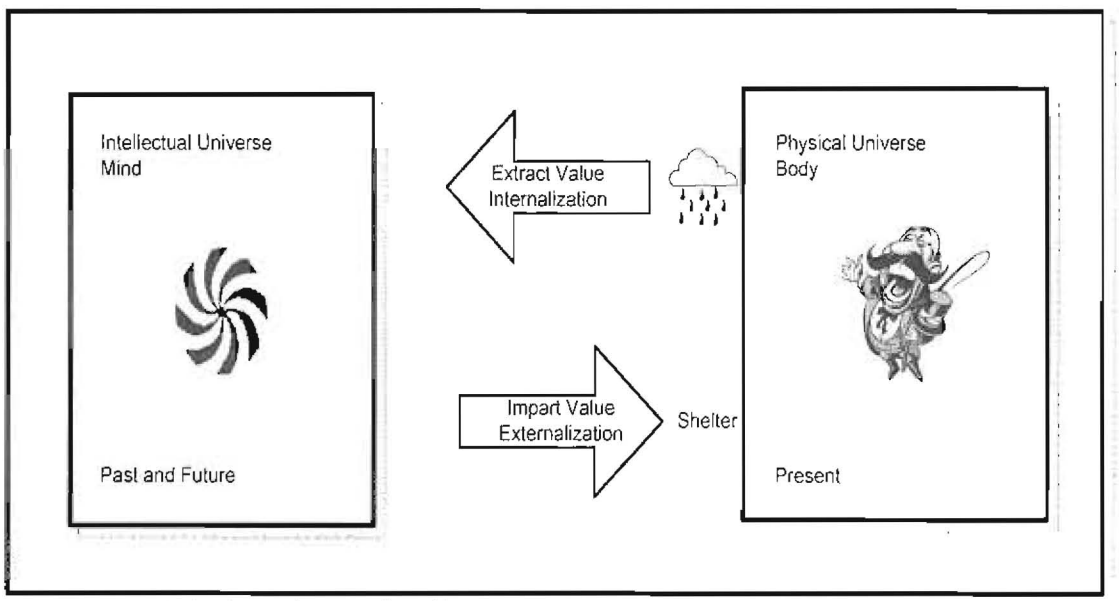


Figure 7: Interaction between the mind and the body - physical initiation

Figure 7 presents a model depicting a situation where an individual is exposed to rainy weather – the intellectual capacity of the person evaluates the physical situation, makes a decision and takes cover. The event is initiated by the presence of physical artifacts – thunder clouds, the soma and a shelter. The presence of thunder clouds is intellectually processed, an intellectual output is formulated and a physical response elicited to take cover. This model presents an event where a physical artifact within a physical situation elicits an intellectual response resulting in a realignment of physical artifacts – the soma is placed in a shelter, outside the rain. This sequence of actions within a single event is classified as an artifact–pattern–artifact (APA) cycle. The term 'pattern' will be expanded later in this document. Note that the "maze" analogy, discussed earlier, belongs within the APA grouping. In physically induced events, the physical environment guides and constrains the intellectual capacity of the individual. The nature of the physical components dictates the boundaries within which the intellectual options are selected— intellectual objective must be formed within the limitations of the physical environment.

5.8.2.1 Introducing the Artifact Pattern Artifact cycle (APA)

In the physical sense, persistence of form across generations implies the propagation or repeating of morphological characteristics from one physical generation to the next. Within higher organisms a pattern, embedded in genetic material, is used to carry attributes of a particular morphological observation, from one physical generation to the next. The properties, for example, colour of eyes, being the persistent aspect. This demonstrates persistence.

A pattern is an abstracted spatially coherent intellectual form. This abstracted level introduces the artifact-pattern-artifact lifecycle, conceptually illustrated by groups 1, 2 and 3 in Figure 8.

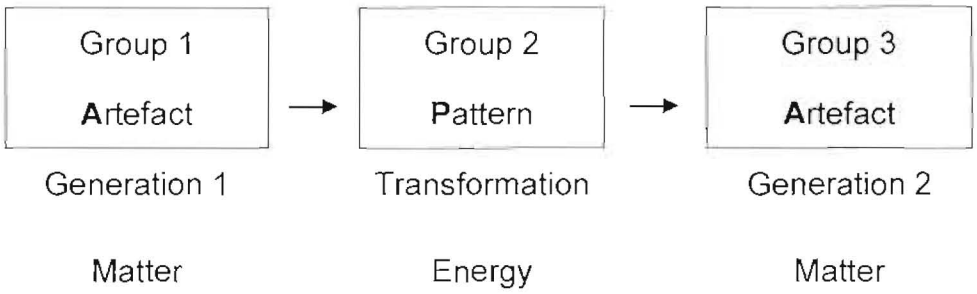


Figure 8: The artifact-pattern-artifact lifecycle

This APA lifecycle suggests that no matter instance is permanently passed from one generation to the next, rather, that biological artifacts propagate using a pattern containing value (in essence, a spatial coherency or value embedded in amino acids (Watson & Crick, 1953) to ensure persistence of attributes from one generation to the next. Each physical generation is constituted from absolute materials.

Biological organisms make use of a pattern containing value, a spatial coherency to propagate morphological characteristics from one physical generation to the next. The value embedded within the pattern between amino acids found within genetic material carries characteristics from the parent to the progeny – the genes and amino acids are temporary vehicles, soon discarded. The value embedded in the pattern is a persistent aspect of biological reproduction. It qualifies as an example of spatial coherency. The attributes it propagates into the next generation are real and physical, but is itself purely a value encapsulated within the genetic material.

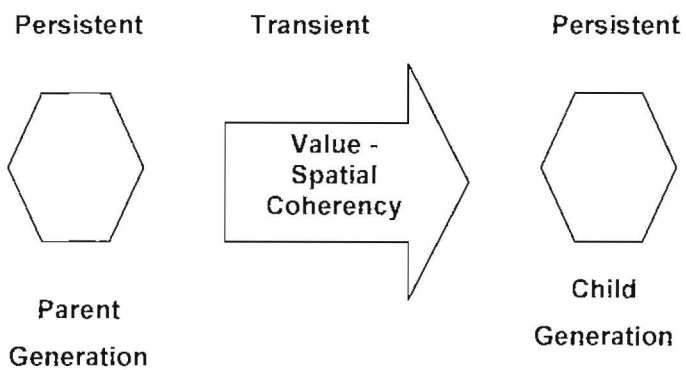


Figure 9: Spatial coherency (biological continuity)

Spatial coherency is the vehicle, the pattern containing embedded value, used to pass characteristics from one biological generation to the next. This mechanism, a characteristic of the biological lifecycle, is unidirectional – parents propagate progeny, progeny cannot spawn parents – and has a hierarchical structure. In sexual reproduction, the mechanism passing the characteristics from the parent to the progeny is indirect, in the sense that spatial coherency (patterns embedded within the amino acid) link the biological characteristics of the parent to their progeny.

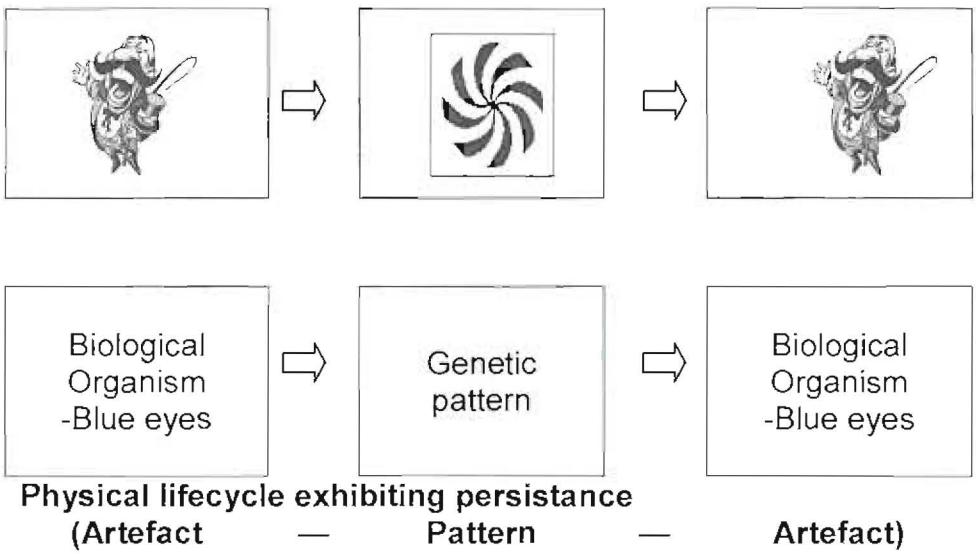


Figure 10: The artifact-pattern-artifact lifecycle

5.8.3 The Mist Scenario

Illustrates where the intellectual universe functions without restraint within the physical world. Imagine an individual in a physical world shrouded in heavy mist - the individual can listen and hear a bell ringing – he can easily turn and is able to walk directly towards the source of the ringing, to retrieve the bell. There are no physical impediments, and intellect is manifested without restriction. He can go where he chooses, without restriction. The physical world opens in front, and closes behind him. This introduces the pattern–artifact–pattern cycle. The individual follows an intellectual progression without physical constraints to achieve the objectives of the exercise. Physical

attributes (sound waves) are harnessed towards this objective, without any restriction.

A pattern based approach uses value delivered from an intellectual effort to align physical artifacts around an intellectual target without restriction. The intellectually induced model abides by the mist analogy – it allows unrestricted intellectual expression using physical artifacts without hindrance, facilitating the attainment of that intellectual goal.

5.8.4 Intellectually Induced Events (PAP)

An event can be triggered intellectually, and the output of this intellectual expression is expressed by changing an artifact and/or changing the relationships between artifacts after which the consequences are reflected back as value extracted from the rearranged pattern. It is where intellect manipulates artifacts.

Note that Intellect is invisible to the physical world – it cannot be examined or accessed directly. It is detected indirectly, by examining its influence on artifacts. It exercises its presence through the manipulation of value which it implants within patterns using spatial objects. Intellectual induced events manipulate spatial components and the relationships between spatial components within the physical world without restriction towards its own end. The limits of this expression are the intellectual capabilities and the nature of the spatial artifacts available.

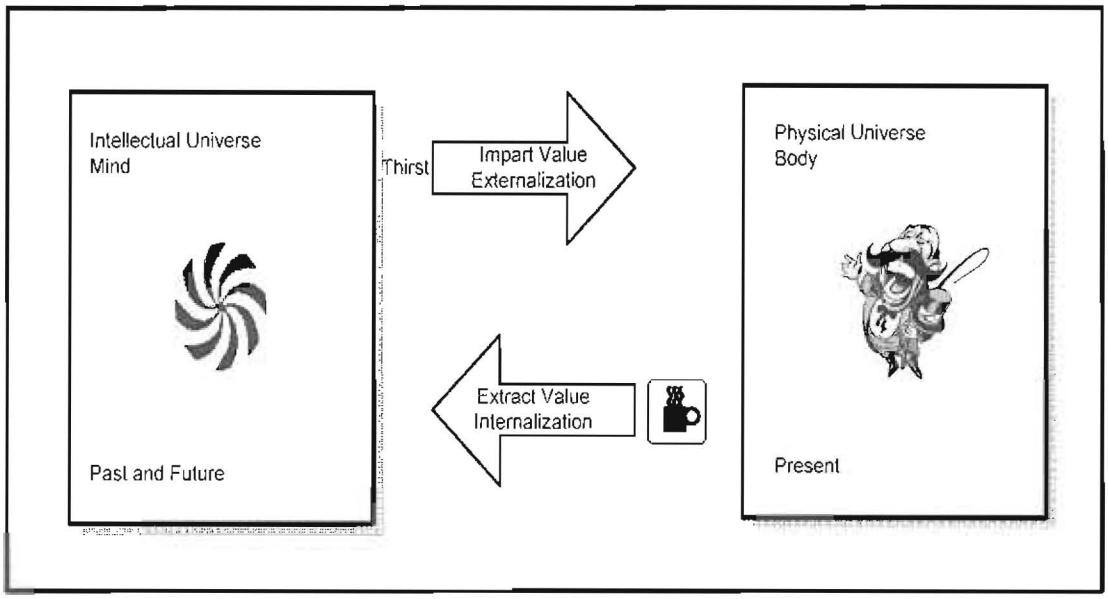


Figure 11: Interaction between the mind and the body - intellectual initiation

Figure 11 presents a model depicting a situation where an individual desires a cup of coffee. The intellectual capacity of the person evaluates the physical situation, makes a decision which initiates a physical response. He reorders the artifacts within the environment when making the cup of coffee. The intellectual need initiates this event, mobilizes the artifacts towards the delivery and fulfillment of this need. This model presents an event where an intellectual requirement mobilizes the redeployment of physical artifacts towards the fulfilling of an intellectual need. This sequence of actions within a single event can be classified as a pattern–artifact–pattern (PAP) cycle. Note that the 'mist' analogy, discussed earlier, belongs within the PAP grouping.

Expanding this PAP model further introduces spatial objects imagined and recalled by the mind – a world of mental imagery, emulating the physical universe. Within this model, imagination has no physical bounds, and mental constructs are limited only by the intellectual capacity of the individual. The mind can construct spatial objects and using logic, immediately relate the one to the other. This world, where intellect and imagination co-exist, is the world of intellectual discovery. It is here where great inventions are conceived.

5.8.4.1 Introducing the Pattern-Artifact-Pattern (PAP) cycle

In the intellectual sense, an intellectual abstraction can also exhibit persistence. Cultural values live on across succeeding generations of progeny, existing long after the originators of a particular cultural aspect have perished. A persistent idea can retain its integrity and be passed over many generations, long after the originator has died. This introduces the pattern-artifact-pattern (PAP) lifecycle.

