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# The Power of Metaphors in Directing ISD Teaching

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## ABSTRACT

Metaphors have a tremendous power to guide our actions. In Information Systems Development (ISD) certain metaphors like Software Engineering has guided our thinking concerning how we practice ISD and also how we teach ISD. The argument of this paper is that if we, as ISD teachers, expand our metaphors of ISD we will be able to think more creatively about how we can teach ISD.

**Keywords:** metaphors, Information Systems Development (ISD) teaching

## I. INTRODUCTION

According to Martínez *et al.,* [2001] researchers and practitioners instinctively make use of metaphorical patterns of thought which persist in their field of study, when they encounter a phenomenon of interest. They describe these metaphors as "*archetypes*" of professional knowledge or as "*blueprints of professional thinking*". These metaphors aid in making us aware of important similarities between entities which otherwise might appear unrelated. Metaphors therefore allow us to see a phenomenon from a specific point of view, but Phillips [in: Martínez *et al.*, 2001] warns that they may also make us unwilling to look for more ample prospects, in that they may "insulate (us) from ideas coming from outside".

Many metaphors from other disciplines are used in the field of information systems. Over the years software engineering, business process reengineering, software architecture and other concepts have drawn from fields such as engineering and architecture [Lee, 1991]. These metaphors have expanded our insights into information systems and have helped us to understand our field better,

but one could also argue that they could lead to unrealistic expectations if not used appropriately, potentially harming the progress we make in our field.

It is important to know that there are implicit worldviews and philosophies behind every metaphor. In this paper we argue that by considering different (more than one) metaphors in ISD teaching, the teacher is forced to re-evaluate the underlying worldviews and philosophies of the metaphors s/he habitually makes use of, enabling him/her to think more creatively about how to teach ISD in a new insightful way.

In the same way Morgan [in: Oates and Fitzgerald, 2007] criticises the sole mechanistic machine-like metaphor, used to describe an organisation in the organisational analysis literature, as being too one-dimensional. He suggests that other metaphors such as organism; brain; culture; political system; psychic prison; flux transformation; and instrument of domination be used in combination to overcome the limitations of applying only a single metaphor.

This paper is explorative in nature and will only introduce the concept of metaphoric usage in ISD teaching; more work needs to be done to make the introduced concepts useful and viable on a practical level.

## II. METAPHOR THEORY

Metaphors are used in teaching as a way of making unfamiliar concepts familiar; they assist students to understand new concepts by connecting the new to the known [Sanders and Sanders, 1984], or as Lakoff and Johnson [1980: 5] put it, metaphors are used to "*understand and experience one kind of thing in terms of another*". According to Oates and Fitzgerald [2007] metaphors "*enable us to take a 'short cut' to knowledge by building on what we already know*." In the light of these references, the emphasis of this paper is on how metaphors could be used by ISD teachers to improve their teaching.

In their book *Metaphors we live by*, Lakoff and Johnson [1980: 11] explain that metaphors are part of the human thought process. Each metaphor represents a principle "*metaphorical concept*" that enlightens our world view. According to Aristotle [in: Stevenson, 2007], metaphors "*convey their information to us as soon as*

*we hear them*". They are therefore fundamental in meaning making, and provide the hearer with new perceptions on a known situation.

Metaphors can help teachers to get distance from their own practice and allow them to "*act almost as an external observer looking upon and reflecting upon their own practice*" [Leavy *et. al.*, 2007: 1220]. Considering alternative metaphors can therefore help teachers to examine their own assumptions.

Leavy *et al.* [2007] propose that student teachers develop metaphors in order to examine, critique and modify their own beliefs about teaching and learning. In the same way ISD teachers could develop these to study, evaluate and adjust their beliefs about ISD.

As mentioned before, it is important for teachers to take note that metaphors are not always positive. They both disclose and hide or even lie [Stevenson, 2007]; they can constrain our conceptual frameworks [Phillips, in: Leavy *et al.*, 2007]; they have strengths, but also limitations; they create ways of seeing, but also ways of not seeing and no single metaphor will provide an "*all-purpose point of view*" [Morgan, in: Leavy *et al.*, 2007: 1221]; each metaphor "*highlights a particular way of seeing … but offers a partial view because it does not include the ways of seeing provided by the other metaphors*" [Morgan, in: Oates and Fitzgerald, 2007].

