EQUIFINALITY IN PROJECT MANAGEMENT

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ABSTRACT

Projects are the best means of creating and diffusing innovation in complex and risky environments. However, surveys reveal that the majority do not achieve their goals and waste huge amounts of resources. Notorious examples are the NHS NPfIT project, which has massively overspent its initial budget by £10 billion in addition to lagging behind completion by several years, and many multibillion EU funded projects involving innovations that were abandoned after the pilots.

Research from academics and practitioners in the past two decades suggests that this failure is the result of using conventional project management methods, which fail to capture the serendipitous, evolutionary and experimental nature of the activities in innovation projects. Therefore the question remains as to the best method to manage projects that involve high levels of change.

The results of my previous research based on multiple EU healthcare innovation projects revealed that a key concept taken from system thinking is most suitable to be developed into a method that helps managing change in projects. This concept, called equifinality, refers to the fact that similar results can be achieved flexibly through different trajectories and in spite of initial circumstances. However a robust method based on equifinality has not yet been established, which is the basis for this proposal. The research question is: How can the system thinking concept of equifinality be applied to current project methods, so as to empower project managers in the handling of change, thereby improving the achievement of their goals?

This paper critically assesses the ways equifinality has been explored in previous research in other fields of management like operations and manufacturing, the discontinuous application of system thinking in management research and explores methods based on multiple case studies and triangulation through which equifinality can be explored further in project management. The issues of holism and interdisciplinarity are discussed as critical to the application of system thinking in project management.

This research does not only provide a new theoretical framework. By taking a concept from one theoretical field (system thinking) and applying it to another (project management), it proves that academia will benefit substantially because by crossing its disciplinary boundaries theory will be enriched through a more holistic way of organizing, improving both the relevance to practice of explanatory rigour of theory and methods

Keywords: equifinality, system thinking, research design, project management

INTRODUCTION

Background

The emergent need for change in academia and industry regarding project management
The field of project management has been dominated since 1969 by a prescriptive paradigm that places an emphasis on process control metrics and the artificial separation of planning and execution in the design process. This emphasis stems from engineering closed- systems, which can be isolated from the environment and manipulated to achieve the desired results under certain specifications. Goals are predetermined, objectives are clear, the sequence of activities is prescheduled and it is just a matter of the managers supervising the execution of activities, who are accountable for any deviation or change. Advocates of the closed systems paradigm employ operations management techniques, such as queuing, scheduling and resource planning in project management for efficiency. These techniques are very effective when applied to predictable activities with clear goals, controllable sequences and predictable results, but in the case of innovation projects regularly involving fuzzy missions and goals, with objectives that are not clearly rooted in a fixed reality, and solutions that need time to emerge, these techniques have been found lacking (Lenfle, 2008; Lenfle and Lock, 2009). More specifically, the fact that innovation projects fail at a high rate has led to the realisation that given the prescriptive paradigm provides universal predefined solutions, there is the implicit assumption that it can predict project conditions accurately, which leads to overlooking the need to provide methods that allow for flexible management.

With the aim of addressing these shortcomings, various recent academic publications reflect on the gap between knowledge and application in practice. Crawford et al. (2006) and Kwak and Anbari (2009) describe the transition from network analysis and planning techniques in the 50-60s, through to teamwork, breakdown structures and systems concepts in the 70s, then on to the ideas of: organization, risk, front end, external influences and standards in the 80s. These authors point out that project management techniques have become packaged goods, which are applied in a piecemeal fashion, surviving only for short periods and consequently there is little opportunity for in-depth learning and debate about the nature of practice stemming from them. Recent academic research(Alderman, Andersen and Winch, 2007) have sought new conceptualizations (such as projectification, actuality, multiple programme management and critical research) aimed at improving project management practice. More specifically, the trend, as evidenced in conferences like EURAM, IRNOP, etc (Geraldi et al., 2008) is to broaden the pool of perspectives, rather than focus on producing more prescriptive techniques. The '*Rethinking Project management EPSRC Network 2007*' project identified the five areas of improvement in the current paradigm, that is, it was concluded that any new theory should be based on practice focussing on the elements of complexity, social process, value creation, practitioner development and the broadening of conceptualization (Winter and Smith, 2006).

