PUBLIC INFRASTRUCTURE PROJECT CAPABILITIES TO RESPECT COSTS, SCHEDULE AND SCOPE IN PUBLIC INFRASTRUCTURE PROJECTS

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Abstract

Scholarly research and practitioner contributions have highlighted technical ability in the management public infrastructure projects as a potentially potent source of project success. However this paper raises a potentially puzzling question; if these abilities are so central to project success, why are successful public infrastructure projects still weak and questionable? To explore this issue, this paper draws on detailed analyses of 115 interviews conducted with many of the predominant stakeholders concerned with public infrastructure projects conducted in the last decade in Quebec. The study suggests that any particular ability to manage a public infrastructure project rests on a complex set of interlinked abilities that usually evolve slowly over time and with failures. Those owners fortunate enough to have focused early on project management with an open and flexible attitude have been much more successful in managing public infrastructure projects: on time, within budget, and without judicial conflict.

Keywords: Ability; Construction Industry; Public Infrastructure Project; Project Manager.

Introduction

Due to the recent failures of major and important public infrastructure projects for example, Gaspezia, Metro extension to Laval, Centre Hospitalier Honoré Mercier, Résidence Riviera, many Inquiry Commission, Auditor General reports, or experts' empirical works led to renewed interest in project manager ability as a source of infrastructure project success. Theoretical work in the area has established that 'competency' or 'ability' is difficult to acquire through routine market transactions and very hard to replicate (Henderson, 1994 ; Préfontaine, 1994 ; Wernerfelt, 1984 ; Bourgault, 1996 ; Teece and al, 1997). Practitioners and governmental decision makers have focused attention on technical or 'hard' assets such as architecture or engineering background knowledge as a required source of training and competence of project managers. Others relevant works focus more on contextual factors. They make out organizational structures (Nelson, 1991 ; Leonard-Barton, 1992), organizational coordination mechanisms (Lawerence and Lorsch, 1967), organizational communication channels (Arrow, 1974), development routines (Teece and al., 1993),and organizational behaviour in relation to its context (Galbraith, 1977) as critical keys to develop and capture competency in project management.

A series of significant practitioner's works has focused further attention on the empirical role of technical project capabilities in shaping the success of public infrastructure project management. Moreover, between 2005 and 2008, 80% of candidates for public infrastructure project manager occupations, had to be members of architecture or engineering orders (Analysis conducted between 2005 and 2008 based on newspaper and web site offers. Major public organizations

considered: CHQ, SIQ, MTQ, CS, Cegep, university, etc). 70% of project managers interviewed in this research are architects, engineers or architectural technicians, 18% are technicians in judicial fields (i.e. grievances), or accountants. The rest come from others fields (e.g., IT, biotechnology, defence) and have basic construction knowledge.

While these research contributions and snapshots are a stimulating basis toward making the concept of ability of public infrastructure project manager empirically concrete, it leaves a number of questions unanswered. First, we know much less about the role of project manager abilities and their potential as a source of public infrastructure project success. Second, if these kinds of abilities are acquired easily, why do public infrastructures projects continue to fail?

These questions are complicated further by the fact that construction project management is somewhat contradictory. Even if a project manager doesn't have to design a project or to validate regulation requirements, he must be an architect or an engineer. Moreover, 86% of professionals who participated in this research found that a competency of public infrastructure project managers is not the management of uncertainty across boundaries within firms and socio-political issues, which characterize the complexity of public infrastructure project today.

Research methods

Given the lack of prior research on the ability of public infrastructure project managers and the methodological difficulty to conceptualise 'ability', a qualitative approach was considered appropriate. In order to understand and to analyse a variety of states of ability concepts, their impact on costs, schedule, and scope respect, and their evolution over a project life cycle, two overlapping studies were conducted.

Step 1 aimed to define concepts and define issues on industry words. Senior government executives have been interviewed, commitment to the case study was sought and 5 Quebec large infrastructure projects were identified (This step was conducted under CIRANO and Secrétariat du Conseil de Trésor research subvention; see Chebil et. al, 2006). Following these interviews, the project managers, civil servants, architects and/or engineers and one or more other participants and stakeholders in each project were interviewed. Table 1 summarizes these projects and persons interviewed.

