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Communication Using Signs: An Empirical Study of a Manufacturing Information System using Stamper's OS Ladder

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Abstract

This paper investigates information exchange during a longitudinal study of a manufacturing information system in a multinational subsidiary where the researcher had the status of a temporary employee. During this study there was a gradual realization that the main locus of interaction was the cell information board. It was here that people gathered to assimilate digital information sources and transform these into "acts". The paper seeks to answer the following research question: how does Stamper's Organisational Semiotic (OS) Ladder stand up to empirical investigation on a manufacturing shop floor? The work makes a contribution by examining a manufacturing information system as a form of symbolic action using empirical data accumulated over two years. The conclusion of the study is that Stamper's OS Ladder requires to be modified based on the evidence of the study. Furthermore, it challenges the IT artefact turn in the IS literature and argues that we should view information systems first and foremost as a service to human activity.

Keywords: Organizational Semiotics, signs, symbols, semiotics, dialogical action research.

1 Introduction

Ronald Stamper (1993p. IX.1) famously proposed that "business is getting things done by using information". Furthermore, he stated that "all information is 'carried' by signs of one kind or another, so understanding signs should contribute to our understanding of information and information systems" (ibid.). This paper takes up Stamper's challenge by examining the focal point of social interaction during a longitudinal study of innovation management in an Irish subsidiary of APC by Schneider Electric. The Corporation had a sophisticated portfolio of information systems (IS) that included: a collaborative client-server software platform; an enterprise resource planning (ERP) system and a customer relationship management (CRM) suite. During the study there was a gradual realization that the main locus of interaction was the cell information board (CIB) shown in figure 1. The term "cell" here refers to a manufacturing cell (aka work centre) consisting of a group of workers and machines. Work is normally organized so that each cell produces a certain family of parts either subassembles or finished products (Groover 2001 p.421).

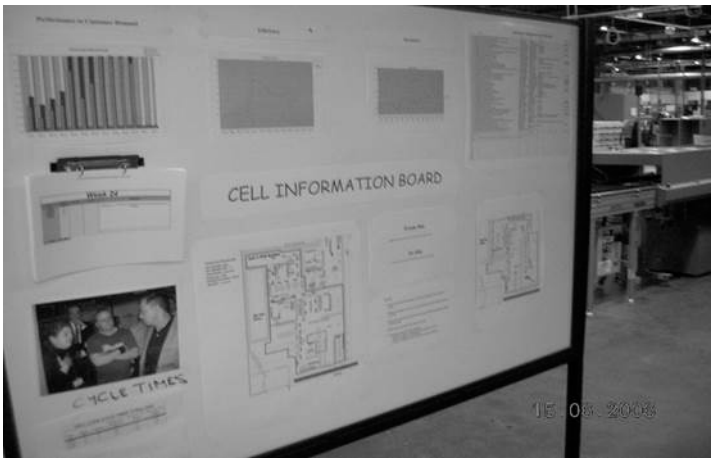

Fig 1: The Cell Information Board (CIB)

It was here that people gathered, formally at the daily scheduled meetings and informally at other times, to assimilate the digital information sources and transform these into "acts". Here the signs and symbols of the value chain were presented, told their stories and solicited action. The CIB became the main position of workplace improvement, being an artifact that was regularly refreshed during the day as updated information became available. In this study we argue that the IS discipline must rethink its conceptualization of an information system from solely being a digital artifact to being a symbolic representation that facilitates human interaction. In doing so, IS will need to go back to its "roots" as encapsulated in the earlier definitions of an information system. The approach employed in the study is dialogical action research (AR) (Mårtensson and Lee 2004) which provides a novel methodology to address the perennial call for more relevant and rigorous collaboration between academics and practitioners (Benbasat and Zmud 1999, Davison et al. 2004, Zmud 1996, Avison et al. 2004, Cranefield and Yoong 2007, Lee 1989, Dubé and Paré 2003) . Herbert Blumer (1954 p. 3) wrote that "social theory in general shows grave shortcomings. Its divorcement from the empirical world is glaring" (sic). This study seeks to address these type of concerns as it applies to the socio-material world of information systems research.

The main intent of the paper is to develop a new perspective to understand information systems as an integrated sign-action system based on the qualitative analysis of a case study using the theoretical framework of Ronald Stamper (Stamper 2001). The paper seeks to answer the following research question: how does Stamper's OS Ladder stand up to empirical investigation on a manufacturing shop floor? In the resulting critique, it proposes a modification of Stamper's theory to include the concept of "mediation".

The layout of the paper is as follows. Firstly there is a review of the literature on signs, symbols and semiotics. After this the case study is presented and the research approach is outlined. Finally the key findings are presented together with a conceptual model of a modified OS Ladder in light of the case study and the call for the utilization of diverse theories by Orlikowski and Iacono (2006).

