Towards a Human Oriented Approach to Information Systems Development

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Abstract. Current approaches to information systems (IS) are roughly based on technical, scientific or formal aspects which miss the human nature of IS or, otherwise in organisational and social aspects highlighting the human but missing concrete implementations. This result too often in IS failures. We think the problem relies in an inadequate paradigm to deal with the human element and we propose a new philosophical stance – human relativism – to overcome the problems felt. This new approach will lead to a new way of developing IS that will be human centred. In this sense we propose also as a possible way to apply this new paradigm a human action oriented perspective that could be used for information systems development. Therefore, human-action is analysed as well and a comprehensive multi-dimensional holistic view of it is given, followed by a particular choice of a selected group of dimensions suggested for use in information system development according to human relativism.

Keywords. Information systems, Information systems development, Information systems approaches and paradigms, Human-centred information systems, Human relativism.

1 Introduction

Nowadays computerised information systems are increasingly integrating all kinds of business and organisations and becoming an essential element of modern societies. In order to develop these systems the information system development (ISD) field proposes different methodologies, methods and techniques with the goal of providing processes and information to organisations and their members by using information and communication technologies. Most of the methodologies in ISD are originated from computer science and software engineering and are technically oriented emphasizing computer and formal aspects of IS. In this sense they are commonly grouped and known as "hard approaches" to ISD [1]. On the other hand there is another group of methodologies known as "soft approaches" that intend to highlight the social and organisational aspects of ISD by giving the primary role to humans. These methodologies can also be called socio-technical approaches to ISD although these last terms are usually connoted to the ETHICS methodology [2] in particular. A

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problem that has been around ISD for a long time is that of information systems (IS) failure (see [3] for an overview). Many developed IS and computer systems in particular fail to meet their goals by taking too much time to develop, to be over budget, to be unreliable, to provoke user dissatisfaction, to not meet the requirements, to be difficult to maintain, etc. In spite the many existent methodologies none of them has proof effectiveness to avoid failures. In fact soft approaches were mainly attempts to overcome the problems felt with the dominant technical approaches that forget the human nature of IS understood as the main reason for failure. The inability of handling the human factor, many times ignored by traditional technical methodologies is in our opinion the relevant reason for most failures. Scientific and objective methods are effective in many domains where predictability, repetitiveness, and stability are present but fail in IS where unpredictable, unique and variable human behaviour is mixed with technical computer systems. The picture today is that "hard approaches" to ISD are still dominant and "soft approaches" that promised to develop better systems didn't achieve the desired acceptance and adoption. We think that the problems felt are originated at higher levels, namely the guiding paradigms of both approaches and we propose a new way of looking to information systems and perhaps to technology in general whenever human behaviour is present that is supported by a new philosophical stance – Human Relativism - that takes the human as the central element. This stance originates a new approach to ISD that is human-oriented and seeks to acknowledge properly the role of humans in IS and ISD.

This paper is organised as follows: section 2 presents most common philosophical stances in IS, section 3 criticises the use of these philosophical stances in ISD and proposes a new philosophical stance for IS: Human Relativism. In section 4 it is shown how we may apply in practice this new paradigm and move towards real human-oriented IS. Section 5 presents related work and, finally, section 6 presents the conclusions and the work being done and planned.

2 Philosophical Basis of Information Systems

2.1 The Nature of Information

The concept of information is at the core of information systems. It is symptomatic to find that this concept has many different meanings within the IS community. For example:

"*Is data that has been processed or interpreted within a particular context to inform or reduce uncertainty*" [4].

"*A collection of symbols which has the potential to alter the cognitive state of a decision maker*" [5].

"*What remains after one abstracts from the material aspects of physical reality*" [6].

"*A numerical measure of the uncertainty of an outcome*" [7].

"*Is the meaning someone assigns to data*" [8].

Besides information there are many other terms that are not clearly defined and generally understood. Key terms like knowledge, communication, meaning, truth,

etc., may have different interpretations for different groups of people. The relative importance of this subject matter is recognized by the International Federation for Information Processing (IFIP) and particularly the FRISCO task group within work group 8.1 on Design and Evaluation of Information Systems that declared in their manifesto (cited in [9]):

"*There is a growing concern within IFIP WG 8.1 about the present situation, where too many fuzzy or ill-defined concepts are used in the information system area. Scientific as well as practice-related communication is severely distorted and hampered, due to this fuzziness and due to the frequent situation that different communication partners associate different meanings with one and the same term. There is no commonly accepted conceptual reference and terminology, to be applied for defining or explaining existing or new concepts for information systems*".

