The Soft Information Systems and Technologies Methodology (SISTeM): A Contingency Approach to Integrated Decision Making and Development

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ABSTRACT: *This paper describes the Soft Information Systems and Technologies Methodology (SISTeM) and provides a history of its evolution to underpin the proposal that it can be considered a contingency approach to integrated decision making and subsequent information systems and organisational development.*

Keywords: Soft Information Systems and Technologies Methodology, SISTeM, Information Systems, SSM,

INTRODUCTION

This paper describes the Soft Information Systems and Technologies Methodology (SISTeM)(Atkinson 1995). This is followed by a concluding discussion of SISTeM's development, through a series of real world in which the integration information systems and technologies with human processes featured strongly. This leads to the proposition that SISTeM may be considered a contingency methodology (Avison and Fitzgerald 1995,1999) to integrated decision making and development.

SISTeM, ITS CYCLES, TOOLS AND TECHNIQUES

SISTeM has its antecedents in the work of Checkland (1981) and his co-operators (1984)(1990) in the field of Soft Systems Methodology (SSM). However the methodologies differ in a number of ways. Firstly SISTeM is based on the concept of the human/machine activity system as opposed to Checkland's (1981) purposeful human activity system. Secondly SISTeM has two cycles rather than one. Cycle 1 focuses on high level, strategic decision-making, decisions of principle. Cycle 2 encompasses operational decision-making, decisions of action followed by the processes of change. For the actors in the problem situation, SISTeM's cycles, stages, tools and techniques facilitate a process of action-based problem solving and learning. They may be applied sequentially or in isolation, overtly or covertly, once or indefinitely. Stakeholders have played an active role in SISTeM's application and development.

Cycle 1 Strategic Decision Making

This cycle has seven stages, see Figure 1. These are similar to SSM's however they differ significantly in their content. The first stage (1.1) encompasses not only the tasks and issues present in the problem situation but also encompass a social analysis, a political/power analysis, a market and organisational competencies analysis, information systems and management analysis and a technology analysis. All of these contribute to drawing up a rich picture of the problem situation from which in stage (1.2) relevant human/machine systems are formed. In practice these have sometimes been integrated to form schematics or networks of interrelated relevant systems. This has been useful when dealing strategically with whole organisations or multiple organisational stakeholders.

In stage (1.3) root definitions and models of human/machine activity are drawn up stemming from the relevant systems. These to date have taken three forms: conceptual models, expressive models and matrix (hybrid) models. The first is similar in form and structure to those of SSM, except that machine (information) activities are integrated with the human activities see Exhibit 1. Expressive models have the same form as conceptual ones, however they differ in their origin. Whereas conceptual models are logically derived from a root definition, actors create expressive models of current real world or potential human and/or machine activities that they see as of relevance to their situation. Often these take the form of current human activities with conceptual information activities added. (The act of expressing these models has alone spontaneously trigger actor debates about both IS development and process reconfiguration). A final model form has emerged from practice. These are matrix models and have been developed whilst working with groups at the strategic IS level. As the name suggests these have the capacity to represent organisational and interorganisational landscapes created by the integration of human and machine activity. Organisational processes (competencies) make up the vertical axis and informational systems stages of development the horizontal. Cells in the matrix are populated with information requirements, a technology specification, organisational development, IS and organisational benefits accruing and the organisation(s) covered.