Table 1. 1st step: projects analysed

Project	Costs and schedule	Persons Interviewed	Ability definition and perception
Acadie Interchange	2001-2004: Delay 1 year. over cost: 100%	PM Engineering firms Ville de Montreal MTQ Builder (6 interviews)	Owner and contractors define ability in a different way According to public owner, ability is management of technical issues According to contractor, ability is to: × manage change × communicate in integrative way × define need and scope
Bibliothèque et Archives nationales du Québec (BANQ)	2001-2004: no delay over cost: 7%	PM BANQ Engineering and architecture firms Government (5 interviews)	Owner and contractors define ability in a different way According to public owner, ability is management of technical issues According to contractor, ability is to: × manage change × understand administrative processes and institutional roles
Métro Laval	1998-2008: 4 year	PM	Owner and contractors define ability in a different way

	delay Over cost : 350%	MTQ AMT Ville de Montreal Engineering and architecture firms (8 interviews)	According to public owner, ability is management of technical issues According to contractor, ability is to: × manage change × understand sociopolitical issues × understand administrative processes and institutional roles × communicate in an integrative way × define scope and owner needs
Palais des Congrès	1999-2002: 1 year delay Over cost: 17%	SIQ Engineering and architecture firms Builder (6 interviews)	Owner and contractors define ability in a different way According to public owner, ability is management of technical issues According to contractor, ability is to: × manage change × communicate in an integrative way
CH Honoré Mercier	2003-2008: 2 years delay Over cost: 27%	PM Engineering and architecture firms Builders (8 interviews)	Owner and contractors define ability in a different way According to contractor, ability is to: × manage change × understand sociopolitical issues × understand administrative processes and institutional roles × communicate in an integrative way × define scope and owner needs

Projects were studied in some detail. The interviews were semi-structured based on an interview protocol. Interviewees were encouraged to develop their own views rather than forcing their experience into priori categories. Furthermore, reports, administrative documents, and press reviews were analysed.

Step 1 permits us to go forward to step 2 with two important preconceptions:

1. Owners and contractors have different expectations regarding ability. They define ability in different ways. Public owners consider technical ability most important '*to challenge contractors and to force them to respect costs by choosing efficient technical solutions without over-design'*.
2. Contractors define precisely what the relevant and required ability is: to manage change, to define owner needs, and to help them to deal with administrative and institutional issues. One of them said: *I'm the architect of this project and I'm paid for. They have to go beyond their obsession of respecting costs by micromanagement of technical details. I need more soft-skills leadership and flexible administrative and institutional processes*.

Step 2 specifically aimed to analyze the ability to manage change. The study focuses on three ability categories: technical, administrative, and project management. Table 2 summarizes these ability categories.

Table 2. Ability categories

	Technical ability	**Administrative and institutional ability**	**Project Management Ability**
Definition	Be an architect, engineering or technician	Understand roles and public process Reduce administrative impact and slowness of public processes Develop personal relationship with government officials and/or organization.	Open attitude and desire to communicate, to resolve difference in flexible manner Connect project with users needs Use project management tools: stakeholders, risks, control tools and process
Quotes	*I have to be sure that the plans are well made* *My credibility is based on my technical skills. In our industry, if you aren't an architect or engineer, you can't manage a construction meeting. It will be easier for them to get your money.*	*Contractual terms are our bible.* *I manage public funds. This requires roles, documents and rigorous public process* *In case of juridical process, all administrative processes and documents come first. All other kinds of relationships become irrelevant.*	*I have to be tough and fair* *I'm a connection between inside administrative culture and contractors' requests* *I need present contractors, involved users and flexible institutional roles. In most of my projects, this is unattainable.*

An attempt was made to identify connections between the owner's and contractor's perspectives. To avoid contextual biases, researchers conducted 115 interviews without project-specific perspectives and with all stakeholders involved in the construction industry in Quebec. Table 3 gives information about persons involved in this research.