This difficulty to clearly define some important terms should be emphasized as it is fundamental for the understanding, application and evolution of a successful methodology in IS development. We need to understand the problems and difficulties that prevent us to define a precise and consensual vocabulary needed to support and ground any methodology. There is a close relationship between information and reality or, in other words, ontology. Ontology, epistemology and other underlying paradigms usually followed by the different IS approaches will be analysed next

2.2 Typical Information Systems Philosophical Stances

Hard approaches to ISD are many times connoted with an objectivist view of the world where reality exists independent of the human being, his perception or his consciousness. This real world is populated with objects, facts, allowing everyone to discover them and check their validity or truth. Creating a model of this world is straight forward implying the creation of a simple mapping connecting concepts to real things. This is the world of natural sciences where the laws of nature rules the world and all the happenings can be scientifically explained, predicted and governed by a general theory. Related philosophical stances include realism from ontology, and positivism from epistemology.

Within Information Systems, many researchers, especially those connected with the soft approaches don't feel comfortable with this objectivistic view. Whenever people are involved objectivity seems to be lost. Human concerns such as goals, intentions, commitments, responsibilities, values, attitudes and many others cannot be clearly identified, defined or represented. Existence is not just a true/false question and involves human interpretation, judgement and negotiation. Human behaviour cannot be accurately predicted. For these researchers, a better perspective should be intrinsically social and, according to them, the best philosophical stance is the constructivist view. For constructivists reality and knowledge are socially constructed. Individuals take the leading role in actively constructing reality rather than passively acquiring it from the environment. In this process previous experience and knowledge are essential means for creating new knowledge. Constructivists don't deny completely an objective reality but assume the existence of different personal realities from which it won't be possible to be sure about the existence of an independent reality. This view seems appropriate because important elements of human

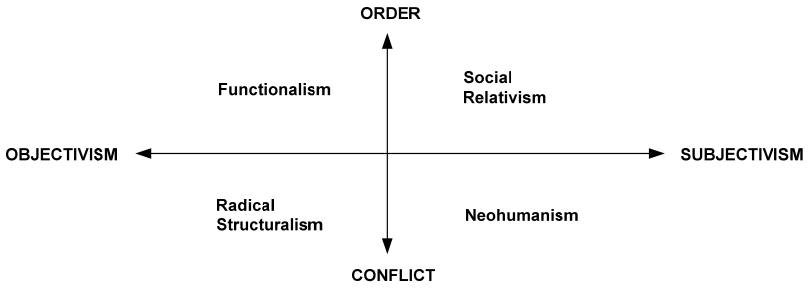

Fig. 1. Information System Development Paradigms (**[10]**).

information systems such as meanings, commitments, goals, and many others are understood as social achievements submitted to negotiation and acceptance. Constructivism can also be related to subjectivism which delegate the primacy to the subjective experiences and reality is seem as created by perception.

Other philosophical stances appear in the IS literature, an example is [10], [11] that proposed four paradigms for IS development. These paradigms were obtained by splitting a plane in two dimensions: an objectivist-subjectivist dimension and an order-conflict dimension (Figure 1). The first dimension deals with an objectivist view of the world from which models and methods of natural science were applied to the study of human affairs and an opposite subjectivist view which is concerned to understand the basis of human life from the subjective experience of individuals. In the second dimension the opposite views are, first an order or integrationist view emphasizing a social world characterized by order, stability, integration, consensus and functional coordination and second, a conflict or coercion view stressing change, conflict, disintegration, and coercion [11]. The resulting four divisions are related to four different paradigms namely: Functionalism, Social Relativism, Radical Structuralism and Neohumanism. Each of these paradigms has an embedded philosophical stance about knowledge (Epistemic) and existence (Ontological). The philosophical stances for each paradigm are shown in Table 1.

Table 1. Philosophical stances of the 4-paradigm for ISD from Hirschheim and Klein.

