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SSM To Information Systems: A Wittgensteinian Approach

By

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Abstract

Subjectivist theories of meaning inhibit the use of axiomatic systems in information system design. Wittgenstein held that language and meaning were primarily public and that a private, purely subjective, language was impossible. The iterative debate among stake-holders that takes place in the practice of Soft Systems Methodology (SSM) can be understood as a Wittgensteinian language game in which meaning is created not just discovered. The conceptual models used in SSM can be developed into Logico-linguistic Models which express stipulative definitions. These definitions can be taken as an axiomatic basis for information system design.

Keywords: axiomatic system; conceptual model; information system design; language game; Logico-linguistic Model; meaning; private language; Soft Systems Methodology.

1 INTRODUCTION

An account of meaning must play a vital role in any analysis of information and in any form of information system design. In the information systems literature much current writing on the nature of meaning fails to take into consideration the philosophical work that has already been done on this subject. Subjectivist theories of meaning are beginning to appear in the systems literature (Stamper, 1987). These theories assume that meaning is primarily determined privately by a subject and that public languages are built up out of private meaning. Wittgenstein's private language argument is widely recognized as having shown that such theories are false. In the following it is argued that the iterative debate in SSM is a public event that creates meaning and, therefore, the SSM method is essentially Wittgenstienian in character. A consequence of this is that SSM can be used to create a model that will open the way for the formal derivation of an information system.

The paper begins with the background to the subjectivist account. Russell's Logical Atomism, which attempted to give a rigorous logical foundation to a subjectivist theory of meaning, and the Wittgensteinian arguments that refuted it are briefly explained. Stamper's recent work (1987) seems to have revived the subjectivist account without producing any new arguments in its favour. It is shown how this conflicts with Wittgenstein's language game theory.

The second section argues that one of the products of the SSM iterative debate is a consensus about how the problem situation should be described. Understood as a language game the debate is not merely a mechanism for the analyst to learn what the clients think but creates an agreed framework of stipulative definitions. SSM conceptual models are not ideal for the logical expression of these definitions as they are limited by the fact that they employ only a single type of logical connective. However, more logical connectives can be added and a more powerful model, a Logico-linguistic Model, can be built using the same type of iterative debate. The Logico-linguistic Model can be formally expressed in the propositional calculus.

In the third section the procedure for converting a conceptual model into a Logico-linguistic Model is described. The final section explains how a Logico-linguistic Model can be used as the starting point of information system design.

2 THE HISTORY OF PRIVATE LANGUAGES

2.1 Logical Atomism

To find an irrefutable foundation for human understanding has been the ambition of countless philosophers throughout history. Bertrand Russell was no exception. In the early part of this century he began developing a set of ideas that became known as "Logical Atomism" (Russell 1918, 1924).

Russell began with the standard empiricist idea that all knowledge comes through the senses. His next move was to say that the only thing we can be certain of is sense experience. Knowledge is, he argued, built up entirely out of atomic units of sense experience. These units he called "sense data". The standard analysis of knowledge, which some attribute to Plato (Gettier 1967), is that it is *true, justified belief*. Russell was saying that only sense data justify belief and thereby turn it into knowledge. This was nothing particularly new, the sense datum theory can be traced back at least as far as John Stuart Mill.

Russell's next move was rather unusual. He went on to say that not only was knowledge built up out of sense data but that meaning was also built up out of sense data. This was quite profound because if sense data are required for meaning they are also required for the formulation of belief. For Russell it was not possible to even believe anything that was not based on sense data. This, therefore, was a unified theory of knowledge and meaning.

The logical apparatus that Russell used to construct his theory is highly relevant to today's problems in information system design. The development of the apparatus begins by analyzing meaning in terms of sense and reference. Frege made this distinction with the terms "sinn" and "bedeutung" (1892), J. S. Mill with the terms "connotation" and "denotation" (1843) and the terms "intension" and "extension" are also used to make the same distinction.

In the 1905 paper "On Denoting" Russell developed his theory of descriptions. This claimed that most names are in fact disguised descriptions. Names apparently refer to individuals but "On Denoting" hoped to show that names can be unpacked into logically equivalent descriptions which have sense but no individual reference. Russell (1918) went on to say that the only "logically proper names" have individual reference and these only refer to sense data.

The elegance of this theory was very appealing. Wittgenstein's *Tractatus* (1922) with its "picture theory of meaning" is firmly in this tradition. Rudolf Carnap and the Vienna Circle were working on similar ideas which were popularized in Britain by A. J. Ayer (1936) in his best selling book *Language, Truth and*

Logic. More than any other text this book represents the views that people began to call "Logical Positivism".

