Revay and Associates Limited

The Revay Report

Project Management and Construction Claims Services

Published by Revay and Associates Limited
Volume 29 Number 3 November 2010

Quality in Execution of Building Projects

by Johanne Guay, B. Arch., M.Eng.
Consultant

Revay and Associates Limited – Montreal

Johanne Guay

A building project is considered a success when it meets initial expectations. With this in mind, are all aspects of a project always planned, organised and executed with the specific aim of making the project a true success? Consider all the parties involved in a project: do owners, consultants and general contractors share the same expectations for a specific project? Are the various expectations given the same priority?

Though one would expect the owner to be the party most interested in the quality of work, it is not always the case. Surveys conducted by groups of insurers in the United States show that views, expectations and preoccupations are not necessarily the same for design consultants and their clients, the owners, especially when assigning priorities. This can seem somewhat surprising although, from the owner's point of view, budget and schedule constraints should obviously remain key elements.

Will such a situation not have an impact on a project's execution? Will the owner be ready to plan for the resources, efforts, processes, etc. necessary to ensure a level of building quality that fully meets expectations? Precious time and money can be lost if a client fails to supply all necessary information from the very start of a project. Too often, program modifications are needed during the design phase and sometimes even during construction. Do these situations not occur too frequently, for example in hospital projects?

But enough talk. We invite you to read the following summary of a few important extracts of the research conducted by Johanne Guay on quality in execution of building projects.

Background

The construction industry is central to the creation of assets in Canada which represents approximately 12% of Gross Domestic Product (GDP)[1]. Asset creation is far from being a straightforward matter. Many decisions need to be made for the initial idea, development, execution and marketing of an asset. Decision-makers continually need to find the right balance between quality, cost and time issues. Although these concepts have been a part of the manufacturing and service sectors for more than 50 years[2], they have not been as present in the construction industry.

In the early 1990s, the British government relaxed its policies on construction procurement in the public sector. This measure led to increased use of various types of construct/operate projects known as BOT (Build Operate Transfer), DBO (Design Build Operate) and DBOT (Design Build Operate Transfer). The PPP (Public Private Partnership) mode, including Private Finance Initiatives (PFI), is also an example of such projects[3]. These execution modes did not always produce high quality projects. More specifically, studies have pointed to poor performance in the construction industry, including inefficient project management, poor building quality[4] and, above all, low levels of client satisfaction. As a result, the British government demanded that the construction industry implement better work practices, with the objective of reaching high levels of building quality.

In Canada, reports and studies on the construction industry suggest similar problems exist, but current practices remain unquestioned, particularly with regard to quality level. This lack of focus on quality is a concern in view of the high costs of upgrading existing buildings or new buildings not initially designed with high levels of quality in mind. Sustainability aspects need to be considered in order to ensure building durability. The current situation in the Canadian market requires action and represents a serious challenge for the various government levels, who would undoubtedly benefit from implementing measures similar to those that now exist in the U.K.

What is Quality?

The dictionary defines quality as "an asset's intrinsic characteristics that give it the capacity to satisfy users' needs and expectations".

In the manufacturing sector, the notion of quality generally refers to a product meeting client expectations based on compliance with specifications, on product performance in terms of purpose of use and value produced and on exceeding the client's needs and expectations[5].

The manufacturing sector makes use of several global quality systems, all of which are centered on satisfying the client's needs. Examples of these systems include the Quality Management System

(QMS), Total Quality Management (TQM) and ISO management standards such as ISO 9000. These quality systems, which aim at minimizing human error, are based on work standards and process automation. The employees' level of responsibility is also a function of their autonomy in solving problems.

In the construction industry, no single definition exists for the notion of quality. For some, it refers to the quality of materials or of project execution; for others, quality is more akin to "beauty". The notion of quality varies according to a party's role and responsibilities, further reinforcing the lack of consensus on the definition of quality. In Canada, we are starting to see that quality refers to a project's integrity as well as to the "process" followed. This definition of quality applies not only to materials or to project execution but also to a balanced process encompassing quality, budget and schedule issues.

