Supporting Material is available for this work. For more information, follow the link from the Table of Contents to "Accessing Supporting Material".

Is the madness home made?

Examining internal causes of workload fluctuation in project enterprises

Steffen Bayer, David Gann, Ammon Salter

Tanaka Business School

Imperial College London

22nd International System Dynamics Conference, Oxford, July 25 - 29, 2004

Imperial College London

Abstract

Project enterprises supply their products and services as tailored or one-off projects for specific clients. Their business depends crucially upon bidding, or negotiating discrete task-oriented packages. Architectural practices, advertising agencies or management consultancies are typical examples.

A common challenge for project enterprises is a fluctuation in workload: periods of low capacity utilisation are followed by periods characterised by an excessive workload when "fire-fighting" becomes a standard activity and catching-up to demanding project schedules increasingly difficult. The variation in workload of a project enterprise over time is influenced by changes in the demand for its services and products. However, the external environment does not provide a comprehensive explanation of workload dynamics. This presentation examines the *internal* causes of workload fluctuation.

We investigate the influence bidding behaviour (in particular the time allocation to project acquisition and execution) has on workload fluctuations using a system dynamics model of a stylised project enterprise. The system dynamics model combines an organisation level structure (for staffing, acquisition, cash flow etc.) with a project model representing project execution.

Introduction

- Architectural practices, engineering consultancies and other project enterprises supply their products and services as tailored or one-off projects for specific clients. The management of these organisations poses major challenges. A common challenge for project enterprises is a fluctuation in workload.
- The "lumpy" nature of projects", their relative size compared to the total activities of the organization and the comparatively low probability of bidding success present particular challenges to project based organisations. While the time delay between project bid and project start suggests some similarities to manufacturing supply chains, the uncertainty of bidding success makes it more difficult to manage this particular "ordering process".
- Our work forms part of a growing management literature on project-based organisations (Gann and Salter 1998; 2000; DeFillippi and Arthur, 1998; Grahber, 2002; Hobday, 2000; Keegan and Turner, 2002; Prencipe and Tell, 2001).

Approach and research questions

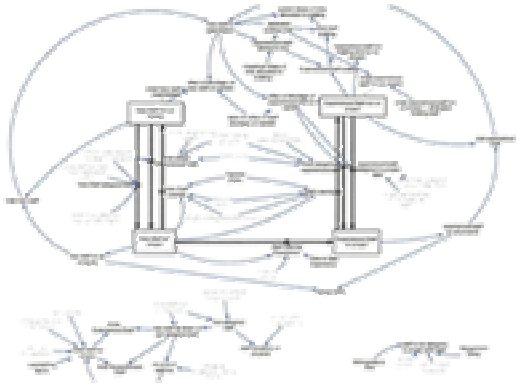
- Approach
  - This work is part of a wider project on performance and innovation in project-based enterprises which includes in depth case studies and qualitative analysis in different sectors.
  - Our use of a system dynamics approach for the study of a project-based organisation, builds on and complements the system dynamics work on the dynamics of single projects (Cooper 1980, Lyneis *et al.* 2001) and the growing research on the interaction of projects (Repenning 2000).

- Research questions
  - What causes fluctuations in workload?
    - behavioural patterns (bidding / project acquisition policies)
    - organisational culture
    - nature of projects (discrete size)
    - market conditions
  - Which strategies help to reduce fluctuations?

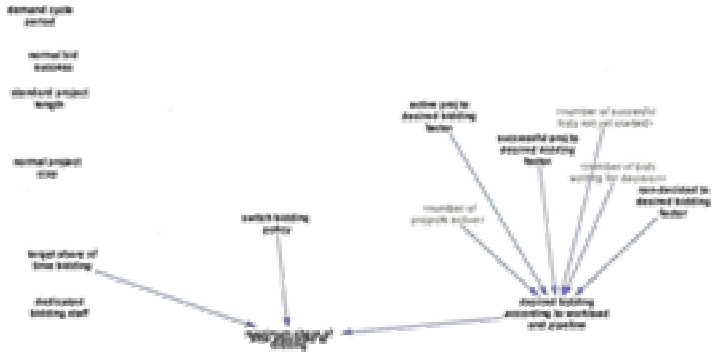
A model of a project enterprise (1)

- The model combines an organisation level model (for staffing, acquisition, cash flow etc.) with a project model representing project execution.
- The (probabilistic) organisation level structure determines start date, duration, project size and initial staffing and staff availability for later staff assignments for each of the projects of the organisation.