1. Sign, Symbols and Semiotics

Throughout civilization people have utilized signs and symbols to convey their thoughts where language alone does not suffice. Symbols and images are used as a shorthand for ideas and concepts (Wilkins 2003). This section will look at these concepts and, while running the risk of being considered overly long, its purpose is to provide a grounding for those not familiar with the literature. Let us begin with two important definitions (ODE 2006)

> A sign is an object, quality or event whose presence or occurrence indicates the probable presence or occurrence of something else.
>
> A symbol is a mark or character used as a conventional representation of an object, function, or process.

Importantly for IS, the theory of signs is the "philosophical and scientific theory of information-carrying entities, communication, and information transmission" (Wilson 1999).

A comprehensive theory of signs can be traced back to the medieval scholastic philosopher John of Saint Thomas (Gracia 1999) which attracted significant attention in the 20th century from philosophers such as Maritain (1999).
He developed taxonomy of signs (Murphy 1999) firstly according to their relationship with their objects:

- Natural signs (dark clouds as a sign of rain)
- Customary Signs (decorations as a sign of a celebration)
- Stipulated signs (when an acronym is coined)

Secondly according to their relationship to the mind:

- An instrumental sign which in the first instance must be cognized as an object before it can signify (e.g. a written word)
- A formal sign in contrast directs the mind to its object without having first been cognized (e.g. precepts and concepts)

John Locke, the eminent English philosopher of the 17th century, introduced the term *semiotic* as the science of signs and signification. Later Edmund Husserl proposed a twofold sense to the word sign – it may signify expression or indication (Derrida 1973). Furthermore he insisted that "there can be no sign without signification, no signifying without the signified" (p. 17). Interestingly Ricœur called the early work of Husserl, his *Logical Investigations*, as "the phenomenology of signification" (Moran 2000).

A near equivalent term to semiotic is *semiology* which was proposed by the Swiss linguist and founder of the school of structural linguistics Ferdinand de Saussure (Wilson 1999). The distinction between sign and symbol was first explored in the work of C.S. Peirce an American philosopher of the late 19th and early 20th century who is best known as the originator of pragmatism (Blackburn 2005). Symbols are used in place of something to bring it to mind or to elicit appropriate reactions or emotions. Semiotics according to Peirce is primarily a theory of understanding the interpretation of signs which involves developing our knowledge of the object in question (Hookway 2005). Importantly Peirce proposes that we think only in signs for

we are, in the words of Chandler (2007), *homo significans* "meaning makers". In addition Chandler counsels that as we are surrounded by signs then those who do not understand them and their associated systems are in greatest danger of "being manipulated by those who can". Semiotics is too important to be left to semioticians (p. 225) and it draws heavily on the concepts and ideas from linguistics which is a more established discipline. Sassoon and Gaur (1997) argue that in this computer age young designers must learn the accumulated wisdom of over five hundred years of printing signs and symbols. Furthermore software architects must be cognizant of all the elements of design; such as letters, signs, symbols and icons; knowledge that cannot be substituted wholly by technical ingenuity. For information is carried by signals and flows through signaling networks which not alone transmits the signal but "filters, combine and processes it in various ways" (Skyrms 2010). Let us now take a closer look at the two schools of semiotics, the European school associated with Saussure and the American school associated with Peirce and the pragmatists (Wiley 1994). Saussure's model of the sign is in the dyadic tradition of Augustine, Albert Magnus, Hobbes and Locke.

The relationship between the signifier and the signified is known as signification Saussure taught that the signifier and the signified are two sides of the same coin. Derrida was an admirer of the way in which Saussure "absorbed linguistics into semiology …thereby paving the way for grammatology" (Moran 2000) (p. 450). Saussure considered the spoken sign to be more important than the written sign as language and writing are different systems of signs (p 462).

Peirce offered a triadic theory of signs and this formulation can be traced back to Plato, Aristotle, Husserl and Morris. He classified signs as natural (e.g. clouds sign of rain) or invented (e.g. a picture of a man with a shovel indicates road-works). The latter he termed *icons* as they bear a natural resemblance to that which is signified. Furthermore sign relations encompass the following triad (Hilpinen 1999):

- Involving the sign itself (representantum)
- Its object (or what the sign stands for)
- An interpretant (how the sign represents the object –the meaning of the sign)

Habermas (2001) asserts that "mind only makes contact with its environment in a mediated way" and offered the following thought-provoking meditation on symbols by Ernst Cassirer (p. 7).

> The fact that sensory contact with the world is reworked into something meaningful through the use of symbols is the defining feature of human existence, and also constitutes from a normative standpoint, the basic trait of a proper human mode of being.

Now we will discuss the influence of signs, symbols and semiotic thinking on the information systems field.