Paradigm	Epistemic stance	Ontological stance
Functionalism	Positivism	Realism
Social Relativism	Anti-positivism	Social Constructivism
Radical Structuralism	Positivism/materialism	Realism
Neohumanism	Positivism (in technical control) and anti-positivism (in mutual understanding and emancipation)	Realism (technical interests) and Social Constructivism (mutual understanding and emancipation)

3 A New Paradigm for Information Systems – Human Relativism

3.1 Issues in Common Information Systems Philosophical Stances

All philosophical stances presented in the previous section have their own 'truth' and all of them are defendable and useful in different situations.

The objectivist view proofed to be useful to science and technology in which theories and knowledge obtained from the analysis of an objective reality permit to explain and predict that reality in many useful ways. It should be noted that the elements analysed by science usually exhibit a repetitive, reproducible and/or predictable behaviour that can be observed and stated with accuracy without ambiguity or differences in interpretation. This is not usually the case in organizations where there are many elements that cannot be easily predicted (such as human behaviour) or stated clearly (such as information). In fact elements like human behaviour are highly dependent on individuals, on their knowledge, experience, mood, values. Also information expressed by language and all the terms used to represent and communicate the organizational reality are not possible to state accurately and are dependent on individual perceptions, interpretations, knowledge, judgement, experience, etc. This information and interpretation dependence on individuals can be seen as another form of dependency on human behaviour. Humans are responsible for the perception, interpretation and communication processes. Any misunderstandings occurring between humans are relative to them and are part of their behaviour. Constructivism acknowledges these evidences and is supposed to deal with this social and human dependence by adopting a view of an organizational shared reality in constant construction by its members where meanings came from negotiation and agreement. Although a better approach, constructivism is again difficult to apply, the dependence on each situation and the myriad of possible interpretations and behaviours makes it too hard to generalize, to define or to create reproducible and applicable theories. Moreover, constructivism misses the rigor of science to deal with the predictable and precise aspects of the organizational reality. To overcome these problems a new philosophical stance is needed.

3.2 Human Relativism

In this paper we propose a new philosophical stance – human relativism – with the goal of giving a different perspective of the world by acknowledging the power of the different views described before and by permitting to use formal methods and theories without the errors and assumptions of most objectivist stances.

One fundamental problem with all previous approaches is the unpredictable behaviour usually originated or related to the human element. This behaviour includes most inter subjective experiences such as interpretation, knowledge, beliefs, intentions, values, etc, which stand hidden from our senses. Scientific methods and objectivism are unable to deal with human behaviour in general; it is not possible to reproduce or predict things like interpretation or understanding or to regulate mechanically human actions. These are heavily human dependent. On the other hand IS reality, according to the adopted perspective is essentially human centred.

Everything an organization is or does is for people through people. Therefore using scientific methods in organizational activities seems to be wrong. But, a nearer look will show us that all human kind and their achievements also live in organizational structures and may be seen from an IS perspective. Even in science itself we acknowledge the presence of individuals and organizations behind all scientific discovers and theories. This increases the importance of a successful IS modelling and development. But, a question remains, how can we take advantage of the power and success of scientific and technical approaches in the IS field? The solution, seems to be first to acknowledge the human centeredness and its unpredictable behaviour. Human relativism recognizes this human centrality in all human activities by acknowledging an objective reality as human relative. There are many evidences of this human relative view even in objectivitism. As an example everything we see using our eyes, according to science and to our experience and beliefs, is particular to human kind. Our vision is limited to a range of frequencies from the electromagnetic spectrum denominated the visible spectrum. Science gave us the possibility to see images translated from different ranges of frequencies such as infrareds. The visible images transformed from infrareds into the visible spectrum allow us to experience a different reality where human bodies cannot be easily separated from the environment, because there are no clear boundaries. However, this reality is in fact seen and experienced by some animal species as science proofs. In this sense we may question ourselves, which is the real reality, the reality we observe with our vision or the reality observed using, for instance, the infrared spectrum? Or, are they different views of the same reality? There is no claim in human relativism that the reality we see is the real reality, neither an explanation nor sense of what a real reality is. The solution is more a practical solution – this is the reality we have, we experience and we share. By assuming the human at the centre we also assume and accept his view as bounded, focused and particular.