Unfortunately, the quality systems used in the manufacturing sector are seldom applied to the building industry in Canada. Many reasons can explain this situation. First, a building project includes several architectural, structural, mechanical and electrical elements and therefore calls for coordination of the various parties involved. A project team needs to be formed for every new project and will be involved in many different activities during the project's life cycle[6].

A project's team members often have a different appreciation of a building's level of quality. Individuals from a similar profession generally use the same codes and accept criticism from their peers more readily. It is harder, however, to accept criticism from a different profession. According to Kaatz[7], architects and engineers use different references as a basis to assess the quality of a construction project. As a result, they often make design decisions without adequately considering the impact produced on other disciplines[8]. In the end, the parties involved in a given project develop their own objectives, goals and value systems.

Compared to integrated teams in the manufacturing sector, teams in the construction industry are fragmented[9], resulting in a lack of communication between the various parties. In addition, construction teams last only for a project's duration. Dissolution of a team at project completion impedes improvements in performance and makes it more difficult to learn how to work as a team.

An additional point is that quality assessment is not systematically implemented in all building projects. Given the need for coordination and for a vision common to all parties, it would seem natural for clients to require the use of a quality management plan. They do not, however, and prefer to rely on the architects and engineers, assuming that the desired level of quality will be reached. Moreover, prior to the construction phase, clients rarely verify whether the drawings and specifications developed by their consultants are likely to satisfy their needs, neither do they confirm that their needs have in fact been met when this phase is completed.

Quality Assessment Tools

Although it is generally acknowledged that adequate identification of needs at the planning and design phases is a precondition for appropriate design development and ultimate project success, very few tools exist for assessing how well the client's stated needs have been satisfied. Regrettably, insufficient emphasis on the identification and assessment of quality criteria, on contract document management and on communications between the various parties prevents reaching high levels of quality. This lack of attention is often the cause of changes during construction.

In order to use the quality systems developed for the manufacturing sector, it would first be necessary to adapt them to the construction industry[10]. In The U.K., the National Health Service (NHS) based its efforts on those systems and was able to respond to the British government's demands by developing the ProCure 21 System in cooperation with the Construction Industry Council (CIC), with Sheffield University and with the Commission for Architecture and the Built Environment (CABE). The system aims at implementing a culture of continuous improvement in hospital projects[11] and encourages the integration of four main approaches, including design quality.

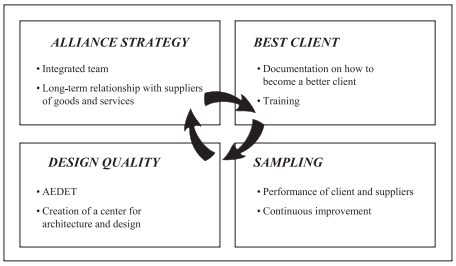


Figure 1 – ProCure 21: Main Approaches[12]

ProCure 21's approach for design ensures project quality by using, among other things, a quality assessment tool. Quality level is assessed by means of the Achieving Excellence Design Evaluation Toolkit (AEDET). This assessment tool is essentially a survey on the definition of quality and is based on Vitruvias' Beauty, Solidity and Utility criteria[13].

These three components of the AEDET tool are defined using ten criteria, which are in turn described by 59 clear, non technical statements (see Table 1). An adequate level of quality is reached when all of a component's criteria have been met.

The AEDET tool, by using 59 clear statements, provides a common language that allows for needs to be clearly identified and for a discussion to be initiated between the client, the consultants and other parties to the project. This discussion can take place at each phase of the project's life cycle[14], thus ensuring that the client's initial expectations are continuously being met.

This tool was created to ensure that client needs and quality criteria are clearly identified by all project participants and that nothing is forgotten or left aside during project execution. However, the AEDET tool cannot be used to analyse financial gains or to assess the design process.

The Research - An Overview

There is no agreement, in the Canadian construction industry, on a single definition of quality and, consequently, on a standard way to assess it. A consensus on the definition is necessary, however, for the notion of quality to be uniformly understood, communicated and integrated to the industry. Agreeing on a quality assessment tool would also provide a starting point for developing a quality system that could subsequently be used in Canadian building projects.

It is with this in mind that a definition of quality, along with the AEDET tool, were presented to several participants of the Canadian construction industry for validation.