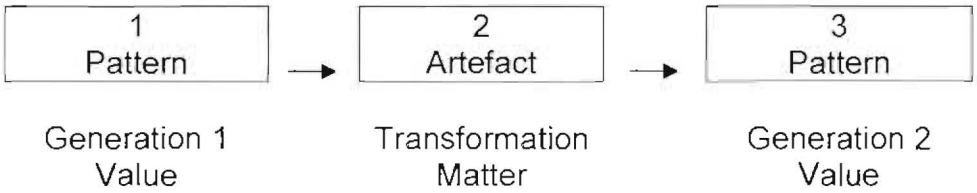


Figure 12: The pattern-artifact-pattern cycle

A set of cultural values can be described as intellectual phenomena manifested as a grouping of social memes (Dawkins, 1976). It can outlast or outlive the individuals who abide within the belief systems of that culture. This example of persistence in the intellectual sense enables a value system, a set of beliefs to attain permanency, lasting after the biological organisms that constitute that belief system have passed away. "In 30 years' time, we will be designing products we don't know, incorporating materials which haven't been invented, made in processes yet to be defined, by people we have not yet recruited. Under these circumstances, all we can carry forward is our knowledge and our knowledge of how to improve our knowledge" (Siemieniuch, 2004:1104-1125). Knowledge, retained as intellectual spatial objects, can to be propagated and carried forward from one generation of patterns to the next. The mechanism used to transport it will be a physical transfer, either by word of mouth, or via the written word.

Intellectual mediums require physical artifacts to transfer persistency to the following intellectual generation.

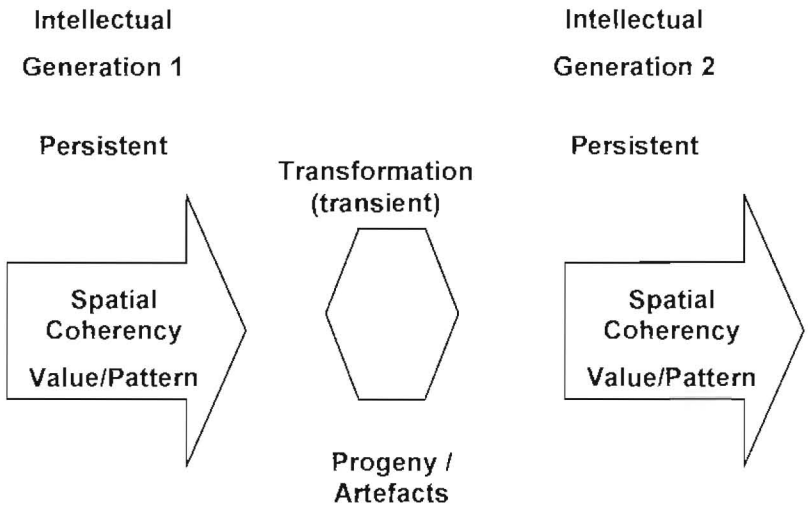


Figure 13: Spatial coherency (intellectual continuity)

Spatial coherency in the intellectual sense encompasses the conscious understanding and memories of the mind, both individually and collectively. Cultural values and remembered fact (intellectual spatial objects) are constituted and based on a form of intellectual spatiality. Intellectual spatial coherency describes the value found in the relationship between memes. It is a collection of memory and remembered experience and lore (learning), unique to each individual (Dawkins, 1976). This collective set of memes and their relationships is passed through a physical medium, which can be the biological progeny, books or engravings, and ultimately propagated as cultural and knowledge assets within the intellectual treasures of that group. Intellectual spatial coherency is the vehicle used to pass intellectual characteristics from one intellectual generation to the next.

Propagation of intellectual values can be seen as an intellectual phenomenon visible only to those intellectually aware.

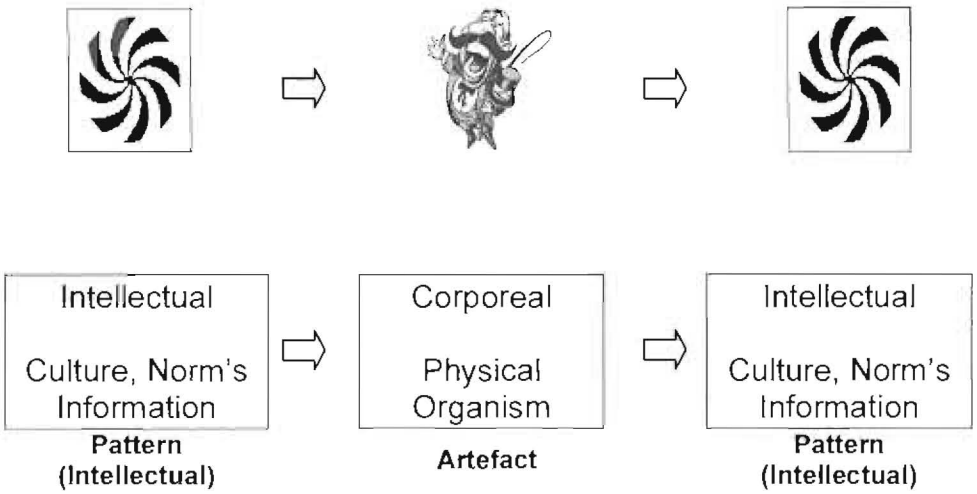


Figure 14: The pattern–artifact–pattern lifecycle

Multiple pathways exist for a give PAP cycle. For example, value can be passed by way of mouth and by the written word (Gray, 2006). Knowledge is locked within the human brain, is externalized as information, becomes internalized by a second individual, and then becomes knowledge once again (Van Beveren, 2002). In terms of the APA cycle, knowledge (patterns of the mind) is externalized (through external stimuli which are the physical artifacts containing or interpreting the information patterns (voice, eye or sensory receptors). These patterns are then internalized by a recipient using the physical artifacts available (eyes – biological matter or reading – physical matter) and then once again stored as intellectual patterns within the memory of the recipient.

5.9 The dichotomy of metaphors

Metaphors, as bridges across the intellectual and corporeal divide, have two roles – each role invisible to the other:

5.9.1 Intellectual perspective - intellectual value

Metaphors carry intellectual meaning encapsulated in patterns from one intellectual domain to another. This intellectual embedded meaning can only be realized in real time during intellectual inspection. Note that the realization of intellect value is akin to the energy released when a candle burns – it takes place only in 'real time', only in the present tense. As intellectual energy is

temporal, and lacks persistence, the only mechanism linking one intellectual "thought" instance (Hooper, 1917) to another is via the physical, spatial components or the intellectual equivalent, spatial objects stored and recalled as elements of memory.

From an intellectual perspective, value (in turn embedded in patterns) is transferred from one intellectual universe to the next using an artifact as the filling of a sandwich – this follows the principles of PAP.

5.9.2 Physical perspective - spatial constructs

Metaphors are constructed using real, remembered or imagined artifacts. Source and target artifacts are expressed within a single container (the metaphor itself). This container exhibits persistent, and thus can be used to link the source component to the target component. Note that logic is transient, and has no direct memory - access to spatiality delivers the memory – it must access a spatial component (real or intellectual) to access information (locked in a value embedded in patterns) from the past. Conversely, logic must use spatial components to carry information (locked in a value embedded in patterns) from the present to the future.

From a corporeal perspective, persistent characteristics or attributes (e.g. eye colour embedded as value in patterns) are transferred from one biological generation to the next using value embedded in patterns (emulating time – carrying attributes from the past to the future) using the principles of APA.

5.10 Metaphors and the Artifact – Pattern – Artifact Cycle (APA)

Metaphors which make use of a source and target component as a sandwich, with a filling of intellectual reflection conform to APA criteria.

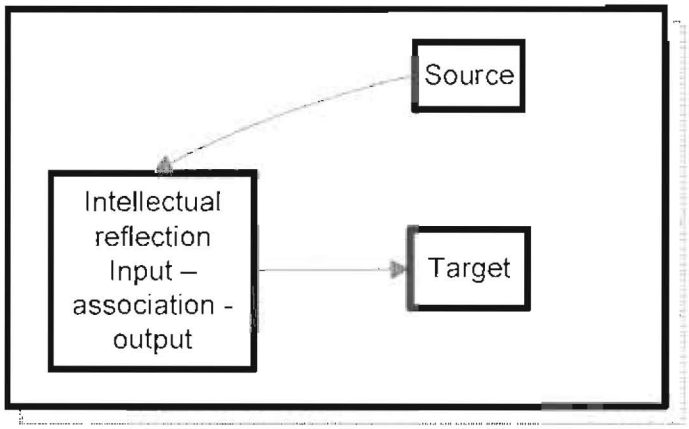


Figure 15: Generic model of a metaphor

Figure 15 illustrates a metaphor split into the physical universe components and the intellectual universe components. The source and target components, both physical (and remembered) artifacts, are illustrated on the right hand side, and the intellectual components are presented in the box (pattern) on the left. The act of evaluating the metaphor is the act of intellectual reflection.

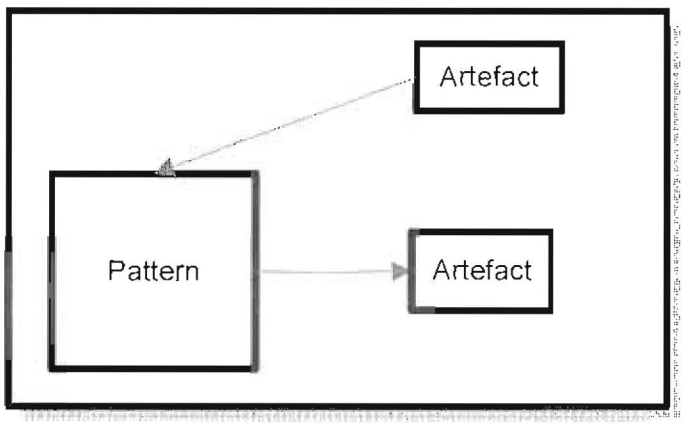


Figure 16: Intellectual and physical mapping of a metaphor

Figure 16 completes this explanation. It details generically, the relationship between the source artifact, the application of logic using value embedded in patterns, and the target artifact. This diagram illustrates the Artifact–Pattern–Artifact cycle. The Artifact represents the 'thing's and relationships between things – rules. The intellectual value – a characteristic found only within the intellectual domain – is reflected using patterns. This illustrates a physical induced event – the APA cycle.

The event is triggered when the computer application presents a screen with a host of icons, fields, tables and prompts to a user, together with a number of options available to that user. The user, using his intellectual capability, evaluates the patterns displayed on the screen and extracts information (value embedded in patterns) from these patterns. Once the immediate screen has satisfied the intellectual thirst of the user, further action can be decided, based on the options available within the particular transaction. The event is driven firstly by the artifact; the user reacts intellectually to this stimulus, after which a subsequent screen image is displayed. The intellectual freedom of the user is constrained by the boundaries of the computer application. This model fits the physical induced event model, a characteristic of the APA cycle. Current computer applications do not make use of pattern based instruments to swap between the Physical and Intellectual universe between each event. They are locked in a single monolithic construct, rigid, inflexible and with vast amounts of redundancy of logic.

5.11 Intellectual Patterns the Pattern – Artifact – Pattern Cycle

Intellectually induced events were discussed earlier, where an intellectual need to transfer intellectual capital to other intellectuals initiates an event. In this scenario, the intellectual transfer of information takes place without physical hindrance – physical artifacts are mere physical instruments available to the mind, and are easily manipulated towards an intellectual end. This document is an example of the PAP cycle. Intellectual capital externalized as value embedded in patterns is transferred by written word and diagrams (the patterns) onto an electronic / physical medium. These patterns are then ingested, value extracted, and internalized. The intellectual capital of the source passes through a physical medium before once again becoming patterns embedded as value within the target. This event is launched by the author, and ends with the target, the reviewers. The physical medium is deployed effortlessly around the intellectual objectives, and forms a container within which the value is transferred.

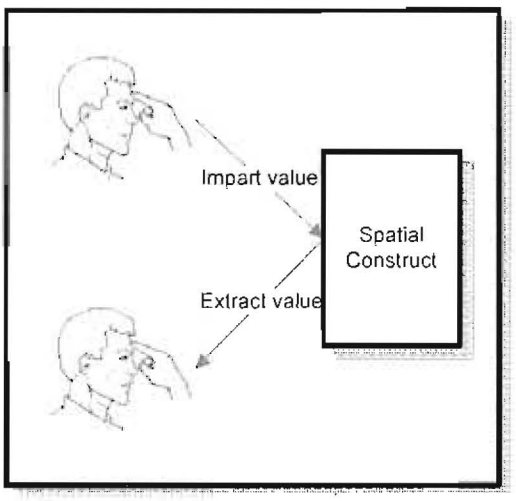


Figure 17: Transferring intellectual capital

5.12 Persistence: Physical, Biological and Intellectual Cycles

Lifecycle Type / Mode	Type	Mechanism of persistence
Physical	Matter (Inorganic)	None
Biological	Matter (Organic)	Artifact-Pattern-Artifact
Intellectual	Memes (Dawkins 1976), Thought-objects (Hooper 1917)	Pattern-Artifact-Pattern

Figure 18: Persistent and non-persistent lifecycles

Persistent lifecycles (biological and intellectual) have complimentary propagation mechanism's to promote persistence – they both require and pass through two states, the artifact and pattern phases; the difference is the base states. The physical lifecycle has a physical base state, whereas the intellectual lifecycle has an intellectual (value embedded in patterns) base state. Both can be classified using a common set of properties.

The table below classifies characteristics of each of the four lifecycle states. The properties are explained in paragraphs following the table.