Metaphors can be used either in an inductive or a deductive way [Oates and Fitzgerald, 2007]. In the former approach teachers will try and determine the underlying metaphors which they are already using and which already influence their thinking and actions. In the deductive approach the teacher will come up with a metaphor and apply it to a specific phenomenon to see what it could offer that might be of use. In this paper we will make use of the latter approach.

## ROOT-METAPHORS

When setting up conceptual metaphors for understanding ISD, it is important to base these on "*basic conventional metaphors*" [Oates and Fitzgerald, 2007]. Kilbourn and Álvarez [2008] use a framework by Steven Pepper that describes six so-called root-metaphors. According to Pepper most ways of human sense making of experience stems from only a few "*traditional philosophies*". These root-metaphors have been so "*intellectually productive*" that they have given birth to

complete philosophical systems [Pepper: in Kilbourn and Álvarez, 2008]. They encapsulate how people in history have created meaning.

These root-metaphors are:

- **Formism:** emphasising the grouping of things into similar categories. Fundamental concepts are similarity, form, class, groups, habits, patterns and norms.
- **Contextualism:** emphasising the quality of experiencing a thing within a specific context. Fundamental concepts are change, relativity and wholes.
- **Mechanism:** emphasising the workings of things as if they are machines. Fundamental concepts are parts, quantity, causality and efficiency.
- **Organicism:** emphasising the integration of things. Fundamental concepts are integration, unity, synthesis and coherence.
- **Animism:** emphasising the certainty of authority (mostly of a deity). Fundamental concepts are power, spirit, certainty, control and hierarchy.
- **Mysticism:** emphasising the certainty of intuition. Fundamental concepts are love, peace and unity.

As these root-metaphors are "*metaphysical orientations*" and are therefore very fundamental, ISD teachers might find it difficult to attach meaning to them. According to Morgan [in: Oates and Fitzgerald, 2007] it is "*important that a metaphor has 'resonance' for individuals, enabling them to link two things together in a meaningful way, which could produce new insights*." For this reason the authors have come up with the following more conceptual metaphors to represent each of the root-metaphors: They are:

- **For Formism:** the Library, because it is fundamentally concerned with the categorising, storing and retrieving of information.
- **For Contextualism:** Town planning, because its main purpose is to provide a living context (plots, roads, electricity, water, etc.) for people.
- **For Mechanism:** Engineering, because engineering is primarily concerned with developing functional working artefacts.
- **For Organicism:** Architecture, because good architecture, over and above its functional purpose, aims to provide an anaesthetically pleasing and integrated living/working unit.
- **Animism:** an Army, because it requires unquestioning obedience, as if from a deity, from its followers in a very controlled command hierarchy.
- **Mysticism:** the Family, because it represents an environment which provides love peace and unity to all its members.

Each of these metaphors will be described in more detail in the sections to come.

## The Library Metaphor

A library is a place where a specific entity, namely information, is managed. One of the defining features of a library is the systematic way in which everything is stored. Using the Dewey classification system, every informational object (book, record, CD, magazine, etc.) is stored in a specific place. Linked to this are various indexing systems specifying where specific informational objects are kept. This is done to ensure that a specific informational object can be found easily (or it can be shown as unavailable and not in the library at all).

The main functions in a library are: (1) the acquisitioning of new informational objects within the given budget, based on the library users' requirements, and the library's policy and standards; (2) the classification, identification, indexing and storing of informational objects; (3) the facilitation of the process of a user taking out and returning informational objects; (4) help in the use of the library, especially in searching for specific information; and (5) providing general informational and training functions, like presenting pottery classes, etc.

Using this metaphor an information system could be seen as a library and the process of ISD as acquiring, managing and distributing the information necessary to develop the information system.

## The Town Planning Metaphor

Taylor [1999] looks at the two major shifts that have taken place in town planning theory since the end of the Second World War in mainly Britain and North America. This divides the thinking concerning town planning up to the present time into three phases.

The first phase, the physicalist, design-based view, is the twenty years from World War II until the 1960s. During this phase town planning was seen as physical design carried out by trained architects. Town planning and architecture were not distinguished, except in scale (town building and individual building). Because of this, town planning was viewed as an "art" (accommodating functional requirements) and aesthetic considerations were regarded as central.

The second phase, the systems and rational process view, started in the 1960s. This view contains two distinct theories. The systems view was concerned

with the object of planning, namely, the town, which it considered to be a system. The rational process view was concerned with the process of planning and the making of the rational decisions itself.