Table 3. Entity involved

	%	**Number**	**Details**	
Owners	49%	57	22% health services 34% education 9% Municipality or local 6% Transport 16% High Civil servants Others 13%	**Background**: 16% architects 38% engineers 16% technician s 18% accountants, judicial, etc. 12% others
Builders	14%	16	Personnel Under 5: 11% From 5 to 50: 44% More than 50: 44%	**Contract mode**: Only traditional: 25% Traditional and/or design build: 75%
Professionals (architect and engineering)	12%	14	25% architect 75% engineering	**Experience** Less than 20 years of: 69% 20 to 30 years: 9% More than 30 years: 22%
Others (lawyers, political, associations, etc.)	25%	28	Federal: 4 Association, corporation, orders: 8 Insurance: 3 Politicians: 4 Claims firms: 3 Media and Lawyers: 6	

Data analysis

The objective of the data analysis was to understand the kind of project manager abilities needed to respect costs, schedule, and scope in public project infrastructure management, their impact and their evolution during the project life cycle and factors influencing them. Interviews for the first two steps produced over 1600 pages of transcripts and over 200 pages of field notes. There was thus a vast amount of qualitative data that was not easily amenable to analyze. The data analysis was done in a systematic and comprehensive fashion. Nvivo 2 was used. Concerns expressed about source, impact, and categories of ability to manage change management were identified.

Copies of each concept transcripts were then made and analyzed separately. At this step, comments related to the factors affecting uses of each ability category and their impact were identified.

Research question

What kind of project manager *ability* is required and what is the impact in public infrastructure project management?

After reading the transcripts for each ability category and identifying the common concerns in the sources and the impacts of each, a summary was constructed for each change type. Table 4 present one of these summary efforts: considering the link between kinds of change in the construction industry and the owner's basic ability to deal with this change.

Table 4. Ability category versus change kind

	Example	**Ability most indicated**	**Comments**
Work change	Owner's new demand New law affected a project scope Adjustment of project scope according others project simultaneously in progress	Institutional and administrative flexibility Focus on public business core Final users continuously involved Stakeholders and risk analysis	No technical ability considered Administrative ability is considered in all responses to deal with administrative slowness Project management tools are needed to manage change in proactive and integrative ways
Differing site conditions	Contamination Rock	Postmortem analysis Risk analysis	Project management tools are considered by all interviewees.
Defective contract document	Lack of plan coordination Lack of respect regarding construction codes or roles	Final users continuously involved Institutional and administrative flexibility Owner's have to consider time and effort to produce a fulfilled plan	Technical ability is considered here in all responses. This ability is needed not to make plans or to comment on them, but more to consider effort needed to accomplish architectural and/or engineering works Administrative ability is considered to define a new administrative possibility Project management tools are needed to communicate, to define need and to keep final users involved
Others	Weather Act of god	Institutional and administrative flexibility	Administrative ability is considered to define a new administrative possibility

These summaries also included links to memos or administrative documents. A one page summary was conducted for each interview and for each category of ability. Each page used a standard form and was prepared by examining the memos, administrative documents, and transcripts. Together, the above analytical and conceptual tools enabled the author to decontextualize the interviewee point of view and to define it more according to this research aim: understanding and exploring ability to respect costs, schedule, and scope. This was helpful to raise patterns otherwise missed, and to suppress patterns which may be considered spurious according their original interviewee.

By providing a structure for analysis of qualitative data, systematic procedures were devised and used to minimise the possible effects of subjectivity. The major goal in reporting research is

transparency, use of descriptive data, gathering, and analysis as well as to return, if necessary, to the interviewee to clarify quotes or to better define the sense of a word.

Research Objectives:

- Understand and explore project manager abilities to respect costs, schedule, and scope in public infrastructure projects.
- Understand abilities to manage change.
- Understand sources and evolution of project manager abilities.

Research results

Four dummy variables were correlated with higher ability:

- Project design: a public infrastructure project is managed by an independent and cross disciplinary project team rather than by an inside structure not dedicated specially tothe project.
- Project manager leadership and power: the majority of key resources allocations, budget definition, and management and project processes and procedures were made by a project team rather than by ministerial and/or multileveled administrative committees.
- Project management tools and methods: project management tools and methods are used, institutionalized, and committed through the owner's organisation.
- Owner / contractor relationship: Owner and contractor share fundamental project parameters, particularly contingency, and define a change procedures and impacts together.