Physical Lifecycle without persistence	Biological Lifecycle with persistence	Intellectual Lifecycle without persistence	Intellectual Lifecycle with persistence
Physical	Physical	Ephemeral	Ephemeral
Hierarchical	Hierarchical	Network	Network
Direct	Indirect	Direct	Indirect

Figure 19: Properties of physical, biological and intellectual lifecycles

5.12.1 Physical / Ephemeral property

The base state of physical artifacts is that of a physical presence, the base state of the intellectual phenomena is an ephemeral (non physical) consciousness. This consciousness, this intellect, proportionally increases with the intellectual capability and intelligence of the respective biological organism.

5.12.2 Hierarchical / Network property

Both persistent lifecycles are dependant on a preceding manifestation, thereby adding another node on a hierarchical tree, continually growing and evolving. Each successive generation is dependant on a preceding one.

A networking capability is found within the intellectual lifecycle with persistence – the nature of memes and their relationships allows the coupling of any one meme to any other, as the thought process progresses. Knowledge, an intangible abstraction, is described by Mouritsen (Mouritsen, 2005:371-394) as "not a separate thing but an element completely tangled in networks".

5.12.3 Direct / Indirect relationship property

The "physical lifecycle without persistence" and the "intellectual lifecycle without persistence" are examples of direct manifestations.

The APA and PAP lifecycles both propagate through two stages, in the case of the APA lifecycle, a pattern must be the intermediary and in the case of the PAP, an artifact must be the intermediary. Biological artifacts must pass through a pattern or "essence" phase where the inherited value is transported from one spatial generation to the next; intellectual artifacts must pass through a physical phase. This indicates an indirect propagation mechanism.

5.13 Characteristics of conventional computing technologies

5.13.1 Patterns characteristics

Patterns (a collection of related electronic spatial objects) delivered by conventional standard applications are created by programs. Each screen (which is equivalent to a pattern) is invoked by a specific program. More advanced applications may have more sophisticated programming. The size of the application executables (a physical container in which the temporal component is encapsulated) and data (a physical spatial component) is proportional to the lines of code developed. Advance estimation mechanisms have been developed which allow effort and complexity to be included when estimating effort and risk (Boehm, 1981).

5.13.2 Hierarchical

In traditional development, logic, structure and intellectual need are included into programs (logic) and files (spatial structures). Menu items are used to access these objects. Object oriented programming practices construct classes. In both cases, the product is rigidly compiled, and delivered within the final application. The relationship between components within the conventional programming family is hierarchical.

5.13.3 Physical

Conventional standard approaches have, as an end result a tangible, real, compiled set of components, each dedicated to delivering a particular business need. The source code can be examined, and the executables

contain the binary equivalent of the logic and spatial components constituting the developed application.

5.13.4 Direct

Conventional approaches have components which directly interact with each other. Routines calling subroutines provide a name when calling the sub–routine. Each called component is aware of the calling component.

5.14 Characteristics of an intellectual lifecycle

5.14.1 Patterns characteristics

Patterns delivered by metaobject based applications share characteristics of metaobjects – they exist independently of one another. Preceding and succeeding patterns are anonymous and autonomous. They do not know where they come from, and they do not know where they are going – the past and future do not exist for them. They emulate time using a number of mechanisms, which are discussed in 6.6.

Intellectual needs select options presented within a pattern event – this spawns the metaobjects which then constitute the next generation pattern, together with the permutation of options for presentation – the cycle then repeats itself. Presentation of patterns follows the selection requested by the information seeker. No program code exists for a particular pattern, rather related metaobjects are constituted, manifest and dissipate, guided by the selections of the user. The size of a metaobject based application remains unchanged, regardless of the number of patterns displayed (for a given information domain). Customization may present a need to make the metaobjects, containing the customized requirement, persistent for later retrieval – this results in physical space been required.

5.14.2 Networked

Metaobject based information displays "virtual components" constituted from metaobjects which reference temporal and spatial elements. The relationship between these metaobjects is managed using intelligent labeling which allows

many-to-many relationships. Extensibility within the metaobject approach is absolute, in that the intelligent labeling (in essence a complex key) can easily accommodate a new entry.

5.14.3 Ephemeral

Metaobject applications, once completed, consist of a library of absolute temporal components, and metaobjects with intelligent labels, and references to a single specific temporal component, and the single spatial component to be instantiated. The metaobjects are clustered using the intelligent label, and when invoked, together will present a virtual component.

5.14.4 Indirect (anonymity)

Individual metaobjects are implemented totally anonymously of others. Parents are not aware of children spawned, and children are unaware of the identity of their parents. A unique metaobject is not directly aware of other metaobjects at any point, be it previous, currently nor future.

NOTE The past is inherited using "genetic material" carried within the intelligent label, the present is influenced through "situational awareness" and the future is forecasted using "situational pre-cognizance" (these concepts are discussed in 6.6).

5.15 Conclusion

Livari & Maansaari (Livari & Maansaari, 1998) evaluated various systems development methods, built largely on the use of CASE and OO. This paper proposed a fresh approach, that the second, PAP based approach be considered when evaluating information delivery development methods. Each has been evaluated using persistence as a criterion, and a number of aspects identified proposing categories.

It is suggested that information is value embedded within patterns – an intellectual construct, which must pass through a physical medium before the next iteration can be manifested. It is suggested that information thus belongs

to the PAP lifecycle, and information delivery should emulate this lifecycle when delivering information.

The PAP approach has the potential to move the focus away from the challenge of translating "Essence" into "Accidental" aspects (Brooks, 1987) towards the challenge of communally understanding "Essence".

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Emulating the Intellectual Lifecycle – A theoretical approach

ABSTRACT

This paper suggests that, by applying the principles found in the Pattern–Artifact–Pattern (PAP) lifecycle, information delivery vehicles will be able to emulate the intellectual lifecycle. The PAP lifecycle describes persistence mechanisms found when propagating intellectual material across generations.

This capacity to carry attributes from one intellectual generation (today's norms, cultural values, knowledge base) forward to succeeding intellectual generations (tomorrow's norms, cultural values, knowledge base) using spatial artifacts as batons can be emulated in the information lifecycle using electronic artifacts to encapsulate value within intellectual patterns carrying the value – "Essence" (Hartman, 1976) from one information generation to the next. These dynamic intellectual patterns, or "metaobjects" are introduced, and their characteristics described.

6.1 Introduction

Computing solutions today are direct, physical and hierarchical. These three properties also reflect the constraints found in existing information delivery vehicles.

Computing solutions of the future can learn from observations and understanding the indirect, ephemeral and networking characteristics of an intellectual lifecycle. This understanding should provide an insight into intellectual spatiality, and the interaction it has with intellectual temporal agents. These two phenomena when energized by an intellectual thirst are harnessed towards the instantiation of information patterns aimed at quenching this thirst. Memes, a term loosely applied to describe intellectual spatial objects (Dawkins, 1976), are harnessed by consciously applying logic (intellectual temporal agents) – the process of thinking. Thinking can be

described as an intellectual temporal agent, used to iterate patterns of memes from one generation to the next, each generation developing a scenario, each scenario spawning further generations. "Ultimately, thinking is processing of memes: our "mind" is the process of absorbing, understanding, adapting and broadcasting memes" (Scaruffi, 1998).

Emulating this intellectual propagation mechanism using memory and logic mechanism's available within computing technology forms the focus of this paper. The challenge to information delivery professionals will be to emulate this intellectual lifecycle.

6.2 Current computer solutions

This section discusses current approaches towards the computerization of memory and logic management.

6.2.1 Emulating memory

Currently, spatial objects are stored as cells within tables or files retained within databases. Relational aspects are encapsulated into these sets using keys, unique access routes used for retrieval and storage of the data sets. Content is encapsulated within the database infrastructure, and relational entry points are rigid, retained as separate key sets. These spatial objects are data sets, designed around the principles of normalization as described by Codd (Codd, 1970).

6.2.2 Emulating logic

Logic in terms of the current technologies is applied using algorithms, encapsulated within a compiled program. Sets of instructions are executed sequentially (Von Neumann, 1948). These sets of instructions are in turn called by other sets, ultimately forming onion rings of logic. Dynamic binding allows the relationships to be determined at run time. Compiled sequences of instructions are rigid. The granularity of function is determined by the amount of functionality within a particular sequence of instructions. Finely grained functionality has a single function; course granularity indicates a

corresponding increase in the number of functions within the instruction set. Extensibility capability is a function of the granularity within the programming environment, the more finely grained the program, and the more adaptable it is to extensibility.

6.2.3 Current APA Architectures

Onion rings of logic, layers of instructions calling other layers, allow access for user interaction by providing published methods, including buttons, menu items, pull downs, entry fields and related mechanisms enabling user input. The logic to be applied is rigidly encapsulated into the programming code. This model is appropriate for the various First to Fourth generation languages as well as the Object Orientated (OO) languages emulating the intellectual lifecycle.

Generic Equivalent	Current Technologies	Intellectual Lifecycle	Emulated Intellectual Lifecycle	Metaobject approach
Memory	Database	Meme	Intellectual spatial object	Content is retained in persistent memory. Metadata referencing content is embedded in metaobject
Logic	Program	Thought	Intellectual temporal agent	Code fragment contains absolute algorithm. Reference to absolute code fragment is contained in metaobject
Intellectual reflection	Menu item, button, etc	Meme patterns	Metaobject sets	Patterns manifested as sets of meta objects—the metaobject handles dynamically being constructed and responding to information requests

Table 1: Emulation of the intellectual lifecycle

6.2.4 Emulating memory

Memory represents a capability to remember things, as well as the relationships between things, known in the physical lifecycle as physical spatial objects and their relationships. In the intellectual sense memory refers to intellectual spatial objects, or memes. Current computing models store these spatial objects as database files each with a specific key or set of keys. A computing model emulating the PAP model requires that the referential aspects be removed and carried as a pattern; groups of related metaobjects within related metaobject sets.

6.2.5 Emulating logic

Logic in terms of the intellectual model is reduced to code fragments, each code fragment being an independent absolute autonomous unit of logic. These are equivalent to manifestations of temporal agents. Code fragments are constituted indirectly and dynamically using metaobjects when an information request is received; they execute and then dissipate. The order and sequence of these code fragments is determined indirectly in response to patterns as manifested within metaobject sets. The order and nature of these sets is dynamically constituted in response to the information need.

6.2.6 Responding to intellectual reflection

Information seekers pursue intellectual clues when thirsting for information. Each clue received prompts a response, each response, responding to information received, begetting a new set of information requirements. Each information set must be delivered using a collection of spatial objects specifically containing the value in which the information set is embedded. Intellectual scrutiny examines this value, and liberates the information embedded in the spatial collection.

6.3 Redundancy

Redundancy is the cancer of information delivery. Redundancy can be found in three main areas – rule, logic, and structure. Each redundant (duplicated)

constituent exponentially increases the complexity of the application. Ultimately, uncontrolled redundancy within computer applications, and at a higher level, within business processes, becomes a critical threat to the delivery of services. Three pillars of information delivery exist where the management of redundancy is vital.

Data structures (Rules)

Normalization (Codd, 1970) has advanced the understanding of spatial constructs used in information delivery. Normalized data structures remove redundancy within table and file structures – duplicated elements are eliminated. Data modeling delivers a finite number of rules for a given information requirement.

Logic modules (Logic)

Redundancy of logic is rampant within computer applications today. Every class, every object instantiated runs the risk of duplicating logic. This arena lends significant risk within the information technology industry. The duplication comes at a great cost – the size of the executables reduces run time performance, the number of lines of code which need to be developed and maintained becomes significant. The general complexity of computer applications is proportional to the functionality delivered by that application. PAP based applications have "normalized" logic modules. Logic components remain constant for a given set of functional requirements, regardless of the size in entities, of the application. In PAP based applications, logic is normalized into a finite number of autonomous, reusable temporal agents. Normalization of logic (Dosen, 2003) removes duplicated code, and delivers a finite number of temporal agents for a given information requirement. PAP introduces the acronym "write once reuse everywhere" – WORE.

Intellectual roles (Structure)

The intellectual thirst for information is infinite – limited only by the intellectual needs of the information seeker and the availability of the physical means to support the need. PAP based information delivery to the information seeker for a given domain can be easily enhanced, attained and presented using PAP – customization and population will be undertaken by the users themselves. This role is usually managed by allocating Company based responsibilities (Human Resources, Production Marketing Divisions) and profiles to knowledge workers responsible for defined areas of contribution.

6.4 A PAP based approach

6.4.1 Emulation of Time

Time is an intellectual construct – emulating it using instruments within a physical world can be done by employing patterns (manifested as Metaobjects) as event drivers, using spatial objects to sustain persistence between events, and employing temporal agents modules of the finest granularity to action logic during the event. Each pattern spawns a single event – each event can spawn large numbers of patterns. The flow of the physical components is illustrated in Figure 20. In an initial base state (pre-combustion), temporal agents containing absolute logic and rules describing spatial objects and their relationships exist in a state of limbo. The introduction of a pattern forces interrogation of the pattern, the logic and rules required for that event are identified, and the event is initiated. Once completed, the logic and rule components return to their dormant state. The event which is invoked is constituted from large numbers of patterns, presents an output, after which it terminates. Persistent aspects flowing from the event are stored on persistent medium for later retrieval.