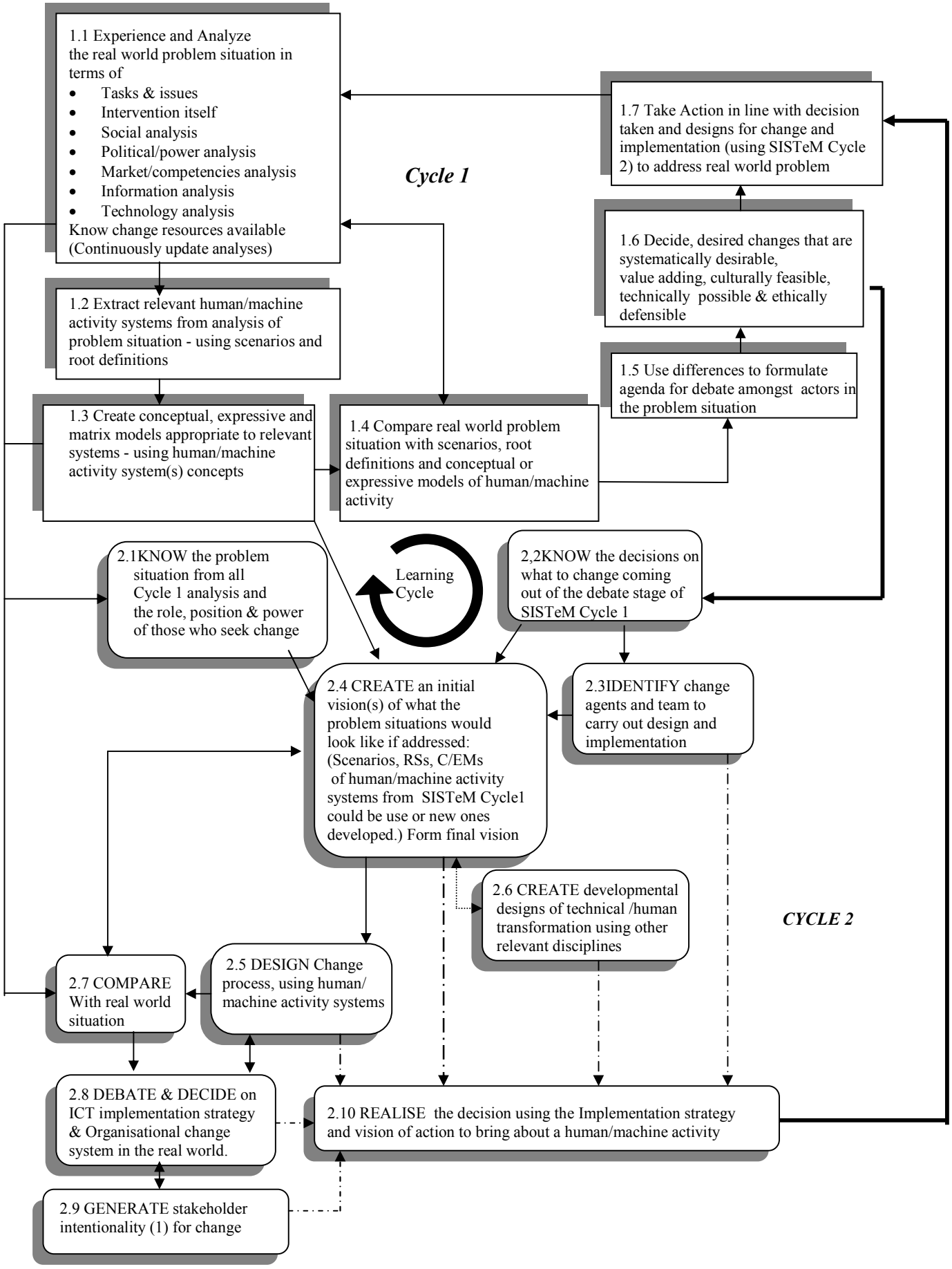


Fig 1 The Soft Information Systems and Technologies Methodology

In the comparison stage (1.4) the activities in the model are compared with the problem situation to form an agenda for the debate (1.5). In practice within SISTeM these have often melded together into single process with the debate stage. The debate (1.6) itself is one in which various interests and agendas arise. It has both rational and irrational elements, being replete with exercises or power, influence and politics. It results typically encompass *imbroglios* of *organisational* development, cultural change, political aspirations, IS applications, technical specifications, possible architectures, and global budgets. Decision criteria arising from practice are that changes be: *systematically desirable, culturally feasible, organizationally value adding, informationally and technically feasible and ethically defensible*. The intended outcome, though not always achieved, is a 'robust accommodation' between the competing agendas and actors on a strategic, decision in principal, to proceed to change and Cycle 2.

