KEYWORDS project · project management · success · criteria · factors · innovation management

DOI NUMBER: 10.19255/JMPM01106

EXPLORATORY STUDY OF SUCCESS FACTORS FOR RESEARCH AND DEVELOPMENT PROJECTS RUN BY SMES IN QUEBEC LINKED TO SECONDARY AND TERTIARY ALUMINUM PRODUCTION.

Caroline Durand[1]
[1]LemGP – Université du Québec à Chicoutimi
Caroline.Durand@cqrda.ca

Christophe Leyrie[1]
christophe_leyrie@uqac.ca

Julien Bousquet[1]
julien_Bousquet@uqac.ca

ABSTRACT

Despite extensive literature on the subject of success, there is no consensus. However, it is accepted that success is evaluated by certain criteria and that it is dependent on success factors. Moreover, these concepts can vary according to the type of company, project and especially the stakeholder evaluating them. Within this context, the present study will discuss these criteria and factors as applied to projects run by SMEs working in the secondary and tertiary aluminum industry. The aim of the study is to help create a generic model applicable within the specific field of R&D projects submitted to the Centre québécois de recherche et de développement de l'aluminium (Aluminum Research & Development Center of Quebec).

1. Introduction

The Centre québécois de recherche et de développement de l'aluminium *(Aluminum Research and Development Center of Quebec – CQRDA)* is subsidized by the Ministère de l'Economie, des Sciences et de l'Innovation du Quebec *(Ministryof Economic, Sciences and Innovation of Quebec)*. It offers financial, human and technical support to research and development projects in the aluminum sector. Its scientific committee is an advisory body to its Board of Directors and consists of 20 experts in a variety of fields. Its basic role is to evaluate projects based on relevance and quality and to recommend these projects to the Board of Directors. The challenge lies in determining a project's chances of success based on its documentation in order to decide whether to provide funding. Since the creation of CQRDA, over 1000 projects have been submitted, of which 813 have been accepted and funded in five different areas. Evaluating a project's chances of success is a difficult endeavor that should be optimized and given a more solid basis.

The concept of project success has been largely addressed in the literature. However, there is no single agreed definition or measure for this, as highlighted by Pinto and Slevin. For several years, a project was considered successful if it met the three requirements in Atkinson's "iron triangle": cost, time and quality. This outlook seems reductive as it implies that project success depends solely on the success of its management. Moreover, the extent of a project's success is inevitably linked to the knowledge and understanding of two concepts: success factors and criteria. The problem is, given the unique nature and complexity of individual projects, it is impossible to theoretically determine all the key factors and success criteria involved. In addition, the normative aim of the theoretical processes from which they often arise makes it difficult to transfer them into practical situations, especially in certain specialized areas of activity.

Finally, the literature provides few or no answers pertaining to small and medium enterprises *(SME)*, and these are even more scarce for those SMEs that work in the aluminum industry. Within this context, it seemed relevant to investigate the factors that lead to success for research and development projects run by SMEs working in the secondary and tertiary aluminum industry in Quebec. This research aims to identify criteria capable of predicting success for the majority of projects submitted to the Center. To this end, a base model was developed at the start of the study and was used as a guide for the resulting investigations.

2. Literature review

The design that made it possible to develop an understanding of the theoretical nature of this study is close to themes inherent in the idea of "project success" such as project management, projects, SMEs, research and development, etc. By "historicizing" the concept of "project success," we discovered that a stream of North-American research has been studying the history of managerial thinking since the 1960s, much like the history of economic or political thought **[George, 1972, Wren, 1994]**. The advent of the idea can thus be traced back to this period.

Cleland and King *(1983)*, two authors who have contributed significantly to the emergence of project management as a discipline, define a project as "a complex effort to achieve a specific goal that must follow a schedule and budget, typically goes beyond merely organizational aspects, and is unique and generally non-repetitive in its organization." For O'Shaughnessy *(2006)*, "a project is the implementation of specific, temporary actions with the aim of producing unique deliverable goods to achieve specific results." Slevin and Pinto *(1989)* determined that a project generally consisted of four phases and used the terms "conceptualization, planning, execution and termination" to characterize these phases. The four phases are illustrated in the **Figure 1**.