Practice, on the other hand, suffered when managers tried to use prescriptive techniques that did not work as intended, thus leaving managers having to improvise. The Stantish Group (2000) found that only 28% of ICT projects were successful, whilst 23% were

written off before completion, with the remaining 49% failing in terms of cost, time or scope. In particular, this failure is attributed to management methods that do not address the projects' exceptional level of sensitivity to initial conditions and even to small changes (Tan, Wen and Neveen, 2005). In response to these shortcomings, leading practitioners in the field have been developing new models, with most being applied to ICT projects, as these projects need approaches that embrace change. Various ad hoc models have been invented to counteract the prescriptive Waterfall model, which was the dominant project management tool in early ICT projects and two types of these can be distinguished: those that try to get more operational techniques infused into project management practices, such as: lean project management, kaizen, critical path, 6-Sigma and TQM project management. The second type are those with aim of combining control with change, which include Iterative and Incremental software development, the V-Model, the Spiral (compromise between the Waterfall and Prototype models) the Iterfall (compromise between the Waterfall and the Iterative models). However, the scope of the experimentation involved in such models was rather limited, as they did not go beyond the prescriptive rules of conventional practice. Recognising this, the Agile project management model was officially launched in 2001 with its own Manifesto, which was used to spread the ideas of flexible product development through iterative decision making (decisions are based on the lessons from previous decisions) and strategic flexibility (to avoid irreversible decisions). However, systematic research in agile methods is still anecdotal (Chow and Cao, 2008).

Both academics and practitioners have realized that in innovation projects there is a need to escape the constraints of the prescriptive closed- system paradigm. That is, they recognize that although projects need planning, design and operational control, because they are unique, complex and uncertain endeavours, instead of trying to oppress or avoid the uncertainty and ambiguity that is embedded in them, order and change should be balanced to harness both to the maximum, by using constructs from generic management approaches that can be adapted to benefit all possible project settings. In this regard, I would contend that the focus should shift away from the theories of operational control, towards a system thinking approach to project management.

Comparing the main issues in prescriptive and systemic project management methodologies

Project management is a systems brainchild- it looks at the organization of parts in a project system and their interaction. However, although initial management approaches such as in the Manhattan project were based on open- systems, later established prescriptive methodologies took after an engineering, closed- hard systems, operational research approach (Engwall, 2003). The difference between a closed and an open systems approach in projects is ontological and epistemological in regards to planning and managing change and contingency.

More specifically, the two theoretical streams in project management (as depicted in Table 1) place emphasis on either control mechanisms and/or change (Mantel and Meredith, 2000; Dunkan, 1996). The prescriptive (closed systems) approach was devised to provide a theoretical framework for facilitating control and evaluation (Crawford and Pollack, 2004), being founded on engineering/construction practitioner- led models

(Söderlund, 2004; Shenhar and Dvir, 2007) which achieved a universal status, owing to the monopolization of accreditation (Cicmil, 2006; Fitzerald, 1996). Under the prescriptive approach the project is perceived as an 'island', a closed system that functions predictably according to prescribed formulae (analytic plans, monitoring procedures and performance criteria) (Engwall, 2003; Hodgson, 2000), operating under a persistent instrumental logic, which ignores the fact that a project is a: socio-technical, complex and open system (Cicmil, 2006, 1997). This means that projects are designed according to models of rationality and thus do not incorporate social values (Heeks and Mundy, 2001). Thus, their plans, monitoring and performance criteria do not measure effectively any non- linear project processes. Later project management models were devised to overcome the weaknesses of the prescriptive approach, by introducing risk management and stakeholder consultation to control complexity and change, mostly for the needs of ICT projects. Although this approach incorporated more flexibility in managing change, it still carried the same instrumental rationale.