Staffing



Bidding policies

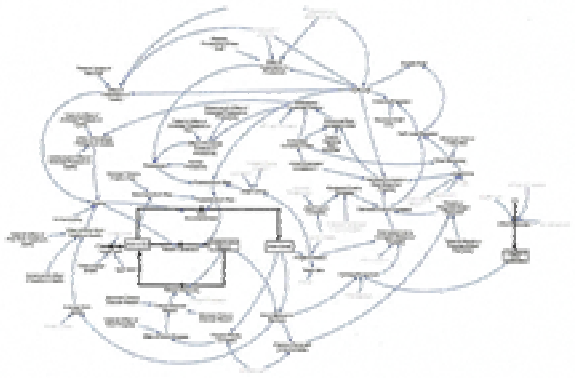


Project acquisition

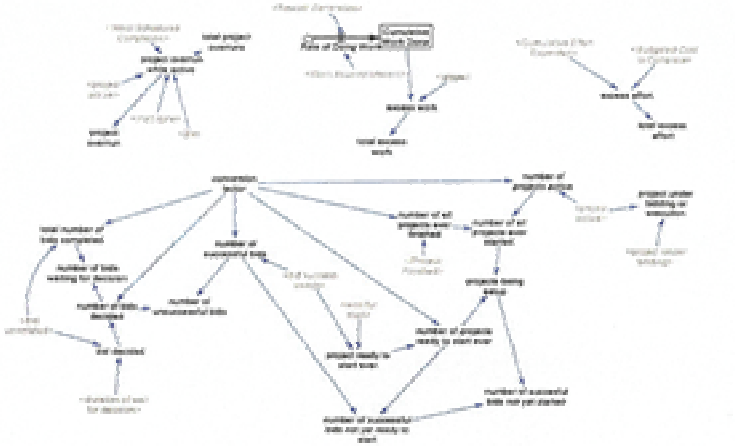
A model of a project enterprise (2)

Project execution

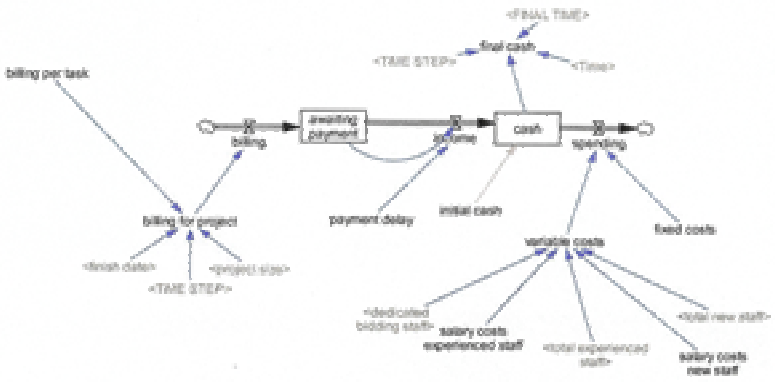
- Project execution of each individual project is modelled using a project model structure (Lyneis, 2004). Parameters for all of the projects executed in the organisation are the same.
- Individual projects are aggregated to give portfolio performance and cash flow of the organisation.



