POST-DOCTORATE POSITION PROFILE AT CENTRALESUPELEC

Planning and managing the risks associated with dividing megaprojects into several contracts

Duration: 1 year (2025, depending on exact start date)

Location: Position based in Gif-sur-Yvette (91, Essonne) at the Industrial Engineering Laboratory (LGI), CentraleSupélec (www.lgi.centralesupelec.fr), Université Paris-Saclay

Status: Contract researcher associated with the Design Engineering team of the Industrial Engineering Laboratory (LGI) at CentraleSupélec

Fields: Project planning, contract management, project risk management, design engineering

Salary: €2400 net/month; 75% reimbursement of public transport fares; teaching at CentraleSupélec possible with additional salary.

Context

Industrial Engineering is the science of diagnosing, modeling, simulating, designing, operating, and managing change in the activity systems of organizations. The Industrial Engineering Laboratory (LGI, http://www.lgi.centralesupelec.fr/) at CentraleSupélec, a member of the Université Paris-Saclay, focuses on (a) product/service systems marketed by companies, and (b) production or business systems. These systems and the processes they entail are examined throughout their life cycle. That means knowing how to observe, diagnose, design, improve, operate (run, regulate, maintain), and recycle them.

The LGI has a staff of 100, including 30 teacher-researchers and 60 PhD students, covering design sciences, industrial engineering, automation, computer sciences, economics, and management. The LGI is organized into four research teams, five cross-disciplinary themes, and five industrial chairs. The teams are Design Engineering, Operations Management, Risks, Resilience, Reliability, and Sustainable Economy. The cross-cutting industrial and societal themes are mobility systems, energy systems, healthcare systems, the industry of the future, and the circular economy.

This research project occurs within the Design Engineering team at the crossroads of Project Planning, Contract Management, and Project Risk Management. The project leader is Professor Franck Marle, who has contributed to these themes for many years in research and teaching. He has led several projects on risk management in complex projects with Alstom Transport (Marle & Vidal, 2014), PSA Peugeot-Citroën (now Stellantis) (Jaber et al., 2015), Renault (Jaber et al., 2018), and the CEA (Pointurier et al., 2015). He also managed a Chair on mega-development projects for Total, which covered several topics, including the contractual breakdown of projects (Mammeri et al., 2017), risk management adapted to such projects (Marle et al., 2017; Ventroux et al., 2018), and assistance in selecting actions contributing to the long-term development of the host country, whether or not related to the project itself (Vidal et al., 2021).

Subject description

Projects are defined by three dimensions: the Product (the system to deliver at the end of the project), the Process (the phases, sometimes including some pre- and post-project phases, like pre-project and operations ramp-up), and the Organization (the internal and external entities and actors that execute the Process to deliver the Product).

Projects are characterized as complex, meaning they are made of many elements of diverse natures with many interactions. That means that it is challenging to anticipate the indirect consequences of planning decisions. Megaprojects are specific complex projects with exceptionally high values in previously introduced complexity-related indicators.

Megaprojects have two main characteristics: they often require to be decomposed into smaller, more manageable items, and they often require an important part of subcontracting to external entities via contracts. We can thus say that megaprojects often require decomposition into multiple interdependent contracts to facilitate execution and management. Figure 1 illustrates an example of such a decomposition, with Product elements in rows and Project phases in columns. The cells of this matrix are called elementary work items (EWI).

Project Scope of Work		Basic Engineering (BE)	Detailed Engineering (DE)	Procurement (P)	Construction (C)	Transport & Installation (T&I)	Commissioning (Com)
Object 1	Elementary Object 1.1						
	Elementary Object 1.2						
	Elementary Object 1.3						
	Elementary Object 1.4						
Object 2	Elementary Object 2.1						
	Elementary Object 2.2						
...	...						
Object k	Elementary Object k.1						
	Elementary Object k.2						
	Elementary Object k.3						
	Elementary Object k.4						

Figure 1 : illustration of the elementary work items (the cell of the matrix)

Elementary work items are grouped to form a Work Element and assigned to an internal or external entity (Figure 2). The initial context of this research was the oil and gas context, where a considerable percentage of Work Elements are assigned to contractors via contracts. We will consider only grouping elementary work items into work elements assigned to an external entity for simplicity. The Work Element is called a contract, and the entity is a contractor. For example, Figure 2 illustrates some examples of contracts (assembly of several EWI) of different shapes and colors, with the indication of the contract type (for instance LS for Lump Sum) and the awarding process (for instance CFT for Call For Tender). The contractor assignment process is out of the scope of this research. However, the link between the proposed Contract scope (Work Element) and the consequences of that process could be studied.