Techniques	
Prescriptive Approach	Prescribed control procedures (WBS, phases) and performance criteria (cost, quality, time) some incorporating stakeholder involvement and risk assessment
Systems Approach	*Both* formal monitoring procedures *and* informal mechanisms for flexibility and social interaction (Project management Systems, STS etc)

Table 1: The prescriptive and systems project approaches and their techniques (the author).

This instrumental rationale contains two fundamental flaws: presupposition of either internal or external control. Regarding the former, it is assumed that internal control can be achieved ignoring social context and contingencies. In this regard, Engwall (2003) argues that in prescriptive methodologies the tendency is to treat projects as closed operational processes, with their activities being treated as empirical` facts with scarce references to embeddedness and learning. Moreover, the structures, routines and relations spanning over successive projects are ignored and so are project memory and knowledge transfer. These presuppositions are not valid in nonlinear evolutionary processes (Smyth and Morris, 2007; Engwall, 2003; Koskela and Howell, 2002), where each project is its own unique system of production and has its own temporary governance structure and its economies/efficiencies are not in relation to scale, but due to recombination and replication (Davies, Gann and Douglas, 2009). In the case of innovation projects, their inherent uncertainty, complexity, and uniqueness make control more difficult and deviation from plans more probable, because plans are formulated for a set of contingencies that have not yet occurred (Sydow and Staber, 2002) and therefore cannot accurately be pre- planned.

Turning to the presumption of external control, prescriptive approaches overlook the need to negotiate action through boundaries. With respect to this, a balance has to be struck between specificity and inter- disciplinarity, autonomy and control, routine and creativity,

inclusivity and exclusivity in relation to the interdependencies crossing project boundaries, otherwise the closed- thinking of prescriptive project management rationales allows the inflexibilities of the external systems to be built or 'mirrored' into the project system. This mirroring or replication of external operational practices into project processes results in a paradox, in that whilst projects are a temporary organizational arrangement performing unique activities, they are aimed at serving long- term organizational goals (the opposite happens with operations being permanent organisational arrangements performing routines geared towards achieving short-term production goals) (Keegan and Turner, 2001). In general, under prescriptive closed-system approaches the techniques that are used for managing project activities are most suited for long- term predictable- operational activities (e.g. batch production), which is not the type of activities found in innovation projects (Lamers, 2002). That is, operational processes in projects are different to those in permanent organizations, therefore a separate model of operational control is needed for each project, that takes into account the whole system by extending its boundaries to include clients, inputs, logistics, outputs and other systemic components (Keegan and Turner, 2001). This is why control through boundaries in projects is designed around tasks and action, whilst in permanent organizations control is linked to hierarchy and governance structures. In other words, project boundaries are defined by their tasks, whereas in permanent organizations boundaries are institutionally legitimized (Lundin and Steinhorsson, 2003). Furthermore, project processes are externally controlled and the need to balance performance with external expectations increases, and thus, operational flexibility is essential (Lundin and Sonderhulm, 1995). In particular, given that in projects the tensions in the feedback loops between the project and its environment are intense, it is essential that the right balance is struck between the levels of control and structure imposed on the project manager by the owner(s) (Muller and Turner, 2005) and this needs to involve a common interpretation of what routine and flexible action entails by all the actors, thereby improving control in innovation processes.

Unlike prescriptive methodologies, open systems approaches do not depend *solely* on planning and performance monitoring of process but incorporate flexibility as a necessary element to controlling process. In order to handle change activities are planned and controlled on their minimum critical specifications. Goals, plans and performance criteria may be pre- specified, but can also be modified, allowing for flexibility in managerial action. The main difference is that behaviour is not predicted *just* by using decomposition of individual project parts-phases-activities. Prescriptive models assume certainty *only* through decomposition. Open systems models include *both* performance monitoring *and* social/contingency practices. The two approaches are not opposite but complementary. The real difference is in the emphasis. Systems thinking accepts the soft *as equal* to the hard; uncertainty and complexity as part of the reality of managing, in addition to planning and control. Systems thinking can provide a generic model that focus on the role of the project manager and the team (Söderlund, 2004), which allows for the redefinition of planning and execution, infused with contingency and flexibility and it is an epistemological shift in the paradigm.