Portfolio performance

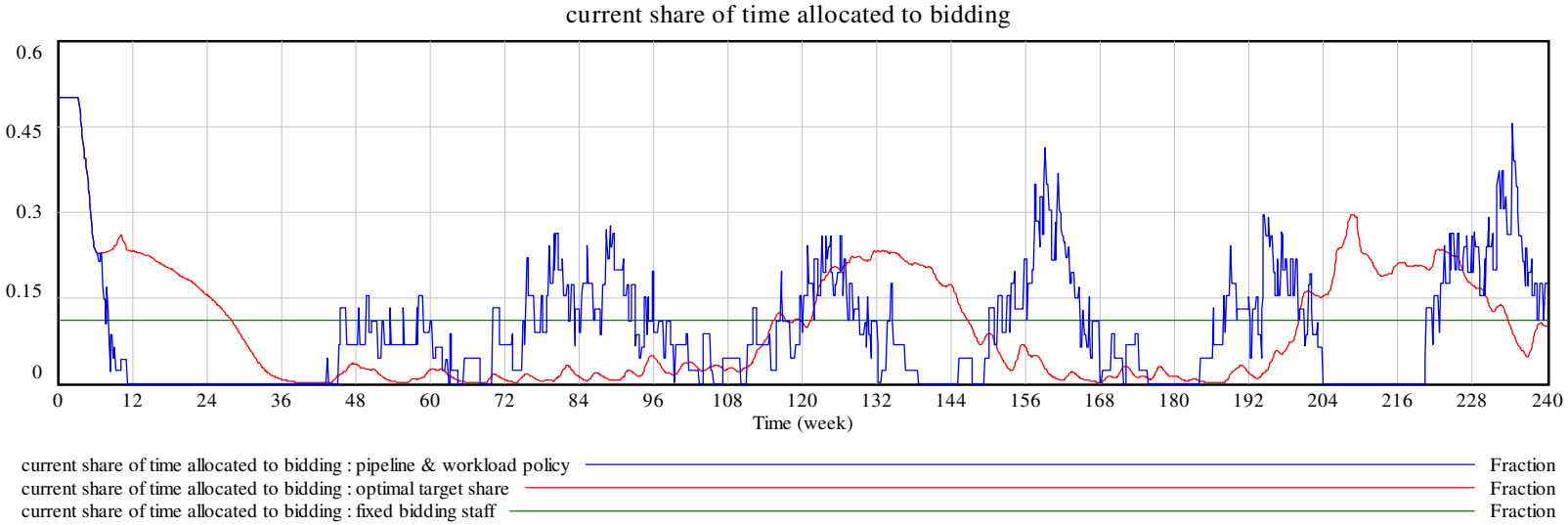


Cash flow



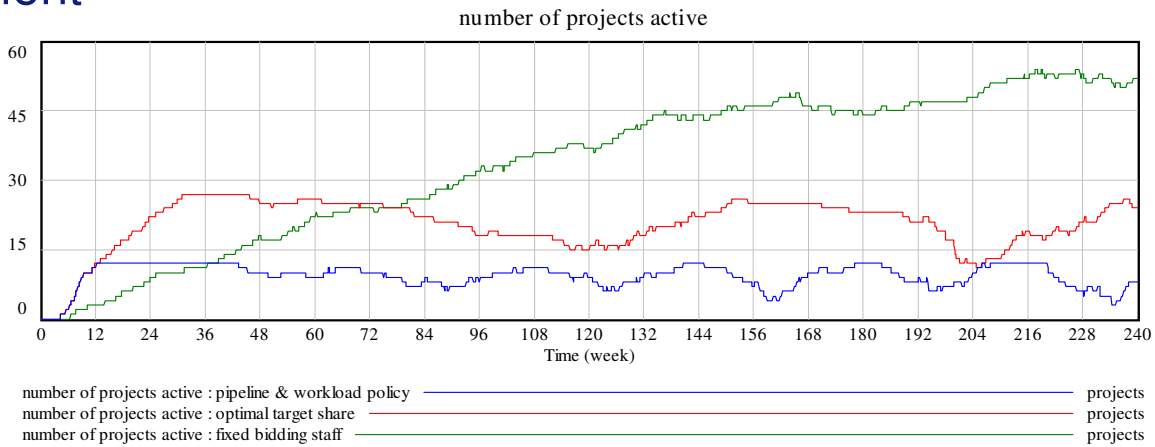
Three types of bidding policies

- Exploration of the effect of three different types of bidding policies on workload:
  - Fixed number of staff constantly bidding
  - Experienced staff bid (up to a fixed time limit) when not engaged in project execution
  - Experienced staff bid when not engaged in projects, bidding limited according to a rule based on projects in pipeline
- Highest profit parameterisation for each of these policy types.
- Optimisation for a situation where market is stable and where there are initially no projects.