When examining all the work linked to the subject at hand, it soon became clear that a distinction must be made between the success of a "project" and that of "its management." As described by DeWit *(1988)* and several other authors, project success is measured in relation to general project aims over a long period. According to the PMI, project management is defined as "The art of directing and coordinating human and material resources throughout the life of a project by using modern management techniques to achieve predetermined objectives of scope, cost, time, quality, and client and stakeholder satisfaction." Project managers must steer through this context using knowledge they have acquired in school or on the job. In some respects, they become a pivot that links and guides all aspects of a project. They could be compared to octopuses, with each tentacle capable of carrying out an independent activity to achieve a specific goal.

In all studies looking at project success, the consensus is that this success depends on several factors and is judged using specific criteria. A distinction therefore needs to be made between these two concepts in order to demystify the language employed throughout this exploratory study. Initially, success factors were described by Leidecker and Bruno, 1984, as "characteristics, conditions

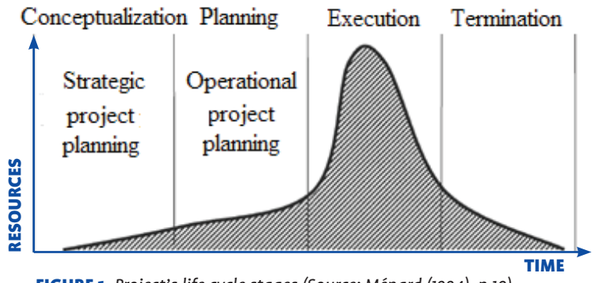

FIGURE 1. *Project's life cycle stages (Source: Ménard (1994), p.10)*

or variables which, when properly sustained, maintained or managed, can significantly impact the success of a firm competing in a particular industry." For Munns and Bjeirmi *(1996)*, the main success factors for a project were objectives, project administration, third parties, relationships with clients, personnel, contracts, legal agreements, politics, efficiency, conflicts and finally, profits. O'Shaughnessy *(2006)* translated and adapted the ten key success factors of Slevin and Pinto *(1988a)*: the aims of the project; support of senior management; action/work plan; continuous communication with the client at different stages of the project; human resources; technical expertise; providing the organization with project management processes, methods and standards; communication with main project stakeholders; and ensuring organizational capacity for taking on the project.

Due to the unique nature and complexity of individual projects, it would be impossible to theoretically define all the key success factors *(Belassi and Tukel, 1996; Cooke-Davies, 2002; Westerfeld, 2003; Hyvari, 2006)*. Nevertheless, many authors - Belassi and Tukel *(1996)* in particular - have noted that generally, success or failure rarely depends on one single factor but rather on a combination of factors across various stages of the project. In order to clarify more easily which elements *(groups of factors)* are needed for success, key success factors from the different stages of a project are placed into universal groups. For example, Belassi and Tukel *(1996)* grouped success factors into four distinct categories: factors relating to the external environment, factors relating to the organization or internal environment, factors relating to the project leader and team and finally, factors relating to the project itself.

Of course, all these factors are influenced by a range of variables depending on the type of company, line of business, etc. In the present situation, examining aluminum processing SMEs in Quebec along with equipment manufacturers making cutting-edge equipment for aluminum smelters around the world reveals specific connections that link these success factors together. As aluminum use is still booming, companies using it are, in some ways, considered pioneers.

The mindset found in this type of organization varies significantly according to several factors. For example, characteristics of the company leader are often linked to the company's development since it is the leaders, or a small group of shareholders, who in the end make key decisions relating to the strategic action plan. Moreover, they are often the ones leading projects without necessarily having any specific training. In the current global environment led by accelerating technological changes, increasingly high client expectations and growing competition, innovation must be recognized as the central tenet of competitiveness. In a context of globalization, competitiveness is reliant on a company's ability to innovate or adapt rapidly to a changing environment *(developments in technology, markets, competition, etc.) (Graitson, 2000)*. Companies that are unable to adapt to these new requirements by changing their methods and adjusting their organization risk losing their market share and competitive position. Constant innovation is therefore required.

Research dealing with the management of innovation through new product development is processed in the same way as traditional project management, under conditions that encourage performance, that must prevail regardless of the type of project and that could favorably influence the performance of these projects. Specifically, it highlights important conditions that could have a significant impact on project performance, planning and implementation processes; individual characteristics such as project team leadership and the project manager in particular *(Pinto and Coven, 1987; Thamhain, 1996; Rivoza, 2006)*; encouragement and motivation of employees; the use of indicators to improve their performance *(Kruglianskas and Thamhain, 2000)*, and the importance of training and ensuring employees are up to date as a condition of project success *(Wycoff, 2003)*.