The following definition was proposed during the research work:

"The quality of the built environment refers to architecture and, consequently,

Table 1 – Vitruvias' Components and AEDET criteria[15]

COMPONENT	CRITERION	NUMBER OF STATEMENTS PER CRITERION
BEAUTY Refers to the design's clarity and intent, to the nature of the built environment based on the shape and appearance of materials used, to interior spatial environment and to general improvement brought by the building to the area.	**1. Character and Innovation** *The general feeling produced by the building, its personality and functionality.*	6
	2. Shape and Materials *The very nature of the building in terms of its shape and of the materials used for its construction. It is not the technical aspects of the materials that are considered here but rather their appearance and the general feeling they bring to the project.*	5
	3. Environment *The building creates an environment that is favourable to the users' best work practices.*	7
	4. Social and Urban Integration *The way the building integrates to neighbouring locations and brings a positive influence on its surroundings.*	5
SOLIDITY Refers to physical criteria, to the construction process and to technical and engineering aspects.	**5. Building's Technical Performance** *The building's technical elements and their performance during the building's life cycle.*	5
	6. Engineering System *Design quality for the building's main systems, i.e. whether they fulfill the desired functions, work properly, are easy to operate and maintain, and are designed to last.*	7
	7. Construction *Technical details regarding the building's main elements and its constructability.*	7
UTILITY Refers to building's functionality and efficiency of operation.	**8. Use** *Whether the building allows users to perform their tasks and to operate adequately in the premises. This criterion applies to elements meant to be highly functional and efficient.*	7
	9. Access *The way a user can move inside the space. For example, is it easy to access the building?*	5
	10. Space *The amount of space available in the building to fulfill the intended function. Are spaces well positioned? Is it efficient?*	5
	TOTAL	59

to the development of a good design which takes into account the three key elements defined by Vitruvias: Beauty, Solidity and Utility. Beauty refers to character and innovation, to shape and materials as well as to social and urban integration and to the environment. Solidity refers to the built environment, based on technical performance and on the project's engineering systems. Utility refers to purpose of use, to access and to spaces created inside the built environment."

For validation, AEDET's ten criteria and 59 statements were tested with selected participants, notably by asking them to qualify the relevance of each of the 59 statements.

Other aspects impacting quality were also considered in the survey, including:

- The party most capable of assessing quality level
- The phases where quality assessment is necessary
- The project execution mode

Participants in the research

To account for fragmentation of project teams in the construction industry, participants were selected based upon their roles:

- Client
- Consultant
- General Contractor
- Other

And upon their responsibilities in construction projects in order to obtain a representative sample. Participants were classified using the above four roles and the following three disciplines:

- Architect
- Engineer
- Specialist

Acceptance of Proposed Definition

The great majority of respondents (92%) consider this definition of quality to be adequate. However, 69% judge the definition to be incomplete when applied to the Canadian context. 44% of respondents, mostly architects (as consultants or clients), consider that the notion of cost should be added to the proposed definition. On the other hand, very few engineers, as consultants or clients, are concerned by this aspect, as architects are traditionally responsible for managing budgets on behalf of their clients.

In addition, participants generally con-

sider that the notion of quality is neglected during the contractor selection process; 92% of respondents believe that the usual method of selecting a contractor based on the lowest bid reduces a project's quality. Almost as many respondents (88%) consider that a project's quality depends on the quality of the work performed as well as on the accuracy of price estimation during the planning phase.

Moreover, 96% of respondents consider that quality level is lowered due to errors and omissions in the drawings and specifications issued for construction. One could think that insufficient fees paid to the project's consultants might be a cause of incomplete contract documents; contracts for professional services are often awarded based on the lowest bid.

Cost seems to be a generalized concern, although it is not the only variable directly impacting a project's quality: balancing the notions of quality, cost and time remains of paramount importance.

Acceptance of AEDET's Criteria and Statements

AEDET proved to be an efficient tool for assessing a client's needs and, as a result, a building's quality level. Indeed, 90% of respondents consider the ten criteria and 59 statements to be acceptable. Moreover, 92% say that a building's quality should be assessed at every step of its life cycle, using an objective assessment tool based on well-established criteria; such a tool would therefore fulfill a real need in the construction industry. 96% of respondents are not aware of the existence of AEDET.