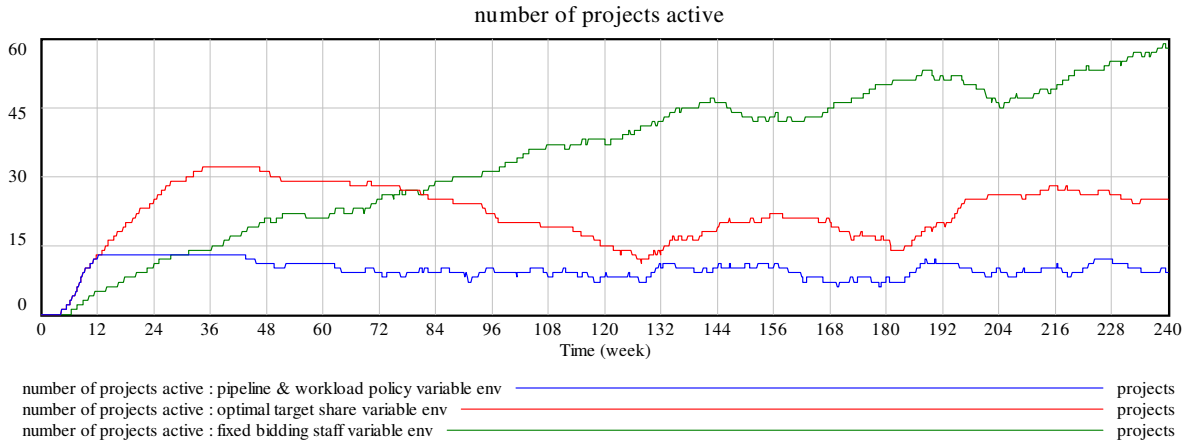


Bidding limited by pipeline and workload policy performs best

- In a stable environment

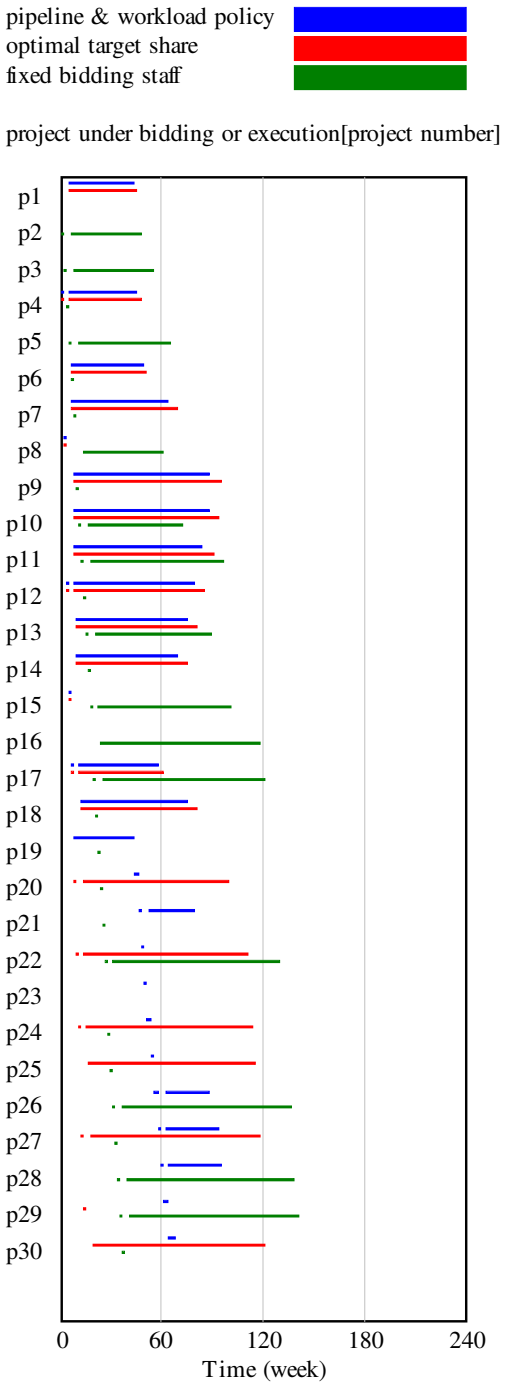


- In a fluctuating environment



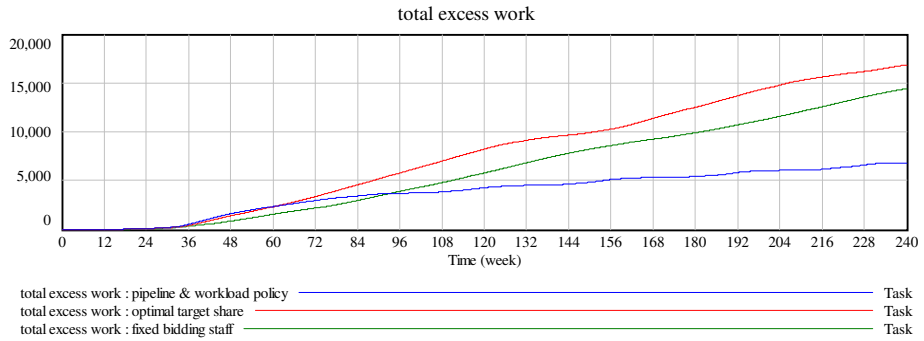
Analysing the policies

- The pipeline & workload policy results in a smaller