The Effect of Complexity and Chaos on Software Project Management

This programme of research is conducted by Professor A S White.

The new theories of Complexity arise from the description of deterministic problems in Mechanics and other areas such as Biology, Economics and Meteorology as non-linear equations [1] [2]. Analysis of non-linear equations tells us that very complex motion can result from very simple equations. Behaviour that looks quite random can result from deterministic equations, with substantially different outcomes by starting at only minutely different inputs. This behaviour is referred to as chaotic.

The fundamental problem in human affairs is to predict consequences of our actions. Hence is it important to know when such aperiodic disturbed behaviour can occur.

The problem of software project management is one which has been a fertile ground for substantial investigation over the years. Much data has been accumulated about the level and scope of problems based on cost, delays and accumulated errors in the software products produced. This is not the primary cause of the problem but only the effects.

Abdel-Hamid & Madnick [3] and others have used System Dynamics to investigate a dynamic model of the behaviour of the management process. System Dynamics was devised by Forrester to investigate business management problems using control theory in the 1960's by identifying feedback of both negative stabilising and positive reinforcing loops examining their effects on the decisions made inside organisations. This technique is still the only numerical predictor of social or human interventions. Its' use in software process predictions is good but it is not widely used.

The models developed by Abdel-Hamid & Madnick have a large number of implicit decision models built in and these have to be validated against practices adopted by an organisation to be effective. The whole model is very non-linear and has therefore the potential to yield chaotic behaviour.

We are not sure whether the System Dynamics models are true representations of the software development process. Nor are we sure whether our model is sufficiently accurate to predict the requisite conditions for instability.

The purpose of this research programme is:

- To identify which parameters and decision processes would lead to chaotic behaviour and compare these with real project data.
- To devise measurements or metrics to identify whether this was taking place to be used by project managers
- To devise control procedures to reduce the chaotic effects.

References

1. Cohen J & Stewart I 'The Collapse of Chaos', Viking 1994
2. Thompson JMT & Stewart HB 'Nonlinear Dynamics and Chaos', Wiley 2002
3. Abdel-Hamid T & Madnick SE 'Software Project Dynamics' Prentice-Hall 1991