The results suggest that the more successful owner organisations maintain a rich flow of information within their own boundaries and with contractors by keeping final users involved and interested in the project. They accomplish this by using cross-disciplinary teams, by allocating key resources to committees after project manager recommendation, by defining contingency following a rich and pertinent risk analysis, and by using project management tools and methods known by all owner organisations and rigorously used in day-to-day project processes. These results are consistent with those obtained by other researchers who looked at the construction industry (Miller and Lessard, 2000) but left unanswered the critical question raised at the beginning of this paper. If such an apparently straightforward owner organisation has such substantial implications for project success, why do public government structures not directly adopt them throughout their infrastructure project structure? Moreover, public owners interviewed readily agreed that independent and cross functional teams, project manager leadership, contractor sharing, final user involvement, and project management tools and methods were critical to project success and, with a few exceptions, they were all trying to acquire these capabilities, in different manners. Why then, should some owners find these methods so difficult with the majority of owners failing to adopt them in practice?

A part of the answer to this question lies in the public project administrative processes and technical life cycles. Public infrastructure projects take place in three stages: a long administrative process to approve the budget, infrastructure design, and infrastructure construction. According a government belief and hope, the budget, defined in an earlier step, will be fixed as the owner has to plan his project carefully and precisely. Then, the owner has to design the project, according to the structure of this budget. According to the owner's belief and hope, construction costs will be fixed as professionals have to design the plan carefully and precisely. Under this regime, successful public infrastructure projects drew on three core hypothesis: needs defined in very fine detail, project managers with abilities to determine contingency according to risks management, and rigorous process and institutional flexible background needed to venture a new administrative

solution, in crisis situation. However, on one hand, many owners were organized functionally, with non-construction fields (education, health, etc.) at the heart of the process, and projects managers worked downstream in a fundamentally reactive mode. On the other hand, the administrative and institutional budget process takes place with many committees and administrative levels. For example, a health infrastructure project has to deal with hospital, agency, health ministries, and Conseil de Trésors levels. With each of them, different administrative documents are requested and delays are observed. Within each institutional level, many authorisations are needed to achieve consensus. All of them take time and consume effort. At the same time, initial needs could be changed, final users have lost interest, and technological generations could have advanced. Then, in addition to these institutional and administrative constraints, design and construction phases suffer from owner and institutional structures which confuse the planning and managing of a project.

Successful owners employed outsourcing project teams to manage professional works, and construction and insourcing teams to define needs and maintain connection between the outsourced team and final users. Many successful projects were managed in this way: McGill virtual emergency school, Bibliotheque nationale et archives nationales du Quebec, extension and renovation of CEGEPs in Montreal and in Sherbrooke, university extensions in Sherbrooke. However, this method of project infrastructure management required a relatively rich communication of knowledge, either across the boundaries of the firms involved or across administrative disciplines and core activities areas within the owner structure. Within public owner structures from project committee to administrative and operational unity communication of knowledge took the form of requests to deal with needs uncertainty or with overlapping projects. Across the boundaries of the firms involved, from outsourcing project teams to professionals firms, knowledge interchange and communication of knowledge took the form of adaptation of users' needs and requests for adapting the plan.

Integrative Ability In Public Infrastructure Projects

Given this transition, in general, the owners were not surprised by these observations. They readily agreed that reducing institutional and administrative processes, outsourcing project management, and defining the need well were critical to project success. Despite the apparent simplicity, acquiring abilities to manage public infrastructure projects is quite difficult. To try to explain the reasons according this research, first the study looks at owner perception of the three abilities categories, then the study looks at perception of the three abilities categories from the contractor's point of view. Finally, divergent reasons are discussed and issues are proposed.

Owner Point Of View

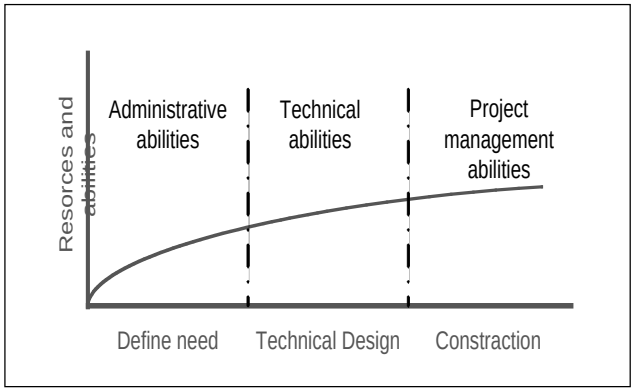

Fig. 1. Abilities required in public infrastructure project

For all public owners, administrative capabilities are significant in dealing with administrative processes, documents, and structure. There are many administrative roles and institutional forms to respect costs, to tender, to receive bids, to inform, etc. It is required as well to develop a helpful hierarchical relationship to find out new administrative possibilities for budget overruns (e.g., a new intern small project) without losing credibility.