Besides persons, IS and organisations also includes information and this is once again human related. Information is extracted by humans from the reality using perception and interpretation processes. The distinction between perceptions, the process of acknowledging the external reality through our senses, and interpretation, the meaning making process, is a useful way to help understanding the nature of information and its acquisition process. Only information goes through an interpretation process, the other elements of the (human) reality are just perceived. In fact, perception filters part of the human reality accessible to a particular individual.

To perceive does not mean to interpret and this separation allow us to understand what is observable. Usually, **observability** concerns what we think a human being is able to percept or to acquire through his senses. This excludes the interpretation process and information as well. Usually information is not observable but it can be extracted from observable things. Observable things can be viewed as material or physical things from the objectivist view. As an example happiness is not an observable thing although it may be expressed by a smile, an observable thing itself. On the other hand we cannot derive happiness from a simple smile in a general way. This will be subjected to interpretation and may have different results depending on people. This leads to the problem of divergent interpretations, one of the most fundamental problems of IS, that is in the basis of the difficulties of applying scientific approaches to IS. To solve this ambiguity or meaning problem the

observability concept described is a first step to reach consensus. So, human relativism makes the following assumption:

Assumption: ***Anything that is observable will be more appropriate to be used by scientific methods.***

Nevertheless we need a second step to recognize the elements that can be used without problems by scientific methods. The notion of **precision** in Human Relativism will deal with this issue.

To achieve a high degree of precision we need to remove ambiguities and different meanings from any term or information making it generally accepted, recognized and shared. This doesn't mean to make everyone agree on it based on negotiation as in the case of constructivism. The solution goes by adopting a kind of operational meaning or human observable independence that makes it clear and precise. Human observable independence is achieved if everyone is able to interpret in the (apparently) same way. It may be necessary to have previous knowledge to reach this shared and accepted interpretation. One way of achieving precision is by using physical measurement. It is simple to say (to be precise) if a specific string has or hasn't one meter of length. Some people could argue about this but without relevance for scientific purposes where it would be used without ambiguities in some technical system.

If it would be possible to measure the precision degree of each term we would be able to assign each term a different value. Surely the elements analysed and used by science, the physical things less correlated with human interpretation would achieve a higher precision value. Concepts are generally difficult to be precise; they are the result of human creation and therefore much human dependent. Therefore they have to be treated with special attention in order to make them or to select them as precise as possible.

The Human Relativistic Hypothesis is:

By adopting high precision observable elements under a human relativistic view it may be possible to derive a scientific and theoretical well founded approach to IS.

A second hypothesis to be drawn is that:

The human behaviour problem in IS (or in other fields) can be overtaken in technical approaches if it is recognized clearly.

Finally, a last hypothesis is:

We may freely apply technical approaches if there is no unpredictable behaviour present, specifically human behaviour.

4 Using Human Relativism in Information Systems as a Guiding Paradigm

4.1 The Human Action Perspective

Human relativism (HR) point us a way to overcome the difficulty of dealing with unpredictable behaviour, in particular human behaviour that is central to IS. When we think of human behaviour we realize that we just have access to its observable part – the (observable) human actions. In effect human behaviour is expressed or externalised through human actions. Therefore, according to HR we should acknowledge the power and the unpredictability of human action (and human behaviour) to be able to design more powerful and robust IS. One way to achieve this is to reduce the dependability of the IS in human behaviour but in this case we would be limiting and reducing the power of the IS as well. A complementary or alternative approach is to use efficiently its power by creating the necessary tools and provide support to human action. This approach will permit to extend human capabilities by using information technologies as specialised tools facilitating, improving, expanding and complementing human action thus allowing the human to express its creative power without expecting a mechanical behaviour from him. In order to achieve this goal a deeper understanding of human behaviour in general and human actions in particular is required.