How can system thinking be applied in project management?

Previous research: Equifinality as the best systems thinking concept to apply to concepts

Kapsali (2008, 2011a) discovered strong evidence that an open systems approach utilising the concept of equifinality is the basis for resolving the control/flexibility tension in project management. Equifinality was introduced by Bertalanffy (1968) and refers to the claim that in open systems, such as biological and social systems, different initial conditions can lead to similar end results, and therefore such a system is not deterministic by nature, unlike engineering systems. In other words, equifinality refers to the phenomenon that regardless of their initially conditions, similar results are achieved when engaging in many potential means, paths or trajectories. This phenomenon is also known as isotelesis (Greek: ἴσος /isos/ 'equal', τέλεσις /telesis/ ' *the principle that any one function is served by several structures and processes through the intelligent direction of effort* ' Zajonc, Murphy and Inglehart, 1989: 16). In essence, the construct of equifinality heralds the need for operational flexibility (Gresov and Drazin, 1997) being built into project methods, because many different pathways can be taken and still produce similar end results, thus increasing the chances of success in non-linear innovation processes. Turning to my previous research (Kapsali, 2008; 2009; 2010; 2011a), my findings revealed that when equifinality is built into the rationale of project management methodologies, projects finish successfully at a much higher rate. Moreover, I discovered that the project as a system should not strive for uniformity, but for agility, and this is best achieved through the practice of equifinality (Kapsali, 2008).

More specifically, Kapsali's (2008; 2011a) research on the EU eHealth projects revealed that by using a systemic project management approach, the same goals could be achieved through the implementation of different project processes and activities, despite the different initial conditions and contextual factors of different projects. The study was conducted using 12 multiple case studies based on Framework Programme eHealth projects which were categorized (embedded) into two groups, each group implementing a specific EU innovation eHealth programme (EARSS and eTEN). The first group of the EARSS case studies investigated represented 12,5% of the total population of the projects at the time. The second group of eTEN projects represented a percentage of 29% of the total population in the eTEN eHealth programme (9 of total 26). It was found that in the case of the EARSS project management, which followed an open systems approach based on critical minimum specifications and strong boundary management activities, achieved their goals in all cases although through different ways in each project. By contrast, the eTEN projects were designed to fulfil strict prescriptive control standards. It was found that pressure for uniformity of activity outputs to plans (the prescriptive methods) inhibited project management in achieving project objectives and restrained the capacity of leaders to direct, communicate (boundary management) and manoeuvre the project group through change. The key element of this phenomenon was the causal relation between programmatic control mechanisms and the project management tasks. When the programme design did not take into account the fact that project objectives can be achieved through multiple trajectories and strong internal and external boundary management, the control mechanisms were bureaucratic and prescriptive and inflicted project managers with rigid planned specifications. In most of the eTEN projects, the management lost control over project activities and run after the fulfilment of time and budget specifications in the planned trajectory, not achieving programmatic goals in most cases. The conclusion of this study was that equifinality should be embedded within

control mechanisms and plans which should support systemic approaches to project management.

Systems thinking in general and equifinality in particular have seen limited application in project management, mainly focused on construction and not on innovation projects (R&D, technology deployment, etc). This lack of application coexists with a diversity of incoherent definitions with insufficient linkages to systems theory; with insufficient elaboration of frameworks; with underdeveloped methodology; and with absence of empirical research to systemic phenomena in projects (Koskela and Howell, 2002). The obstacles to applying systems thinking in project management stem from specific issues that inhibit systemic enquiry in projects and other issues in the methodology of systems thinking.

First obstacle: specific issues that inhibit systemic enquiry in projects
A systemic project management framework has been difficult to develop because the 'soft'- social parts of project management are under- theorized. Theory focuses mainly on the development of specific tools and applications, despite of the efforts of academics for paradigm change (Alderman et al., 2007). There is resistance to developing a (w)holistic, synthetic model by the established academic frameworks and practitioner methods which lead to a hydrocephalic theoretical paradigm. Both cause and effect of this phenomenon is that there are no generic models to manage projects differently according to their type (Shenhar and Dvir, 2007).