2.2 Empiricism, phenomenalism and phenomenology

Taken independently of the theory of meaning, the sense datum theory is just one species of the philosophical position known as "phenomenalism". This comes from J. S. Mill who held that objects were just "permanent possibilities of sensation" (Ayer 1969 p. 224-5). The empiricist says that all knowledge *comes from what we have experience of*. The phenomenalist takes this further and says all knowledge *is made up of experiences*, for the phenomenologist what these experiences are *experiences of* is something we cannot know.

The position known as "phenomenology" ends up being similar to phenomenalism in its account of the external world. However, phenomenologists, such as Edmund Husserl, get there by a different route. This is the route of rationalism which claims that knowledge is *a priori*, a result of thought rather than a result of experience.

The trouble with phenomenalists and phenomenologists it that they board up the window to the outside world leaving the subject completely alone.

2.3 Language games

By the 1940s Wittgenstein had changed his mind completely about the nature of language. In the *Philosophical Investigations*, which was not published until 1953, he produced an argument that was fatal to Logical Atomism, Logical Positivism and many of the ideas in his own *Tractatus*. This became known as "the private language argument". The private language argument shows that it is not possible for a language to refer to objects that only one person can, as a matter of logic, know about. Sense data are logically private because only one person can know his own sense data.

The private language argument is a complex one and cannot be fully explained here. Kenny (1973) considers that the crux of the argument is that the terms of a private language could not be defined. He identifies three prongs to the attack. First, it contends that a private object, a sense datum such as a pain, cannot be ostensively defined. That is, a person cannot merely fix his attention on a sensation and name it "so and so".

"...what does it mean to say that he has `named his pain'? - How has he done this naming of pain?! And whatever he did, what was its purpose? - When one says "He gave a name to his sensation" one forgets that a great deal of stage-setting in the language is presupposed if the mere act of naming is to make sense." (Investigations, 257)

Secondly, a private sensation cannot be defined in terms of a previous sensation.

"We are supposing that I wish to justify my calling a private sensation `S' by appealing to a mental table in which memory-samples of private objects of various kinds are listed in correlation with symbols... To make use of such a table one must call up the right memory-sample: e.g. I must make sure to call up the memory-sample that belongs alongside `S' and not the one that belongs alongside `T'. But as this table exists only in the imagination, there can be no real looking up to see which sample goes with `S', i.e. remembering what `S' means. But this is precisely what the table was meant to confirm. In other words the memory of the meaning of `S' is being used to confirm itself." (Kenny p. 192-3)

Thirdly, a private sensation cannot be defined in terms of public events.

"Let us now imagine a use for the entry of the sign "S" in my diary. I discover that whenever I have a particular sensation a monometer shews that my blood-pressure rises. So I shall be able to say that my blood-pressure is rising without using any apparatus. This is a useful result. And now it seems quite indifferent whether I have recognized the sensation *right* or not. Let us suppose that I regularly identify it wrong, it does not matter in the least. And that alone shews that the hypothesis that I make a mistake is a mere show. (We as it were turned a knob which looked as if it could be used to turn on some part of the machine; but it was a mere ornament, not connected with the mechanism at all.).
(Investigations, 270)

To replace the idea of language as something based on reference to logically private objects and events, Wittgenstein developed the idea of language as consisting essentially of rules. In the *Investigations* the notion of a language game is developed. A language is like a game. You cannot play the game if don't obey the rules but the rules are no more that an agreement among the putative players about how to play the game. There are many games that you can play and new ones are being made up all the time. For the later Wittgenstein language is public, and the references in any language are limited to publicly observable objects and events.

2.4 Private languages revived

The private language argument is just as fatal to phenomenology as it is to phenomenalism. However, while phenomenalism largely disappeared from the Anglo-American philosophical scene in the 60s and 70s, phenomenology continued to be popular on the continent. The phenomenological tradition also remained active in British sociology. This has now resulted in subjectivist theories of knowledge and meaning being put forward as a theoretical basis for information system design. Advocates of these ideas include Ronald Stamper who has done extensive work on the connections between semiotics and computerized information systems.

"Meanings express personal views of reality. When there is a firmly established consensus, and only then, we can pretend that meanings are independent of people. Many semantic problems cannot be solved until one has established who is responsible for the meanings expressed." (Stamper 1987)

What Stamper is implying here is that the subject alone determines meaning - that public languages are a sort of Esperanto built up out of private languages.

If we agree with Wittgenstein then it is clear that Stamper has the boot on the wrong foot. Language is public and refers primarily to public events. References to subjective sensations are derived from a public language. I don't make up my own word for my pains and then translate it into English. I learn the use of the English word "pain" by observing public events and then apply the word to my own pains. This does not prevent people from giving different meanings to the same utterance or symbol, this is because the same utterance or symbol is used in different language games. There can be symbols that mean a certain thing in computer jargon but mean something completely different in prison slang. This is because computer scientists and prisoners play different language games.