4.2 Human Action Holistic View

Because HR is a new guiding paradigm, an analysis concerning observable human actions as part of the human behaviour in IS cannot be found in current IS literature. Therefore, to have an initial understanding of the multiple aspects related to human action and IS a detailed empirical analysis was undertaken. Our goal was to have a multi-dimensional holistic view trying to cover all important aspects connected to human action that would help us to define the key dimensions following HR. A first identification and categorization of the dimensions related to human actions was obtained by applying the common questions framework (CQF) proposed in [12]. The CQF was originally used to compare different modelling techniques according to typical comparison dimensions such as organisational, functional, behavioural, temporal, contextual, and motivational dimensions. These dimensions can be related to some common sense questions used to enquire about some fact or subject, these are the who, what, which, how, when, where, with and why questions, thus the name used.

Applying the CQF to human actions (HA) we identified the following 8 dimensions as shown in Figure 2:

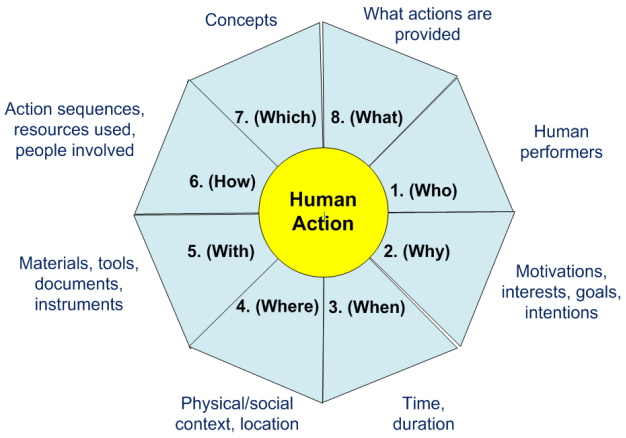

Fig. 2. Human action dimensions identified by the Common Questions Framework.

1. Organisational (who) – The "who" applied to HA refer to its performer, not to the organisational hierarchy or power structures as originally used to.
2. Motivational (why) – Regarding motivation, important aspects related to HA and human behaviour such as interests, goals, intentions, purposes, objectives, and aims are addressed in this dimension.
3. Temporal (when) – The temporal dimension deals with time aspects of action such as duration, start and finish times.
4. Contextual (where) – Context is about the location and the surrounding environment where the action take place. Given our holistic purposes we should extend this dimension to include cultural, political, organisational and other social contexts.
5. Resources (with) – Resources are physical things that are consumed, used or transformed by the HA, they may include, tools, instruments, materials or documents.
6. Behavioural (how) – In the behavioural dimension we will be concerned in the detail of the HA execution, involving the use of tools and other resources, the relations to other actions and so on.
7. Conceptual (which) – This dimension concerns the identification of concepts related to HA. Usually this is a very subjective dimension using mostly non-observable elements and perhaps not useful for objective purposes.
8. Functional (what) – The functional dimension covers the group of actions available without entering in the detail of each one.

In spite of most important dimensions covered by the application of the CQF there is still space to add more dimensions. So, in Figure 3 we provide an augmented view of HA that includes new dimensions in order to form a comprehensive view. From this view other aspects related to HA are added and considered, namely: constraints and rules, pre and post conditions for actions, physical and social measurements or valuations, monitoring, including verification and validation, relationships with other action and triggers for actions. Of course not all of them are to be used for ISD but this list is useful for a complete analysis of human action and for deriving a better support for it in IS.

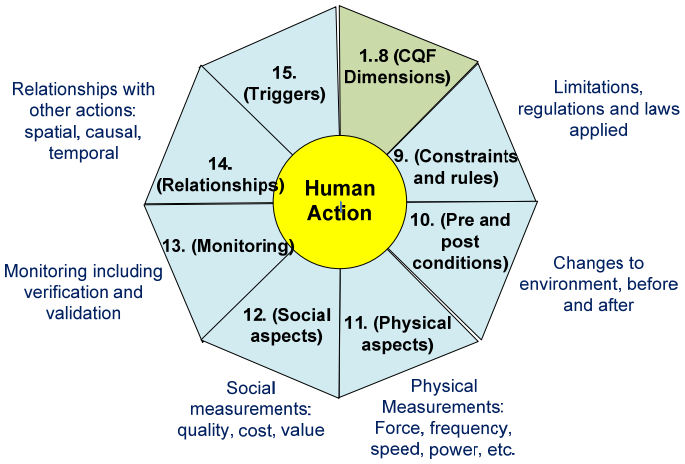

Fig. 3. Human action - a holistic multi-dimensional view.