In the open systems view, structure is the set of arrangements by which the resources are connected through relationships. The system includes the entities (technical and social), their implementation mechanisms (formal and informal), *and* the relationships that emerge through interaction, thus conceptualizing the complexity of this wholeness (Systemicity) and at the same time accommodating varying perspectives about a problem (weltanschauung) (Checkland, 1999). Systems theory helps us recognize the fact that the system itself is embedded in another, larger system. The only way to fully understand why a problem occurs and persists is to understand the relations between its parts and to the whole (Capra, 1996). The larger system exerts substantial influence, which however is not completely deterministic. Every communication carries a definition of their relationship (Elloy and McCombs, 1996; Emery and Trist, 1963). In systems thinking relating between various systemic parts defines power and control and abandons linear causality in favour of circular causal effects. The idea of relating is underdeveloped in projects; however it is a necessary step away from the top- down, control- oriented prescriptive approach with its references on stakeholder involvement.
In order to apply relating in project management though, project processes have to be considered as having boundaries open to external influences, which should be managed through boundary management. Boundary management as a practice involves more than managing relationships, inputs and outputs across system boundaries incorporating, power, knowledge, and learning linking external uncertainty with internal interdependencies (Amado and Ambrose, 2001; Jackson, 1991). Boundary management would ideally be integrated or diffused within all project management tasks (planning, communicating and coordinating-controlling activities). Ideally, boundary management should be practiced in a variety of ways between the project managers, the team and the

external environment to support inter- disciplinarity and alignment of action. The main characteristic of project boundary management would be the constant mutual adaptation between plans and the activities of different actors use boundary activities at the interface of activities.
Prescriptive paradigms on the other hand focus on controlling project processes, 'buffering' them from external influences (DeWeaver and Gillespie, 1997). There is a tendency to impose bureaucratic communication mechanisms in boundaries and interfaces, making boundary management rigid and difficult to handle change when it is needed. In fact, bureaucratic boundary procedures are used mainly as a monitoring mechanism in order to control or avoid unauthorized change in project activities (scope creep) (Khan, 2005; Staber, 2004; Keil et al., 1998; DeWeaver and Gillespie, 1997). Since performance control is the emphasis of such procedures, the essence of boundary communication is tied to control and not innovativeness and creativity. Atkinson (1999) argues that in modern project management flexibility should be embedded into the traditional control mechanisms (the Iron Triangle) in order to manage realistically non-linear feedback processes and changes. Activities should be planned, executed and assessed on *minimum critical specifications*, because regardless of careful planning, activities are always subjected to change. Goals, plans and performance mechanisms may be pre- specified, but should also be modified, allowing for flexibility in managerial action to exploit many ways in achieving its goals (equifinality).

Second obstacle: the neglected issues in the methodology of systems thinking
Generally, systems enquiry is conducted through confirmatory analysis (identifying relationships to optimize functions) and is mostly performance oriented. The closed systems approach strongly tends towards process improvement and depends on feedback and feed- forward loops to quantify (not qualify) interactions (Phelan, 1999). This approach is pervaded by a control- oriented rationale, which aims at uniformity and standardization through creating the necessary conditions for rational action between the boundaries. The idea is that by creating uniformity on project relations, uniformity and order will be 'mirrored' inside the system. As opposed to this control oriented rationale, the open systems approach argues that the system needs to adjust to environmental complexity by differentiating and elaborating its structure and processes and thus by becoming complex internally. Systems thinking accepts the social *as equal* to the technical and uncertainty and complexity as part of the managing tasks, planning and control (Saad, Cicmil and Greenwood, 2002). If systems follow a prescriptive rationale they can not sustain their own structures for long (Pondy and Mitrolff, 1979). *Therefore, an open systems framework should be used to develop constructs on both controlling processes and the adjustment of processes*.