2. The Influence of Semiotics on the IS Discipline

Without the good wine, what the point of all the bottles with pretty labels
Ronald Stamper

A recent special issue of MIS Quarterly has taken up the debate on finding new conceptualizations of information systems (Aakhus et al. 2014). In particular, the special issue argued for the need to study information systems as symbolic action systems and provides the following explanation of this *genre*:

> Symbolic action thus refers to the idea that users of information systems act with symbols (embedded or surrounding the system) and that users' actions are enabled and conditioned by symbols and their interpretation. In this perspective, symbolic action is regarded as a ubiquitous feature of everyday life that defines the very basic nature of human existence: humans are symbol-creating animals (p. 1188).

The special issue proposed that "a common denominator is the fact that symbolic action theories shift attention from the received view's static logic and 'mirror hypothesis' to viewing language as action, and formal rationality as practical"(p1189). The special issue team investigated all publications of four target journals (EJIS, ISR, JAIS, and MISQ) for the years 2002 to the middle of 2013. Of the 26 studies surveyed, only 8 studied communication between users of systems in comparison to communication between developers of systems (p 1194). This paper proposes to address this dearth of investigation from the user's perspective by examining an industry based case study.

Furthermore the MISQ paper challenged IS researchers with three central issues to be tackled in engaging these themes (p. 1191):

- the conceptualization of information systems as mediators of symbolic action,
- illustrations and empirical analyses of use and design of information systems as symbolic action
- methods for investigating information systems as grounds, means, and outcomes of symbolic action.

Again, our paper takes up these challenges in the discussion section below where the concept of mediation is proposed as an enhancement of Stamper's theory and by providing an empirical analysis of the use of a manufacturing information system as symbolic action.

However the debate on signs, symbols and semiotics is not altogether new to the IS field. In 1995 a group of scholars met together in a symposium and workshop resulting in the formation of an Organisational Semiotics (OS) research community. This group based its studies on the pioneering work of Ronald Stamper from 1973 and resulted in a number of important publications on the topic of communicating using signs (Liu et al. 2002, Liu et al. 2001). Furthermore this OS community were committed to the study of the use of information in the context of organisational settings. The group adopted the following definition of Organisational Semiotics:

> Organisational Semiotics is concerned with the interrelationships between individuals and groups, and between humans and technology, functioning in organisations and groups.

The broad issues tackled by the OS community encompasses philosophical, social and technical questions. According to Stamper, OS deals with "information and information systems in a balanced way, taking account of both technological issues and the human and social aspects of information resources, products and functions (p. 115). To illustrate this he developed the OS Ladder shown in figure 2.

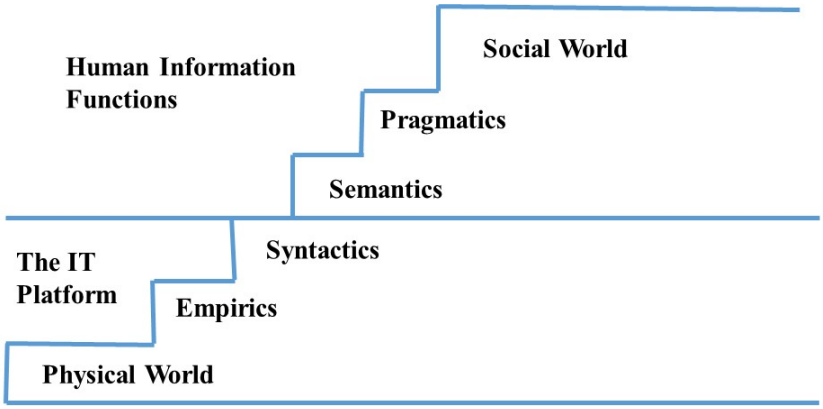

Fig 2. Stamper's OS Ladder (Filipe et al. 2001).

The ladder is further divided into the "IT World" and the "Human World" and an explanation of each level of the ladder is given in the following table. The concepts from each layer will be used in the analysis of the case study later in the paper.

Table1. Levels of Stamper's OS Ladder

PHYSICAL WORLD	signals, traces, physical distinctions, hardware, component density, speed, economics, …
EMPIRICS	pattern, variety, noise, entropy, channel capacity, redundancy, efficiency, codes, …
SYNTACTICS	formal structure, language, logic, data, records, deduction, software, files,
SEMANTICS	meanings, propositions, validity, truth, signification, denotations, ...
PRAGMATICS	intentions, communication, conversations, negotiations, …
SOCIAL WORLD	beliefs, expectations, commitments, contracts, law, culture, …

According to Stamper (1993 p. IX.1)

> There seemed to be one overwhelming reason for this technical efficiency combined with organisational ineffectiveness: we knew all about information technology but precious little about the information it carried. We could produce bottles but we did not understand the wine. Information is the wine. Information is a vague and elusive concept whereas the technological concepts are relatively easy to grasp.