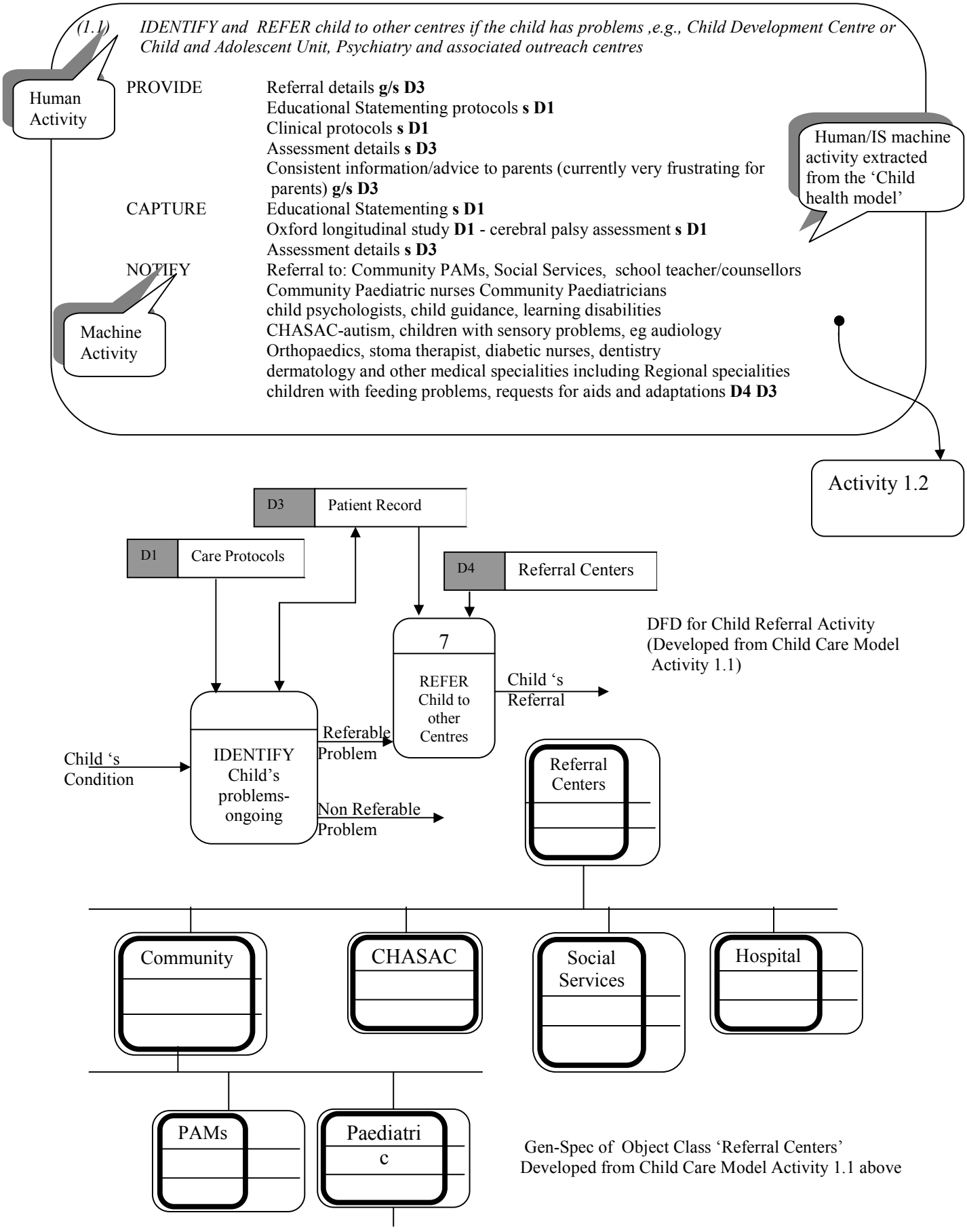
Cycle 2 Operational Decision Making and Realisation