number of projects undertaken at each moment in time.
- Because staffing shortages are avoided, project overruns and required rework are lower.

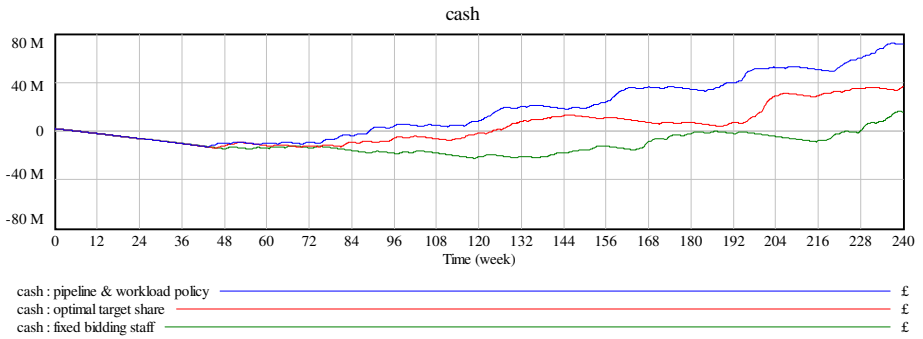


Portfolio effects

- The better performance of the "pipeline & workload policy" is caused by the underlying dynamics of project execution.