Having outlined the theoretical framework on which this paper is based we will now go on to provide the empirical study and argue that Stamper's theory can facilitate our understanding and conception of a manufacturing information system.

3. Study Overview

Lewin is famous for his assertion that "there is nothing as practical as a good theory". However we will take the aphorism of his student Bronfenbrenner (2005) who reversed the classical Lewinian maxim to read: "There is nothing like the practical to build a good theory" (p 48). This is part of a tradition that goes back to Aristotle "who made frequent reference to concrete example to illustrate his theoretical points" (Kenny 2010). Consequently we will outline the empirical study as we grappled with the topic of innovation in a multinational company and reflected on the role of the practitioner and researcher in the process. This study was based in APC Ireland, formerly a subsidiary of the American Power Conversion (APC) Corporation. APC entered a major period of transition with completion of its acquisition by Schneider Electric and the formation of a new subsidiary called APC by Schneider Electric. The strength of the MIS function in APC was viewed as an important advantage by Schneider in their acquisition analysis and APC's "intimacy with information technology" was identified as central to the creation of synergies with Schneider's power solutions subsidiary MGE. This section will focus on providing a background to the APC context in which the work was carried out. APC designs, manufactures and markets back-up products and services that protect hardware and data from power disturbances (APC 2016) . The explosive growth of the Internet has resulted in the company broadening its product offerings from uninterruptible power supplies (UPS) to the high-end architecture in order to meet the critical availability requirements of internet service providers (ISP) and data-centers. This modular design integrates power, cooling, rack, management and services, which allows customers to select standardized modular components using a web-based configuration tool. Before the acquisition, APC aimed to set itself apart from the competition in three areas: financial strength, innovative product offerings and efficient manufacturing. However, financial reports had stressed that the company needed to implement significant improvements in manufacturing and the supply chain. According to these published reports, the company needed to work to develop a "lean, customer-centric, ambidextrous organization" in order to reach "optimal efficiencies in our processes". At the time the empirical research was undertaken APC had two locations in the West of Ireland that served Europe, Middle East and Africa (EMEA) region. The Manufacturing Operations site in Mayo, employed approximately 100 people; and a number of functions including sales, information technology, business support and R&D were situated in Galway with workforce of approximately 300. The widening of a focus from the manufacturing of discrete products, such as UPS, to the delivery of customized solutions provided both challenges and opportunities for the Operations function. Responding to the supply chain challenge, a Lean Transformation Project was set up in the Mayo campus with a cross-functional team of twelve members drawn from Management, Engineering, Manufacturing, Materials Planning, Quality and Logistics functions. Now we will outline the research approach undertaken in the study.

4. Research Approach

The study is presented from the perspectives of a researcher undertaking a longitudinal study of innovation management in the Irish subsidiary of APC by Schneider Electric. The innovation project consisted of two main phases outlined below: an interpretive study followed by dialogical Action Research. It is notable that Mårtensson and Lee (p 515) advocate that the researcher, akin to an anthropologist, spends a year-long ethnography to understand the world of the practitioner.

Data collection methods during the initial phase involved: maintaining a log book, reviewing documents and information systems, records, interviews, observations (direct and participant), artifacts and surveys in order to develop a database and body of evidence (Yin 1994, Gillham 2000). A total of 29 unstructured or open interviews were undertaken that involved approximately 60 hours of interview time and 24 days spent in the company sites. The interviews were conducted across a wide area of the organization that included: Senior Managers with global, EMEA (Europe, Middle East and Africa) and site responsibilities, Middle-Managers, Team Leaders, Engineers and a number of people in general planning roles. Furthermore the researcher had the status of a temporary employee with his own email address and intranet access.

There was an agreement to move forward using dialogical Action Research with meetings every two weeks. In their paper Mårtensson & Lee propose that "reflective dialogues outside the organization can help the manager to reflect on, learn from, and remedy managerial problems in the organization". In particular, the discipline of having to take regular timeout in a time-pressured manufacturing environment was a major incentive for the Plant Manager to agree to this approach. The Plant Manager also considered the framework advantageous since it allowed him to retain control and responsibility for all decisions, implementations and communications. However there are a number of practical risks with this type of longitudinal research in a dynamically changing corporate environment, such as the realities of reorganizations and relocations that are not pointed out by Mårtensson & Lee.

In addition to the above there were 11 meetings with the main point of contact for the project which totalled seventeen hours in duration. These meetings became the basis for the dialogical AR approach during the second phase of the project. Data collection during the dialogical AR period involved recording of the meetings which were subsequently transcribed verbatim by the researcher. Given the rich nature of the data, this was considered the optimum way of capturing the reflective meaning and ensuring consistent interpretation. Analysis was done manually through the examination of each meeting transcript and providing a summary of the topics discussed in the transcripts. This then was sent to the plant manager for evaluation and agreement that it was an accurate portrayal of the meeting. In total these transcripts ran to over 60,000 words. A profile of the interviews is set out in the table below.