The main issue is that systems thinking is widely used to legitimize and guide other theories but has not been used as a research guide or a meta- level language to design and interpret empirical studies or to compare across studies (Checkland, 2000). This is because in order for the systems thinking framework to be trans- disciplinary and highly generalized, it needs to provide constructs that are rather abstract and therefore difficult to operationalize in field studies. For that reason, systems methodologies suffer from low specificity in models and measurements. Adding to this, measurement is undeveloped because of high operational complexity even in comparatively simple systems (Bastedo,

2004). As a result, the methodological approach of systems enquiry still needs to develop constructs that are easier to operationalize and measure. A conceptual framework should be developed that would provide a method to generate flexible but measurable standards or metrics for systems constructs such as equifinality and to embed their application within institutional and procedural arrangements (Ulrich, 1988).

There are several issues to consider about developing systems thinking constructs. Firstly, it is the construct of holism. Holism is not clearly defined in various systems theories. The question of holism brings in the questions of how to define boundaries and of what kind of balance between specialization and inter- disiplinarity we need to build into the system processes (Mulej, 2007). The issue of holism has major importance for the application of systems thinking, because if holism can be clearly defined, a way to find a balance between the necessary specificity of operational constructs and the parallel provision of abstractions will be struck in order for this theoretical framework to be both generalizable and applicable. For example, in a first attempt to do this, a 'system of systems methodologies' can be used to find the interrelationships, variations and common elements between different systems constructs (Jackson, 1991).

Secondly, a significant issue in developing constructs is that it needs inter- disciplinary collaboration. However, academia is fragmented and created partial holisms that are used to transfer findings and ideas from one academic field to another, for the purpose of allowing different specialists to continue working in isolation instead of striving for interdisciplinary cooperation. In the end, there is the conflict between isomorphism and inter- disciplinarity which can only be resolved by requisite holism (Mulej et al., 2007). This contradiction can be transposed in the contradiction between autonomy and choice vs dependence that is usually prevalent between professional boundaries (Gemünden et al., 2005).

Thirdly, there is the issue of causal connectedness. There can be no analysis of boundary interactions and relations unless we assume that there might be causality in the actions between subsystems and actors- thus causal connectedness. Project network models have worked on the relational behaviour of projects, but the most suitable field to study constructs on casual embeddedness is relationality (Kapsali, 2008; 2010). Holism and equifinality discussed above are related to boundary management either directly or indirectly because when projects relate to their environment, they respond to according to their range of choice and dependency that are influenced by the way the boundaries and drawn (holism) and the flexibility build in the management and operational processes (equifinality).

The way forward for managing projects: the development of an equifinality method

In general, the rationale behind prescriptive project management perceives change as an aberration and the primary focus being on the micro- management of a project process as any other production process (Sauer and Reich, 2007). As a consequence, research in the management of change in projects becomes problematic and the question remains as to how to find ways to research the aforementioned tension between control and flexibility, whilst avoiding replicating the prescriptive rationale of prescriptive studies. In particular, this overemphasis on operational control is an obstacle to producing an explanatory and

predictive framework for innovation projects (Muller, 2003), because the focus of enquiry gets lost in the myriads of variables which are used to explain operational behaviour. If an open- systems approach is to be adopted then a holistic understanding of complexity and the dynamic structure and behaviour within a project system should be achieved (Morris, 2002, Achermann et al., 1997). In order to achieve this, Bredillet (2007) proposes that project management researchers should carry out empirical studies based on extant systems theory so as to elicit which constructs can be operationalized effectively and as a result making systemic theories practical in terms of their operationalization.

Therefore, as identified in the previous sections, change and boundary management project practices should be the focus of further research. Equifinality has received limited attention in project management methods and has mainly been used from contingency and strategy perspectives and other process approaches (Melnyk et al., 2010; Jennings et al., 2003; Gresov and Drazin, 1997), focusing on structure and how it fits changes in the environment. However, equifinality which is the tendency to achieve a final state, independently of initial conditions, by a variety of paths and through multiple and different structures, or even contingencies implies operational flexibility or choice and is a missed opportunity for systems thinking (Gresov and Drazin, 1997). Equifinality is both a key condition and an inherent characteristic of the system that is to be built into the initial design of the project system in the form of operational flexibility- embedded in all activity, control and communications mechanisms of the system.