Two researchers who have been at the forefront of current work into success and failure factors for new product development projects are Cooper and Kleinschmidt. In 1990, they presented a two-group classification of these factors. The first group was for characteristics linked to the various stages of the innovation process, from the initial idea to the product launch. Emphasis was placed on the quality of execution for project activities, the methods used and the resources committed. The second group focused on project characteristics such as aspects relating to the market *(client requirements, market size, growth and level of competition involved)*, the organization's familiarity with the project, and the synergy it could create between this project and others, along with any advantages the project could bring to the organization in terms of levels of innovation and sales potential *(Cooper and Kleinschmidt, 1990: 49)*.

The same year, Pinto and Mantel *(1990)* used ten categories to classify critical success factors for new product development *(NPD)*. The authors also offered definitions for each of these factors. **Table 1** outlines these ten factors and their corresponding definitions.

St-Pierre and Trépanier *(2007)* created a model of key innovation factors for SMEs. This divided the factors into five main categories: leadership, resources, business practices, organization and collaboration with the external environment. These five elements would therefore need to be integrated and managed by the SME in order to interact simultaneously to develop an innovative environment. As this model is very similar to the one detailed in the previous paragraph, the five elements will not be defined.

3. Methodology

As part of this research, an interpretive rather than positivist approach was used for epistemological reflection. The basis of this thought implies that the majority of the available information can be found in people's experiences. People who have accumulated decades of experience and survived several social, economic and political cycles would be able to provide an additional dimension to our research which focuses on factors leading to success in research and development projects for SMEs in Quebec linked to the secondary and tertiary aluminum industry. The expected aims for this research are, firstly, to define criteria that would allow the CQRDA to judge that a project has been successful, and secondly, to identify the internal and external variables that must be present in a project for it to end successfully. Finally, we hope to illustrate at which stage of the project these factors should be present.

Group discussions seemed to be the best way of collecting information to achieve these aims, particularly because they would allow us to explore individual reactions to existing or new information as well as to determine the extent to which opinions converged or diverged on various topics *(Patton, 2002)*. The term relates to two types of focus groups: in the first, its members are brought together by a common experience or situation; in the second, the group is invited to "focus" its interactions on one or more predefined topics *(Leclerc, Bourassa, Picard & Courcy, 2011)*.

This qualitative strategy made it possible to extract known variables from the literature in addition to others that may have been overlooked in order to build a model that could be used to evaluate the potential success of a project submitted to the Center. It also made it possible to gather a significant amount of information in a short period. Focused group discussions are not generally used to achieve consensus but rather to facilitate interactions and a process of interinfluence that results in social representations *(Abric, 1994)*. Participants help each other to answer as adequately as possible the questions set by a facilitator. For those who can master this dynamic method using key basic principles, it can result in high-quality information. In fact, this formula lent itself perfectly to the present study and offered considerable advantages. In addition, it has the undeniable benefit of reducing the control held by the researcher by transferring some of their power to the group *(Duchesne & Haegel, 2008)*.

The chosen strategy was divided into two main phases (**Figure 2**). Firstly, as shown in the literature review, stake-

1. Aim of the project: Clearly defined initial objectives and general instructions.
2. Support of senior management: Support of senior management in the way of providing resources and the authority/power necessary for project success.
3. Project schedule/work plan: Detailed outline of individual actions toward implementing the project.
4. Consultation with clients: Communication, consultation and active listening for all parties involved.
5. Personnel: Recruitment, selection, and training of personnel necessary for the project team.
6. Technical tasks: Availability of techniques and expertise necessary to accomplish specific technical tasks.
7. Client approval: "Selling" the final project to targeted end users.
8. Monitoring and feedback: Providing comprehensive control information at each stage of the implementation process.
9. Communication: Providing an appropriate network and necessary data to all key participants involved in implementing the project.
10. Troubleshooting: Ability to handle unexpected crises and deviations from the project plan.

