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Lean toolbox approach

for effective preparation of housing refurbishment projects using critical success factors

Introduction

- Lean has been particularly aimed at new built and private sector projects
- Usefulness of lean tools and techniques to improve managing social housing refurbishment projects
- Requires different approach to project execution and preparation, and applying lean
- Characteristics of refurbishment (Kemmer et al. (2013), Egbu (1997) Egbu et al. (1998), Quah (1992), Ho & Fischer (2009) e.g.
  - Managing refurbishment projects is very variable, unpredictable
  - highly specialized small elements of work
  - Small labour intensive operations scattered in existing buildings
  - higher levels of risk and uncertainty than new build
  - Lack of "as built" drawings to guide designer and builder
  - Unpredictability, problems are not discovered until demounting has commenced
  - complexity and variability caused by presence and behavior of 'social residents'

Critical success factors in construction (Chua et al. 2002)

Categories of analysis	Critical success factors, selected for refurbishment
A. Project characteristics	1 Adequacy of funding
B. Contractual arrangements	2 Realistic obligations and clear objectives
	3 Risk identification and allocation
	4 Adequacy of plans and specifications
	5 Formal dispute resolution process
	6 Motivation and incentives
C. Project participants	7 Project manager competency
	8 Competency of proposed team (all participants)
	9 Top management support (all participants)
	10 Level of service (all participants)
	11 Track record (all participants)
	12 Team turnover rate (all participants)
D. interactive processes	13 Formal communication
	14 Informal communication
	15 Schedule updates
	16 Control meetings
	17 Work organization

Composing lean toolbox for social housing refurbishment

Categories of intervention	Lean tools selected for interventions in case projects
Design	1 Agile Design Management, 2 Target Value Design, 3 Integrated Design, 4 Set based design, 5 Lean led Design, 6 Collaborative design or co-creation
Resident	7 Early end user Involvement 8 Customer journey
Budget	9 Target Costing 10 Value Engineering
Collaboration	11 Early Contractor Involvement 12 Scrum 13 Takt planning 14 Lean planning 15 Daily stand up 16 Toyota Kata 17 Continuous improvement with PDCA 18 Skills matrix 19 Cross training
Information and communication	20 Frontloading 21 First run study 22 Visual Management 23 BIM

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Action research approach and case method

Steps in the action research	Operationalization of the steps
Step 1: Formulating project success	• Per case project success formulated with respondents • Direct and indirect causes of project success or failure
Step 2: Identifying critical success factors	• Specific success factors identified • influence the project positively or negatively
Step 3: drawing a causal loop diagram	• success factors put in a causal loop diagram • insight and analysis of causality among factors and externalities
Step 4: designing case intervention by choosing tools	• Interviews to assess expected result of selected tools from toolbox. • Simulating tool in a serious game to shape the intervention
Step 5: redrawing the causal diagram	• Reassessing the causalities based on serious game • Reassess effects expected of tool application in project
Step 6: intervening in the case project and assessing the effects	• Implementing lean tools in the preparation phase of factual project • Reassessing causal relations between tools, effects and factors

Cases social housing refurbishments

| Cases	Housing type	Project size	Occupation	Contract type
1	Apartments	<10	Occupied	Alliance long term
2	Apartments	>50	Occupied	Alliance one off
3	Houses	>50	Occupied	Alliance long term
4	Houses	<50	Occupied	Traditional
5	Houses	<50	Occupied	Alliance one off
6	Apartments	>50	Not occupied	Traditional
7	Apartments	>50	Occupied	Alliance one off