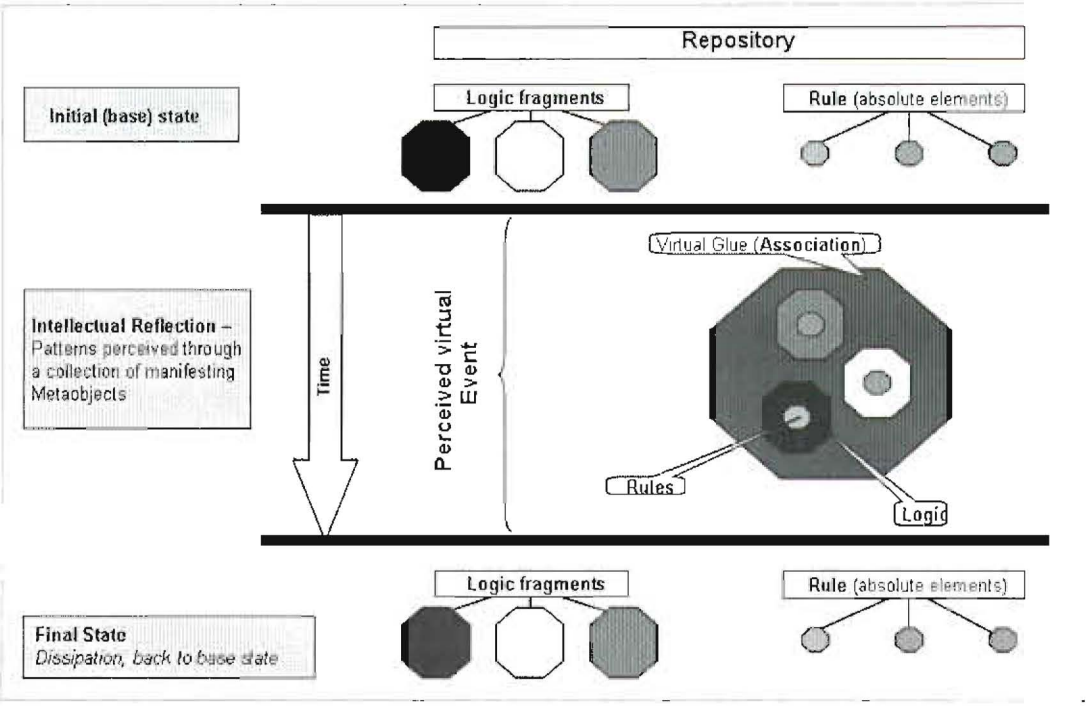


Figure 20: Interaction between logic and rule

Each invocation of a metaobject results in an event, each event is private, and autonomous of other events. Please refer to Paragraph 6.6 for mechanism's used to communicate externally.

6.4.2 A Conceptual Example using PAP

Two examples are presented, and the differences illustrated.

6.4.2.1 Example 1

The requirement would be draw a map with the following sequence:

Start, turn north, proceed for 10 minutes at a speed of 20 km/h, turn west, proceed for 5 minutes at a speed of 5 km/h, and stop.

6.4.2.1.1 Standard conventional approach

A program written using the conventional approach would be coded as follows. Two commands exist, Turn and Speed. Speed has two parameters, time and distance.

The spatial (structure) definitions are:

a North
b West

PROG A
Begin
Turn North
Speed(10,20)
Turn West
Speed(5,5)
End

6.4.2.1.2 Pattern based approach

The temporal (Logic) components are:

A Turn
B Speed

These would be precompiled atomic "units of logic". The spatial (structure) definitions are

a North
b West

Using the pattern based approach, 4 patterns (each row represents a pattern) would be presented as follows:

Column 1 (Pattern identifier)	Column 2 (Reference to temporal agent)	Column 3 (Reference to spatial object)
1	A	a
2	B	(10, 20)
3	A	b
4	B	(5, 5)

6.4.2.2 Example 2

A second requirement would be to start, turn west, proceed for 5 minutes at a speed of 5 km/h, turn north, proceed for 10 minutes at a speed of 20 km/h, and stop.

6.4.2.2.1 Standard approach

A program written using the standard approach would be coded as follows:

```
PROG C
Begin
        Turn West
        Speed(5,5)
        Turn North
        Speed(10,20)
End
```

Note that the program would need to be recompiled.

6.4.2.2.2 Pattern based approach

Using the pattern based approach; patterns would be presented as follows:

Column 1 (Pattern identifier)	Column 2 (Reference to temporal agent)	Column 3 (Reference to spatial object)
1	A	b
2	B	(5, 5)
3	A	a
4	B	(10,20)

The order of temporal and spatial references in column 2 and 3 changes – the temporal and spatial components (Turn, Speed and North, West) remain unchanged.

Intelligent labeling within column 1 allows patterns to be dynamically rearranged without impacting the existing compiled modules. The pattern is refreshed, and the temporal (logic) components are reused.

The power of this approach resides in the ability of an intelligent label to dynamically group and reorder existing logic and structural components in response to changing information requirements. Value found in patterns is an intellectual manifestation based on an intellectual need – information delivered raises a need for additional patterns delivering fresh perspectives and more

information – patterns align themselves around these changing requirements to dynamically deliver the patterns as requested when demanded.

Patterns are dynamically discovered and presented, as the information direction is determined. The same physical components can be reused repeatedly, mobilized by the patterns.

6.5 Introducing metaobjects

By emulating the PAP lifecycle, computing technology can optimize the propagation and delivery of information. Metaobjects are patterns, the corporeal component, the "Form" in which the intellectual focus, the non-corporeal aspect, the "Essence" is ensconced (Copi, 1954). In physical terms these are specialized data records linking one event generation to the following one - used when emulating the PAP lifecycle.

Intellect communicates indirectly with the physical world using patterns passing value across intellectual generations. It cannot communicate directly. The pattern–artifact–pattern cycle, when emulated using metaobjects, would follow the following process.

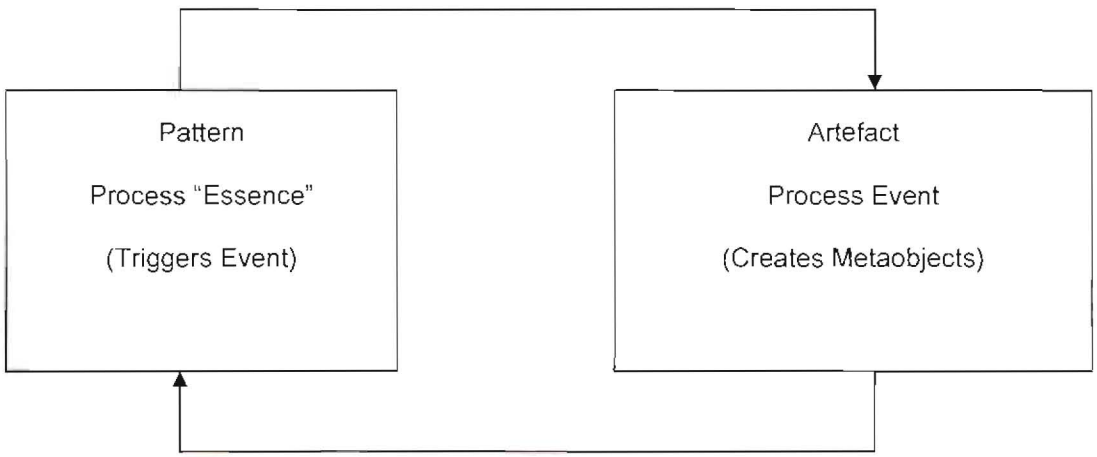


Figure 21: The pattern-artifact-pattern cycle

A metaobject consists of two components – a pattern and attributes of that pattern. The pattern component emulates the corporeal form, with the non-corporeal essence ensconced therein; the attributes represent what will later manifest as the structure, to be used to instantiate the material instance of the

event (Hartman, 1976; Williams, 1958). A metaobject manifested practically as a record with two logical fields – a complex key containing the pattern and a single data field containing the attributes. The attributes are, at a later stage, when an event is invoked, redefined into a handle (invoking a reference to a temporal agent), and a signature built using a set of parameters (providing the spatial rules for that instance). The pattern is used directly to define the sequence for a particular event and indirectly to provide parameters for the temporal constituent embedded within the attributes within the metaobject during combustion (processing).

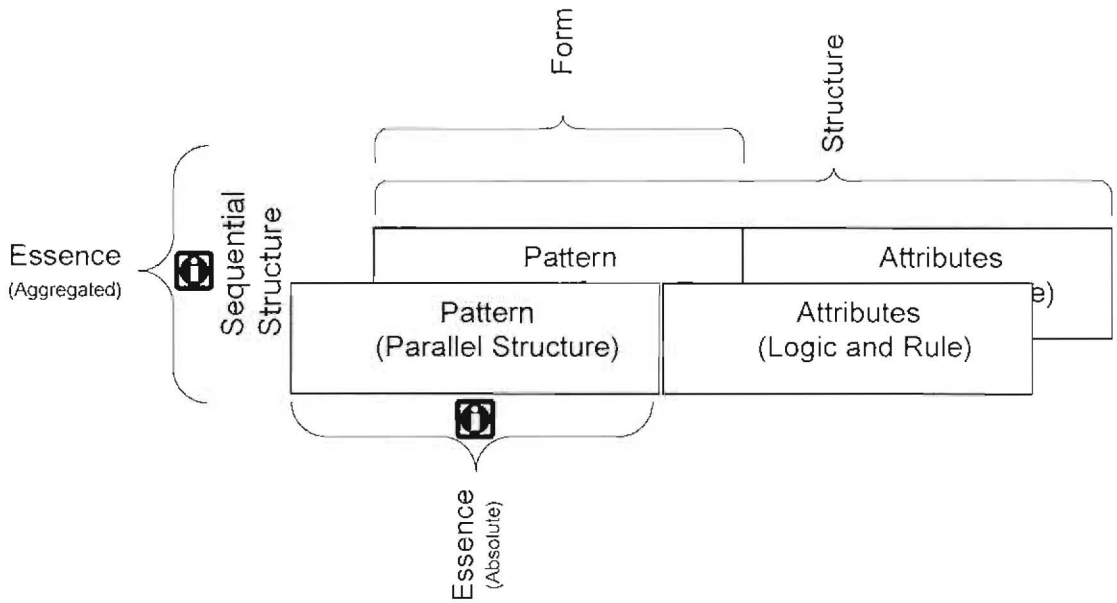


Figure 22: Metaobject Structure

– This symbol represents "Essence" – a non–corporeal, intellectual appreciation or value embedded within patterns.

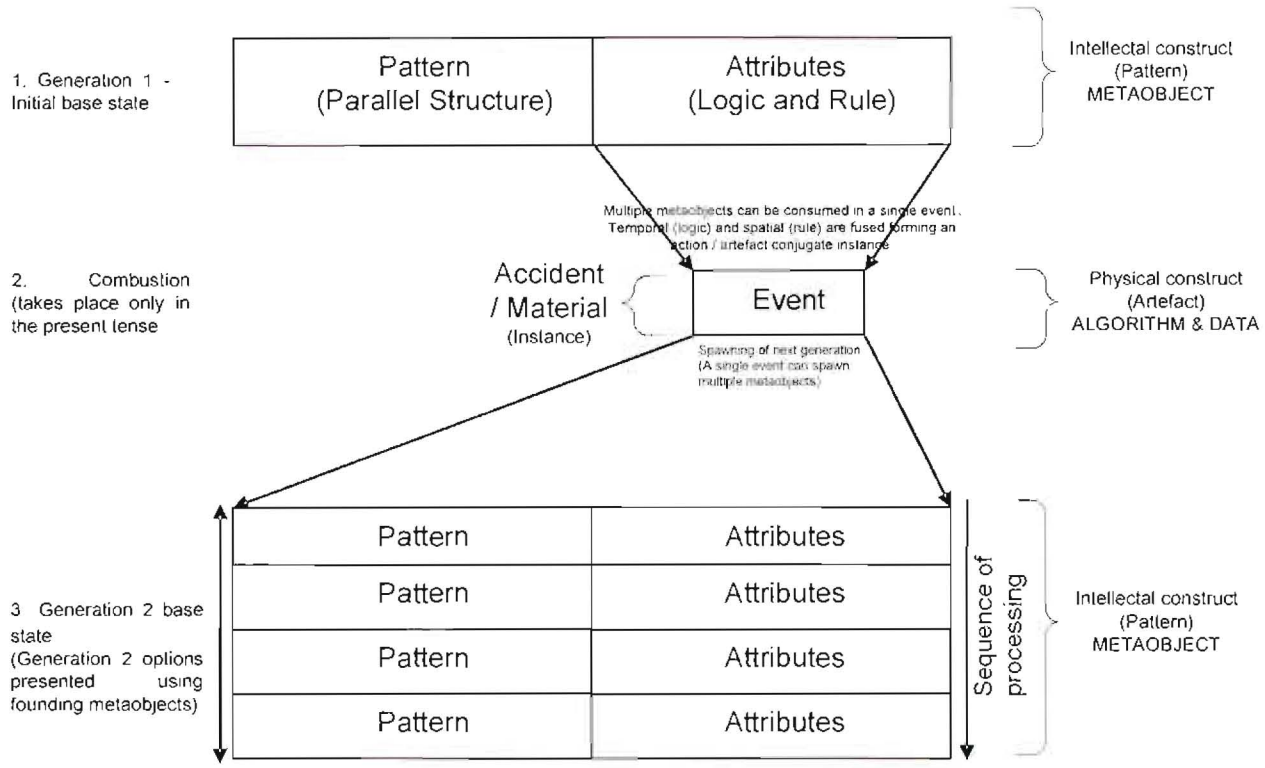


Figure 23: Metaobject Lifecycle –Illustrating PAP

A metaobject can be examined from two perspectives, an Intellectual state, and a corporeal state. The two paragraphs below summarize the PAP cycle.

Intellectual State

During the Intellectual state, illustrated as Generation 1 in Figure 22 the "Essence" embedded within the pattern is active. During this cycle, the absolute and relative values sequence the metaobject, both externally, relative to other metaobjects, and for internally later reference, in terms of the "purpose" or 'reason for being' of the specific metaobject. In this state, the spatial components are unintelligible. This invocation forms the first "Pattern" instance within the PAP cycle. The metaobject exists fleetingly and ephemerally. Ephemeral and persistent states are discussed in 6.8.