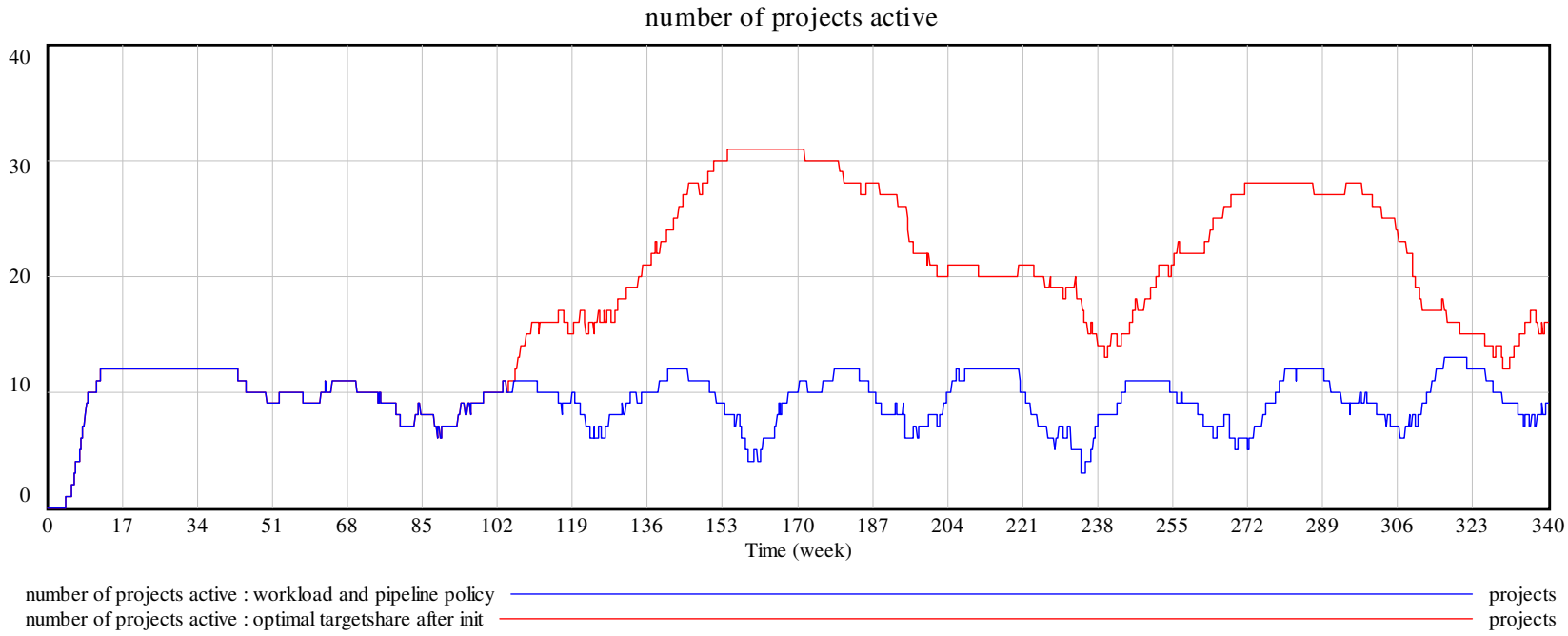


- Taking the bidding pipeline into account when allocating time to project acquisition is financially beneficial.



Fluctuations are not caused by initial conditions

The optimal target share policy creates workload fluctuations even if we initialize with the workload and pipeline policy and switch in week 100.