Although the two views differed fundamentally, they both agreed on the role of the town planner. Both saw the town planner having specialist knowledge and skills, which the layperson did not have, qualifying him/her to plan.

In the third phase, this later view was challenged when it was realised that town-planning judgments were fundamentally political value judgements and not purely scientific judgements on which environments to create. This, as well as the actual experience of town planning during the 1960s, raised the question whether planners had greater "*specialist*" abilities to make these judgements than the layperson.

Based on this a division in planning theory took place which, according to Taylor [*op. cit.*], still persists today. On the one hand, town planning is seen as needing specialist knowledge and skills. On the other hand, town planning is seen as value-laden and political, and therefore involves no specialist knowledge or skills. A third view is also taken which sees planners having no special expertise in making value judgements but having specialist skills in managing the planning process. This involves inter alia, facilitating, mediating between different interest groups, managing the process, communication, negotiation, listening and counselling.

Jarvis [1995] challenges and provokes the town planning community to go back to four "*ancient magic arts*": rhetoric, mythology, draughtsmanship and choreography. These areas can be applied similarly to information systems.

He postulates that instead of just seeing communication as something in planning, planning must be rooted in the arts of rhetoric. He hopes that planners will expand their current expertise in persuasion to include an eloquence that sings as well.

He feels that despite claims of rationality and systematic thought, planning is "*… itself an elaborate and complex myth, predicated on simplifications, definitions, predictions and controls that sustain its apparent logic and variable success. Planning is one of the legends we have created to understand a reality that is too*

*complex for human understanding …*". He therefore sees a need to be aware of the mythic dimensions of the town planner's role in society.

According to Jarvis [*op. cit.*], planners still expect graphic competency and literacy in graduates, but these skills are marginalized in education planning. Although many planners belittle drawing as inferior to planning, he sees drawing as an important process of recording information and ideas.

He finally links choreography, the art that deals with issues of time and space, and things and people with planning.

In comparison to architecture, town planning is concerned with towns, it is planning-oriented, state-driven and of a relative long-term nature.

While architecture looks at the design of a single house or building, town planning looks at the interrelationship between many houses and buildings. In a similar way town planning is related to enterprise architecture which tries to describe and manage the interrelationships between all the different parts of an organisation, especially the information, information system and information technology components.

This view emphasises that the development of an information system is influenced by and influences many other aspects of the organisation, implying that a system cannot be developed in isolation.

## The Engineering Metaphor

An engineering construct, such as a bridge or a dam, provides a needed service in a community. Engineering is the rigorous process of providing such engineering constructs effectively and efficiently.

One of the defining features of engineering is the professional approach taken by the people involved. Somebody can only be considered a professional engineer after they have completed an extensive training and apprenticeship programme.

Another defining feature of engineering is the positivistic approach followed, where everything must be quantified and measured; where the technical aspects of the engineering are supreme and the social aspects at most secondary; and where possible all decisions are determined by a formula or procedure.

The engineering metaphor has been dominating the field of IS for many years. The term software engineering was first used in 1968. The IEEE Computer Society defines software engineering as "*The application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the application of engineering to software.*" [SWEBOK, 2004]

One of the issues of importance to software engineering organisations is to make it a recognised profession. It involves three claims: (1) professionals' knowledge and competence are validated by a community of peers; (2) this knowledge is validated consensually and based on scientific and rational grounds; and (3) the professional's opinion and guidance are directed towards a group of values. An engineering profession is characterised by the following components: professional education in an accredited curriculum; certification of professionals; continuing skills development and education; a professional society; and a code of ethics [SWEBOK, 2004].

## The Architecture Metaphor

A house or other building is a place where people live, work, study or play. Architecture is the process of designing houses to be both functional and aesthetically pleasing.

One of the defining features of architecture is the balance between form and function, where beauty is as important as mathematical exactness.

The similarities between the information systems environment and the built environment are obvious. The parallels between architecture and information systems have been studied in detail by various authors. Lee [1991] describes architecture as a reference discipline for MIS because both are design fields, both involve designers and users and both use technology to create an artifact to serve users.

There is no clear definition of what information system architecture (or software architecture) is. Zachman [1999] confirms this, "*Unfortunately, among the proponents of information systems architecture, there seems to be little consistency in concepts or in specifications of "architecture", to the extent that the words 'information systems architecture' are already losing their meaning!*" Other literature

sources also illustrate the confusion. In studying them it becomes clear that by the one term two distinct concepts are meant.