Cycle 2 (see Fig. 1) commences with three activities necessary to bring the both Cycles to fruition. In (2.1) the problem situation is revisited and any changes that may impinge upon operational decision-making are noted. In the light of this the original strategic decision is often revisited and reviewed (2.2). This could result in a return to Cycle1. A guarantor(s) is (self) appointed someone that can at least ensure that the original decision is given a full hearing in Cycle 2 and that an operational decision is pursued. A team or group who will bring this cycle to fruition is identified together with an initial scope and an overall budget set down (2.3). Having established the necessary conditions a vision, or visions, relevant to the strategic 'decision in principle' are created (2.4). This can take the form of a human/machine conceptual model, an expressive or a matrix model. They become in Cycle 2 'developmental models'. Modelling (2.6) from other disciples associated with informational and organisational development often accompany the vision and can be derived from it (this will be explored in the next section). For example: data flow diagrams, entity relationship diagrams, entity attribute tables, object oriented gen.-spec diagrams, use cases, role activity diagrams, applications output-based specifications, process reconfigurations, organisational development programmes, outline business cases. As well as the modelled vision or visions relevant to the original decision a human/machine model of the potential 'system to bring about the change' is formed (2.5). This has been subsequently formed into a (Avison and Fitzgerald, 1995) Gantt chart and used to manage the project.

Having achieved a model vision or models of the potential change and the process of change, these along with any IS models or other documentation are compared (2.7) with the current problem situation and an agenda for the operational debate is formed. In stage (2.8) the decision making amongst the relevant stakeholders takes place. The focus in this stage and for Cycle 2 is on coming an overt (though sometimes disingenuous) commitment to go forward with the change, or not. In the latter case this may result in a return to Cycle 1 or abandonment of the project altogether. If any operational decision is achieved this results in an overt commitment of personnel, time, finances, resources, project programme, build, outsource or buy IS options and the organisational upheaval that such change entails. Achieving this decision will, again, be the result of much corridor work and behind closed doors lobbying by the team and stakeholders involved, backed up if not led by the project's guarantor. Rational arguments will be more prominent than in Cycle 1, on funding, contracts, organisational reconfigurations, benefits and IS designs, IT architectures and functionality. Though the power plays and political manoeuvrings will still be there. Again all the decision criteria will come into play. The more rational technical and value adding criteria will predominate. One result of the debate is that an 'intentionality to take the decision forward' will have been established (2.9) within the team and wider constituency of stakeholders that took part in the debate. This will have of course to be engendered throughout all or the relevant parts of the organisation, if the change is to be successful.

The next and final stage (2.10) is to realise the operational decision. This entails creating a human/machine activity developmental model of the operational decision to change and the process to bring about the change decided upon. SISTeM is not a methodology for perpetrating the actual transformation of human and ICT activities within or across organisations. There are other professions, disciplines and methodologies, as well as experiential based craft practices that are far more pertinent, well-tried and effective in this area. The deployment of other disciplines, methodologies, (Avison and Fitzgerald, 1995) their tools and techniques (2.6) is however orchestrated through SISTeM's developmental models of the decision to change and can sometimes be directly derived from them (see Exhibit 1). Other disciplines have taken the form of information systems design modelling tools and techniques, process reconfiguring approaches (though SISTeM models can also do this), simulation modelling, Role Activity Diagram 'to be models', training programmes, out put based specifications to support IS applications procurement and so on. Political and cultural change will also have to be addressed. The project's guarantor and change team are charged with marshalling these disciplines in pursuit of a realisation (rather than an IS implementation) of the envisaged operational decision. They also develop and deploy project plans, accommodating them to prevailing contingencies. Of course what is realised will only be in part what is envisioned in Cycles 1& 2.