Stamper appears to assume that meaning must be entirely objective or entirely subjective. He reasons that meaning cannot be entirely objective because words do not have meanings in themselves, and, therefore, meaning must be entirely subjective. But his assumption is wrong. Meaning is public and as such it is dependent upon the existence of at least two knowing individuals *and* dependent upon the existence of independent and observable objects and events.

There are a number of practical consequences that follow from the subjectivist account of meaning. One is that meaning must always be *discovered* in hidden subjective worlds. Following from this is Stamper's contention that formal systems are of little use in connection with meaning because they do not help us *discover* meaning (Stamper, 1987, p. 51-52). The second concerns the meaning of "meaning" and how we wish to distinguish between semantics and syntactics. Semantics is concerned with "reference", the interpretation of terms. Syntactics is concerned with "sense", the relations between terms and rules about terms. Stamper follows linguistics and considers that the study of "meaning" is part of semantics (Stamper 1973). However, in the philosophy of logic "meaning" is used as a synonym for "sense" or "connotation" (see Haack 1978) and is, therefore, part of the study of syntactics. (In this paper "meaning" is used to stand for the sense and reference of a term).

For Wittgenstein reference was not possible outside a rule based language game and so reference as well as sense required a syntax. A new game can be devised and played by a group of people agreeing to a set of rules. In the same way a language game will produce syntactic rules and these rules can be formalized. In the following section it is argued that the SSM conceptual model building process is, in part, a language game. As such it offers a viable alternative to attempts to design information systems on the basis of a subjectivist theory of meaning. The remainder of the paper is largely concerned with a way in which conceptual models can be formalized.

These consequences can be avoided if we adopt a Wittgensteinian approach where meaning need not always be discovered but can be *created* in a language game. Also, as will be shown in the following, axiomatic systems can be part of a language game.

3 SSM AS A LANGUAGE GAME

3.1 Conceptual model building

For the purposes of the present argument a succinct account of the SSM conceptual model building process can be given as follows: After learning about the background of the problem the analyst/facilitator produces a number of models that are considered to be appropriate to the problem situation. The models are presented to the stake-holders of the organization who inevitably find then unsatisfactory. The least unsatisfactory model is revised in an iterative debate. The debate ends when the stake-holders reach a consensus that a model is both relevant and desirable. The model either resolves the problem itself or will form a basis for a solution.

This process could be interpreted as a way in which the analyst makes discoveries about the stake-holders' beliefs and values and how those beliefs and values are expressed. While this is one of the things that goes on during the debate it is not the only thing that goes on, nor is it the most important. Checkland & Scholes (1990) emphasize that the iterative debate can change the way the stake-holders think about the problem situation. The iterative debate is not just a passive process whereby the analyst gains knowledge, it is dynamic and creative.

The changes that can occur during the debate can be changes in values and changes in beliefs. Also there will be changes in the expression of beliefs, and it is this that is interesting in the context of language games. Through the conceptual model building process a consensus is built up about the way the problem situation can be described. This is a language game in which the stake-holders come to agreement about what certain key terms will mean. The final conceptual model can be taken as an extended definition of a desired state of affairs. This has considerable implications for information system design.

3.2 The development of Logico-linguistic Models

Logico-linguistic models have been developed in a number of theoretical papers (Gregory 1991, 1992a, 1992b) in an attempt to resolve a number of logical difficulties found in SSM conceptual models.

The SSM conceptual models, such as the hypothetical one shown in figure 1, consist of commands linked by arrows. The arrows are intended to represent logical contingency (Checkland & Scholes, 1990, p. 36). In figure 1, activity *5* is logically contingent on activity *4*. A logically equivalent way of expressing this is to say that *4* is a necessary condition of *5*.

Gregory (1991) made the point that necessary conditions are not enough to describe a causal sequence. Conceptual models, therefore, lack the power to fully describe physical transformations and cannot form an adequate basis for an information system design intended to support physical transformations. A description of a causal sequence requires sufficient conditions. A sufficient condition can be made up of number of necessary conditions to form a necessary and sufficient condition (an N&S condition). Thus if *P* is necessary for *R*, *Q* is

In the model given as an example in the next section implication and the biconditional will be used to stand for the strong relations of entailment and identity. However, the notation used will be that of a simple propositional calculus which does not reveal the distinction. A modal logic could be used but a such logics must be treated with caution because there are many systems of modal logic. The explanation of a suitable modal system is beyond the scope of the present paper.

The model looks like a cause and effect diagram and there is nothing in its logical expression that indicates that it is not. However, the manner of its construction shows that it is not a representation of a process of cause and effect but that it is a process definition.