The first set of definitions relates system (or information, or software) architecture to a single system in an organization. It sees system architecture as the structure of a single system and the task of the architect as choosing the correct style for the information system.

Garlan and Shaw [1994] in a paper called *An Introduction to Software Architecture* defines software architecture as follows: "*… treat an architecture of a specific system as a collection of … components … together with a description of the interactions between these components …*". They further define an architectural style as the structural pattern of the system in terms of components, connectors and constraints. Typical styles are: client-server model, abstraction layering, object-oriented, etc. According to them the reason for the emergence of the field of systems architecture is the increase in complexity of software systems, which causes the design problem to go beyond algorithms to structure.

John and Bass [2001] define the software architecture of a system as the structure/s of the system consisting of software components, the externally visible properties of those components and the relationships among them.

The next set of definitions see, in contrast to the above definitions, system architecture as related to the overall relationships between all the systems of an organization.

According to Carter [1999] information architecture, "*… is the collective term used to describe the various components of the overall information infrastructure which take the business model and the component business processes and deliver information systems that support and deliver it.*" It has the following major architectural components: data, systems and computer architecture.

For him, information architecture is the collective term for the various components of the overall information infrastructure based on the business model and processes to deliver information systems to support and deliver it. Information architecture is dependent on and driven by business vision and strategy, which help to reconcile resource conflicts and differing priorities.

Lee and Kim [1996] define information systems architecture as the high-level description of the types of information needed by an organization and how it should be processed. It is in the formal blueprint of the organizations information needs.

Zachman [1999] describes the architectural approach by considering the deliverables or work product of a classical architect. He believes that it "*… can lead to the specification of analogous information systems architectural products and, in so doing, can help to classify our concepts and specifications*."

He examines the various deliverables produced by a classical architect in the process of constructing a building.

- The **conceptual representation** depicts in broad terms, the size, shape, spatial relationships and basic intent of the final structure. This is based on the initial conversations between the architect and prospective owner.
- The **architect's drawings** are the translation of the owner's requirements. It includes floor plans, cutaways and graphic representations of the final structure. These drawings are modified until the owner is satisfied.
- The **architect's plans** are the translation of the owner's requirements into a representation of the final product. It puts an explicit specification around the material composition of the final product. It is used as a basis for negotiation with sub-contractors.
- The **contractor's plans** represent the builder's perspective taking into account technological and complexity issues.
- The **shop plans** are drawings of subsections that will be manufactured or assembled.
- The **building** is the final deliverable.

Zachman [*op. cit.*] states that the above set of "*architectures*" may be generic to the building of any complex engineering product. In his paper he does a cursory examination of military airframe manufacturing to prove this point. This strengthens the argument that an analogous set of architectural representations is likely to be produced during the process of building an information system.

Zachman [*op. cit.*] further observes three fundamental architectural representations, one for each role player, namely, the owner, the designer and the builder. The owner envisages a product that will serve some purpose. The architect translates the owner's idea into a representation of the physical product. The builder then creates the physical product within the constraints of technology and laws of nature.

The nature of these architectural representations is different nature from one another. They don't merely display more detail than the previous level. Level of detail is an independent variable, varying within any one architectural representation.

Zachman [*op. cit.*] further sees different types of descriptions for the same product. For instance, descriptions oriented to the material of the product, to its function and to the relative location of its components. Although they describe the same product, they are each unique, serve different purposes and none of the descriptions says anything about what the other descriptions are saying.

In summary, it can be stated that architecture is concerned with individual buildings, is design-oriented, customer-driven and of a relative short-term nature.

## The Army Metaphor

The army is a place where human and other resources are brought together to achieve the goal of defending or attacking a country or other grouping.

One of the defining features of an army is discipline and authority. It has many checks-and-balances and controls in place. Everybody has a clear role and responsibility.

To become a member of the army you first have to pass a rigorous "*basic training*" programme that is as much a skills transfers exercise as it is a disciplining and initiation programme.

If we apply this metaphor directly, saying an information system is an army, without understanding that an information system is more than the hardware and software, the metaphor does not yield much. But, seeing everybody involved with the development of an information system as an army, yields a lot. The function of developing an information system can be seen as creating a defence or an offence in the ongoing war the organisation is in. This "*war*" can be against external competitive forces, external security threats or even internal inefficiencies.