Exhibit 1. Illustration Human/Machine Activity Extracted from Child Care Model and derived DFD and Objects



The realising of the operational decision if successful (even if not) results in a new problem situation. New issues and opportunities arise and SISTeM is again available to support the actors in their task of dealing with this new situation, facilitating further problem solving learning cycles that are potentially never ending, manifesting what Paul (1993) calls a 'living systems' approach. This is the opposite of what he sees as the 'fixed point' theorem of the one-off requirements based development life cycle that underpins many data-driven information systems development methodologies (Avison and Fitzgerald, 1995). In taking this form SISTeM is typical, it will be argued in the next section, of a contingency approach to integrated IS and organisational development and problem solving.

SISTeM A CONTINGENCY APPROACH TO INTEGRATED DEVELOPMENT: A DISCUSSION

From earlier research into soft projects it was observed (Atkinson 1987) that '…The actual methodologies used in soft systems projects are contingent upon the *context*, the *use* and the *users* of that methodology'. This has been evident in SISTeM's developmental trajectory and will be the basis for arguing that SISTeM can be viewed as a contingency approach to integrated decision-making and development as envisage by Avison and Fitzgerald (1999).

SISTeM Cycle l emerged out of the contingencies of a project (Atkinson 1997,) with an IS focus in which the client requested the use of a soft systems approach. The work was to assist a multi-professional group convened by the UK NHS Executive, to come to a shared appreciation of what constituted an 'electronic patient record' (EPR). This was necessary to their arriving a decision on whether and how to take forward a national multi-hospital pilot project on the EPR (Atkinson, 1997) in the UK. The project's modus operandi was to build up 'primary task' (Wilson 1984) conceptual models of doctor's and nurse's clinical practice and to use these to stimulate discussion and debate amongst the group members as to what would be the EPR's functionality in support clinical practice. This took place and lead to the EPR being seen not just a record, but also a complete electronic clinical environment that was an active constituent within clinical practice and a hospital's management. The methodological problem was how to model this role systemically. This was addressed by changing SSM's (Checkland and Scholes, 1990) underpinning concept from the 'purposeful human activity system' to that of the *'human/machine activity system'*. The result was that a machine's activities, in the form of verb-noun combinations – see Exhibit 1, similar to those that represent human activity, were incorporated into systems models and root definitions. Leading on from this an EPR development pathway was extracted from these models and formed into four schematics stages for 'growing not building' (Atkinson and Peel 1998) a hospitals electronic clinical systems infrastructure. An IS architecture was subsequently derived. This resulted in a shared appreciation in the group of the EPR and 'active clinical systems' and the project proceeded. The schematics underpinned the project initiation documents and supplier contracts. From this came the idea of a methodology that could in all its activities accommodate machines as well as humans.