Most things are defined by their qualities. A chair can be defined as an object with a seat, a back support and more than two legs. Other things are defined by the process of their production. Whiskey is a spirit distilled from fermented malted grain. This means that if you take some grain, malt it, ferment it and then distill it you end up with whiskey - no matter what it tastes like. By the same token something that has the same taste, alcohol content and colour as whiskey is not a whiskey unless it is produced by the defining process. For example, in Thailand there is a popular liquor called "Mehkong" which is made as a substitute for Scotch. Originally Mehkong was made from rice, which is a grain, and Mehkong was, correctly, called a whiskey. These days it is made from molasses, which is not a grain, and so Mehkong is now described as a "liqueur" despite the fact that it has the same alcoholic content and looks and tastes the same as it always did.

4 BUILDING THE LOGICO-LINGUISTIC MODEL

4.1 Stake-holder construction

A Logico-linguistic Model is an expanded version of a traditional SSM conceptual model and it is intended that it should be developed in the same way as a conceptual model. That is, the analyst/facilitator determines the logical form of the model and makes suggestions as to the content. The content is then debated and amended by the stake-holders until agreement is reached through the iterative process.

The example given here is a model produced as a case study for a seminar held by the United Kingdom Systems Society at the University of Warwick (see Systemist, Vol 14, No. 3, 1992). It is a model for an information system which to support the activities of a programme committee involved in arranging a working conference. It must be stressed that conceptual models and Logico-linguistic Models are intended to be built by stake-holders in the client organization not by analysts. As there was no client organization for the case study the model must be regarded as hypothetical. It is intended to show what the Logico-linguistic Model might have looked like if there had been stake-holders available to build it.

necessary for *R*, *R* is necessary for *P* and *R* is necessary for *Q* then "*P* and *Q*" will be an N&S condition of *R* and *R* will be a N&S condition of "*P* and *Q*". A second paper (Gregory 1992a) pointed out that some causal relations are sufficient without being necessary. These sufficient but unnecessary conditions (SUN conditions) also need to be represented.

The second level of difficulty concerns the phrase "logically contingency". This is because strictly speaking logical connections are between declarative statements, or elements of declarative statements, not between activities or other real world events. Normal logics cannot operate on SSM conceptual models because the elements are expressed as commands rather than as declaratives. This leads some to the conclusion is that SSM models are not "logical" but some sort of representation of a causal sequence (see Probert, 1991).

The first stage of the solution is to convert the commands into propositional form. The next stage is to convert statements of causal relations into logical relations. If we say that event *P* is necessary for event *Q* then what we are saying is that if *Q* has occurred *P* must have occurred. Let us take "*p*" to be the statement "*P* has occurred" and "*q*" to be the statement "*Q* has occurred". Given this the statement "*P* is necessary for *Q*" will be equivalent to "*q* cannot be true unless *p* is true" or simply "*q* implies *p*". This is expressed in the propositional calculus as "*q* --> *p*". If *P* is a SUN condition of *Q* this will be expressed as "*p* --> *q*".

Taking "*r*" to be the statement "*R* has occurred" we can now express an N&S condition. *P* and *Q* being necessary for *R* will be expressed as "*r* --> (*p* & *q*)" and *P* and *Q* being sufficient for *R* can be expressed as "(*p* & *q*) --> *r*". A state of affairs where "*r* --> (*p* & *q*)" is true and "(*p* & *q*) --> *r*" is true is known as mutual implication and is expressed as "*r* <--> (*p* & *q*)". The symbol "<-->" is known as the biconditional.

In the early days of the propositional calculus mutual implication was indicated by a symbol consisting of three parallel lines. This was sometimes known as "logical equivalence" or "identity". The term "logical equivalence" is justified by the fact that the formulae on either side of the biconditional will have the same truth value. Equating the biconditional with "identity" is much more contentious and few present day logicians would be inclined to do so. Identity is considered to be a stronger relation than mutual implication. Any case in which identity holds will be a case in which mutual implication will hold, but the reverse is not true, not every case of mutual implication will be a case of identity. Modal logics extend this distinction to implication, they distinguish between "material implication" denoted by "-->" and "entailment". Entailment is the stronger relation that includes, but is not included in, material implication.

This brings us back to Probert. If the conceptual models are essentially causal in nature then material implication and mutual implication are the strongest relations we can use. If conceptual models are essentially definitional, as is contended in this paper, then the stronger relations of entailment and identity can be used.

Figure 1 gives an example of a conceptual model that could have been built by traditional SSM methods. An imaginary Logico-linguistic Model, that could have been built out of Figure 1, is shown in Figure 2. The development has followed a number of rules, these are briefly as follows:

4.2 Rules of conversion and expansion

Rule 1. Convert commands into statements.

Figure 2 is expressed in the language of commands. In order to use traditional logics, such as the propositional calculus, we require statements. A command such as "make a call for papers" can be expressed as a parallel statement as follows: "the command *make a call for papers* is, was or will be, obeyed". For the sake of brevity and elegance this is rendered as "a call for papers is made" in the figure.