Corporeal state

The cycle then progresses to the corporeal state or "Accident" phase (Copi, 1954) of the cycle, where the spatial aspects of the metaobject are invoked. The attributes take on meaning, where logic and rule are conjugated to form an instance. This initiates an event, where logic is manifested using algorithms and data rules and files are accessed. In this state, the essence aspects are not visible. This invokes the "Artifact" phase within the PAP cycle. The event itself will then manifest, during which the next generation of metaobjects will be spawned, in turn spawning second generation events. The interaction between the Intellectual and Corporeal states is discussed in 3.3.3 and expanded in 5.1.3.

6.5.1 Identity polymorphism: the "Jekyll and Hyde" principal

Each metaobject assumes two identities: "Essence" during the "Pattern phase and "Accident" during the Artifact phase (Copi, 1954)

1. The "Essence" – manifested in a pattern with a string of unintelligible attributes (The P–Pattern phase of the PAP cycle).

2. The "Accident" – a corporeal function with parameters (The A–Artifact phase within the PAP cycle).

A metaobject has two identities. In the passive mode (before invocation) the metaobject consists of a pattern and attributes. When invoked, the attributes are divorced from the metaobject, and launched anonymously as a function and the metaobject dissipates – the Pattern phase is complete, however, the launched function persists, and the attributes (previously an unintelligible string in 1 above) take on meaning – the pattern with embedded "Essence" is also passed as a parameter to the function when it is called. This pattern is the mechanism used to pass the value or essence to the following generation. The biological equivalent to a metaobject is genetic material. A more detailed description is presented in 6.6.1.

Each of the two metaobject identities is not visible to the other. When a metaobject is functioning within the pattern dimension, other patterns are visible, and the relative order of one metaobject to the other can be established. However, attributes within any particular pattern are meaningless to both the pattern and other patterns. When functioning as a function, the second identity is assumed, and the attributes assume the identity of a function and are launched. A number of parameters depending on the function can be carried. One of these parameters will be used to carry the pattern string identification as a parameter into the function.

6.5.2 Information Hiding

The concept of Information hiding was introduced by Parnas in 1972 (Parnas, 1972). "In programming, the process of hiding details of an object or function. Information hiding is a powerful programming technique because it reduces complexity. One of the chief mechanisms for hiding information is encapsulation – combining elements to create a larger entity. The programmer can then focus on the new object without worrying about the hidden details. In a sense, the entire hierarchy of programming languages – from machine languages to high–level languages – can be seen as a form of information hiding" (Webopedia, 2007).

6.5.3 Event hiding

Event hiding is an abstraction of Information hiding. Metaobjects are at the finest level of granularity, and contain a single logic and a single rule reference. Publishing a metaobject makes it visible. Without publication, the corporeal event will not be manifested and the event will appear to be 'hidden' – the reality is that event will not be instantiated. Each metaobject is responsible for a specific event within a complex network of relational events. A single metaobject forms a unit of logic at the finest point of intellectual comprehension. In physical terms, it is a record built using a complex key which forms the pattern, and a single field containing a string of attributes. A grouping of metaobjects can combine to deliver a particular event. Collections of grouped metaobjects deliver complex events. Event hiding in its simplest

form, for example, hiding a button within a more complex event, is achieved by restricting the invocation of a single metaobject record (either by not spawning (presenting) it, or not instantiating it if presented). Event hiding in the more complex sense, for example, hiding a set of fields would entail restricting the invocation of a selected group of metaobjects, also by not presenting it or not instantiating it. Event hiding restricts a component within the current generation. An event, for example, a capture screen with multiple data fields and "ADD", "AMEND", "VIEW" "DELETE" buttons as optional functional choices, together with a "SORT" option, is constituted from multiple metaobjects. Each metaobject is hidden from the next, and each generation of metaobjects can be hidden from previous and succeeding generations. Generation hiding is an extension of event hiding, based on intellectual perspectives. Generation hiding is found when founding metaobjects are not published. It restricts a component within the following intellectual generation.

6.6 Emulating time using metaobjects

In the physical world, the world of inorganic reality, the intellectual construct of time does not exist, rather, random spatial reordering based on a continual cycle of spatial and temporal interaction takes place. The rate of this interaction determines a rate of combustion. If the intellectual appreciation of time is to be emulated artificially, mechanisms to cater for the three main states need to be created, and management of state change, from the one to the next implemented. Metaobjects are instruments which provide the mechanism of moving from one generation to the next, change agents carrying rule, logic and structure from one generation to the next.

Metaobjects pass through a number of phases during their lifetime. They are created during an event previously spawned by a founding metaobject. An event, instantiated in response to a founding metaobject, seeds numerous metaobject siblings – this can be by presenting a GUI object within an event (together with other seeded metaobjects) making up a particular event. A triggered event, for example, the selection of a button or menu item based on a specific information need, would allow the user to select one of the presented seeded metaobjects (displayed as a button, menu item or general

GUI screen artifact), which would then immediately seed and create the next generation of metaobjects, after which it would then dissipate. A founding metaobject seeds metaobjects indirectly via an event. The founding metaobject initiates seeding independently and unknowingly; the seeded metaobject has no direct coupling to the founding metaobject, or to its siblings. Events separate founding metaobjects from their seeded Metaobjects. The anonymous nature of these relationships requires that a specialized approach to communicating between the metaobjects be derived. The following mechanisms are applied.

6.6.1 Genetic material

Patterns are passed as metaobjects from one event to the next through the application of genetic material. The interrogation of the pattern embedded within the genetic material enables decisions around the purpose, the context and the identity of the event instance to be resolved. The identity of an instance within the enabled event generation is rigid, and cannot be changed, but by altering the genetic material pattern received (and thus the pattern) future generations can be influenced. Patterns pass value using genetic material from one generation to the next.

6.6.2 Situational preconditions

An instance resulting from the invocation of a pattern is dependant on specific preconditions. These preconditions are established by the preceding patterns instance before the spawning of the progeny pattern is initiated, and carried as parameters embedded as attributes within the pattern.

6.6.3 Situational awareness

As a metaobject is built its founding event interprets and responds to environmental stimuli. These stimuli can be within the situational preconditions received through the genetic material, or they can be real time stimuli presented as parameters when the founding event was instantiated. Conclusions are included in the attributes of the metaobject under

construction within what will later become the signature of the event to be instantiated.

6.6.4 Situational precognizance

Situational precognizance (future awareness) allows a specific, unique event the capability to identify permutations required for the next event generation, and preparing an index of potential appropriate metaobjects for later spawning.

6.7 Repository philosophies

Two philosophies exist when considering repository architectures. Metaobject models can be constructed using an internal approach (genetic model), where each metaobject carries all future possibilities within itself, or an external approach (situational model) can be considered, where the possibilities available to each metaobject are carried within a repository.

6.7.1 Genetic model

The genetic model creates a single founding metaobject with all relevant possibilities embedded within it, for each branch of the tree within the domain to be addressed. As the status of the first branch changes from seeded to founding, second generation branches are spawned, each one carrying a full compliment of future possibilities. This model embeds the possibilities within genetic material, and is more advanced and sophisticated than the situational model. This conceptual model is not included in the developed prototype.

6.7.2 Situational model

The situational model makes use of an external repository—whenever a metaobject is seeded, a corresponding set of possibilities for that metaobject is referenced from the repository. This implies that a repository must be available whenever seeding takes place. Customization of the repository takes immediate effect and is immediately in metaobjects created thereafter. This model has been included in the developed prototype.

6.8 Persistence philosophies

Metaobjects can be ephemeral, in that they are seeded, instantiate events, become founding metaobjects and dissipate, or they can be persistent, in that they can be created and permanently saved to a persistent medium.

6.8.1 Ephemeral model

The ephemeral model is characterized by its virtual nature. The amount of disk space taken once the application is closed is exactly the same as it was before the application started. All metaobjects which were seeded, selected, became founding metaobjects would have dissipated without trace. This model is appropriate for space sensitive applications not requiring customization. Each manifestation of an application would be the same, based on the default rules embedded within each metaobject type.

6.8.2 Persistent model

The persistent model writes each new metaobject to disk, and checks the existence of an existing metaobject before creating a new instance of a metaobject. This model is appropriate for applications where customization is required, but because storage of metaobjects is required, the repository size will grow as the applications functionality is applied. The persistent model allows customization, something not possible with the ephemeral model.

6.9 Standard programming technologies

Computer applications are built using programs containing algorithms activated at run time, and files containing persistent components. A single processor processes a single stream of instructions. The principles of sequential processing were first described by John von Niemann (Von Neumann, 1948). Evolution of language development progressed, starting with the 1st generation based on machine languages and progressing through 2nd, 3rd, and 4th and currently exploring multiple 5th generation avenues, including OO and AOP based approached.

The object oriented (OO) approach creates classes which are developed by sequencing program statements. A program statement consists of a logic component (the instruction) and an operand. The instruction forms the logic component and the operand describes a spatial aspect. Classes are built from lines of code, which can be inspected. They contain fused, rigid temporal and spatial definitions dedicated to a specific information need. As the information requirements become more comprehensive, so the classes are expanded. Ultimately, the size of an OO application is a function of the number of classes constituting the application.

6.10 Metaobject based technologies

A metaobject consists of an intelligent label defining structure, an indirect reference to a logic module introducing the logic, and an indirect reference to a spatial component containing the spatial rules.

Information, an intellectual appreciation of value embedded in patterns, can be categorized as an intellectual phenomenon beholden only to the human mind. Information and allied phenomenon such as knowledge, social norms, and cultural value systems abide by and subscribe to an intellectual lifecycle when propagating (Dawkins, 1976).

A "virtual component" based approach does not code temporal and spatial aspects rigidly within a single program statement, nor does it group statements in a program, class or component (Cahill, *et al.* 1997). Rather, a virtual component is ethereal, a "Structure", not "Material" (Hartman, 1976). A virtual component consists of a grouping of metaobjects, in a specific order and manifested dynamically. Each metaobject equivalent to "Form" contains a non-corporeal appreciation, an intellectual value, being "Essence". Each metaobject has an intelligent label, the pattern, which references a single atomic temporal component and a single atomic spatial component. These two components, when instantiated, are the accidental components of the manifestation. The order of individual metaobjects constituting a virtual component is controlled using the intelligent label.

Metaobjects within a virtual component are sequentially processed at run time, and each metaobject, when processed, associates the algorithmic and structures referenced for the processing, presentation and delivery of patterns. A single metaobject can reference only one spatial object and only one temporal agent. A virtual component consists of a hierarchy of metaobjects and its components can be related in a network fashion to other virtual components.

This approach makes use of permutations of finite, universally independent, temporal, atomic components, together with permutations of finite, spatial, atomic components to deliver finite sets of predetermined patterns, referenced using metaobjects. This splitting of the temporal and spatial aspects and indirect invocation using metaobject references promotes optimal reuse of temporal (logic) components. Each logic component, which is a 'code fragment' built using programming code instructions, can be reused without restriction.

An information domain is defined by spatially determined boundaries in which the "things" and the relationships between "things" are predetermined.

Metaobjects containing these references are fleeting, and exist only in the present tense, when customization (see discussion in the next section) is not required. Metaobjects simulate intellectual phenomenon, and have the same characteristics as that of a fleeting thought.

This in turn brings about a significant reduction in both the complexity and the physical size of an application.

6.10.1 Customization

The application size (executable library) of metaobject based technologies not requiring customization, in terms of disk space required by the system, remains constant, irrespective of whether one file or one million files are included. Metaobjects are instantiated and consumed instantly – the metaobjects are temporary and exist fleetingly.

Should customization be required, then a capability to edit and retain the changes to metaobject instances is required. This retention requires that metaobjects become persistent, and thus saved for later reference.

6.10.2 Resource utilization

The application size of metaobject based technologies is proportional to the need for customization. Should no customization be required, then no additional disk space is required. CPU memory and utilization will vary, but return to base levels when terminated.

Metaobjects make use of precompiled executables (containing the temporal agents), and no further development is required once a function has been developed. A data dictionary (reference source which provides information on a given list of terms, list of items with corresponding information used for reference) will grow as the number of entities and the complexity of relationships grows, but the application size is unaffected by this. The temporal agents referenced when metaobjects are consumed are finite, and once developed, can be reused as many times as required, without further customization, for a defined need.

6.11 Conclusion

An approach using an intellectual lifecycle is suggested, in which metaobjects (a richer extension of memes), are adopted towards delivering information. This approach could support Robinson (Robinson, *et al.* 1998) in their plea for a new, more humble approach to software development. This approach has the potential to attain a code re-usability index of 100%, implying that users without programming knowledge will be enabled to develop their own information solutions. Specialized spatial object modeling skills will still be required. An index, which measures re-usability of code, would be 100%, within the boundaries of the intellectual domain (determined by the boundaries of defined the spatial objects) within such an environment – this implies that no programming would be required. Current applications architectures would be replaced such that the user would manually construct permutations of

metaobjects, with no need to understand programming languages or compilers. Testing would become redundant, the code fragments having been verified and validated.

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Emulating the Intellectual Lifecycle – a practical example

ABSTRACT

Modern software development has adopted Object Orientation (OO) programming as a standard mainstream industry approach, in which classes are created, and instantiated from objects. Classes are developed using coding syntax. Components within a class are compiled into rigid physical structures (a program) which hierarchically references related objects.

This paper suggests a metaobject based alternative, where temporal components (a specialized compiled set of program statements) and spatial components (rules defining the persistent aspects, data structures and relational rules) are stored separately in a passive state. They are dynamically associated within a metaobject when required, groups of related metaobjects manifesting as a "virtual component". During execution, the virtual component processes and delivers the data forming a pattern (a pattern in this context is a grouping of GUI objects for example a form, a table, or combinations). These screen displays allow intellectual inspection after which the virtual component dissipates, and the temporal and spatial components are restored to their passive states.