Results from this research, echoing the Kaatz study, indicate that interest for a particular component varies according to the disciplines and roles of the various parties involved in a construction project. Clients who are also architects, engineers or specialists give more importance to the Solidity component, whereas general contractors focus on Utility and architects are more interested in the Beauty component.

These results show that the role played within a project influences judgment and leads a party to put more emphasis on certain criteria and less on others. Without an integrated approach to procurement activities, differences in perception may lead to decisions regarding design and quality that do not take into account the possible impact on other parties involved. In such cases, some criteria are given more importance than others.

As an example, consider the Solidity component's Construction criteria, which concerns technical construction details and work sequencing. This aspect of a project must be considered as early as the design phase so as to minimize the impact of construction work on current activities and on sites that need to remain operational during project execution. Despite the significance of such an issue, results from the research show this criterion to be more important to clients than to consultants, who are more concerned with the Character and Innovation criterion of the Beauty component, which makes the project stand out and is therefore more useful for promotional purposes.

The client would be better served by assigning responsibility for the Construction criterion to the general contractor, whose opinion as to proposed design solutions is more pragmatic. General contractors, who tend to put more emphasis on the Utility component, generally do not take part in a project's design process; and as client involvement in design is usually insufficient in traditional project execution, an imbalance is created. This imbalance could be rectified if, for example, architects focused more on the Solidity and Utility components, thus producing a better balance between the three components. Greater participation to the project's development process by the general contractor would also help, but would require changing the project execution mode.

Results also show that architects consider it necessary to integrate a sustainable construction criterion/LEED (Leadership in Energy and Environmental Design) to the proposed tool in order to make it more complete. Because of the interest for sustainable development and LEED certification in recent years, this approach is often seen, in Canada, as a guarantee of high quality for construction projects. In the U.K., the certification system known as BREEAM (Building Research Establishment Environmental Assessment Method), which is the equivalent of the American LEED certification, is used to complement the AEDET tool. In this context, results from the research suggest that AEDET could be used in Canada without modification, using LEED as a complement.

The Party Most Capable of Assessing Level of Quality

As mentioned earlier, appreciation of quality differs according to roles and disciplines; project teams should therefore be better integrated to encourage exchanges and improve work coordination. In the U.K., in order to better manage the specialization of roles and responsibilities, a new participant was added to project teams: the "Client Design Advisor" or "Design Champion", who is responsible for keeping the notion of quality present during all project phases.

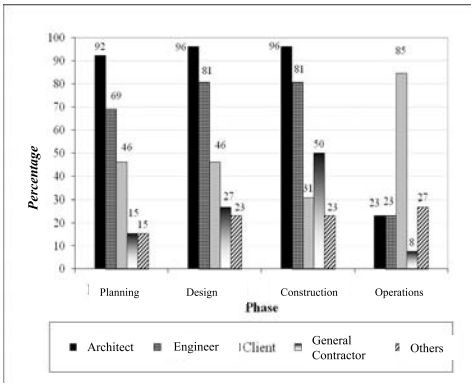
Survey results show the differences that exist among respondents regarding this new way of executing projects. A common belief is that the architect is always the sole party responsible for quality; more than half of respondents (58%) consider that an additional participant is not needed for assessing a project's level of quality. However, the architect is no longer alone in guaranteeing a project's quality, as tasks associated with project execution are now assigned to parties from other disciplines, even in the case of more traditional execution modes. This new sharing of tasks is even more present in PPP projects.

Figure 2 shows that architects, in traditional execution mode, are considered better qualified to assess a project's level of quality. 92% of respondents assign this role to the architect at the planning phase; the figure increases to 96% for the design and construction phases. It is significant that 85% of respondents consider that assessment of a project's quality is the client's responsibility at the operations phase, indicating that consultants do not see it as their role to verify that client needs have been met, especially if no fees are specifically associated with this task.