TABLE 1: *New product development project's success factors*

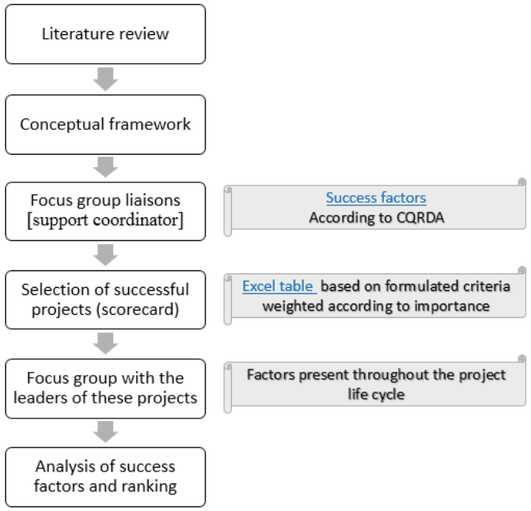

FIGURE 2: *Methodology*

holders judge whether a project is successful. Each stakeholder's opinion must therefore be considered in order to understand how they evaluate this success. To achieve this, two key groups needed to be studied: R&D staff from the Center and project managers of successful projects supported by the Center.

An initial investigation was therefore planned with support coordinators from the Center to determine which criteria they used to establish the success of a project. The aim of a support coordinator is to raise awareness of the Center by canvassing companies and other organizations in their area. In return, they must find out about the company's activities, achievements, influence, R&D projects and of course their needs. The support coordinator can then demonstrate which CQRDA services can help to move a project forward or provide suggestions for solutions to problems within the company. Coordinators also monitor the research projects for which they are responsible and remain in contact with organizations of interest to CQRDA. These coordinators work in close collaboration with project managers across all of the Center's research streams.

Subsequently, following the results obtained in the first phase, a number of projects considered successful were chosen using a selection grid populated with criteria weighted according to importance. The second sample was therefore made up of project managers who, according to the Center, led their projects to successful completion. All participants were company shareholders since, as noted previously, the Center's target group is mainly small companies with fewer than 25 employees. All projects targeted were managed by the head of the company involved, as are most projects submitted to the Center.

4. Results

Support coordinator focus groups

As the members of this study sample were not familiar with the terminology surrounding project management literature, it was necessary to provide a detailed explanation of the slight difference between success criteria and success factors at the start of the session. As this is the key point on which the study is based, this step was essential. Once this was completed, the group discussed in general terms the criteria used by CQRDA to define a successful project. Agreement was reached for most of the ideas discussed. Some criteria were mentioned immediately, as soon as the discussion got underway. Essentially, this statement was made at the beginning of the session: "Marketing; selling many products from the project," and in the same vein: "I have three suggestions: good, attractive and cheap." Marketing success therefore seems to be one of the most important criteria. The idea of meeting initial targets is given similar weight. As expected from the literature review, one of the elements of the Iron Triangle *(cost, time, quality)* was mentioned: quality. Some linked this to respecting client needs: "That's why you have to pay attention to quality. You can have a good quality product that doesn't quite match client needs." Elsewhere, marketing was also linked to client needs: "If you want it to be a commercial success, you need to meet client needs."

Other criteria, such as creating knowledge for the industry, were hotly debated. Initially everyone seemed to agree. However, one of the coordinators remarked, "Even if the project is a total failure, at least you've still learned something!" After some back and forth discussion, everyone agreed with him. This situation can only occur in focus groups.

The second part of this meeting was to classify each criterion according to its level of importance. As at the start of the meeting, the coordinators needed to be made aware of the concepts they should use to classify the criteria, since the study is based on an assessment of the Center, which is a stakeholder in every project presented to it. Initial discussions focused on the concept of marketing. Half of the participants believed that successful marketing was not a criterion for success as a project could still be technically successful. One person said: "Projects always accomplish something; there is technical success and commercial success. When it goes wrong, it's often due to commercial failure. But it's rare to see technical failure." Following a lively discussion, one of the coordinators raised the point that when a project is marketed, the amount paid to the company is reimbursed and the Center becomes self-funding. Using this argument, he was able to convince other coordinators who aligned themselves with his position.

Protecting intellectual property was also the subject of some debate as some participants considered this to be an important criterion while others disagreed. The main argument that had an impact was that when a product is copied, any money invested in it could be lost. Other participants seemed to accept this point. The following table summarizes what was said during this focus group.

One of the most important criteria was without a doubt the creation of a prototype. Generally in R&D projects, manufacturing an alpha version of a product makes it possible to validate the concept. In addition, the Center requires this stage be completed before any request for financial support is made.

Despite the intellectual protection and successful marketing criteria, answers obtained were unanimous and are shown in the table below.