Even though the owners don't discuss utilities, they explain that this takes a lot of time and requires effort. The issue here is that these abilities become more important than others to manage complexity and to preserve credibility.

Like administrative abilities, technical abilities are identified by all public owners. They aim to challenge architects and engineers to move them forward to innovative technical solutions, to validate plans, or drafts and to participate better in technical meetings. However, the major reasons for these abilities are construction supervision. Given that supervision is commonly underestimated, project managers have had to supervise construction, even though they did not have enough time to do so.

25% of public owners found these abilities required but not crucial and ask more for project management abilities. These act on two overlapping levels: to prevent users' new requests,(i.e. to do an analysis post-mortem, to keep up with new technology and construction techniques), and to manage change by opening systems of communication by sharing important project information, especially contingency information. These owners found project management abilities crucial since administrative and/or technical capabilities cannot create and fill out the roles of preventive project management teams who are able to respect costs, schedule, and scope.

However, most public owners bluntly explain that they don't need project management capabilities because they themselves manage small projects. Furthermore, nearly all of them are closed minded when it come to the idea.

Only 14% of public owners involved in this research recognize the necessity to have all three of these capabilities. Public infrastructure complexities involve many institutional levels, many technical challenges, and many contractors. To deal with all the issues and challenges, all three competencies are helpful, not only technical ones.

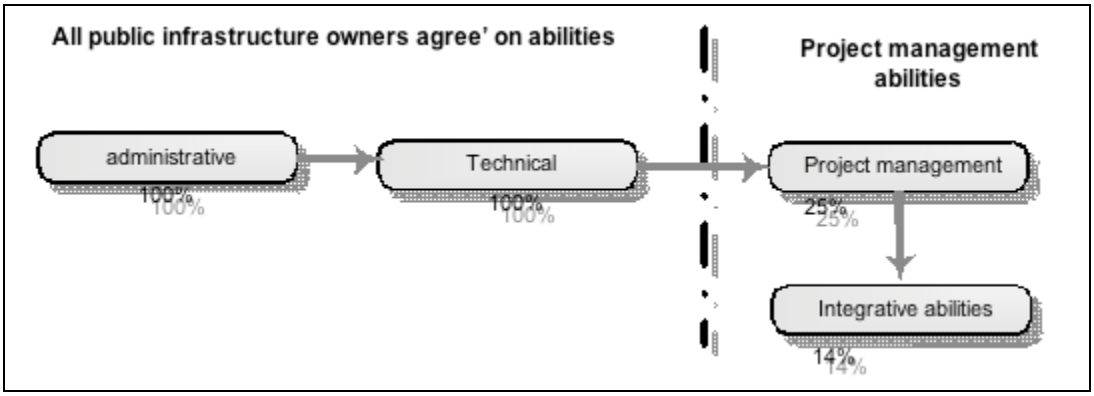

Fig. 2. Public owner's point of view of abilities

Contractor Point of View

Most contractors observe a lack of owner capabilities in the management of public infrastructure complexities. They point out the slowness of administrative processes, different levels with different powers, and a micromanagement attitude rather than a connection with end users' need. Rather than evoke administrative, technical, or project management capabilities, contractors observe two attitudes: open and closed ones. Public owner with an open attitude share problems

and analyze solutions which come from all contractors, not only from the architects. They demonstrate administrative agility to be tough and fair. They are respected not only for their technical abilities but also for their attitudes and fairness. Public owners with closed attitudes apply bureaucratic processes and roles without considering complexity or project specificity. They negotiate change management under one-sided roles with easily enforceable changes.