Respondents with experience in PPP projects consider that all parties involved in such projects participate jointly in assessing quality. The architect's usual monopoly in traditional project execution during the planning, design and construction phases is not as clear-cut in PPP projects. A single party is not solely responsible for quality assessment anymore, a task that now falls to a multidisciplinary group.

It is the client who, in PPP mode, is considered best suited to assess a project's quality level. However, the client shares this role with the general contractor. Almost half of respondents (44%) assign this role to the general contractor, compared with 8% for traditional project

Traditional Execution Mode



PPP Projects

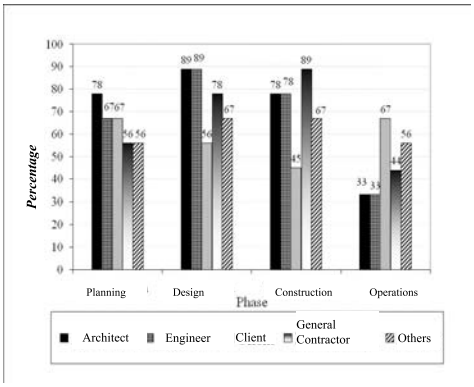


Figure 2 – Party Most Capable of Assessing a Project's Level of Quality – Traditional and PPP Modes.

execution. These figures are not surprising, as the operations phase of a PPP project is usually the general contractor's responsibility for a pre-established duration. In this situation, it is essential for the general contractor to ensure that the project is completed based on the client's needs.

One last characteristic of PPP projects is that 56% of respondents consider that other parties involved are capable of assessing quality levels during a project's entire life cycle. These parties can be specialists, who provide assistance or advice to the client during all phases of a project, similar to Britain's "Client Design Advisor" or "Design Champion".

Phases Where Quality Assessment is Necessary

Results from the research indicate that quality is not assessed frequently enough in Canada. Figure 3 shows theoretical and effective quality assessment for traditional and PPP projects at each phase

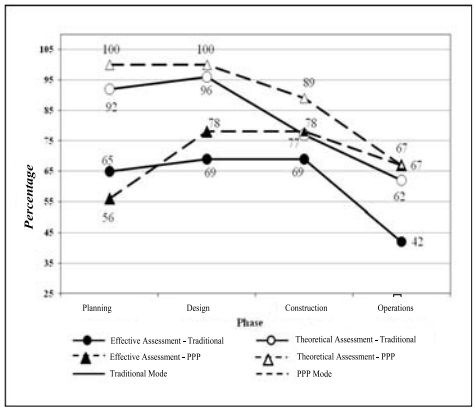


Figure 3 – Theoretical and Effective Assessment of Quality

of a project's life cycle.

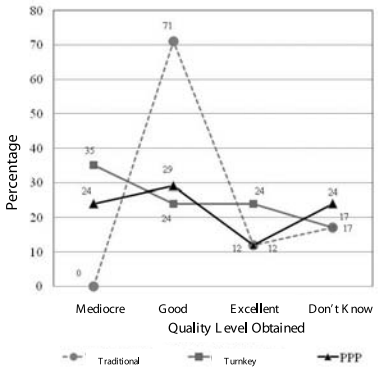
Respondents consider that quality assessment is, in theory, more important during the planning and design phases. Indeed, for both traditional and PPP projects, these two phases are given a degree of importance ranging from 92% to 100%. At the construction phase, results decrease to 78% for traditional execution modes and to 89% for PPP projects. Theoretically, for both project execution modes, respondents consider quality assessment to be less important for the operations phase; results show a degree of importance of only 62% for traditional execution and 67% for PPP modes. However, all authors consulted during the review of available literature emphasize the importance of assessing quality at all project phases, from design to operations. With this in mind, percentages for theoretical assessment of quality should have been closer to 100% for all phases of project execution.

In practice, respondents indicated that they had performed quality assessments at a much lower frequency: 78% or less, for all phases combined. The wide gap between theory and practice becomes even more significant when compared to the optimal assessment frequency, theoretically 100%, thus confirming that quality is not assessed frequently enough in Canada, in both traditional and PPP projects. This can be explained by a lack of tools for quality assessment; and no process for quality assessment has yet been recognized by the Canadian construction industry, a fact confirmed by 96% of respondents.