The next stage in SISTeM's development as a contingency approach was through a spin-off to the previous project. It took place in one of the EPR national pilot project's associated hospitals, then in the early stages of procuring an IS application on which to base a clinically focused hospital wide IS infrastructure. The NHS Executive sponsored the project, to explore further the concept of the EPR. It was intended to support the hospital's multi-professional project team in understanding what they required in terms of the hospital's IS functionality and then to use it as part of the assessment of prospective supplier applications. The' primary task' *human/machine conceptual model* developed in the previous project was seen as lacking in cogency within this context of a major procurement. It did not capture the richness, the complexity of clinical practice and the information currently in place or missing, and so *expressive models* were born. The contingencies of the project necessitated capturing through interviews and groupwork the clinical activities enacted by a large number of clinicians along a whole pathway of care, one such model was breast surgery. The model, using the verb/noun structure, spanned the initial referral and assessment, through admission, surgery, resuscitation and pain control and then to recovery, intial discharge and follow up through to final discharge or death. Over forty clinical activities were identified by the clinical professionals and treble that number of associated informational activities with their existing or needed data items were extracted. The model was shared with potential users and changed in the light of their comments. It had considerable utility in revealing to the professional and managerial stakeholders involved and the project team, the complexity of information that was currently used and it's multiplicity sources. Issues surrounding current clinical practices and processes and the lack of information spontaneously surfaced and were explored and addressed. As the procurement was intended to enhance all facets of care delivery and its management, including finances and clinical audit, relevant systems covering all these aspects were identified and integrated into a schematic. This captured the whole range of relevant systems and their interrelationships any future IS procurement was intended to enhance. Expressive models and conceptual models of these were formed. The project team used them to explore the project's scope and evaluate contractor applications. The contingencies of this project resulted in the new form of *expressive modelling* and the *schematics of relevant systems*. SISTeM's *Cycle 2* for supporting, as in this case, operational

decision-making and change subsequent to a prior strategic decision was also delineated from this project. All were important developments for SISTeM.

A further project involved replacing the legacy patient administration system (PAS) used in a number of hospitals across a NHS Region with a one that had a large data repository facility that would support clinical practice, clinical audit and management to which in-house developed systems could be linked. These in-house information systems would in turn act as data-feeders to the repository. SISTeM rich picture building and modelling, working with in-house IS professionals and clinicians lead to the idea of deriving *designs of information systems using standard modelling tools directly from expressive models*. This proved feasible and resulted in the DFDs, Entity relationship models and attributes, objects and use-case being derived directly from SISTeM's models (Exhibit 1 illustrates this).

Another application of SISTeM was to support a multi-stakeholder/organisation project in which a strategic decision had to be taken to proceed to or not to a new IS infrastructure. The IS would support rapidly evolving clinical and managerial processes in a community care NHS Trust and link to other healthcare organisations; hospitals, GP surgeries, Health Authorities, Primary Care Trusts. The contingencies of this project resulted in the *matrix model* form being developed (Atkinson 2000). It was created to map out a strategic landscape of integrated IS and organisational development along a six stage maturation pathway. *Expressive models* (in Exhibit 1) were also used. Post a positive decision to procure aspects of SISTeM's Cycle 2 were used by the multi-professional team to create an output based specification which they then used in choosing an IS application. This (and other projects) entailed developing and deploying a project process plan based on a human/machine project *developmental model*.

SISTeM's history of development, as illustrated above, has been shaped by both the contingencies it had to meet and its soft systems antecedents. The latter has given the approach its adaptability and capacity to be adapted by, those who use it and the circumstances of its use. Its cycles, stages and tools can and have been 'omitted, carried out in different sequences' if and when required. Often they have been used unconsciously. The former action based research and learning over a range of projects has developed it substantively. The result of this is that SISTeM actively seeks to facilitate the integration of human and technological development through the concept of the human/machine activity system. Working both, instrumentally and normatively (Pouloudi 1999) with multiple stakeholders in applying SISTeM has been the norm. The additional decision criteria *organisationally value adding, informationally technically feasible and ethically defensible* came out of several healthcare projects. It actively merges with other disciplines, ISD and OD methodology as well real world craft practices to address the contingencies of the problem situation. Finally SISTeM encompasses within it competing paradigms. These range from the *formal/rational* in its modelling and information systems and organisational process development, *interpretativism* in its rich picture building and its expressive models and the *social/political* aspects of decision making and organisational transformation. SISTeM seeks to accommodate the incommensurablities in these paradigms within the analytic domain, its real world practices and especially in the human/machine activity systems underpinning framework. From the above description and discussion it is argued that SISTeM in its emergence, its philosophies, its cycles, stages, tools, decision criteria and its use is a 'contingency methodology' (Avison and Fitzgerald 1995,1999), one capable of facilitating integrated decision-making and human/machine development.

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