7.1 Introduction

7.1.1 Enterprise architecture

Enterprises develop enterprise solutions aimed at managing their information needs into the future (Zajac, *et al.* 2000). This is an enormous task that seldom achieves the objectives originally envisaged for many reasons. One of the more prominent being the inability to translate the logical enterprise information need into a physical information delivery application, covering the full gambit of the enterprise. The reason is the slow pace of development and its complexity, when building the information application. The slow pace in

turn is due to the inertia of application development, integration and interfacing, and the complexities and impact of the legacy technologies (Robinson, *et al.* 1998).

The metaobject based approach, based on the concept presented in this study, has the potential to reduce programming time significantly. This is done by reducing redundancy by normalizing the logic (temporal agents) allowing reuse of program statements.

Metaobjects allow program statement and functions, normally compiled into a program, to be removed, and indirectly referenced. These logic modules (temporal components) have been reduced to the finest level of granularity. In a sense, the logic aspects of programming are normalized. "Two derivations represent the same proof if and only if they are equivalent" (Dosen, 2003:477-503). References to logic modules and rules supporting data structures and relationships (spatial components) are associated using a highly specialized key. This key manages relationships, a relative value between electronic spatial objects, both internally and between other metaobject. This is where the "Essence" (Copi, 1954) is managed.

The relationship of one metaobject to another determines the sequence of processing; this relationship is controlled using a complex label (key) which defines the patterns. This replaces the need to sequence program statements.

Metaobjects remove the need for programming for a predetermined scoped information need. The scoping is an intellectual exercise modeling the information requirement. The prime focus is around understanding the spatial aspects of the information need. The boundaries of the spatial object needs are determined by the width and depth of data modeling undertaken. Temporal components need not, once originally defined and delivered, be addressed again - the availability of appropriate logic functionality once established, is permanent. Both are both finite for a given information requirement.

Metaobjects remove redundancy from programming, thereby speeding up the information delivery process. Table 2 conceptually illustrates the shift in the

system development life cycle (SDLC) effort. The row titled "Project Activity Distribution by Phase" reproduces metrics for a medium sized project presented in Software Engineering Economics (Boehm, 1981). The row titled "Relative Project Activity Metaobject Based SDLC" provides a relative estimation for similar activities using a metaobject based approach. Table 4: Results from a metaobject based application presents actual measures attained using a prototype.

	Plans and Requirement	Product Design		Programming		Integration and Test	Solution Implement	Development	Maintenance
Project Activity Distribution by Phase **Medium sized application** **(Boehm, 1981)**	8	18		54		28			
		Program Specifications	Data Analysis	Programming (Programmers)	Customization (Power Users)				
Relative Project Activity Metaobject based SDLC	Unchanged	Lower	Higher	Insignificant	Deeper involvement	Negligible			

Table 2: Shift in the SDLC effort

Effort currently spent developing program specifications, programming and testing will be re-channeled towards understanding the business's information needs, and translating these needs into the entities, keys and attributes required for information delivery.

7.2 Practical example

An entity-relationship model with the measures shown in Table 3 has been used to test the prototype. The Entity-relationship model is presented in Figure 24 with examples of one–to–many relations, many–to–many relations, subtypes, and hierarchies.

Number of Entities	122
Number of Keys	251
Number of Key Elements	350

Table 3: Measures in the entity-relationship model

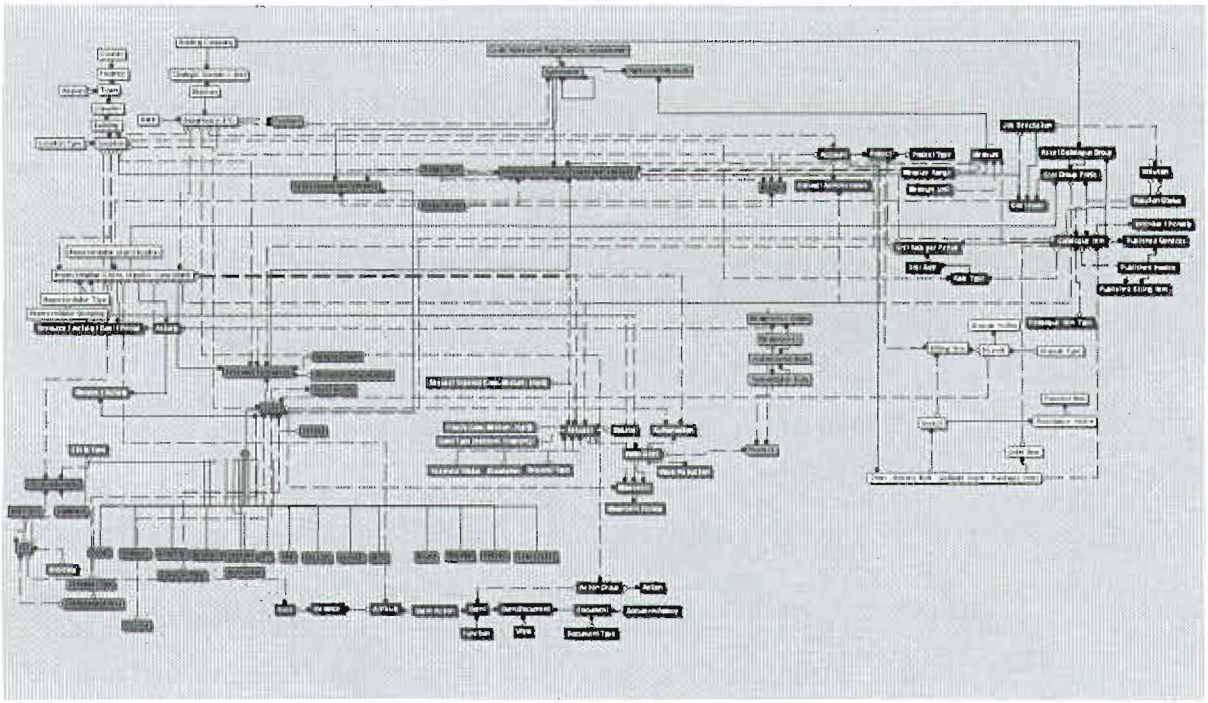


Figure 24: An entity-relationship model

Development Effort	4 minutes					
	Time Started. 11:13:30					
	Time Ended: 11:17:30					
Number of "Founding" Metaobjects[3] created	9013					
Total number of metaobjects in prototype (Assume 20 siblings for each iteration, 5 iterations)	Foun-ding Meta-objects	Level 1	Level 2	Level 3	Level 4	Level 5
	1	20	400	8,000	160,000	3,200,000
	9013	180,260	3,605,200	72,104,000	1,442,080,000	28,841,600,000[4]

Table 4: Results from a metaobject based application

7.2.1 Testing

The metaobject based approach splits logic, manifested in autonomous clusters of program statements, from the rules of an application. These rules include the data structures, content and relationships. The logic modules, once written and tested are available for reuse. The "index of code reuse" within the metaobject approach is 100%. This is qualified by stating that functional components may be identified which do not exist – once developed and implemented, that functionality need never be recoded. A practical example is the arithmetic "ADD" and "SUBTRACT" statement – they cannot be decomposed further; the logic modules within the metaobject based approach can similarly not be decomposed.

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3 A 'founding' metaobject is capable of spawning metaobject 'children'. The number of descendents is related to the number of spatial elements and relationships which exist, and the characteristics of a particular pattern.

4 It must be emphasized that this is the estimated number of metaobjects. They are never directly accessed – only indirectly, through published methods. Secondly, in their natural state, they are ephemeral and transient, not requiring disk space. They exist only in the present tense - they become 'real' only when customization requires that they be stored as persistent objects for later retrieval.

7.2.2 Impact of skills set

A metaobject based approach has the potential to significantly reduce the need for technical designers and programmers. "The essence of a software entity is a construct of interlocking concepts: data sets, relationships among data items, algorithms, and invocations of functions. This essence is abstract in that such a conceptual construct is the same under many different representations. It is nonetheless highly precise and richly detailed" (Brooks, 1987).

"I believe the hard part of building software to be the specification, design, and testing of this conceptual construct, not the labor of representing it and testing the fidelity of the representation" (Hartman, 1976:545-561).

The hard part of delivering information lies in understanding and manipulating "Essence" (Hartman, 1976). Once achieved, managing the accidental aspects of information delivery becomes incidental, almost to the point of irrelevance.

A corresponding shift in skills required can be anticipated as the metaobject approach becomes more accepted. There will be a move increasing demands for skills supporting the definition and concretization of the essence of the information need, and a corresponding decrease in skills responsible for the accidental aspects.

7.3 A metaobject based practical example

The prototype demonstrating the metaobject concept has been developed using a DOS based language, CLIPPER using Dbase IV files with .NTX indexing. The following images present some of the features within the Metaobject based application whose measures are listed in Figure 24 and Table 3.

7.3.1 Customization of metaobjects

Each metaobject type has an internal editor. When instantiation of a metaobject of a particular type takes place, and development mode is enabled for that metaobject type, the editor is enabled, allowing editing of that

instance. Figure 25 demonstrates the methods available for editing of a "Field" metaobject:

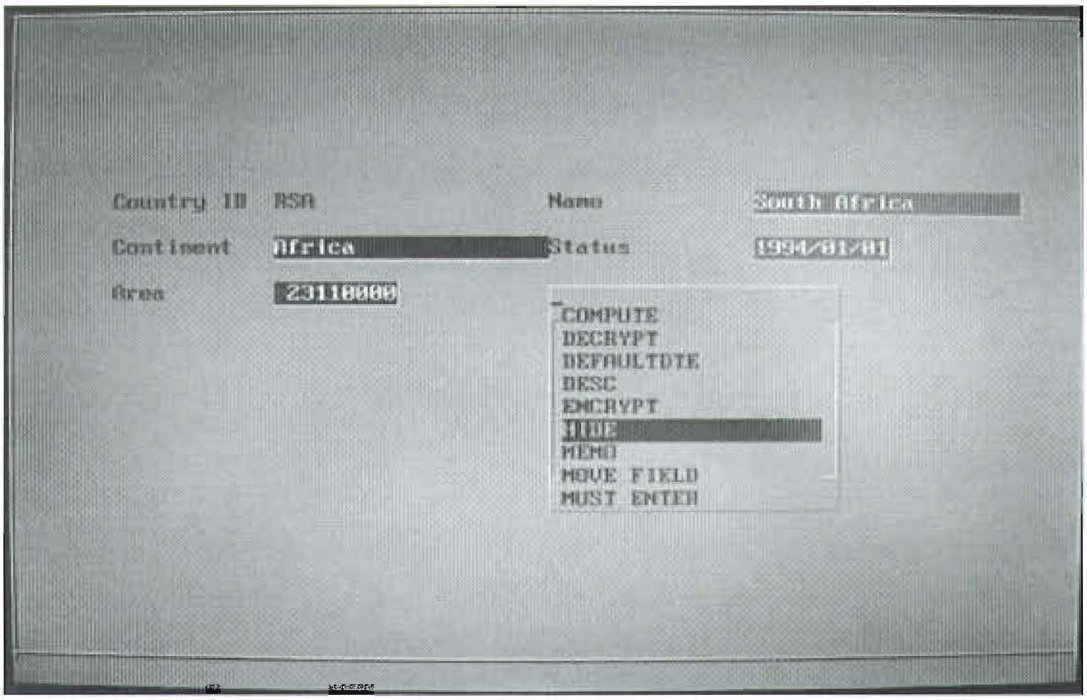


Figure 25: Editing of a "field" metaobject

Numerous methods can exist for a metaobject type: Table 5 shows a brief overview of the methods available to customize the "Field" metaobject.

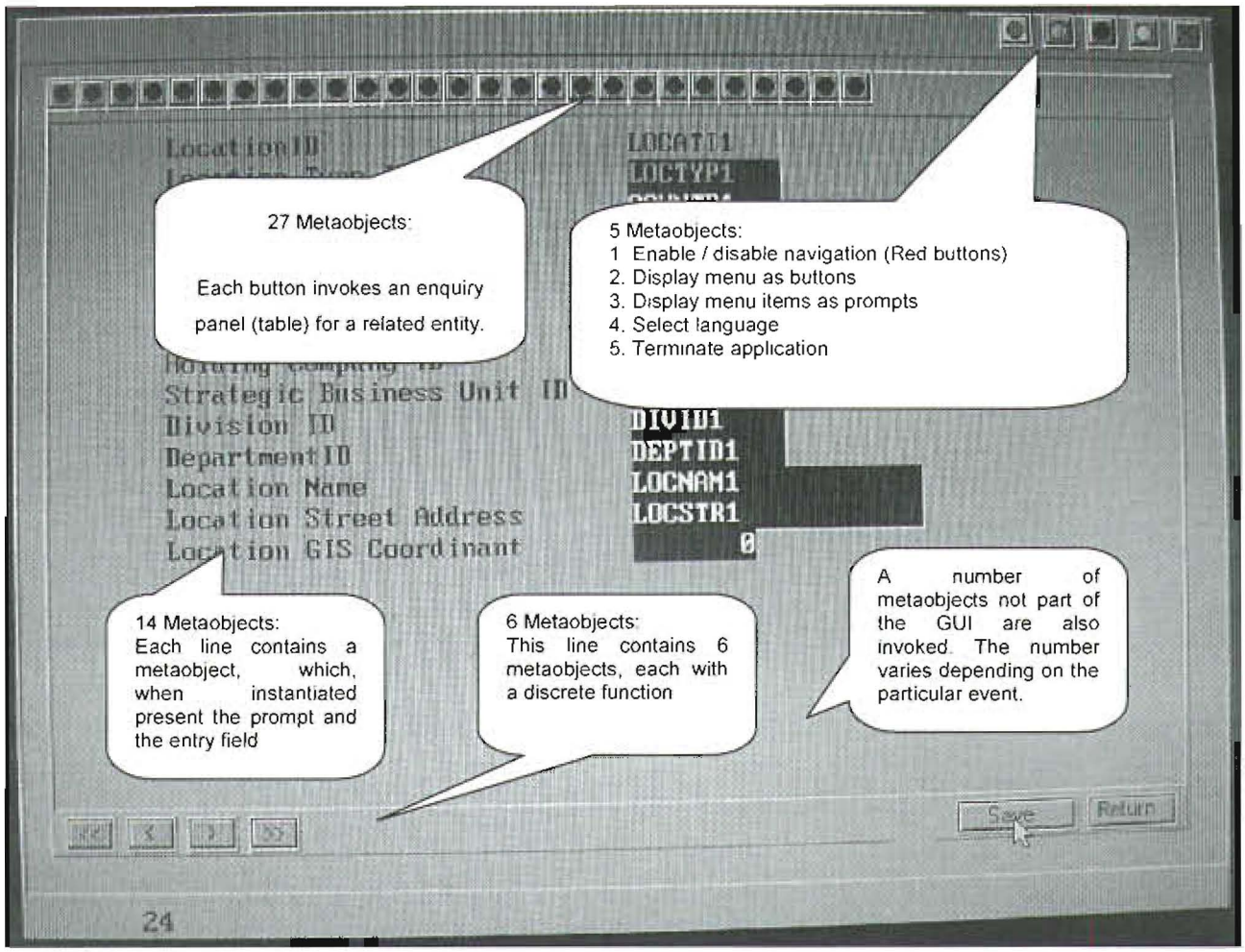
Compute	Enables an algorithm to be attached to the field
Decrypt	Decrypts the field when carried as encrypted on the database
Defaultdate	Inserts the current date into a date field
Descr	Allows a description to be carried as a constant
Encrypt	Encrypts a field before writing to disk
Hide	Hides the field
Memo	Defines the field as a Memo field
Move Field	Allows the field prompt and the field to be relocated on the screen

Must Enter	Forces entry of a field

Table 5: Methods available to customize the "field metaobject"

These are a few examples of published methods for a metaobject type. Each metaobject type is linked to a specific permutation of methods and editors.