Causal diagram understanding critical success factors

Causal Diagram before intervention
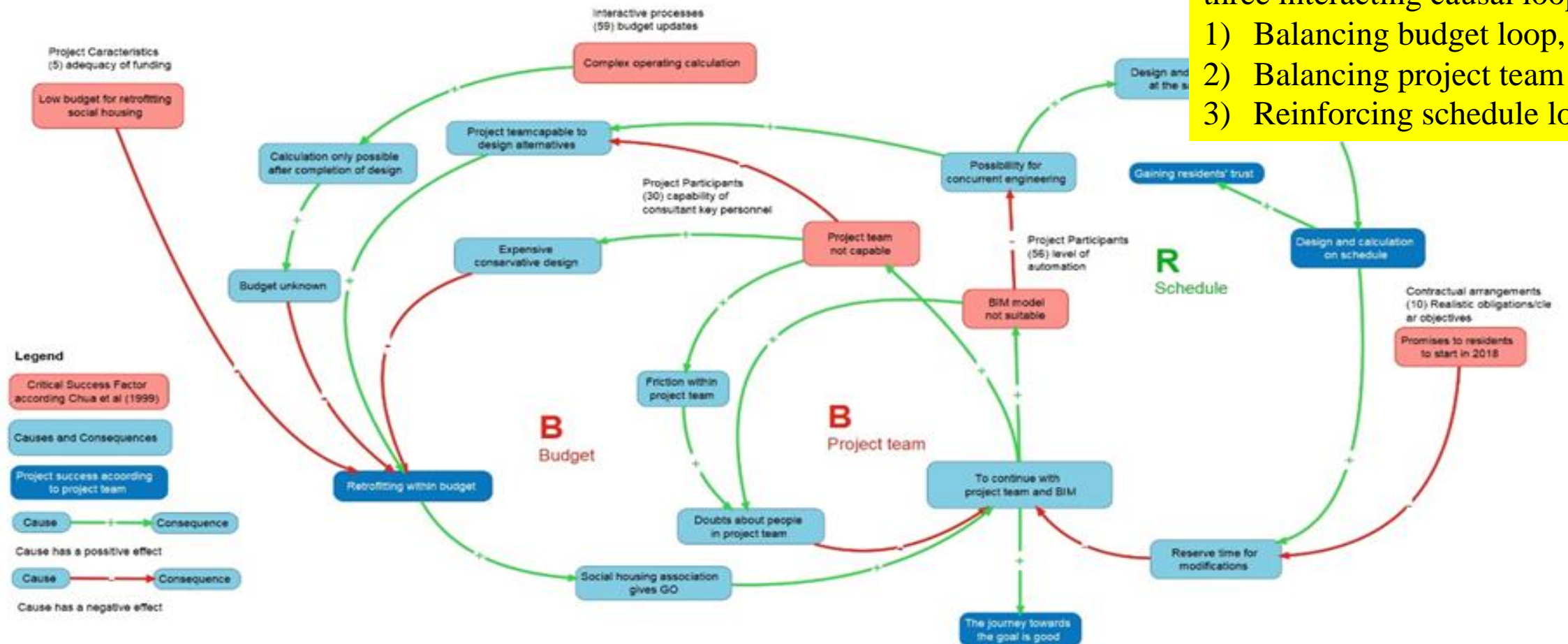
three interacting causal loops:
1) Balancing budget loop,
2) Balancing project team loop
3) Reinforcing schedule loop

Tools selected for application to project preparation in cases

Cases	Design	Resident	Budget	Collaboration	Information and communication
1	Integrated Design, Collaborative Design	Early residents Involvement	n/a	Early Contractor Involvement, Scrum	Frontloading
2	n/a	n/a	n/a	Early Contractor Involvement, Takt planning	BIM
3	n/a	Early residents involvement,	n/a	Early Contractor Involvement, Takt planning, PDCA	Frontloading
4	n/a	n/a	n/a	Cross training, Lean planning, Daily stand up, Continuous improvement with PDCA, Toyota kata	n/a
5	n/a	Early resident involvement, Customer journey	n/a	Continuous improvement, Toyota kata, Skills matrix, Cross training	n/a
6	n/a	Early residents Involvement,	n/a	lean planning	First run study
7	n/a	Early residents Involvement,	n/a	Lean planning	First run study

Relating critical success factors to lean tools applied

Critical success factors	Manifestation of lean tools in cases, evidence of effect
Adequacy of funding	First run studies make work transparent, reveal potential hidden issues in existing stock.
Realistic obligations and clear objectives	Joint planning verified by all to prevent 'planning optimism'. Inserting strategic buffers without making deviations easy.
Risk identification and allocation	Proposed solutions include needed levels of flexibility capable to cope with variation.
Adequacy of plans and specifications	Offering multiple flexible alternatives based on expertise of suppliers.
Formal dispute resolution process	n/a
Motivation and incentives	n/a
Project manager competency	n/a
Competency of proposed team (all participants)	n/a
Top management support (all participants)	Formal and informal learning across projects supported by long term alliances and commitment.
Level of service (all participants)	n/a
Team turnover rate (all participants)	Being able to exchange multi-skilled personnel between tasks.
Track record (all participants)	Involving known suppliers in an early stage in the design and engineering
Formal and informal communication	n/a
Schedule updates	Frequent checks and updates of planning. Redistributing work time among suppliers.
Control meetings	Early involvement suppliers in design and meetings with residents for expectations.
Work organization	Formalising process control independent from personal preferences of individuals.

Conclusions

- More lean tools available than usually known, now more conscious
- Usefulness of availability of lean toolbox in project preparation
- Mostly used tools selected involving residents, collaboration and information exchange, hardly budget and design
- More power granted to tools in theory than in practice, more in simulation game than in the intervention in reality
- No hard evidence but respondents felt to be more in control
- Connection existed between success factor and tools applied
- Operational problems and balancing loops solved with lean tools
- Reinforcing causal loops and wicked problems hard to solve though