Table 2. Data Collection Summary

Number of Formal Interviews Estimated hours	22 34.5	Senior Managers Middle-Managers, Team Leaders, Engineers
Meetings with main point of contact (additional to above) Estimated Hours	11 17	Senior Engineering Manager
Dialogical Action Research Meetings Estimated Hours	16 22.5	Plant Manager
TOTAL INTERVIEW HOURS	74	
TOTAL DAYS ON SITE	42	
Additional detailed discussions Estimated Hours	8 18.5	VP for Software Development, Customer Engineers, Customer Service Manager.

The interviews were conducted in a responsive (Rubin and Rubin 2005) or reflexive (Trauth 2001) manner, allowing the researcher to follow up on insights uncovered mid-interview, and adjust the content and schedule of the interview accordingly. In order to aid analysis of the data after the interviews, all dialogical action research meetings were recorded with the interviewee's consent, and were subsequently transcribed, proof-read and annotated by the researcher. In any cases of ambiguity, clarification was sought from the corresponding interviewee, either via telephone or e-mail. Supplementary documentation such as minutes of meetings, company records, quarterly published reports, quality statistics and customer feedback were analyzed.

5. Findings and Analysis

Now the main findings of the study will presented together with an analysis using the theoretical framework of Stamper's OS ladder. The transcripts of the dialogical action research indicated one major process innovation which had a significant impact on the operations function. This was the short interval management system (SIM). This section will provide an overview of SIM derived from a procedure issued by the Mayo plant manager. SIM has a dual purpose to effect communication and support running of the production line. Its function is to communicate any issues upwards through the organization and to feed information to the production line. It is designed to enable the speedy communication to all concerned of potential health and safety issues, feedback from customers and quality issues; as well as to track production build versus the production plan. By definition the system is short interval with the approach of breaking large tasks into manageable sizes and then reporting progress on a daily basis. Production teams meet twice every day for a maximum of ten minutes and the meeting is chaired by the cell supervisor or delegate. The chief communication vehicle of the process is the SIM "cell information board" where the health and safety, quality and production issues are captured and dealt with in that priority. To enforce the priority given to health and safety, the supervisor is responsible for post-

ing a photograph on the problem on the board. The board information has a standard format with the health and safety issues on the extreme left, followed by quality issues and production issues with the priority from left to right. Any potential barriers to meeting the build plan are identified and if necessary escalated to the support staff.

The cell support team hold a mandatory daily meeting which should be a maximum of thirty minutes which is run by the production manager. Membership of this team includes the manufacturing and quality engineers, the material specialist and the cell supervisor. These meetings are also open to any of the management team to attend. The agenda follows the set priority referred to earlier where the following issues are reviewed: Health and Safety; Customer feedback; Quality issues; Issues escalated from the production SIM meeting; Agreed action items from the last meeting; Feedback from operations personnel on active issues and finally agree the issues for action prior to the next meeting. The last item requires actions to be both specific and deliverable with the focus on meeting the short interval rather than any long term requirements. The layout of the SIM cell information board, shown in figure 3, reinforces the priorities outlined above.

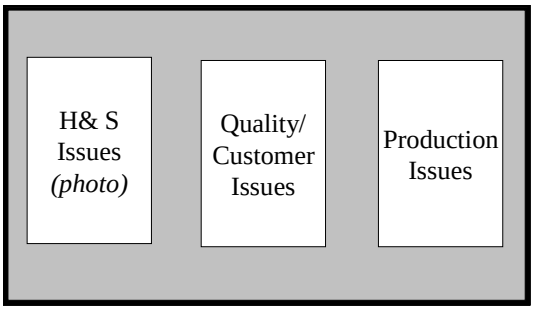

Fig 3. SIM Cell Information Board

The following extracts from the transcripts illustrate the impact of the SIM process on the operations of the manufacturing facility and we will reflect on these data from the perspective of Stamper's OS Ladder outlined in figure 2 and table 1 above. As a general point, the use of dialogical AR and the in-depth analysis of a dialogue with one key actor are in keeping with Blumer's assertion *that one "acute observer" is worth a hundred "unobservant participants"*.

5.1 Physical World

The physical world of this study consisted primarily of the manufacturing shop floor. The physical layout of the cell information board is shown pictorially in figure 1 and diagrammatically in figure 3.

The following extract refers to the operation of the SIM process in the world of the manufacturing subsidiary.

> The SIM process gives visibility to everyone on the floor; it drives closing things off; it encourages people to come forward with their suggestions. Those are things that make the difference.

5.2 Empirics

This extract suggests that SIM is based on standard Lean processes but has been adapted for the Schneider production system. It build on the concept of efficiency in the empirics rung of the OS ladder.