The developed system either helps the users to protect themselves and the organisations as a whole from enemy attack or to help them to attack the "*enemy*" in an improved way.

### The Family Metaphor

The family is a place where couples put their resources together to become, for all practical purposes, a single unit. In most cases a family also raise children, taking them from dependence to independence.

The main function of a family is to provide in all the physical and emotional needs (food, shelter, security and love) of the family members.

One of the defining features of a family (or at least a well-functioning one) is unconditional love for all members, especially for the children. Families also provide care for those members that can not care for themselves, like the elderly, the disabled and the sick.

In a similar way than the army metaphor, the family metaphor is applied to the whole information system, including the humans involved with it. The need for information and for determining your own future requirements can be seen as a basic need of the system users that has to be adhered to. The ISD "*experts*" can be seen as the parents in the relationship, providing for these needs.

Instead of looking down on the users for their lack of technical knowledge, the "parents" will try and get their "children" from dependence to independence.

These principles can also be applied by senior ISD people using on-the-job training to train and grow the juniors. It is also applicable from the users' side, with the users being the "*parents*", teaching the ISD "*experts*" the intricacies of their field.

## IV. ISD TEACHING INSIGHTS THAT CAN BE LEARNED FROM THE PROPOSED METAPHORS

### THE LIBRARY METAPHOR

In the engineering and even in the architecture approach more emphasis is placed on developing systems from scratch, e.g. an engineer would mostly focus on building a new bridge and an architect on designing a new building. Adding to or adjusting an existing bridge or building is not the primary focus of these disciplines, and would rather be considered as maintenance. The first insight that ISD could gain from applying the library metaphor, emphasises the possibility of

acquiring/identifying “a library of” already existing similar or even identical systems or functional components of systems, which could be combined into a totally new functional system, or which could be modified to fit into a new system. An example of this is choosing, adjusting or modifying certain already existing ERP modules to fit the requirements of a specific organisation. Our ISD curriculum should therefore not only include methodologies for ISD from scratch, but it should also incorporate alternatives such as buying off the shelf and modifying/adjusting according to business requirements.

This relates well to the problem of recreating or acquiring a software component for which the functionality might already exist. Following on the library metaphor, one could keep strict control of all available software components, categorised according to different criteria, such as programming language, functionality, etc., as is the case in a library. This could lead to less duplication of software resulting in minimised waste.

Secondly, in the engineering approach, the user is considered to be of less importance as engineers regard themselves as experts who know what would be the best for the users of their artefacts. The library approach teaches us that a library could only be flourishing if it is abundantly used by its users, and this will only happen if the library is stocked with the newest and best informational objects covering the interest of all its users; and if users find it easy to acquire what they are looking for (i.e. with the least effort).

From an ISD teaching perspective the library metaphor would therefore emphasise the fundamental purpose of information systems to provide information in a meaningful way and the fundamental importance of determining the users’ requirements for the information system. Much more effort should therefore be spent on teaching students what a good requirement is; how to formulate unambiguous requirements; where to look for and who to ask for business requirements; etc., resulting in more user centred ISD.

## THE TOWN PLANNING METAPHOR

The first insight that the ISD teacher can gain form the town planning metaphor, is that everything is interrelated and that a system should be designed and developed in context. The system’s context can include political issues,

government regulations, industry trends, existing technical infrastructure, international standards and ISD team limitations. The town panning field has exhibited a similar history to that of ISD, moving from a purely functionalist emphasis to a more political, social one.

Secondly, the four "ancient magic arts" as proposed by Jarvis [1995] can also shed light on ISD teaching. Rhetoric shows the importance of communication in the process of developing information systems. Mythology warns against the mythic proportions that certain aspects of ISD has achieved without any rational evidence. For instance, in spite of all the methodologies in place, IS projects are still failing on a massive scale, causing authors like Introna [1996] and Nandhakumar and Avison [1999] to talk about the fiction of methodological development. Draughtsmanship shows the importance of the visual elements in designing systems, while Choreography again emphasises the interrelatedness of all things, but this time from the perspective of time and space.