Rule 2. Include conditions that are sufficient but not necessary (SUN conditions).

The arrows in SSM Conceptual models indicate necessary conditions. So, in figure 1, we find that 5 is a necessary condition of 6, and 4 is a necessary condition of 5. In causal terms this would mean that 6 cannot happen unless 5 happens and 5 cannot happen unless 4 happens. However, if we take the relations to be definitional then we will say that the truth of 6 entails (logically implies) the truth of 5, and that the truth of 5 entails the truth of 4. To these relations of necessity we can add relations of sufficiency. These are indicated by broken lines in figure 2. Here 10 is sufficient for 1, which, in causal terms, means that if 10 happens 1 must happen. However, 10 is not necessary for 1 because 1 can happen without 10 happening; in the case in point this would be when 11 (which is also sufficient for 1) happens. Therefore, 11 and 10 are individually sufficient but unnecessary for 1, i.e. they are SUN conditions. SUN conditions are not mutually exclusive, that is both 10 and 11 can happen. In the language of causation we would say that 1 can be caused by 10 or 11 or both. Taking the relations to be definitional we can say that the truth of 10 entails the truth of 1 and that the truth of 11 also entails the truth of 1.

Rule 3. Make sure that all possible SUN conditions are included.

There are two ways of defining a class: extensive definition and intensive definition. An extensive definition specifies all the members of the class while an intensive definition gives the criteria for class inclusion. If we think of 1 as a class, the class of calls for papers, 10 and 11 can be regarded as members of that class. If they are the only logically possible members of the class, then they will constitute an extensive definition. This can be expressed in the propositional calculus as follows:

$$1 \longleftrightarrow (10 \vee 11)$$

Taking the biconditional here in the strong sense of "identity" this formula states that 1 is the logical equivalent of 10 or 11 (or 10 and 11). In in other words they are the same thing. In terms of the development of the model what has happened is that the stakeholders' have defined 1 as being 10 or 11 (or 10 and 11). Put another way, what "a call for papers is made" means is that "*a call for papers is published in a periodical* or *experts are individually requested to produce papers* or both".

It must be noted that if all the logically possible SUN conditions cannot be specified then we cannot have an extensive definition. If is possible for there to be SUN conditions that we do not know about then the class must be defined intensively.

Rule 4. Make sure that the set of necessary conditions is sufficient.

Figure 2 shows that 2 is a necessary condition of 3. But it is not sufficient for 3, it possible for 2 to happen without 3 happening. To make sure that 3 happens we must add more necessary conditions (Gregory 1991) namely 25 and 22. Now the set comprising 2, 25, 22 is sufficient for 3. As 2, 25, and 22 are each also necessary for 3, we can say that the set comprising 2, 25, 22 is a necessary and sufficient (N&S) condition of 3. In symbols:

$3 \longleftrightarrow (2 \;\&\; 25 \;\&\; 22)$

Again taking the biconditional here in the strong sense of "identity" this formula is a complete intensive definition of 3. It states that if anything is to count as a paper distributed to referees then that paper must have been received, it must have had competent referees selected for it and it must have been distributed to the referees. Any paper that does not meet these three criteria cannot, by definition, count as a paper distributed to referees.

4.3 Establishing what is definitional

The words used to express definitions do not always, or even usually, indicate that what is being expressed is in fact a definition. Looking at a defining statement in isolation we will find that it could just as easily be a statement of fact i.e. an inductive hypothesis or a statement based on an inductive hypotheses. For example, "Manx cats do not have tails" could be part of the definition of a certain breed of cat, or it could be an empirical statement about the cat population on the Isle of Man.

The problem is compounded by using process definitions and extensive definition. People tend to think that a statement about a process is always a statement of contingent fact. Likewise statements that specify all the members of a class are usually factual rather than definitional. People are, therefore, likely to think that they are never definitional. They are apt to find unconvincing the definition of "a call for papers" as "something published in a periodical or individual requests to experts". However, we easily imagining a case where the stake-holders would give the term "a call for papers" this unusually narrow meaning. For example, it might be that this is specified in the constitution of the organization concerned.

One of the main tasks of the facilitator in the construction of a Logico-linguistic Model will be to distinguish definitions from contingent statements of fact.

4.4 Logical expression

Figure 2 can be expressed in the propositional calculus as follows:

Formula 1

6 <--> ((29 & 5 & 28) & (5 <-->(4 & 27)) & (4 <--> (26 & 3)) & (3 <--> (2 & 25 & 22)) & (22 <--> (24 & 23)) & (2 <--> (19 & 21)) & (19 <--> (9 & 15 & (17 v 18 v 20))) & (15 <--> (13 & (14 v 16))) & (13 <--> (12 & 1)) & (1 <--> (10 v 11)))

This enables us to make a number of inferences. We can derive the following:

Formula 2

6 <--> (29 & 28 & 27 & 26 & 23 & 24 & 25 & 21 & 9 & 12 & (10 v 11) & (14 v 16) & (17 v 18 v 20))

Formula 2 states that if all the necessary conditions and one from each of the three sets of SUN conditions from figure 2 are fulfilled we will have a state of affairs in which papers are grouped into sessions and chairmen for each session are selected.

