Transformation Processes for Complex System's Evolution: A complexity theory perspective on the emergent complex socio-technical systems

Background

Complexity science emerged as an opposition of social science, which appeared to seek improved scientific legitimacy by bringing the linear deterministic modelling of classical physics, with business and economics. And the natural science which is already strongly rooted in linear determinism, is now moving toward non-linear computational formalisms (Henrickson and McKelvey, 2002).The postmodernist perspective takes note of the heterogeneous agent ontology of social phenomena, which calls for the abandonment of classical normal science (were described by Thomas Kuhn (Hoyningen-Huene, 1993). The main differences lie in epistemology and its assumptions of homogeneous agent behaviour, linear determinism, and equilibrium. Likewise, the 'new' normal science alternatives are being unravelled by complexity scientists, these scientists assume, then model, autonomous heterogeneous agent behaviour. From these models, they study how supra-agent structures are created. Scrapping the equilibrium and homogeneity assumptions and instead emphasising the role of heterogeneous agents in the social order creation processes is what brings the ontological view of complexity scientists in line with the ontological views of postmodernists.

Complexity science and theory were widely adopted by other areas such as computer science, business and economics, organisational science, system engineering, and information systems. We are in the 21st century; almost all of the systems are heterogeneous, interconnected, and distributed. Systems are heterogeneous because they are composite of social, technical, informational, situational, or environmental systems. They are interconnected because they are tightly dependent on each other's operation, endurance, and evolution.

The new literatures of socio-technical systems` analysis and design argue that the deployment process is long and passive in handling the complex and rapid changes in organisational and technical requirements (Baxter and Sommerville, 2011). Therefore, this process needs modernising to fit into the new advanced technical and business structures to facilitate its complexity and understand the changing nature of the new socio-technical environment in the information era. The proposal suggests the use of complexity theory principles to represent a framework to understand the requirements needed in handling modern and complex socio-technical systems.

Expected results:

The application of this proposal will provide a conceptual model which describes how multi-level and multi-directional co-evolution in the modern, complex socio-technical systems require a new understanding of the context, external and internal factors (technical, social, and ecological) which will change the way that an organisation understands the requirements. This will result in a more effective system design and operation. The new principles adapted from the complexity theory should emerge as a theoretical contribution, the importance of these principles lie in the ability of describing the new requirements of complex socio-technical context.

Methodology:

This proposal suggests starting with a review of the limitations of the current methods of analysis and design in complex systems, with particular emphasis on the description of the system in order to produce the design requirements that evolve with the context and are more capable to deal with the current complexity. It should develop a pragmatic framework for change to deal with the evolving nature of the requirements to enable rapid adaptation.

This research is based on qualitative analysis, with both qualitative and quantitative data potentially will be used to form the theories and to suggest new practices. Understanding of social research methods and information management or socio-technical systems approaches is a great advantage to tackle the research activities.

Impact:

This research can be initiated with any large scale complex organisation; typically this organisation has multi-scale, multi-layers, multi-divisions, and IT business applications (e.g. healthcare, manufacturing, public services, emergency, etc.). We expect to facilitate the complexity of these systems, bring new understanding of how they operate in the meantime, how factors influence adaptation and progression, as well as understanding the obstacles and challenges of future evolution.

Person`s specification:

The applicant must have:

- A first class or a good upper second class degree in system engineering, management science, information systems, or a similar area, master degree is an advantage.
- Understanding of information capturing
- Excellent communication and interpersonal skills.

Experience in the following areas also desired but not must:

- In conducting and designing interviews
- Previous work with industry
- Understanding of social and technical aspects in an organization context
- Understanding of change management, systems thinking and agile approaches

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References:

1. Henrickson L. and McKelvey B. (2002) Foundations of "New" Social Science: Institutional Legitimacy: Philosophy, Complexity Science, Postmodernism, and Agent-based Modeling. Proceedings…Nat. Acad. of Sci. 99, 7288–7297.

2. Hoyningen-Huene P. (1993) Reconstructing Scientific Revolutions: Thomas S. Kuhn's Philosophy of Science. Chicago: University of Chicago Press.

3. Baxter G. and Sommerville I. (2011) Socio-technical Systems: From design methods to systems engineering. Interacting with Computers. http://dx.doi.org/10.1016/j.intcom.2010.07.003.