Discussion and Conclusions

A recent series of significant and detailed empirical studies has focused attention on the pivotal role of project management tools and methods in shaping the capability of project management. The most relevant of these studies focuses on governance regimes (Miller and Hobbs, 2005), shaping project risk mechanisms (Miller and Lessard, 2000), institutional transparency (Flybjerg et al, 2003), political and institutional contextual impacts (Altshuler and Luberoff, 2003), and tools (Besner and Hobbs, 2005) as core issues of a project manager's capability. All of them shift attention from planning efficiency to change management efficiency. Day to day project management is dealing with how to shape planning in real project contexts. Even this shaping effort needs costs and resources; it's rarely related to the project management scholar's contribution.

Key Lessons Learned:

- 14% of public owners use relevant capabilities to manage public infrastructure project.
- Technical abilities are not sufficient to respect costs, schedule, and scope in public infrastructure projects
- Project management abilities are crucial to prevent change, keep final users involved, and to manage risk carefully.

The study has tried to highlight the complexity of integrative capabilities in public infrastructure project management practice. The main reason for this complexity is that their development depends on a number of factors that evolve slowly and in a concise way.

Successful owners are aware of contractor dynamics, and understand public administrative issues and institutional constraints. They share information, communicate a lot, and develop relationships according to project complexity. At the same time, above all they uses administrative, technical, and project management abilities in integrative ways to manage change. The integrative capability is the competency to integrate knowledge across both owner and contractor boundaries. Integrative capabilities play crucial roles in shaping success for public infrastructure projects, even if, as this research shows, they seem to be used only by 14% of public owners.

The results raise intriguing questions about the relationship between the development of project management ability and the larger institutional context of the construction industry, since both professional orders and the consideration of judicial mechanisms as trivial appear to have shaped the capability in the industry.

*All **quotations** tr**anslated from French to English** by the author.*

References

Althsuler Alan et Luberoff Davis, (2003) *Mega Projects – The changing politics of Urban Public Investment*. Brookings Institution Press. Washington DC.

Arrow, K (1974) *The limit of Organization* Norton: New York.

Bourgault M. (1996) *Compétences des entreprises et sous-traitance nord-américaine : le cas de l'industrie aérospatiale*. Thèse de doctorat. École Polytechnique Montreal.

Chebil F., Joanne Castonguay et Roger Miller (2006) *La gouvernance des grands projets d'infrastructure publique. Analyse des grands projets réalisés au Québec*. CIRANO – SCT.

Flyvberg Bent, Nils Bruzelius et Rothengatter Werner (2003) Megaprojects and Risk.Cambridge University Press.

Galbraith J,R, (1977) *Organization design* Addison Wesley Publishing company.

Henderson, Rebecca (1994) "The evolution of integrative capability: Innovation in cardiovascular drug discovery" *Industrial and computer change*, Vol. 3, No 8, pp.607-629.

Lawrence P.R et Lorsch, JW., (1969) *Organization and Environment. Managing differentiation and intégration.* Homewood. Richard D. Irwin Inc.

Leoanard-Borton (1992), "Core capabilities and core rigidities: a paradox in managing new product development". *Strategic management journal*, 13, 111-126.

Miller and Hobbs, (2005) "Governance regimes for large complex projects". *Project Management Journal*; 36, 3.

Miller Roger and Lessard Donald (2000) "*The strategic management of large engineering projects*" Massachusetts Institute of technology.

Nelson R. (1991) Why do firms differ and how does it matter? The strategic management journal,12 61-74.

Préfontaine, Lise (1994) "Les compétences organisationnelles favorisant l'innovation technologiques dans un contexte de PME manufacturier" *Thèse de doctorat – UQAM*

Teece, D,J, S Winter, R Rumlet and G, Dosi (1993) "Understanding corporate coherence: theory and evidence". *Journal of economics and organisation*, 22.

Teece, Pisano and Shuen (1997) "Dunamic capabilities and Strategic management". *Strategic management journal*. 18:7, 509-533.

Wernerfelt, B. (1984) "A resource-based view of the firm". *The strategic management journal*, 5, 171-180.

Author's Biography

Fethi Chebil is an industrial engineer. He has expertise in infrastructure and engineering project management. Over the course of the past 12 years, Fethi has managed several major construction, innovation, and high-technology projects in Quebec and abroad. He has delivered airport infrastructure and information technology. His professionalism, communication style, and natural leadership abilities have directly impacted the success of every project he has been involved with.

Fethi is particularly interested in client/supplier relationships, inter-firm coordination, and in managing change orders in early-stage front-end projects as well as during the construction phase.