These types of formula can have direct practical application. They can be used as the basis for system control algorithms (Gregory 1991) and a logical account of system efficiency can be expressed as the choice between SUN conditions (Gregory 1992a). However, the most important application is likely to be in information system design.

5 TOWARDS INFORMATION SYSTEM DESIGN

5.1 The general and the particular

The elements in the Logico-linguistic Model are general terms. The expansion of the model using general terms and the rules given above can only go so for. Eventually general statements will have to be broken down into particulars. For example, a break down of "Experts exist" would have to be statements of the form "Adrian Adams is an expert" or "Betty Brown is an expert" which have reference to particular states of affairs and are true or false depending upon whether that state of affairs obtains or not. This marks a profound change in status with regard to meaning, logic and epistemology. Hither to, the truth of the statements in the model could be established by deduction and definition. This is no longer possible, and the truth of the particular statements must be established empirically.

Also the general statements in the model, those expressed in Formulas 1 & 2, are necessarily true (because the stake-holders' have set it up that way) while the particular statements are contingent. This is evident if we consider time. The model comprising Formulas 1 & 2 will be true for all time but the particular fact that Adrian Adams is an expert will indubitably become false at some time in the future. The definitional general statements which the model expressed could be taken as the axioms of a formal system while the particular statements could be taken as instantiations of the system.

Parallels to computerized information systems can now be drawn. A correspondence can be seen between general statements with their logical connections and the structure and processes of a computerized information system. Particular statements have a correspondence to data items. This is most evident in declarative language programs such as Prolog. The Logico-linguistic Model can be expressed in the predicate calculus and in this form the general statements have the same structure as Prolog rules while particular statements have the same form as Prolog facts (Gregory 1992b). In data base design particular statements correspond to records while fields correspond to the subject predicate structure of the particulars.

5.2 Similarities to "holons"

It seems that in information systems circles the term "interpretivist" is now being used to denote methods that imply that a social situation is open to more than one interpretation, while the term "positivist" is used to denote methods that imply that there is only one valid account of a social situation. In this sense SSM is interpretivist, as apposed to positivist, in its account of social events. This leads some people to believe that it must be subjectivist in its account of meaning, but this does not follow. A subjectivist account of meaning entails an interpretivist account of social events and this is why they tend to be found together. However, a rejection of subjectivist accounts of meaning does not entail that there is only one valid account of a social event. The language game theory of meaning is compatible with that idea that there are a number of equally valid ways of describing a social event. This is clear if we consider the similarities between Logico-linguistic Models and holons.

Checkland & Scholes (1990) use the term "holon" to denote a system of thought. As such a holon can be distinguished from a system in the real world. A similar distinction can be drawn with regard to Logico-linguistic Models. A Logico-linguistic Model is an extended definition and as such need not have any correspondence with the real world; the model could just as easily be that of the family tree of a Greek God as anything in the real world. A second important point about the notion of a "holon" is that there is no single holon that is correct in regard to a given situation. There can be a number of equally valid holons relating to the same situation. The same is true of Logico-linguistic Models; the same situation could be described using a difference set of definitions.

There is also a similarity with axiomatic systems here. The mere fact that an axiomatic system has been formulated is no guarantee that it has any correspondence with the real world. We also find that the same system, such as the propositional calculus, can be formulated using different sets of axioms.

Expanded into Logico-linguistic Models the SSM conceptual modeling method can be a way of producing axiomatic systems. This stands to be very useful because one of the problems with axiomatic systems is that there is no logical reason for anyone to accept them. If there are reasons for accepting a statement then that statement must be some form of inference not an axiom. Generally it is said that axioms are self evident, but this is just another way of saying that they are accepted without reason. Admittedly some axiomatic systems, such as arithmetic, seem to be very useful whereas others do not. Nevertheless, before an axiomatic system can be shown to be useful it must be accepted, if only tentatively, and there is no reason to do this. SSM can pragmatically avoid this problem; as the stake-holders make up their own axioms the question of their acceptability does not arise. However, the question of their usefulness does arise.

In some forms of activity all that seems to be required is a holon or logico-linguistic framework. For example, we can invent a game. All we need for a new game is a group of players who will agree to a set of rules and abide by them. The case is different when we consider the tidal wave that recently killed over 100,000 people in Bangladesh. This happened quite independently of our holons or logico-linguistic framework. However, the disaster could have been prevented or at least mitigated if we had a Logico-linguistic Model that corresponded to the way the weather behaves. In some, but not all applications there is the need for models that will map on to the real world. This will include any information system that is concerned, in any way, with predicting any physical events.