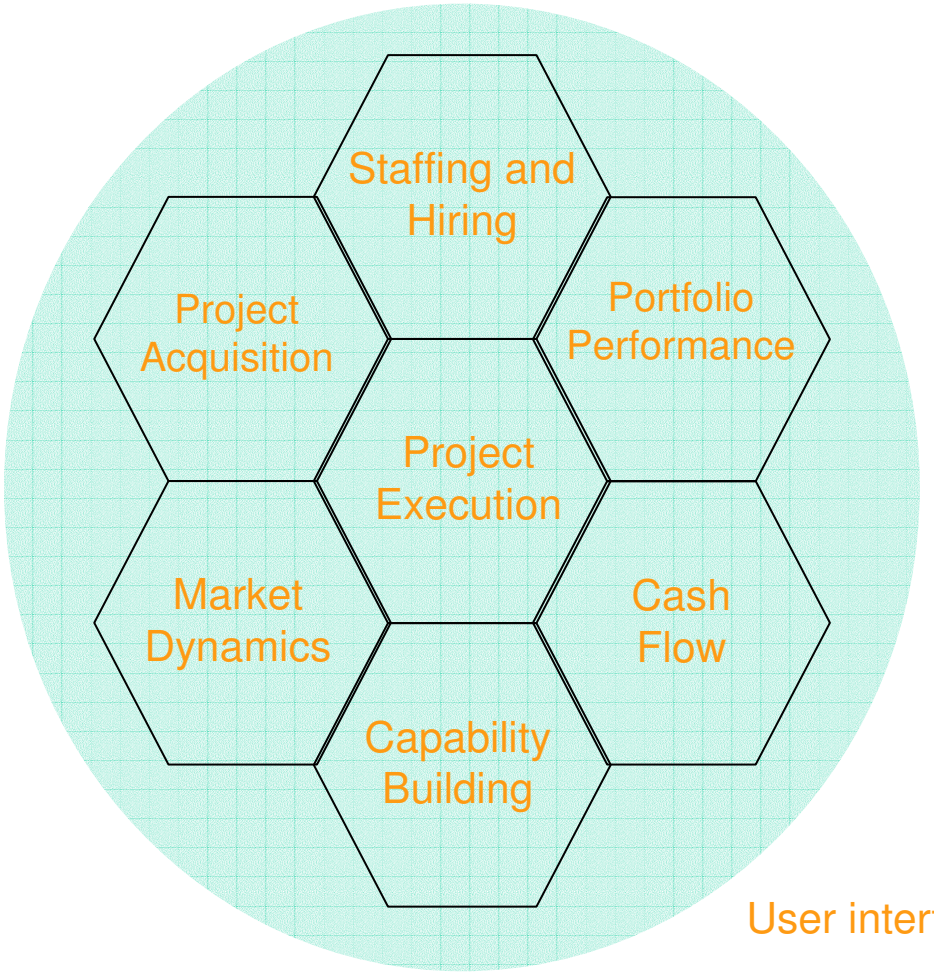


Conclusions

- The madness is (at least partly) home made. Bidding policy influences the size of workload fluctuations.
- Because of the dynamics of project execution, a bidding policy which takes into account the bidding pipeline and therefore avoids overbidding is financial beneficial.
- Sometimes, it is better not to do anything, then to win additional business!
- The fact that the dynamics of project execution have dramatic effects on organisational performance indicates that it was appropriate to combine project model and bidding model in this case.

Next steps

- The model is being adapted to the situation of a large architectural practice.
- Further versions for other project-based enterprises (e.g. consulting engineering organisations) are planned.
- We will add a model section on capability building and a more detailed incorporation of market dynamics
- Ultimately, we plan to develop a training package around the simulation model.



Bibliography

- Cooper, K. G. (1980), 'Naval Ship Production: A Claim Settled and Framework Built', *Interfaces*, vol. 10, no. 6, pp.20-26.
- DeFillippi R. and Arthur, M. (1998), 'Paradox in project-based enterprise: the case of film making', *California Management Review*, Vol. 40, no. 2, pp. 125-139.
- Gann, D, M. and Salter, A. J. (2000), 'Innovation in project-based, service-enhanced firms: the construction of complex products and systems', *Research Policy*, Vol. 29, no. 7-8, pp. 955-972.
- Grabher, G. (2002), 'Cool projects, boring institutions: Temporary collaboration in social context', *Regional Studies*, Special Issue on Production in Projects: Economic Geographies of Temporary Collaboration, Vol. 36, no. 3.
- Hobday, M. (2000), 'The project-based organisation: an ideal form for managing complex products and systems', *Research-Policy*, Vol. 27, no. 7-8, pp. 871-893.
- Keegan, A., and Turner, J. R. (1999), 'The versatile project-based organization: governance and operational control', *European Management Journal*, Vol. 17, no. 3, pp. 296-309.
- Keegan, A. and Turner, J. R. (2002), 'The management of innovation in project based firms', *Long Range Planning*, Vol. 35, pp. 367-388.
- Lyneis, J.M. (2004), Course 'Project Dynamics', Worcester Polytechnic Institute.
- Lyneis, J. M.; Cooper, K. G.; Els, S. A. (2001), 'Strategic Management of Complex Projects : A Case Study Using System Dynamics', *System Dynamics Review*, vol. 17, no. 3, pp. 237-260.
- Prencipe, A. and Tell, F. (2001). 'Inter-project learning: processes and outcomes of knowledge codification in project-based firms'. *Research Policy*, Vol. 30, no. 9, 1373- 1394.
- Repenning, N. P. (2000), 'A Dynamic Model of Resource Allocation in Multi-Project Research and Development Systems', *System Dynamics Review*, vol. 16, no. 3, pp. 173-212.
- Turner, J. R., and Keegan, A. (2001), 'Mechanisms of governance in the project based organisation: the roles of the broker and steward', *European Management Journal*, Vol. 19, no. 3, pp. 254-267.

Contact:

Steffen Bayer

Tanaka Business School
Imperial College London
South Kensington Campus
London, SW7 2AZ, UK

s.bayer@imperial.ac.uk

Back to the Top