## THE ENGINEERING METAPHOR

Most of the insights in the field of ISD have been gained from the engineering metaphor, but the one which we could still strive for is the pursuit of professionalism. The field of ISD is "*plagued*" by fly-by-night consultants normally fixated on the current fad without understanding the deeper implications of it. Imagine the tremendous advancement of our field if we can establish professional mechanisms. The authors, though, believe that higher education institutions can still teach their students the ethics of professionalism, even without a formalised professional body.

## THE ARCHITECTURE METAPHOR

There are a number of insights that ISD trainers can gain from the Architecture metaphor. Firstly, unlike most of the professional disciplines like Engineering, Architecture and Chartered Accounting, the ISD discipline does not have clearly defined roles. Role definitions are vague and any person can call himself, for instance, a "Business Analyst", "Programmer" or "Web designer". A related issue is that it is possible to be promoted from one role to another without any formal training or evaluation process. Many good programmers have become systems analysts after a number of years' experience, without any other accreditation or evaluation.

ISD training, especially on tertiary level, needs to have the right balance between general and specific role-based training.

Secondly, the architecture metaphor emphasis that ISD is multi-disciplinary and cannot be taught from only one perspective (in most cases the technical perspective). ISD also involves political, social, financial, organisational, managerial, as well as many other perspectives.

## THE ARMY METAPHOR

There are a number of insights that ISD trainers can gain from the Army metaphor. Firstly, ISD must not be seen as an end in itself, but as a means to a greater end, normally on an organisational level. Many ICT people have an inflated view of their own importance, not realising that they are servicing the rest of the organisation. This service orientation should be instilled in ISD students.

Secondly, the ISD field cannot be as undisciplined as it has been in the past. There is a world-wide trend to more control, especially in information systems, and this shift in thinking should be instilled in our students. This implies, among other things, that frameworks and standards like ITIL, COBIT, CMMI, and TOGAF will form a bigger part of the curricula in the future.

It is interesting to note that most universities already have a final year ISD project that is very similar to the basic training exercise in the army. Students are placed in a position close to real-life, with difficult deadlines and other constraints and limitations.

## THE FAMILY METAPHOR

There are a number of insights that ISD trainers can gain from the Family metaphor. Firstly, in this view the whole task of developing a system is not only seen as producing deliverables, as in the engineering metaphor, but as the growing, nurturing and training all of the people involved in it. The ISD field is very complicated and because of its multi-disciplinary nature it is not easy to learn. Apprenticeships, learner ships and mentoring programmes should be considered to add to the needed practical experience that the employers of our students require. This is especially important in the light of the current demand for ICT graduates.

Secondly, this approach can also address the issues of ethics in ISD. In the engineering approach efficiency and effectiveness is important but ethics is mostly neglected. If everybody concerned with ISD is seen as part of a family, design will be done in such a way as to not hurt any of the members of the family. This includes not justifying the cost of the system in terms of retrenchments and not creating systems that demean the user's job.

Thirdly, like parents, our job entails more than just teaching specific skills. Our teaching task also involves linking students to jobs that fit their personalities, background and abilities. More emphasis could be placed on providing students with "softer, cross-over" skills like communication, interpersonal relationships, negotiation and time-management.

## V. CONCLUSION

In this paper the importance of using more than one metaphor in ISD training is emphasised. This is to overcome the intrinsic problem with metaphors where an obvious fact is obscured by the limitations of the metaphor.

The root-metaphors of Pepper [in: Kilbourn and Álvarez, 2008] were used to provide a solid basis for choosing more accessible metaphors. These root metaphors, their corresponding more accessible metaphors and the fundamental insights that can be gained from them are:

- **For Formism:** the Library metaphor emphasises the need for the categorisation and organisation of ISD artefacts.
- **For Contextualism:** the Town Planning metaphor emphasises the need to always consider the bigger context.
- **For Mechanism:** the Engineering metaphor emphasises the need to create functional, working information system.
- **For Organicism:** the Architecture metaphor emphasises the integrated, multi-disciplinary nature of information systems.
- **Animism:** the Army metaphor emphasises the service orientation of ISD and doing things for the greater good.
- **Mysticism:** the Family metaphor emphasises the need to not only teach students but to also nurture them into their eventual careers.

The metaphors were used to shed some new light on the field of ISD. These insights can be used to teach ISD in a richer and more holistic way, emphasising not only technical issues, but also organisational, social, political and ethical issues.

## VI. REFERENCES

*Editor's Note:* The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that
1. these links existed as of the date of publication but are not guaranteed to be working thereafter.
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