5.3 The problem of reference

Holons, Logico-linguistic Models and axiomatic systems are of limited use unless they map on to the real world. This mapping or isomorphism, as Hofstadter (1980) calls it, will only take place if there are particular instantiations of the general statements. Unfortunately there are logical difficulties here because what is to count as an instantiation will be determined by the structure of the Logico-linguistic Model or axiomatic system.

There is good reason to think that a solution can be found by expanding the model to include inductive hypotheses as well as definitions and particulars (Gregory 1992b). However, preliminary research indicates that the solution is not simple and may require the use of modal logics and non-monotonic logics.

6 CONCLUSIONS

Logical Atomism and Logical Positivism are the most forceful attempts at a subjectivist account of meaning. The leaders of these movements all abandoned this idea in their later writing. The subjectivist account of meaning takes us back to the beginnings of Logical Atomism. There is, therefore, a danger that the information systems literature will start to rerun a futile debate that began in the 20s and finished in the 60s. This will not be necessary if due attention is given to the legacy of Wittgenstein.

Understood as a language game the SSM iterative debate provides both a firm theoretical foundation and a powerful practical tool for the development of information systems. Computer systems are rule bound and formal. It has been argued above that there are rules implicit in SSM conceptual models. these rules can be developed and formalized in Logico-linguistic Models. This opens the way for the rigorous development of computerized information systems that need not be limited by the subjective ideas of professional analysts and designers.

7 LOGICAL NOTATION

$-p$ means not p (negation). It is true when p is false.

p & q means p and q (conjunction). p & q is true only if p and q are true.

$p \vee q$ means p or q or both (alternation). $p \vee q$ is true if p is true or if q is true or if p and q are true.

$p \rightarrow q$ means if p then q (the conditional). $p \rightarrow q$ is only false when p is true and q is false, otherwise it is true. Sometimes known as *implication*.

$p \leftrightarrow q$ mean p if and only if q (the biconditional, sometimes known as logical equivalence or identity). $p \leftrightarrow q$ is true if p and q are both true or if p and q are both false, otherwise it is false.