7.3.2 Metaobject within an update transaction



Shows the update screen contains more than 52 metaobjects (27+5+14+6+n). Each is carried as a data record, clustered uniquely and indexed using an intelligent label. The published methods are the only manner which allows these metaobjects to be accessed.

7.3.3 Example of a pattern

Figure 26 is an example of a table–form (homogeneous) pattern – it displays a one-to-many relationship for a single entity. A table is presented with a number of rows, and a form is presented under the table, displaying the data of the focus record selected in the table. This view allows full updating capabilities. An enquiry screen, without insert, amend and delete functionality, would be a separate cluster of metaobjects, without the insert, amend and delete metaobject entries.

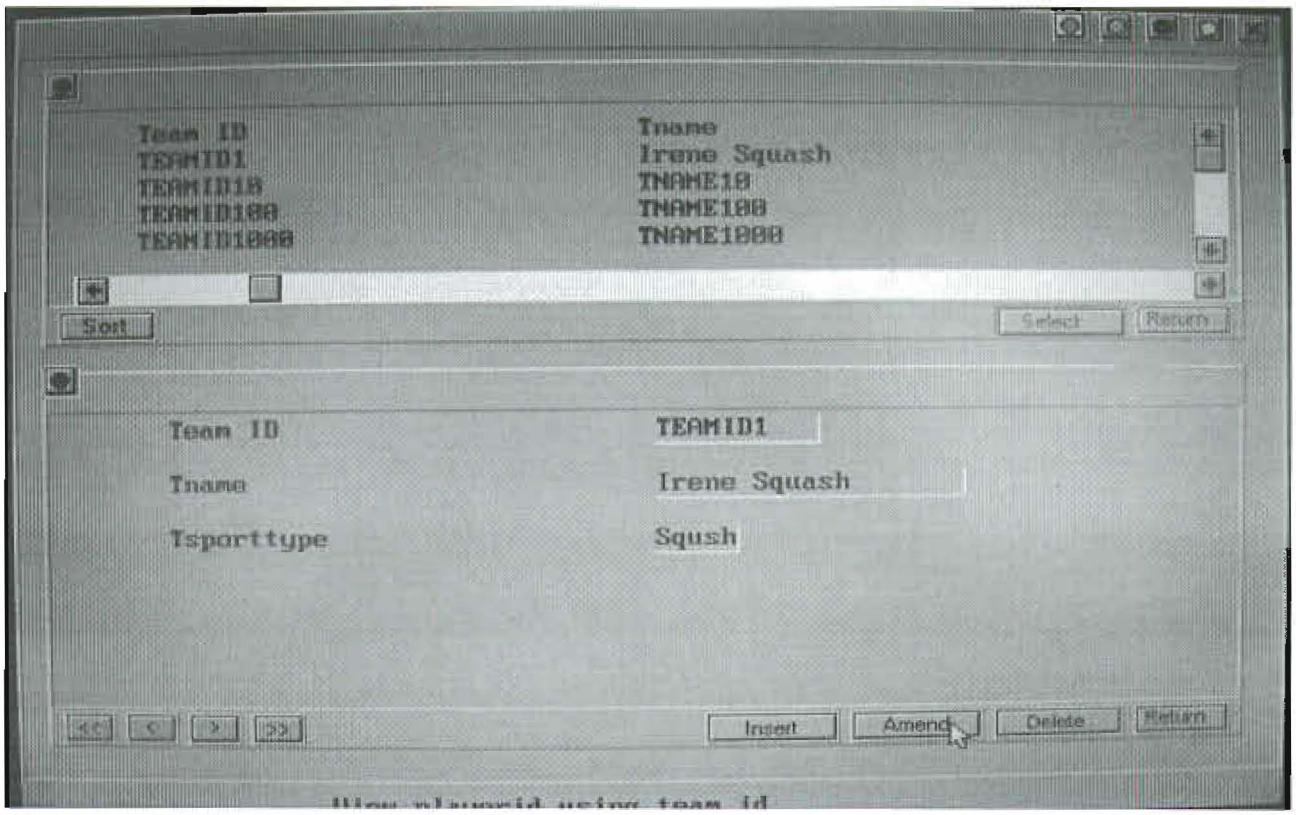


Figure 26: An example of a GUI pattern

7.3.4 Constraints

"Logic" components referenced using the metaobject approach can be developed using any coherent selection of program statements – the constraints would be similar to those of the native language utilized when developing the logic modules. Where specific needs cannot be accommodated, the option remains open to developing the module separately, for incorporation. Limitations lie within the technology architecture selected, and not within the metaobject approach. The metaobject approach lends itself well to development and maintenance of commercial systems, where databases have been professionally designed. This does not preclude its use as a middleware instrument for integration and interfacing.

7.4 Conclusion

A metaobject based approach has been evaluated, and measures derived. With a metaobject based approach, the application uses existing code and is instantiated automatically (using the output from a model), and no testing is required (the logic modules would have previously been tested before release). Time required to deliver the application is insignificant (less than a few minutes). Metaobject management allows customization reducing the need for specialist skills. This concept should contribute significantly to the speed of development, and the ease of maintenance of computer applications.

7.5 References

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Findings and recommendations

8.1 Introduction

The concluding chapter of this dissertation describes the findings of the research, and proposes recommendations on how these findings can best be exploited.

8.2 Findings

Removing redundancy from the logical (algorithmic) pillar of information delivery has the potential of improving development and maintenance productivity significantly. The effort required to manage the accidental aspects of application development have the potential to be significantly reduced, thereby improving the effectivity and efficiency with which information solutions are delivered, and also reducing the maintenance burden. Released effort can be channeled towards understanding the information needs of the information seeker, and focusing more on the essence of the information requirement.

The findings of this study indicate that the use of computer code can be optimized, and the same "code fragments" utilized in multiple modules (a "code fragment" is equivalent to a container containing the logic – the temporal agent). This study indicates that the relationship between a "code fragment" and program module, in industry today is a "1 to 1" relationship (one code fragment is used in one program module). It is demonstrated how this can become a "many–to–many" relationship, where a single code fragment can be applied in many program modules, and conversely, that a single program module can utilize multiple "code fragments". A metaobject is the associate which resolves this compound relationship.

The findings of the study are presented immediately below, the corresponding "Objective of the Study" paragraph (numbered) is reproduced from Chapter 1.3 for ease of reference:

1. To determine if the persistent and algorithmic components supporting information delivery can be retained independently and separately during the dormant phase.

   The persistent and algorithmic components can be retained independently and separately during the dormant phase. An overview of the dormant states is presented for both the rule and the logic aspects, as follows:

   - A metadata repository containing metadata supporting the rules of the system tables and their relationships is populated during a single startup processing event. Each founding metaobject, when created during a subsequent phase, would be primed with the rules supporting its specific "raison d'être", retained within this repository.

   - An executable containing the full gambit of logical requirements is available and accessible in the search path. Each event, once triggered by a metaobject, would locate its corresponding routine within this executable.

2. To investigate how these two (the persistent and algorithmic components) constituents can be harnessed towards satisfying an information need on demand.

   - A metaobject, when consumed, invokes a procedure using traditional means. The string which triggers the procedure is constituted from a handle, a signature and an operation. The handle is a complex compound key. The signature contains the rules, and the operation calls the procedure.

3. To identify mechanisms which can adroitly react to the ephemeral flow of the information need, dynamically streaming the harnessed constituents towards an appropriate response.

- The mechanism which has the characteristics described in this objective is extremely complex. It assigns two roles to a metaobject:

  Role 1: This is the "gluing" role – gluing the one program function to the next. It manages the sequencing both of sequential and parallel processing needs. It also provides the specific metaobject instance with an identity used to determine its behaviour within the immediate event. This intellectual role emulates "Form" and "Essence".

  Role 2: This is the "event management" role. The metaobject provides the accidental identification required to launch the procedure (event). The function call, the calling string, emulates the corporeal role of "Structure", the function, once instantiated, emulates "Material".

4. To investigate whether it is possible to deliver an executable whose size will remain constant, irrespective of the size of the information need.

   - The study has delivered an executable which is constant in size, satisfying a significantly large number of presentation formats. These formats, once defined and their accompanying functionality developed become permanently available.

5. To determine whether removing duplication from rule (persistent aspects), logic (algorithmic agents) and structure (intellectual appreciation) introduces a meaningful reduction in development and maintenance effort.

   - The study has found that removing duplication from rule (persistent aspects) logic (algorithmic agents) and structure (intellectual appreciation) introduces a meaningful reduction in development effort. Indications are that these reductions will also wash through to reduce the maintenance burden.

- A significant improvement in development time can be demonstrated. Customization at the finest level of granularity can then be undertaken, applying the embedded editors found in each function type within the application. The prototype can deliver a traditional application, once modeling is complete, within approximately 5 minutes. The equivalent number of lines of code to develop an exact equivalent in Java Swing is in excess of a million lines.

8.3 Recommendations and future research

This dissertation provides a philosophical and theoretical introduction into a metaobject based information delivery solution. Additionally, measures taken from a prototype are included.

Further steps include the following options:

- The significance of this research is such that the credibility of these findings should be confirmed. This can easily be accomplished through the presentation of a demonstration of the concept at work.
- Further research and documentation at a more detailed level is recommended.
- A formal study to determine whether this is an innovative and disruptive technology is suggested.
- The approach documented within this study must be classified within current understanding.

8.4 Conclusions

This chapter has described the findings of the research, and proposed recommendations on how these findings can best be exploited.

Terminology

Artifact	A tool; object; man made object (often referring to primitive tools).
Emulating intellectual lifecycles towards the delivery of information	In this research, intellectual components (consisting of intellectual spatial objects and intellectual temporal agents) are evaluated in terms of information technology capabilities. A model is derived, mapping each against constructs of memory and logic. Additionally, time, a fundamental metronome of both the physical and intellectual lifecycles, is examined, and suggested to be a variable intellectual construct within which the past and future are reflected. The present tense is suggested to be a function of the interaction between energy and matter for a particular event, combining in a process described as combustion.
Energy	Energy assumes its natural state during the process of combustion, when matter and energy interact. In its inert form, it is embedded in matter. It is an agent of change. The speed of combustion, or the rate at which matter and energy interact, determines the rate of combustion. Rates of combustion vary, and are dependant on the nature of the matter, and the rate of release of the energy from its embedded matter container. Energy manifests itself only in the present tense; otherwise, at all other times it is inertly embedded in matter. Energy is transient, and not persistent. This real time manifestation of energy is a temporal attribute; hence the energy aspect within information delivery vehicles is described in this document as a change agent or temporal component.

'Logic' can be seen as an energy form—a change agent, contained within a matter component called an 'Algorithm'—the logic is released during a 'combustion' process within a CPU. An algorithm is a persistent sequence of programming statements, applying syntax rules, embedded electronically as source or binary code or physically in a document.

Essence

"Essence" is a non-tangible intellectual appreciation, a value available for inspection, embedded within a pattern (it is NOT the pattern). It is the non-corporeal compliment of "Form". This value is not visible outside the intellectual world. The greater the intellectual capability, the more significant the "Essence". "Essence" is not a temporal component. It is persistent, the persistence a function of the stability of the container containing it. "Essence" can be unlocked intellectually, using the direct application of energy as a catalyst, during the real time process of combustion. In the corporeal world this energy is presented as metabolic energy and in the intellectual world it presents as an intellectual temporal agent. At all other times essence remains invisible. It is resides as a higher intellectual order of information, where information is an intellectual appreciation embedded in patterns.

"Form" and "Essence" are complimentary. "Form" is the corporeal pattern complimenting the non-corporeal "Essence". "Form" is the corporeal constituent, "Essence" the intellectual constituent. "Essence" is invisible to the corporeal world; conversely, "Form" is visible to the intellectual world.