TABLE 2: *Summary of the first focus group*

Very important criteria	Important criteria	Criteria of little importance
Client approval	Number of jobs created	Securing intellectual property protection
Improving productivity	Increase in turnover	Staying on budget
Product quality	Number of sales	Improving company competitiveness
Achieving initial goals	Reasonable selling price	Approval of the project by the project team
Working prototype	Manufacturing price less than or equal to expectations	Company investment following the project
Innovative product	Better product than competitor's	The project ensures the continuation of the company
Overcoming expected technical issues	Complies with high standards	

Project managers focus group

The second focus group with project managers provided invaluable information. As with the first group, participants were introduced to the differences between criteria and factors. Following on from this, discussions proceeded without any pauses. The first factors mentioned were leadership of team members, availability of financial resources, flexibility of participants, access to regional laboratories, predicting marketing costs at the start of the project and many other factors presented in the following table.

TABLE 3: *Factors emerging from the second focus group*

A-	Flexible leadership whereby different team members can act as leaders as needed when problems arise
B-	Availability of financial resources
C-	Financial resources at the start of the project
D-	Simplified administration for programs
E-	Flexibility of employees and organizations
F-	Accessibility of regional laboratories
G-	Active participation by the client
H-	Efficiency of the team
I-	Organization of the project team
J-	Constant analysis of needs
K-	Company personnel is open to change and innovation
L-	Company's capacity to change ways of doing during the process (e.g. automation)
M-	Setting aside funds for commercialization from the start
N-	Perseverance of the promoter
O-	Constant technology watch (general benchmark)
P-	Understanding of the client's **REAL needs**
Q-	Specialized workforce
R-	Product presents competitive advantages
S-	Good publicity (internet very important)
T-	Easy access to product specifications on the internet
U-	Looking out for new technologies
V-	Prototype for testing before manufacture
W-	Client understanding and strategy
X-	Knowing how to explain its advantages to the client
Y-	Understanding of the market
Z-	Participation in shows with the product
AA-	Company vision regarding opportunities
BB	Modernizing to lower manufacturing costs
CC-	Product in line with the company's strategic vision
DD-	Understanding the company's limitations
EE-	High risk tolerance
FF-	Confidence in the ability to succeed

GG-	Believing in one's strengths
HH-	Adapting to cultures
II-	Presence of a focal point
JJ-	Presence of a competent university expert
KK-	Stable government policies
LL-	Access to competent external resources
MM-	Adequate and continuous training within the company
NN-	Competent communication expert
OO-	Realistic initial budget
PP-	Study of prior art

A comparison of factors discussed with those in the literature revealed that almost all the themes were mentioned, although they were sometimes expressed differently. In fact, two new concepts were discussed that had been absent from the literature thus far. The first can be described as flexible leadership. Naturally, promoters mentioned that the inherent uncertainty in research and development projects often lead to moments of difficulty. During these discouraging moments, team members informally take turns to act as motivator and leader to ensure the project stays on track. The second newly identified factor was that products should provide competitive cost advantages. It was mentioned that when project deliverables provide competitive cost advantages, the project has a higher chance of being successful as it is easier to market the end product. It was said that globalization and the advent of the internet created fierce competition. SMEs are obliged to innovate and stay at the cutting edge of new technology, trying to provide better products at reasonable costs.

The second part of the exercise involved identifying when these factors should occur during the project. Some of these factors were identified as being important for the entire duration of a project. These included flexible leadership between team members during difficult phases, availability of financial resources, flexibility of partners and organizations, active client participation, team effectiveness, project team organization, promoter dedication, constant technology monitoring, remaining on the cutting edge of new technologies, knowledge of the market, ensuring the product is appropriate to the company's strategic vision, knowing the company's limitations, good risk tolerance, being confident about a successful outcome, stable government policies, access to competent external resources, appropriate and continuous training for the company, and a study of prior art. They all emphasized the following three points: clients, funding and opportunity.

All the factors identified by the participants for the initial stage, ideas, seem to be of equal importance. This stage involves a needs analysis as well as identifying costs, requirements to be met, the strategy to be followed, etc. It does not generally involve significant costs beyond labor. It is therefore understandable that the factors identified relate mainly to clients, their participation and an understanding of their needs. In addition, factors linked to the competence of team members, including the project manager, were highlighted. Competences are obviously helpful in correctly identifying the best aims and strategies for implementation. Market knowledge was a final key point that should not be ignored. The better the company knows its market, the better its strategy will be. Factors similar to those mentioned in the literature were noted in this stage.