8 ACKNOWLEDGMENTS

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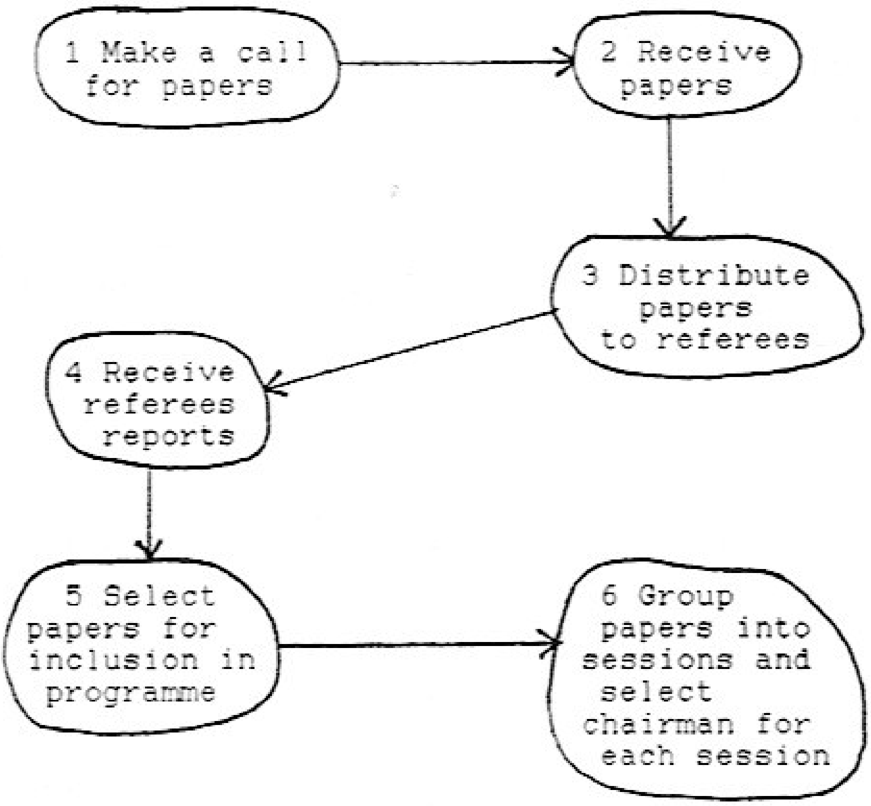
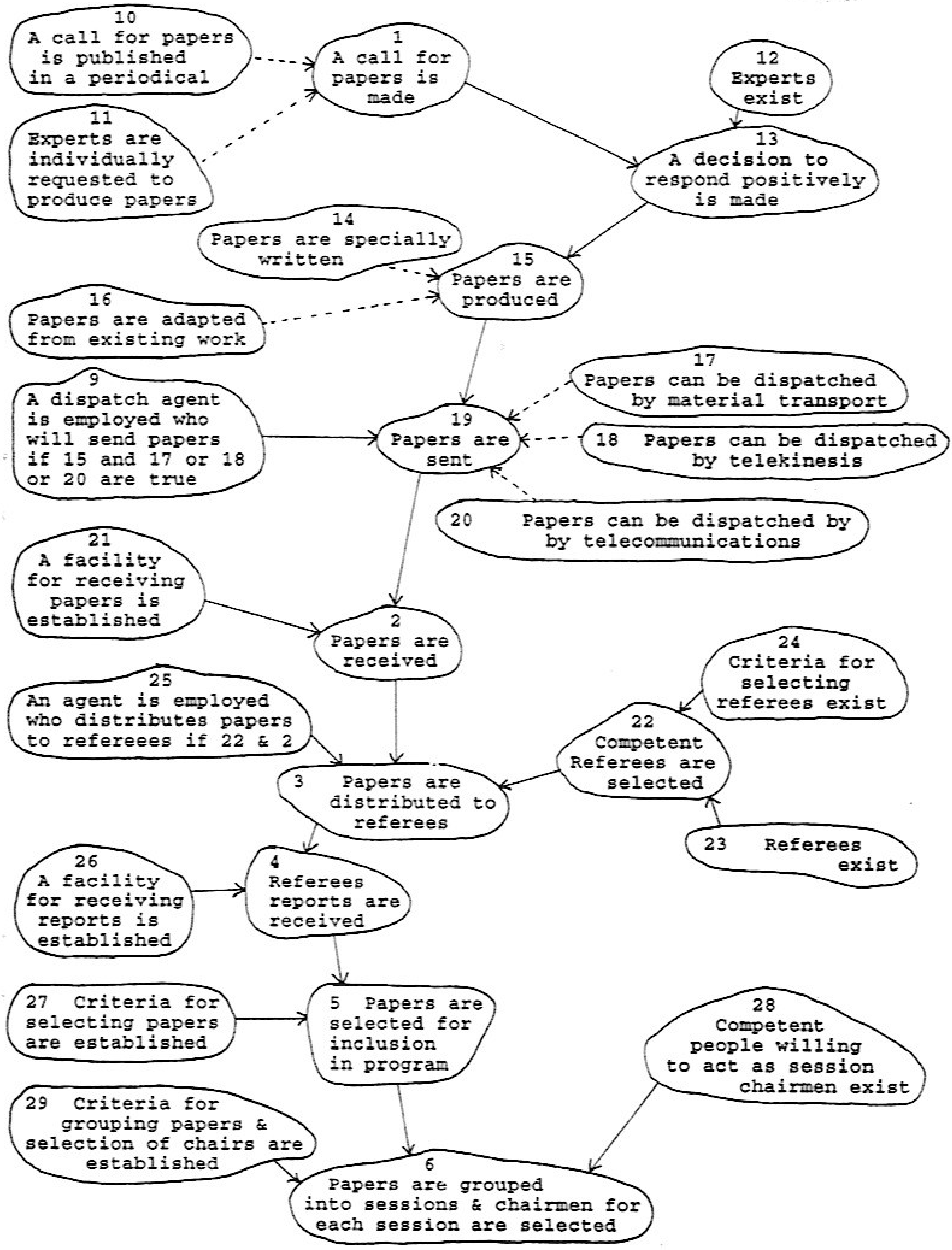

1 Make a call for papers
2 Receive papers
3 Distribute papers to referees
4 Receive referees reports
5 Select papers for inclusion in programme
6 Group papers into sessions and select chairman for each session

Figure 1



10 A call for papers is published in a periodical
1 A call for papers is made
12 Experts exist
11 Experts are individually requested to produce papers
13 A decision to respond positively is made
14 Papers are specially written
15 Papers are produced
16 Papers are adapted from existing work
17 Papers can be dispatched by material transport
9 A dispatch agent is employed who will send papers if 15 and 17 or 18 or 20 are true
19 Papers are sent
18 Papers can be dispatched by telekinesis
20 Papers can be dispatched by by telecommunications
21 A facility for receiving papers is established
2 Papers are received
24 Criteria for selecting referees exist
25 An agent is employed who distributes papers to refereees if 22 & 2
22 Competent Referees are selected
3 Papers are distributed to referees
23 Referees exist
26 A facility for receiving reports is established
4 Referees reports are received
27 Criteria for selecting papers are established
5 Papers are selected for inclusion in program
28 Competent people willing to act as session chairmen exist
29 Criteria for grouping papers & selection of chairs are established
6 Papers are grouped into sessions & chairmen for each session are selected

Figure 2