> Really the Toyota Way or any other of these books on Lean…talk about a fast-food chain and having a 5 minute meeting in the morning to start to plan for the day. That is very much the same thing but we call it SIM. In terms of here there is nothing proprietary about it. It's having regular meetings one to one and giving people opportunities to come forward with their ideas. Something else came up today-and I need to push this again- everything comes up from the SIM meeting …we had some major part issues that is going to hurt us on the bill plan this week. When we started digging into it -it bubbles up through the SIM process – and when we looked at that again it highlighted that our structure is all wrong.

5.3 Syntactics

The primary management information system employed by APC was Lotus Notes, a collaborative software system that managed its knowledge flows. It provided a tightly controlled environment for asynchronous group work; where collaborators can have different or independent work patterns. Though not part of the software suite, the amount of suggestions being captured by the SIM process in an excel spreadsheet were significant.

> Oh yes ….even if you look at our SIM process there we said that the operators handwrite it on the board –I will explain that to you - then we get [name] to type it up ….she typed it up last Friday and it is nearly full again now. That is significant. I don't have a number but just at a simple level passing by the sheet and noticing that it is full again.

5.4 Semantics

The following excerpt is provided as an example of how the plant manager developed meanings from the interaction with the researcher.

> A significant output for me was just the whole learning process of putting a structure around an innovative culture – it is not just a fuzzy thing – I have a clear image in my mind of what that means.

While being a vehicle for process innovations SIM was regarded as being a radical innovation in itself bringing a whole new meaning to the term innovation for the plant manager.

> I like how this has evolved actually, how innovativeness can be viewed as having two aspects..…the incremental and the radical. The SIM process is a radical new process [innovation] itself.

5.5 Pragmatics

Here we provide evidence of the communication and conversations items encompassed in this layer. The advantage of SIM replacing multiple and often invisible processes is now highlighted. Also this extract highlights that the SIM process acts as an information system *per se* if you consider the definitions that do not emphasize a computer system.

> We had too many other things before. We had process audits that went out to check our processes, we had a health & safety [process] but it was not as structured; we had our test process where we looked at failures; we had me walking around complaining that the place is looking disorderly and to get it to look more organised. The point I am getting to here is that there were multiple ways for things to get suggested. There are a couple of problems with that, because there

> were not structured methods around it …all the things I told you about. If Joe Bloggs on the floor sees an opportunity for improvement, none of those methods that I just described lend themselves to that person making a suggestion. Secondly if someone was really proactive and identified a trip hazard it goes up into a database which is invisible because the operators don't use the computer system so they don't know if it is being actioned or closed off or not. Whereas now this is visible and instantly actionable – they can see day to day what is being done about it.

5.6 Social World

These extracts support the argument that SIM affected the culture of the manufacturing organization. Here again we see that the SIM process is providing a mechanism to harness process innovation.

> I will give you a more basic insight into what SIM is about. People are inherently intelligent ….and once you put a mechanism in place to use that [intelligence] they will use it. That's where you will get your organisational change from. In the absence of our SIM process we didn't have the mechanisms to either get the suggestions from people or to get people to act on it. So by putting that mechanism in place you are allowing that natural ….instinct to want to create. People want to create everyday but if they don't have the mechanism to allow them to do that it just won't happen. The SIM process allows the natural creativity go forth and suggests the changes. The SIM process provides the structures to get them implemented. These are just some example of how this is coming about.

Furthermore SIM was instrumental in the plant receiving a National Award for Health and Safety.

> The National Standards Authority of Ireland (NSAI) is responsible for checking health and safety (H & S) procedures. There was a Health & Safety conference recently where they announced the winners of different categories. We won the regional ward for the West. What's more we won the new Gold Standard in Occupational Health & Safety award which is actually the SIM processes [in operation]. The judge thought it was the bees-knees and it was really groundbreaking.

The purpose of this section was to present the findings from the researcher's interaction with the plant manager in terms of Stamper's OS ladder. From our empirical data we can argue that the OS Ladder provides a tool to understand the real-world environment that we were studying. This was done in a novel way by examining extracts from the dialogues in relation to the OS perspective. It sought to "dig out" and "probe" the empirical "world" encountered during the interactions. We will now go on to discuss implications from our review of Stamper's OS theory and our findings from the empirical domain.

6. Discussion

In a commentary on their seminal 2001 paper, Orlikowski and Iacono (2006) contend that "a diversity of perspectives, methods and theories will help us make adequate sense of the development, use and implications of information technology in society" (p. 290). In a previous paper they had proposed that further research on the circum-

stances that "enable people to make dynamically complex systems work in practice may be critical "(p. 132) (Orlikowski and Iacono 2001). Stamper's OS ladder had a significant impact on an influential group of IS scholars working in the 1990s. In our paper we argue that Stamper's OS ladder can enlighten the conceptualization and sense-making of IS as a sign-action system. Furthermore the situatedness of the cell information board enabled the actors in the case study to make the complex array of information systems "work-in-practice". Now we will further develop this argument by returning to some early definitions of IS.