Form	In the biological world, "Form" is contained in spatial components used to establish persistence – to pass attributes from one generation to the next: In biology this is the genetic material containing the genetic code. In the intellectual world, persistence of intellectual value is carried using spatial objects, either physical specifications or blueprints (expressed as hieroglyphics, diagrams, written word) or intellectually (intellectual spatial objects). Intellectual spatial objects are emulated in computer systems using metaobjects. This study suggests that "Form" is found only in the biological and intellectual Universe, where persistence exists. Metaobjects are the "Form" equivalent when emulating the intellectual lifecycle.
Founding metaobject	A 'founding' metaobject is capable of spawning metaobject 'children'. The number of descendents is related to the number of spatial elements and relationships which exist. The number of metaobjects grows as the complexity of the requirement increases
Functions	Functions make use of genetic material to understand the past, situational awareness to evaluate the immediate environment, and situational pre-cognizance to determine future options available for that instance. Retro-causality is also possible, should it be required. When a function finishes processing, it terminates, and all trace of the function dissipates. Evidence that a function has been invoked can be found by examining persistent medium to which the function may have written. Metaobjects may be retained if customization is required, but they too can terminate without trace.

Information	Information is value extracted or imparted using patterns.
Instantiated	Produce a more specifically defined object by replacing some variables with values.
Intellect	Intellect is an ability to extract or impart value using patterns.
Intellectual existence - intellect	Energy and matter (the physical world) form a platform for a third, higher manifestation of existence. This higher form makes use of two capabilities which have been established in the higher order organic organisms: *Memory*: Memory retains the consequence of experience, and allows experience to be recalled, either consciously or unconsciously. The ability to 'remember' introduces an ability to recall what has happened, after it has happened, and so introduces the concept of 'past'. Memory recalls those things and their relationships which have previously been experienced, and retained. These can be described as intellectual spatial objects. These intellectual spatial objects link the past to the present. In the physical world this is emulated using persistent memory. A single mechanism bringing spatial content (for example, a person's name) from a previous intellectual generation to the current intellectual generation using persistent medium exists—this persistent medium can be organic or inorganic.

Logic: The ability to remember allows higher organisms an ability to evaluate multiple experiences. This evaluation introduces an ability to comprehend the implications of cause and effect. Ultimately, using logic, the concept of the future was introduced. Logic is a capability to predict and promote order. Application of logic during the thinking process is similar to the expenditure of energy when energy and matter combust in the physical existence process. Logic can be described as an intellectual temporal agent.

A single mechanism to forward (intellectual intellect) logic from the present generation to a future generation exists, using patterns. Patterns are embedded in a persistent medium. Logic already consumed is spent and no longer exists.

Intellect: Intellect has been defined as an ability to extract or impart value using patterns. Patterns are relationships, perceived or real, discerned between or within artifacts, abstract or real. This implies that for a given physical environment with a given pattern, value extracted will be a function of the intellect examining the pattern—the intellectual capability of the beholder will determine the number and level of complexity to be derived. A limited intellectual capability will see only flowers and stems when examining a bunch of roses (a pattern)—a sophisticated intellectual capability will identify many additional value aspects, for example, classify each flower type, appreciate the nuances of the arrangement, discern diseases which may exist, note the material if real or synthetic, and so on. In this example, the same pattern (a collection of physical

artifacts) the value identified differs limited by the intellectual capability of the beholder.

Thus although there is, physically, a single collection of artifacts within a single pattern—intellectually there can be an infinite number of interpretations of these artifacts—each interpretation is the discernment of value within that particular pattern. This is an intellectual value which is an intellectual phenomenon, created by the human mind. Each value appreciation in turn generates multiple intellectual patterns within the mind of the beholder.

Intellectual lifecycles

Persistent *Intellectual* Lifecycles: Intellectual lifecycles, whose characteristics do not exhibit persistence (An example is Knowledge within an individual, lost when that individual dies).

Persistent *Intellectual* Lifecycles: Intellectual lifecycles, which do exhibit persistence (Culture, Social Norms, Value Systems propagated across generations). This lifecycle does have a networking capacity, not found elsewhere.

This suite of papers suggests that the physical nature of information delivery, as it is currently, falls into the persistent physical lifecycle. They exhibit physical, hierarchical direct properties, which can be augmented by emulating the persistent intellectual lifecycle, using ephemeral, networked indirect properties.

Intellectual reflection

The conscious or subconscious phenomenon found in higher organism's in which an understanding of cause and effect incorporating the concept of time (past, present and future) exists.

Lifecycles: physical and intellectual lifecycles

Within the inorganic world recycling of matter takes place as geological forces constantly form and erode matter. In the organic world, organism's make use of sophisticated reproduction mechanism's to pass characteristics from one generation to the next. Primitive organism's reproduce in an asexual, vegetative manner. Higher organisms reproduce in a sexual manner. Both pass a genetic *pattern* from parent to progeny. This genetic pattern is an example of spatial coherency, *relationships* between groupings of attributes, passing characteristics from parent to progeny.

Intellectual phenomena such as knowledge and cultural values can be described as forms of intellectual spatial coherency. Propagating these intellectual characteristics from one intellectual generation to the next is done through the physical progeny. In other words, the intellectual aspects pass from one generation to the next through a physical individual. Once adulthood has been attained, an individual will be equipped with an intellect borne largely from the intellectual contribution of his parents (amongst others). This is achieved by exposing the child to the intellectual intelligence and active mentorship given by the parent. This retention and propagation of cultural values, knowledge, customs, folklore (intellectual phenomena) are examples of how intellectual phenomena are passed from one intellectual generation to the next, using a physical organism as a link. The behavior of these intellectual phenomena is closely related to Memes, as described by Dawkins.

Material	Physical components constituting physical (corporeal) artifacts. An analogy using an atom is presented for explanatory purposes. Imagine an atom, labeled "A1" with two parts - a single electron labeled "E1", and a single proton labeled "P1". P1 and E1 describe the instances of the physical components constituting the atom, not the atom itself.
Matter	Matter consists of atomic artifacts. In the physical world it is a real tangible artifact. Artifacts can be constituted from groups of smaller artifacts, (the nature of such a relationship is always hierarchical—see later) and be physically related to other artifacts, either directly or indirectly. Matter exhibits a characteristic of persistence—it exists in the past, present and future.
Memes	A term used to refer to any cultural entity such as a song, an idea or a religion
Metaobject	A metaobject is made up using an "intelligent label" referencing pointers to both logic and structure elements, decomposed in both cases to the finest level of granularity)
Metaobjects	Metaobjects can be transient or persistent—transient metaobjects are propagated, manifest and then dissipate. Persistent metaobjects are stored for later retrieval—needed to enable customization.
Need for programming	Intelligence embedded within the label of a metaobject removes the need for programming. Size and complexity of the information requirement are of little or no significance.
Pattern	A pattern is a grouping of relationships, for a particular

	information need. Simple patterns are a form, or a table. Compound patterns will be a homogeneous table form combination (single entity), or a heterogeneous table form combination (one-to-many manifestation)
Patterns	Patterns are relationships, perceived or real, discerned between or within artifacts, abstract or real. Examples are continually perceived—a telephone on a desk identifies two artifacts with a single relationship, a computer screen containing an update transaction has a form with fields, a table with rows and columns, and various buttons. This screen would present a pattern. A transaction displayed as a single form is a simple pattern; a more complex pattern would be when a table and form are linked, the table presenting rows of data, the form presenting detail of the table row for editing.
Physical existence – energy and matter	Existence in the physical sense depends on the presence of energy and matter. Organic and inorganic matter belongs within the domain of physical existence. Energy can also be confirmed as a physical phenomenon.
Physical lifecycles	Apersistent *Physical* Lifecycles: Physical lifecycles, which do not exhibit persistence (for example, a stone. It contains no characteristics that can be inherited by succeeding stone generations). This lifecycle makes use of energy and matter to form an object or artifact, as found within the inorganic environment. No intellectual component is discerned. Persistent *Physical* Lifecycles: Physical lifecycles,

which do exhibit persistence, and have characteristics which can be inherited. Found naturally only in biological organisms. This lifecycle makes use of energy and matter to form the organism, or artifact, and introduces a spatial coherency, the genetic *pattern* which allows the carrying of characteristics (e.g. eye colour) from one physical generation to the next.

Pillars of information

Energy and matter were classified as real physical constructs, and intellect classified as an intellectual construct. Temporal components have similar characteristics to that of energy, in that they can only manifest in the present tense and spatial components similar characteristics to that of matter, in that they are persistent. Temporal and spatial components can both be classified further, having physical and intellectual characteristics:

Temporal components

Physical temporal components

Temporal components within computer applications belong to the physical realm and are made up using 'logic' which is embedded within sequences of program code, ultimately translated or compiled into an executable file. Logic is an energy form, which can only manifest in the present tense (it is embedded directly in persistent artifacts—code, source or binary) and interacts both directly and indirectly with the persistent components constituting the application. Temporal components embedded within computer applications can be readily accessed, by embedding the logic rigidly within physical code using rules of

syntax.

Intellectual temporal components.

Temporal components exist within the intellectual realm—in essence, logic applied during the thinking process as a consequence to intellectual effort is an example of an intellectual temporal component—each absolute logical event takes place singularly. The application of intellectual logic is a high speed, sequential process of the mind.

Spatial components

Physical spatial components

Spatial components in the physical world surround us, and can easily be inspected. A room with a desk and chairs, chairs with legs, a seat and a backrest are examples of physical spatial objects, each spatial object related to the other. A bill of materials presents a hierarchical view of a spatial object, together with its components, each in turn a spatial object. The nature of the relationship between physical spatial objects is hierarchical—this in contrast to the nature of the relationship between intellectual spatial objects (see below), which is networked.

Spatial components within today's computer applications belong in the physical realm and are directly and indirectly related towards the delivery of information. Spatial components, which are directly related, form the persistent structures which describe the information domain, for a particular information requirement. These are the structures and content describing the 'things and the relationships between

these things' which interest the information seeker. Classes within the OO approach rigidly include a name, attributes and operators (Objects instantiated from classes' conjugate physical temporal and spatial components); ER models present relationships which are time independent and not sequences of events which are time dependant. Entity relationship modeling thus provides a pure form of spatial modeling with which to identify the spatial aspects delineating an information need.

Spatial components which are indirectly related and which are persistent are the hardware, facilities, premises and other apparatus required to support the development and operation of a computer application.

Intellectual spatial components

Spatial components which are imagined during the thinking and dreaming process are intellectual or intellectual in nature. Think of lighting a match and the image which springs to mind is that of an intellectual spatial object (the match and the matchbox) and the energy (thinking, logic) applied in envisioning the image equates to the intellectual temporal (logic) component.

Intellectual reflection—understanding 'understanding'—conscious reflection of intellect

Intellectual reflection is an intellectual phenomenon which makes use of intellect to extract and impart value from and into patterns. Intellectual reflection constantly recycles patterns towards the promotion of intellectual objectives. The cycle of intellectual value

	(demand and delivery) is triggered by an initial information thirst, quenched with the supply of patterns satisfying the information need during which the material is intellectually consumed, begetting a new wave of information thirst. This initiates the next cycle.
Spatial objects	'Spatial objects' is a term used to describe a collection of related objects.
Substance	Given there is an atom "A1", and the electron "E1" is replaced with electron "E2", and the proton "P1" subsequently replaced with proton "P2", Atom "A1" appears to be unchanged. The 'Substance: remains unchanged, whereas the "Material" has been swapped. The substance describes the composite atom "P1". The "substance" is different to "Material". (Hartman, 1976).
Temporal	Transitory, temporary, impermanent, intermediate, passing
Understanding physical and intellectual pillars of information	The two physical pillars of information are temporal agents and spatial components. Physical temporal agents and spatial components fall within the realm of the physical world, and can easily be inspected and confirmed—energy of a fire illustrates the presence of energy in its pure form, examining a physical environment will identify the tangible spatial objects and their relationships. Intellectual temporal and spatial components together with intellectual reflection are constructs of intellect, beyond physical science, and are more abstract in nature. They form the foundation for human emotions and feeling. They also are constructs indirectly

delivering information (extracting value from intellectual spatial objects) 'internally' during the thinking process. The intellectual temporal and spatial components are conjured intellectually to form images of the mind—these images form patterns, these in turn are introspectively inspected, and information extracted, immediately consumed, the mental temporal and spatial conjugates within the mind's eye are refreshed, reconsidered, and further refreshment is undertaken. This process proceeds at speed—the speed of thought.

Understanding the difference between the physical and intellectual pillars of information

An understanding of the differences which exist between the physical and intellectual pillars of information enables an insight into how patterns can be presented from which information can be gleaned—this insight allows information delivery mechanisms to be evaluated and measured. Three major differences exist between physical and intellectual pillars:

Network versus Hierarchal relationships

Physical spatial components are hierarchically related to each other—a room can contain a desk, conversely, that same desk cannot contain that room. Intellectual spatial objects are networked—it is easy to imaging a pin within a house, conversely, it is as easy to imagine a house on the head of a pin.

Physical versus Ephemeral

Physical spatial and temporal components are real, and can be touched and felt—they indubitably do exist, and their characteristics can be measured and

described. Intellectual spatial and temporal components are more abstract, for example, when 'imagining an ice cream'; an ice cream image is conjured in the mind's eye of the beholder. Each beholder, however, would conjure a different image. For a shared information need, a similar pattern is required, which is not possible given the subjectivity with which intellectual spatial components are conjured. The images, although ephemeral which are invoked by the beholder are real to that beholder.

Direct versus Indirect

Physical artifacts have a direct 'real' relationship with one another—as previously discussed; a desk drawer is within a desk, a desk is found within a room and so on. Intellectual artifacts can be imagined independently of one another—as one's mind wonders, so intellectual artifacts will be conjured and disregarded.

Virtual components

Virtual components are made up using intelligent metaobjects.

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