Contractual Strategy		Basic Engineering (BE)	Detailed Engineering (DE)	Procurement (P)	Construction (C)	Transport & Installation (T&I)	Commission-ning (Com)
Object 1	Elementary Object 1,1	(CFT) **BE**	(CFT) **EP** *LS*		(CFT) **C T&I Com** *R*		
	Elementary Object 1,2		(CFT) **EPC T&I Com** *UR*				
	Elementary Object 1,3						
	Elementary Object 1,4						
Object 2	Elementary Object 2,1	(OBT) **EPC** *R*					
	Elementary Object 2,2	(DC) **EPC** *LS+* ***T&I*** *EO 2,1 LS*					
...	...	...					
Object k	Elementary Object k,1	(CFT) **E** *R*		(CFT) **P** *R*	(CFT) **C T&I Com** *R*		
	Elementary Object k,2	(CFT) **EPCm** LS **+C** *R*					
	Elementary Object k,3						
	Elementary Object k,4						

Figure 2 : illustration of grouping EWI into Work Elements that can be assigned to external entities or not

However, determining optimal contract scopes that balance work coherence, interface management, and overall project performance remains a significant challenge. This research project aims thus to develop a decision support system (DSS) to assist project managers in decomposing megaprojects into multiple contract scopes by clustering elementary work items while accounting for their characteristics and interdependencies.

The research will build on existing work in project planning (notably Work Breakdown Structures (WBS)), contract planning, risk management, and decision support systems. Specifically, it will draw from the literature on interdependency modeling and assessment and interdependency-based clustering algorithms. The decision support framework will notably incorporate methods for quantifying and visualizing interdependencies at different levels (elementary work items and work elements), like Design Structure Matrix or other alternative visualization techniques.

The proposed DSS will employ a multi-criteria decision analysis approach to evaluate potential contract scope configurations. Criteria may include minimizing interfaces between contracts, maximizing work coherence within contracts, and optimizing risk exposure.

The research methodology will involve developing the conceptual framework, implementing a prototype decision support tool, and validating it through case studies. The expected outcome is an evidence-based approach to support the critical task of contract scope definition in ways that enhance overall project performance and decrease overall risk exposure.

This work aims to contribute to the project management body of knowledge by providing a novel, quantitative approach to a traditionally heuristic-based process. The resulting decision support system has potential applications in major infrastructure, engineering, and technology development projects.

Mission

The candidate's mission will be to develop and publish the overall theme. That will involve building on previous work on this theme and other related work developed in-house.

Profile

- If possible, the candidate will have a doctoral thesis related to at least one of the three themes mentioned (Project Planning, Contract Management, and Project Risk Management),
- Ideally, he/she will already know a sector related to large, complex projects,
- Ability to write scientific articles in English,
- Ability to model and analyze interdependencies between project objects (knowledge on network theory-based tools like clustering will be appreciated),
- Thoroughness in analysis and synthesis,
- Creativity and initiative.

Application

Candidates should send their application by e-mail to franck.marle@centralesupelec.fr.

The application will include:

- A cover letter,
- A detailed CV including a list of publications,
- Any other document proving experience,
- Optional letters of recommendation.

Auditions will be held on a rolling basis. The candidate will be recruited to start in early 2025 at the earliest.

References (previous publications within the team)

Jaber, H., Marle, F., & Jankovic, M. (2015). Improving Collaborative Decision Making in New Product Development Projects Using Clustering Algorithms. *IEEE Transactions on Engineering Management*, *62*(4), 475–483. https://doi.org/10.1109/TEM.2015.2458332

Jaber, H., Marle, F., Vidal, L.-A., & Didiez, L. (2018). Criticality and propagation analysis of impacts between project deliverables. *Research in Engineering Design*, *29*(1), 87–106. https://doi.org/10.1007/s00163-017-0254-7

Mammeri, M., Marle, F., & Ouerdane, W. (2017). An assistance to identification and estimation of contractual strategy alternatives in oil and gas upstream development projects. *Understand, Innovate, and Manage Your Complex System! - Proceedings of the 19th International DSM Conference*.

Marle, F., Ventroux, J., & Vidal, L. A. (2017). Assistance in selecting a project contracting strategy by combining complex systems theory and risk and vulnerability analysis. *Journal of Modern Project Management*, *5*(2). https://doi.org/10.19255/JMPM01406

Marle, F., & Vidal, L. (2014). Forming risk clusters in projects to improve coordination between risk owners. *Journal of Management in Engineering*, *30*(4), 06014001. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000278

Pointurier, C., Marle, F., & Jaber, H. (2015). Managing a complex project: Using a risk-risk multiple domain matrix. *Journal of Modern Project Management*, *3*(2).

Ventroux, J., Marle, F., & Vidal, L.-A. L. A. (2018). Organizational reshuffling to facilitate coordinated decisions in complex projects. *Concurrent Engineering Research and Applications*, *26*(3), 299–309. https://doi.org/10.1177/1063293X18756718

Vidal, L., Marle, F., & Dernis, M. (2021). Modeling and Estimating Host Country Values in International Projects to Facilitate In-Country Value Creation. *Sustainability*, *13*(5592).