In terms of information systems this study fits into the broader category of the definition of an information system as taken from Buckingham *et al.* (1987) cited also by Fitzgerald *et al.* (2002) .

> **An information system** is a system which assembles, stores, processes and delivers information relevant to an organisation (or to society), in such a way that the information is accessible and useful to those who wish to use it, including managers, staff, clients and citizens. An information system is a ***human activity (social) system*** which may or may not involve the use of computer systems (*emphasis ours*).

The following definition of information is given in the early work of Whitten, Bentley and Ho (1986) also fits into the broader category.

> **An information system** is an arrangement of components that interact to support the operations, management, and decision -making information needs of an organisation

The study challenges us to view information systems as not primarily being the IT artifact but pertaining first and foremost as a service to human activity. This is what Ciborra (2002) termed as an "alternative centre of gravity: human existence in every-day life" and is particularly relevant to the theme of innovation which was the initial motivation for undertaking this research. As a result it is argued that a return to the early and broad definitions of IS (e.g. Buckingham *et al.* adopted for this study) can help us grapple with the difficult conceptualization of innovation and its relationship to information systems. Furthermore in the area of information systems development there is recently an increasing interest and study of Agile development and its link to innovation (Conboy et al. 2011, O'hEocha and Conboy 2010, Wang et al. 2012). Perhaps we need to look to the "storyboard" as the place where innovation is facilitated rather than in processes or systems. Our study demonstrated that the analogue and visible milieu where innovation takes place is through the human social information system rather than through material IT artifact. A suggestion would be to further investigate how ISD storyboards could be designed to accommodate the capturing and diffusion of innovations.

6.1 Modification of Stamper's Ladder from the Empirical Investigation

The concepts introduced in the literature review: Saussure's theory of signs and Stamper's OS ladder are now combined in light of the empirical case study to form a model. This will be done through the capturing the manufacturing information systems as a sign-action system and modifying Stamper's OS ladder to illustrate the learning from the study. A significant and new process innovation, short interval management (SIM) was introduced during the study and this became the focus of the practitioner and researcher attention during phase 2 of the project. Using the broad

definition of an IS presented above it is argued that the SIM cell information board (CIB) is a *de facto* information system which acts as the human interface to the ERP (enterprise resource planning) system and other IS applications. Furthermore this transformation was likened to a digital to analogue conversion process by the plant manager. "Digital" information is extracted from the ERP and other information systems and placed on the SIM CIB, in an "analogue" format by the relevant people in the organization. The human activity of symbolic interaction results in the database information being prioritized and acted on. For example the ERP forecasts were transformed into daily build plans and takt[1] times. After the work is completed, the updated information is then placed back into the relevant systems for further processing. In this conceptualization, the SIM CIB becomes an interface and a transformation location; between the digital world where the information resides and an analogue world where the information is acted on and implemented. The IS raw information in Saussurean terms acts as the signifier (from which the sign takes e.g. ERP data). By a process of signification, carried out by human actors, this data then becomes signified onto the cell information board (CIB) i.e. it conceptually shows the sign (data) which it refers.

Thus through a process of symbolic interaction, the humans act toward the signified data on the basis of the meanings that they have for them. The meaning of the signified information is derived from, or arises out of, the social interaction between people engaging with the SIM storyboard. These meanings of the information are then developed through an interpretive process which results in actions by the human protagonists. Finally this symbolic representations are decoded and then transferred back to the IS signifier in the form of processed information that can be transmitted to another place in the value chain where it undergoes a similar signification. Furthermore we argue that this has implications for Stamper's OS ladder as the empirical data gathered in this research study suggests that there needs to be a locus of "mediation" between the IT levels and the human levels. In this study the Cell Information Board accomplishes this task. Building on the analogy of the ladder or stairs this function is conceptualized as a "mezzanine" i.e. an interim floor which acts as a mediation between both worlds.