The second stage of a project, planning, can be seen as more of a study of all the aspects that will make it possible to complete the project. In innovative projects, it serves to validate the technological approach as well as to monitor prior art, plan costs and schedules, etc. We noted that the key factors in this stage were primarily financial. Indeed, as this stage is mostly about planning budgets, it is essential to have competent team members to create an accurate evaluation of expenses and investments that need to be made for this stage to be executed successfully. Moreover, the availability of financial resources is a prerequisite for the next stage. Once again, the results closely matched those found in the literature.

The third stage of a project, the execution of the project, involves implementing the strategy identified in the first stage. It is often at these moments that the skills of all project participants, both internal and external, are the most called upon. Similarly, access to laboratories and appropriate equipment is a bonus for innovation projects. A comparison with the literature also revealed that following the initial plan makes it possible to keep a project focused on its desired targets.

Once these stages are completed, innovation projects move on to a stage in which the functional prototype is created and the company initiates the marketing process. Unfortunately, as highlighted by all our participants, companies often go all out at this point, without necessarily providing the means to follow through. For this reason, an appropriate strategy must be defined from the beginning.

The **Table 4** sets out a summary of the group discussions.

CONCEPTUALIZATION	PLANNING	EXECUTION	DELIVERY
Needs, specifications and ideation	Technological research, study of prior art	Development	Commercialization
Perseverance of the promoter (Q)	Perseverance of the promoter (Q)	Perseverance of the promoter (Q)	Perseverance of the promoter (Q)
Risk tolerance (Q)	Risk tolerance (Q)	Risk tolerance (Q)	Risk tolerance (Q)
Confidence in success (Q)	Confidence in success (Q)	Confidence in success (Q)	Confidence in success (Q)
Openness to innovation (Q)	Openness to innovation (Q)	Openness to innovation (Q)	Openness to innovation (Q)
Flexible leadership (C)	Competent external resources (Subcontractors) (C)	Specialized workforce (C)	Confidence in success (Q)
Efficiency of the team (C)	Specialized workforce (C)	Flexible leadership (C)	Flexible leadership (C)
Constant analysis of client needs (C)	Flexible leadership (C)	Efficiency of the team (C)	Efficiency of the team (C)
Looking out for new technologies (C)	Efficiency of the team (C)	Constant analysis of client needs (C)	Constant analysis of client needs (C)
Presence of a competent university expert (C)	Constant analysis of client needs (C)	Presence of a competent university expert (C)	Competent external resources (Subcontractors) (C)
Competent external resources (Subcontractors) (C)	Presence of a competent university expert (C)	Looking out for new technologies (C)	Looking out for new technologies (C)
Constant technology watch (F)	Looking out for new technologies (C)	Competent external resources (Subcontractors) (C)	Competent communication expert (C)
Study of prior art (F)	Realistic initial budget (M/F)	Prototype for testing before manufacture (F)	Product presents competitive advantages (F)
Product in line with the company's strategic vision (F)	Constant technology watch (F)	Modernizing to lower manufacturing costs (F)	Constant technology watch (F)
Understanding of the client's real needs (F)	Study of prior art (F)	Constant technology watch (F)	Study of prior art (F)
Organizational structure of the project (F)	Product in line with the company's strategic vision (F)	Study of prior art (F)	Product in line with the company's strategic vision (F)
Understanding of the market (F)	Participation in seminars, exhibitions, etc. (F)	Product in line with the company's strategic vision (F)	Capacity to change ways of doing during the process (e.g. automation) (F)
Company vision regarding opportunities (F)	Understanding of the company's limitations (F)	Organizational structure of the project (F)	Understanding of clients and strategy (F)
Understanding of clients and strategy (F)	Adequate and continuous training of employees (F)	Understanding of the market (F)	Participation in seminars, exhibitions, etc. (F)
Flexibility of employees and organizations (E)	Stable government policies (E)	Understanding of the company's limitations (F)	Adapting to cultures (F)
Adapting to cultures (F)	Active participation by the client (F)	Adequate and continuous training of employees (F)	Understanding of the market (F)
Product presents competitive advantages (F)	Availability of financial resources (M)	Active participation by the client (F)	Organizational structure of the project (F)
Active participation by the client (F)	Accessibility of regional laboratories (E)	Availability of financial resources (M)	Understanding of the company's limitations (F)
Setting aside commercialization costs (M/F)	Flexibility of employees and organizations (E)	Accessibility of regional laboratories (E)	Active participation by the client (F)
Availability of financial resources (M)	Stable government policies (E)	Flexibility of employees and organizations (E)	Availability of financial resources (M)
	Bureaucracy is absent or limited (E)	Stable government policies (E)	Flexibility of employees and organizations (E)
			Stable government policies (E)