Project Execution Mode

Almost all respondents (96%) consider that a project's mode of execution affects its level of quality. As indicated in Figure 4, few projects actually reach high quality levels, based on survey results from respondents with experience in all modes of project execution.

Participants With Experience in Traditional Execution Mode



Participants With Experience in Both Traditional and PPP Execution Modes

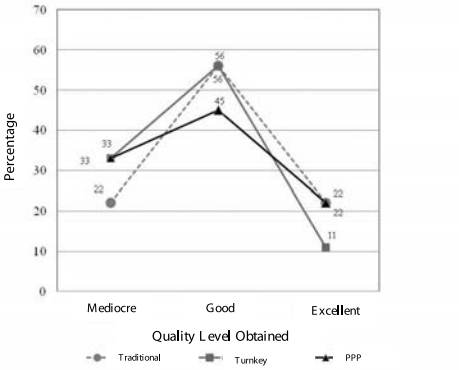


Figure 4 – Quality Level Obtained, According to Respondents With Experience in Traditional Execution Modes Only and Respondents With Experience in Traditional and PPP Modes.

Respondents with experience limited to traditional project execution consider these projects to be, for the most part, of good quality, with none seen as mediocre, and perceive PPP projects as being of lesser quality. On the other hand, respondents with experience in PPP projects have a more balanced opinion of projects completed using the various modes.

With no tool recognized in Canada for quality assessment, we note that respondents with experience wider than only traditional execution modes (e.g. with experience in turnkey or PPP projects) report a perception of project quality that is less unilateral. Results show that experience bears a direct relationship to a party's appreciation of a project and perception of the quality level desired and obtained.

Conclusion

As projects become more complex, the need for reaching high levels of quality in construction projects is of the utmost importance. In view of the large construc-

tion projects to be undertaken during the next decade, it is urgent that the construction industry modify its current practices in order to elevate the notion of quality to the same level as cost and time issues.

The AEDET tool, by encouraging better communication between the various parties in a construction project, provides a possible foundation for assessing quality. It allows for all parties to use a single definition of quality. This tool, or something similar, would respond to a long-standing concern of the construction industry, i.e. the need for higher quality buildings.

Changes are needed, however, to adapt the AEDET tool to the Canadian construction industry's practices and ensure higher quality of our buildings. To reach this goal, we offer the following suggestions:

- Make clients and other parties aware of the new practices in quality management
- Encourage better integration of project teams
- Establish long-term relationships between project participants
- Encourage continuous improvement of performance
- Create a center for architecture, the main mission of which would be to promote architectural quality

To make a concrete change and reach a balance between quality, cost and time, current practices need to be modified. In order to confront resistance to change on the part of the various parties involved, it is recommended that: i) terminology associated with the concept of quality be harmonized, ii) information on quality be widely distributed, and iii) the various parties be made aware of the importance of quality.

To ensure durability of our built environment, measures must be put in place to promote the highest levels of quality in our buildings. Considering the major advances that have taken place across the world since the 1990s, it is high time that Canada joined the trend and update its own practices in order to build long-lasting, high quality buildings.

Johanne holds a bachelor's degree in Architecture from Laval University and a master's degree from Montreal's École de technologie supérieure in Construction Engineering - Project Management. Her experience spans over 15 years in execution of building projects in Canada and the United States, both as project manager and client representative. Johanne is an associate at Revay and is specialised in project management and client support for all phases of project execution. Her services also include preparation and assessment of construction claims for purposes of negotiation, mediation or arbitration.

Her interest in quality assessment led her to receive training on the Design Quality Indicator (DQI) at DQI USA, an organisation certified by the Construction Industry Council (CIC). This tool, developed and used in the U.K., is similar to the Achieving Excellence Design Evolution Toolkit (AEDET), the reference tool studied in this research. Early experience with the DQI in the United States is very promising and points to wider use of this assessment tool for building projects in the United States in the near future.

1 HUMAN RESOURCES AND SOCIAL DEVELOPMENT CANADA, 2001. Government of Canada funds the establishment of the Construction Sector Council, [Online], [http://www.rhdsc.gc.ca/fr/sm/comm/nouvelles/2001/010409_f.shtml] *

2 GOETSCH, David L. and Stanley B. DAVIS. Quality Management - Introduction to Total Quality Management for Production, Processing and Service, 5th Ed., Pearson Education, 2006, 832 p.