4.3 Human Action Dimensions for Information Systems Development

In the previous holistic view of human action some of the dimensions may overlap and may not be suited for practical ISD. On the other hand regarding HR, observability establishes what can be used without much ambiguity. From this perspective, as observers we are just able to easily identify physical things such as HA performers, all kind of involved physical artefacts and the surrounding physical context. The informational aspects remain hidden because they are particular to each individual after perception and interpretation. In fact, we should understand information as non-observable and provide a separate dimension exclusive for it. Thus, from a practical (and observable) point of view we selected and purpose a group of five essential dimensions as follows:

1. *Information dimension* – joins most non-material aspects of human action such as the why, how, when and where dimensions plus other aspects such as cost, quality, verification, validation, etc. It is a key dimension for IS analysis and design
2. *Communicational dimension* – captures the links and exchange of information between humans. A communication can be seen as exchanges of speech-acts, also a speech act is effectively a kind of non-material human act that corresponds to an observable human action.
3. *Material dimension* – joins all the material aspects involved in human action except for the human performers. It is the with dimension
4. *Human dimension* – this must be a separate dimension because of the relevance of the human actor within the human relativist view. The human dimension is concerned about the humans involved in human actions.
5. *Context dimension* – In order to enable any kind of human action it is necessary that the environment afford us that action. The state of the environment that enables that human action provides the necessary context.

Although other choices may be done, these group of dimensions seems to us fundamental for IS analysis and goes with our goals to integrate some soft approaches to ISD in a new approach that intends to be more effective and succsseful than current ones.

5 Related Work

Within IS there are different attempts to escape from traditional ISD towards human-centred or human-oriented ISD. Nurminen, considered the father of the humanistic approach for ISD proposed in [13] this alternative perspective contrasted to the current systems-theoretical and socio-technical approaches, roughly related to the hard and soft approaches mentioned at the introduction. His perspective shares our understanding of information technology as an auxiliary tool and the emphasis in human beings, human needs and human activities. Much of his considerations are quite valuable but he doesn't really give us an effective solution for ISD and doesn't root his ideas in strong philosophical foundations. A good analysis of human-centeredness in ISD can be found in [14], where the trend towards a human-centred solution is clearly found in ISD. Starting with early hard approaches that ignored many human aspects, and going through participative solutions where the user is included in the design process, through end-user computing leaving to the user the tailoring of the system according to his needs, through prototyping expecting the user to collaborate actively in the interactive aspects of the final application and ending in actual combinations of methods originated in human-computer interaction (HCI) and computer supported collaborative work (CSCW) fields in ISD. Still, as the authors argued, there is "...a lack of a holistic picture of how the users should be studied or considered in ISD, or what should be their role there". In another article - [15] - user-centeredness in ISD is studied as a multidimensional concept along the following four dimensions: 1) as user focus, 2) as work centeredness, 3) as user participation and 4) as system personalization. Again in the conclusions the authors posed the question whether any of the user centred design approaches analysed forms a systems development approach by itself. The answer was not clear with many aspects being considered revealing the absence of a real human-oriented approach to ISD.

6 Conclusions, Present and Future Work

In this paper a new paradigm for information systems – Human relativism - was introduced. Human Relativism shows a new way to look into information systems that acknowledges the human nature of it and provides the essential basis for a well founded technical approach. In this sense a possible direction in how to apply this new paradigm by focusing the analysis of IS within a human action perspective is provided. Besides a holistic view of human action according to a comprehensive set of dimensions, also a selected group of important dimensions is proposed for use in ISD. In fact, this perspective is part of our current work where a new modelling language – NOMIS - was developed allowing analysing and model any IS according

to a coherent set of views along each of the dimension proposed. These views are aligned with three theories that are integrated in NOMIS namely the Theory of Organized Activity ([16]), Organisational Semiotics (see [17]) and the Language Action Perspective (in [18] and [19]). NOMIS by following Human Relativism and using the views mentioned before defines a new form of business process modelling closer to the organisational reality. As future work we plan to test this approach in an e-learning application prototype already developed and we intend to apply, use it, test it and evaluate it in some other different experimental projects before it is released.

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