Key
Factors related to competences (C)
Factors related to monetary aspects (M)
Factors related to ways of doing (F)
Factors related to personal qualities (Q)
Factors that are external and cannot be controlled (E)

TABLE 4: *Summary of the second focus group*

5. Discussions, limitations and lessons learned

The main aim of this study was to identify the key factors that make it possible to assess the potential for success in innovation projects put forward to the members of the Center's scientific committee. An analysis of the data made it possible to identify which factors the Center's R&D team could assess. Although it is difficult to measure the perseverance of an unknown promoter, this factor could represent an asset for promoters that have already received backing and are resubmitting an application. Moreover, as the CQRDA already asks companies to present résumés for their team members and subcontractors, it can evaluate their skills and effectiveness to a certain extent. Other supporting documents such as financial packages, studies of prior art, proof of concept, market descriptions, etc. are already considered when analyzing applications for funding. The current evaluation process for projects has proved to be credible; adding a few more elements will only increase its effectiveness. These elements, which have been newly identified as critical and assessable by CQRDA, are set out in the table below:

TABLE 5: *Factors used by CQRDA*

Identified factors
Efficiency of the team (C)
Specialized workforce (C)
Looking out for new technologies (C)
Presence of a competent university expert (C)
Competent external resources (Subcontractors) (C)
Constant technology watch (F)
Study of prior art (F)
Product in line with the company's strategic vision (F)
Prototype for testing before manufacture (F)
Understanding of the market (F)
Understanding of the company's limitations (F)
Product presents competitive advantages (F)
Planning for commercialization costs (M/F)
Realistic initial budget (M/F)
Availability of financial resources (M)

Following the results obtained by this study, a strategic meeting was held for the team leading R&D projects at the Center, as this team is also responsible for preparing project documentation in partnership with companies before their presentations to the scientific committee. Subsequently, the process and project evaluation grid were subject to a strategic review with the aim of improving their content to increase efficiency. From now on, the Center will include these factors in their project analyses before awarding funding. All studies have their limitations, and these must be identified and taken into account by the researcher in their analysis and during their attempts to generalize the results. In this study, it should be highlighted that the projects studied were distributed across a wide variety of industrial sectors *(transport, smelting, cycling, etc.)* and were from small companies with fewer than 100 employees. This had minimal impact as most of the CQRDA's member companies have fewer than 100 employees. Despite these specific characteristics, the research made it possible to better identify factors likely to influence the successful outcome of these R&D projects in the secondary and tertiary aluminum industry.

6. Conclusion

Completing this study made it possible to clarify some aspects of success in projects linked to the secondary and tertiary aluminum industry. Because this type of project has not yet been addressed in the literature, this study is the first step toward partly filling this void. In addition, this study revealed that SMEs do not manage their projects in the same way that large companies do. This is often because project stakeholders are usually company shareholders, and their involvement and motivation therefore have a completely different drive.

Similarly, as these are SMEs, their resources are very different from those available to large companies, and they must find the funding needed in different ways. These include using organizations such as CQRDA and many others. Completing a detailed financial package is therefore a key factor in project success.

In conclusion, the knowledge gained during this study can be used and adapted by other organizations complementary to and working in parallel with the Center. In short, this study will surely provide the Center with valuable insight, helping interested companies become aware of issues they need to take into account in R&D projects in the secondary and tertiary aluminum industry.

authors

Julien Bousquet Ph.D., is a marketing professor at the University of Québec at Chicoutimi (UQAC) since 2003. He earned a Ph.D. in administration at the University of Quebec at Montréal (UQAM). He is actually director of the project management master's degree and director of the Multidisciplinary studies in project management (www.uqa.ca/lemgp). His main areas of research focus principally on relationship project (marketing and communication theories applied to project management) and stakeholders management.

Christophe Leyrie holds a Master of Science in project management and a Doctorate of Science in business. He has been a professor of project management at the Université du Quebec à Chicoutimi (UQAC) since 2000 and he is currently in charge of this university Doctorate program in project management. He also acts as academic director of the Master program in project management that UQAC delivers in China. Christophe Leyrie is a member of the multidisciplinary studies laboratory in project management where his research interests center on project stakeholder management and organizational politics in projects.