3 WEIL, Sylvie and Véronique BIAU. Comprendre les pratiques européennes - Le développement de la procédure de PPP/PFI en Grande-Bretagne. Survey Report, Interdepartmental Mission on Public Works, MIQCP, 11 France, Arpège, 2003, 152 p.

4 THE NATIONAL AUDIT OFFICE. Modernising Construction : Report by the comptroller and auditor general: HC 87 – Session 2000-2001, London Office, 105 p.

5 *BESTERFIELD, Dale H, Carol BESTERFIELD-MICHNA, Glen H. BESTERFIELD and Mary BESTERFIELD-SACRE. Total Quality Management, 3rd Ed., Pearson Education International, 2003, 544 p.*

6 CONSEIL DE LA SCIENCE ET DE LA TECHNOLOGIE. Building and Innovation : Trends and Challenges in the Building Industry, [Online], 2003, [http://www.cst.gouv.qc.ca/IMG/pdf/CSTBuildInnovate.pdf.]*

7 KAATZ, Ewelina, David ROOT and Paul BOWEN. Broadening Project Participation Through a Modified Building Sustainability Assessment, Building Research & Information, vol. 33, no. 5, 2005, p. 441-454.

8 GUNASEKARAN, A. and P.E.D. Love. Concurrent Engineering : A Multi-Disciplinary Approach for Construction, Logistics Information Management, vol. 11, no. 5, 1998, p. 295-300..

9 *GAREL, Gilles. Pour une histoire de la gestion de projet - Gérer et comprendre, no. 74, December 2003, p. 77-89.*

10 *LOVE, P.E.D., J. SMITH and H. LI. The Propagation of Rework Benchmark Metrics for Construction, International Journal of Quality & Reliability Management, vol. 16, no. 7, 1999, p. 638-658.*

11 *WOOLLISCROFT, Peter. NHS ProCure 21, [Online], 2006, [http://www.nhs-procure21.gov.uk/content/history.asp]**

12 *Ibid.*

13 *Roman architect, 1st century B.C.; he was first to define the concept of quality*

14 *GAAN, David, Ammon SALTER and Jenniver WHYTE. Design Quality Indicator As A Tool for Thinking, Building Research & Information, [Online], September 2003, [http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_082089]**

15 *DEPARTMENT OF HEALTH. AEDET Evolution – Design Evaluation Toolkit, [Online], 2008, [http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_082089]**

* All Web sites mentioned were operational at the time of this report's publication..

The Revay Report is published by Revay and Associates Limited, a national firm of Construction and Claims Specialists, assisting owners and contractors in achieving profitable and trouble-free construction projects.

Edition française disponible sur demande.

Please advise the Montreal office of any change of address.

REVAY OFFICES:

MONTREAL
4333 Ste. Catherine St. West
Suite 500
MONTRÉAL, Québec H3Z 1P9
Tel.: (514) 932-2188
Fax: (514) 939-0776
montreal@revay.com

TORONTO
2255 Sheppard Avenue East
Suite 402
TORONTO, Ontario M2J 4Y1
Tel.: (416) 498-1303
Fax: (416) 491-0578
toronto@revay.com

OTTAWA
39 Robertson Road
Suite 230
NEPEAN, Ontario K2H 8R2
Tel.: (613) 721-6801
Fax: (613) 596-8172
ottawa@revay.com

CALGARY
10655 Southport Road, S.W.
Suite 540
CALGARY, Alberta T2W 4Y1
Tel.: (403) 777-4900
Fax: (403) 777-4903
calgary@revay.com

VANCOUVER
1755 W. Broadway
Suite 401
VANCOUVER, B.C. V6J 4S5
Tel.: (604) 737-2005
Fax: (604) 737-2008
vancouver@revay.com

Revay & Associates Inc.
1105 N Market Street
Suite 1300
WILMINGTON, DE 19801
Tel.: (302) 427-9340
Fax: (302) 651-8426

http://www.revay.com
Publications #40042162