This part of research studies looked mostly at the derivative of equifinality, flexibility, as practiced into mainly manufacturing processes and information systems (Lau, 1999; Fitgerald and Siddiqui, 2002), with lesser extend into services (Schmidt, 2006; Hierzalla, et al., 2009; Verdu-Jover et al., 2004) and with very few exceptions looking into project management (Kapsali, 2011a). Various aspects of process flexibility have been measured, like functional, operational, control and informational and some types of organizational flexibility have been discussed like strategic, capability and structural. Flexibility in these studies is linked to uncertainty, strategy, change, performance and supply chain and managerial actions have been suggested like the incorporation of slack resources in operations. A branch of research on flexibility has looked into modularity, which is a very promising area for achieving project flexibility; however service studies on modularity are fewer and less developed than in studies in manufacturing and virtually none in projects. In addition, modularity studies do not often follow holistic systemic approaches; rather they take a more process-metric approach, although their potential usefulness to explain complex systems is large (Starr, 2010).

On the bright side, complex adaptive systems (CAS) is a framework which is most suitable to investigate equifinality and its derivative flexibility though, the applicability of systems paradigms (including complex systems) in project management research is limited because of the neglected issues in systemic methodologies mentioned in the earlier sections. This phenomenon is also evident in studies in the application of CAS in healthcare systems (Plsek, 2001). The applicability of CAS in healthcare can provide an example of paradigm development, as recent research has shown that it can become more applicable by the ‘infusion’ of modularity methods in CAS frameworks (Kapsali, 2011b).

A similar approach in innovation projects would help tailor management methods that try to comprehend the Systemicity in a project system in order to handle the increasing complexity in innovation projects. This CAS-modularity framework can be realized by investigating the causes and frequency of change in innovation project activities and develop a tangible equifinality approach based on modularity methods (such as for example the combination of parallel and sequencing activity planning) combined with system integration boundary activities at the interfaces of process components.

It is a challenge to develop the CAS-framework framework, and it will require a combination of research methods. It is envisaged that using triangulation of methods would be most suitable, practiced in three ways.

First, a survey in measuring causes and frequency of change based on Vanguard or the Viable Systems models. The idea is to measure the situations where and how frequently deviations from plans occur, their 'distance' from the prescriptive practices they used and base on this information 'change- scenarios' that describe the situations where change most frequently happens during projects. These scenarios are going to be used in the second round of simulation games. Simulation games in focus project groups is novel although they are a well established and widely used teaching method in other industries- eBusiness, Banking and Airline Management to name a few for over 20 years; there are management simulations today used in several universities and companies. Albeit not widely used, it is not the first time that simulation games are applied in the field of project management. This method has been tried before by Cano and Saenz (2003) and Cano et al. (1998). Smeds (1998) for example uses a Simulation Laboratory for the analysis of change processes and other project management simulators are being used in the industry, but also in academia, like the PROSIGA simulation developed by the CAESAR project, which was funded by the Leonardo Da Vinci Programme. Although these simulation games have been used for teaching and learning, they could be used to measure the responses to changes during project runs under controlled conditions. The principle is that the participants to be subjected to a series of situations occurring during the development of a project, gathered by the survey, and provide their solutions to these situations and justifications for these solutions. The novelty is that it will use this tool for learning from the participants to develop our research apart from facilitating them to learn. The findings from the simulation games will be the basis for the development of an equifinality metric. Thirdly, the use of case studies- based on observation and/or in- depth interviews. Case studies can also be used as a control group, but also as an experimental case, where the CAS-modularity framework can be tested in practice. This is an indicative method, but other systems models could be useful to investigate equifinality in project systems.

The findings of such research can produce an equifinality solution to the problem of frequent and unexploited change in projects using a CAS framework. Equifinality in project management is an invaluable concept and its development will provide a necessary advance in project management practice and in academic conceptualization of systemic complexity and its relevance to practice.

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