Caroline Durand holds a bachelor's degree in Civil Engineering and is a graduate student in project management at the Université du Québec à Chicoutimi (UQAC). She has been working for the Aluminum Research & Development Center of Quebec since 2013. She is interested the success criteria and factors of the SMEs innovation projects related to aluminum transformation.

references

Atkinson, R. *(1999).* Project management: cost, time and quality, two best guesses and a phenomenon, it's time to accept other success criteria. International Journal of Project Management, 17, 337-342.

Belassi, W. and Tukel, O. *(1996).* A new framework for determining critical success/failure factors in projects. International Journal of Project Management, 14 *(3)*, 141-151.

Cleland, D.I., and King, W.R. *(1983).* System Analysis and Project Management. Paris: Mc GrawRil Book Co.

Cooke-Davies, T. *(2002).* The "real" success factors on projects. International Journal of Project Management, 20, 185–90.

Cooper, R. G., & E. J. Kleinschmidt. *(1990).* "New Product Success Factors: A Comparison of Kills Versus Successes and Failures." R&D Management, 30*(1)*: 47-63.

De Wit, A. *(1988).* Measurement of project success. International Journal of Project Management Vol. 6.

Duchesne, S., & Haegel, F. *(2008).* L'entretien collectif: l'enquête et ses méthodes *(2nd edition)*. Paris: Armand Colin.

George C. S. [1972], The history of management thought, Variant Title: Management thought, Englewood Cliffs, N.J. Prentice-Hall.

Graitson, D. *(2000).* "Les grappes industrielles: concept et méthodologie," report presented during a Walloon conference on innovation.

Hallegatte, Damien *(2013).* "Rétromarketing" PhD thesis. Montreal *(Quebec, Canada)*, Université du Québec à Montréal, PhD in Administration.

Hyvari, I. *(2006).* Success of projects in different organizational conditions. Project management journal, 37 *(4)*, 31-41.

Kruglianskas, I., & Thamhain, H. *(2000).* "Managing Technology-Based Projects III Multinational Environnements." IEEE Transactions on Engineering Management, 47*(1)*, 55-64.

Leclerc, C. Bourassa, B, Picard, F. and Courcy, F. *(2011).* Du groupe focalisé à la recherche-action: défis et stratégies. Recherches qualitatives, Numéro spécial: Entretiens de groupe: concepts, usages et ancrages, 29 *(3)*, 144-166.

Leidecker J. K. and A. V. Bruno. *(1984).* "Identifying and using Critical Success Factors." Long Range Planning. vol.17 *(1)*, p.23-32.

Lim, C.S., Mohamed, M.Z. *(1999).* Criteria of project success: an explanatory re-examination. International Journal of Project Management, 17*(4)*,243-248.

Munns, A. K., & Bjeirmi, B. F. *(1996).* The role of project management in achieving project success. International Journal of Project Management, 14*(2)*, 8] -87.

O'Shaughnessy, Wilson *(2006).* Guide méthodologique d'élaboration et de gestion de projet, Trois-Rivières, Les Editions SMG, 126 p.

Pinto, J. K., & Covin, J. G. *(1987).* "Critical Factors in Successful Project Implementation." IEEE Transactions on Engineering Management, 34*(1)*,22-27.

Pinto, J. K., & Mantel. Jr., S. J. *(1990).* "The Causes of Project Failure." IEEE Transactions on Engineering Management, 37*(4)*, 269-276.

Pinto, J. K., & Slevin, D. P. *(1988).* Project success: definitions and measurement techniques. Project Management Institute.

Rizova, P. *(2006).* "Are You Networked for Successful Innovation?" MIT Sloan Management Review, 47*(3)*, 48-55.

Thamhain, H. J. *(1996).* "Best Practices for Controlling Technology-Based Projects." Project Management J01l171al, 27*(6)*, 37-48.

Westerfeld, E. *(2003).* The Project Excellence Model®: linking success criteria and critical success factors. International Journal of Project Management, 2 I *(6)*, 411- 418

Wren Daniel A, [1994], The evolution of management thought, New York: Wiley.

Wycoff, I. *(2003).* "The 'big 10' Innovation killers." Journal for Quality & Participation, 26*(2)*, 17-22.