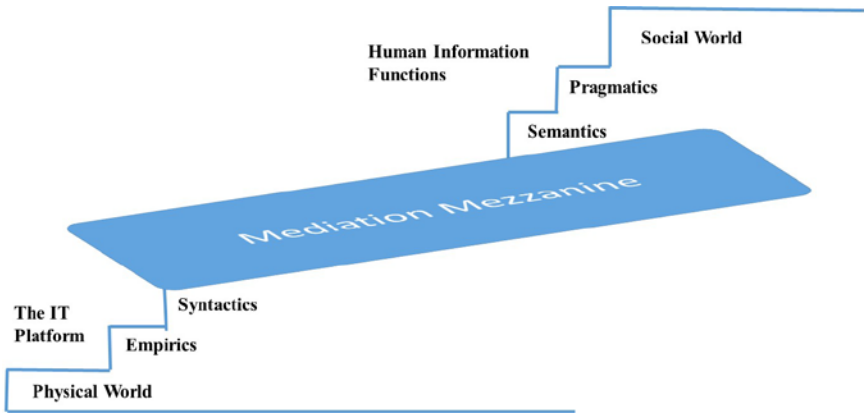

Fig4. Stamper's OS Ladder modified with the "mediation" conceptualization

[1] The maximum time allowed in order to make the product meet the demand.

Limitations of the research study include that it was confined to one site. However as Mårtensson and Lee (2004 p. 533) point out there is a growing acceptance of "intensive research methods" and that a single-site case study can be deemed scientific. Lee's (1989) seminal paper also lays the foundation for single case studies. The problem of bias is fundamental to dialogical AR which is based on reflective on-to-one dialogues with a single individual. This makes triangulation more difficult but it is possible to search for supporting external evidence. For example the enthusiasm for the SIM process by the practitioner was backed up by the plant winning an external national health and safety award that resulted from the implementation of the process.

7. Conclusions

This paper argues for a re-discovery of the human aspect of information systems. It did this by providing a review of signs and symbols in the literature; specifically from the work of Ferdinand de Saussure and Charles Sanders Peirce. Then it presented the concept of Organisational Semiotics as proposed by Stamper. The setting was an empirical study of innovation management in an Irish subsidiary of APC by Schneider Electric. The approach taken was dialogical action research as it provided a mechanism to implement change while keeping the operational details under the control of the practitioner. In particular the paper examined the focal point of social interaction that emerged during the research, namely the cell information board used by practitioners as an interface between the information system and praxis. There are a number of key implications from the work. *The Sciences of the Artificial* (Simon 1996) is having a renewed influence on information systems scholarship, particularly in the area of design science (Hevner et al. 2004). Simon's thesis proposes that human behavior is *simple* and its complexity is derived from the environment. We would disagree and argue that the human communication of signs, symbols and language and the subsequent actions derived from these are the most *complex* aspects of the information sense-making process. Furthermore, we propose that *homo connectus* can only be understood in term of action and inter-subjectivity (*homo inter-connectus*). This extends Peirce's contention, mentioned previously, that "we think only in signs". Based on our work, we offer a vision of information systems which combines the school of the "IT artifact" and the "human-centric" school as follows: the primacy of the IT artifact as *service* to the human actor as an acting and interacting agent. Consequently, IS becomes meaningful through the action of signs and symbols. The study presented early non-IT centric definitions of an information system which, it was argued, included the short interval management process (SIM) observed during the research. A return to these definitions was proposed as a point of renewal of the concept of an information system in the complex world of human meanings and understanding. The contribution of this paper is to propose a novel perspective to understand IS as an integrated sign-action system based on the qualitative analysis of the APC by Schneider Electric case study. Furthermore this paper supports Lyytinen's thesis (1985 p. 61) that "the very idea of an information system…is to provide a means and an environment for human communication" quoted in (Aakhus et al. 2014 p. 1189). Consequently the conclusions of the study challenge the IT artefact turn in the IS literature and argue that we should view information systems as pertaining first and foremost to facilitating human activity. Furthermore, we argue that we have pro-

vided empirical evidence to support his call that IS involves a human encountering with technology rooted in the world of experience.

> This is the domain of existing in the world. Hence, a different perspective on information systems should be anchored to the unfolding of the human process of encountering the everyday world (Ciborra 2002 p. 6).

We suggest that the study has implications for other areas of research. This includes agile software development with its emphasis on a storyboard and "scrums", the use of storyboards as instruments of innovation and communication, and the practice of using *living walls* as places of contact and loci of social interaction. Further work is required to provide a firm philosophical underpinning of the model presented in the paper (figure 4) such as the questions arising from the call for more pragmatic research engagement (Ågerfalk 2010, Goldkuhl 2012), Moreover, it is suggested that a phenomenological approach would be profitable in this area using the intersubjective work of Edmund Husserl, Edith Stein and Hans-Georg Gadamer as according to Stamper (2001 p. 137) "Computers don't operate on meanings. People do". Furthermore we argue that our empirical study sheds light on Stamper's statement quoted in section 2 above regarding computers being used with great skill but with little effect. It also supports the contention of Habermas (following Cassirer), also quoted above, that "sensory contact with the world is reworked into something meaningful through the use of symbols".

In conclusion, perhaps it is time for the information systems discipline to heed the words of T.S. Elliot in *Little Gidding*: "We shall not cease from exploration. And the end of all our exploring will be to arrive where we started and know the place for the first time.

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