Assessing the Influence of Cultural Issues on the Adoption of Life Cycle Management Tools

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Abstract

Among the industrial sectors, construction is probably the one with the highest 'human density', due to the great number of different actors involved in each phase of a project. It is acknowledged that cultural issues and cultural diversity impact considerably on the outcome of construction projects, due to the peculiar nature of contracting, procurement and collaborating with partners within the supply chain. In a traditional culture, the transfer and implementation of innovative philosophies and methods implies a radical modification of shared assumptions, values, and practices, which often results in a strong resistance to change. Life Cycle Management (LCM) tools (mainly Life Cycle Costing and Life Cycle Assessment) are an emblematic example of innovative approaches with a long tradition in theory but a rather complicated take-off in everyday practice. Literature has always reported on difficulties in finding suitable data, sharing standard methodologies, or choosing the most user-friendly tool. However, technical barriers cannot be overcome if culture within the organization hinders the decision process. This study adopted a structured and systematic research approach to analyze literature sources with the objective of understanding to what extent culture has an influence on the implementation of LCM tools. LCM literature has been studied by means of relational content analysis, performed with a multiple-software approach. The first phase, unsupervised concept mapping with Leximancer V4, was performed in order to enlarge the corpus, look for connections among concepts, and build the coding scheme of the following manual coding phase, performed with NVivo9. In the manual coding, four categories of actors (decision makers, clients, supply chain, and stakeholders), and four main categories of barriers (behavioral, organizational, financial, and technical) were identified as 'nodes'. Cluster analyses and matrix coding queries were used to investigate the connections between actors and barriers, organized in sub-nodes. The analysis revealed that organizational culture was the most coded barrier, and professionals were the most relevant actors. A strong statistical correlation between clients and decision makers can be considered as an indicator that these traditionally detached groups of actors perceive the same problems on the topic, such as unreliability and uncertainty of the tools.

Keywords: content analysis, organizational culture, LCC, LCM

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1. Introduction

Life cycle management (LCM) is a “flexible, integrated, framework of concepts, techniques and procedures to address environmental, economic, technological and social aspects of products and organizations to achieve continuous environmental improvement from a life cycle perspective” (Hunkeler et al., 2001: 385). Under this umbrella, Life Cycle Costing (LCC) and Life Cycle Assessment (LCA) are among the most discussed tools in the last decades. Numerous literature sources report on a scarce application of these tools despite their strong theoretical basis. This is particularly true in the construction industry, which is traditionally slow in innovating its products and processes. This paper reports on the obstacles encountered in the practical application of LCM tools in construction. Content analysis (CA) was chosen for this investigation because it allows to “read through the lines” of archival sources by assessing the presence of certain words, concepts, and themes in an objective way. CA enables to observe the latent content of a message, made of concepts that ‘cannot be measured directly but can be represented or measured by one or more indicators’ (Hair et al., 1998, cited in Neuendorf, 2002: 23). The objective of this work is to find evidence that cultural barriers hinder the process of accepting and adopting LCM tools in the construction industry. Where technical barriers may be seen as “perceived” obstacles (numerous software packages and databases are now available), cultural barriers may represent the “real” problem.

2. Literature review

2.1 Organizational culture in construction

Hofstede et al. (2010) define culture as ‘the collective programming of the mind that distinguishes the members of one group or category of people from others’ (Hofstede et al., 2010:6). The so called “software of the mind” represents the basic set of rules that are necessary to establish and keep the social order within a group. These “rules of the game” are habits of thinking, espoused values, underlying assumptions, shared meanings, and common practices that can be correctly interpreted only by the members of a specific group (Hofstede et al., 2010; Schein, 2010). Since culture derives from one’s social environment rather than genes, its strength and stability is due to the fact that it is group-based. Culture groups can be distinguished at different scales, from macro to microcultures: occupations that exist globally, such as medicine, law, engineering share the same occupational values despite national boundaries (Schein, 2010). The core of each culture is occupied by *values*, shared, abstract ideas about what is good, right, and desirable (Williams, 1970, cited in Sagiv and Schwartz, 2007). Cultural values, mostly learned during childhood, represent both the broad goals that the members of a collectivity are encouraged to pursue, and the justification for the actions taken to accomplish these goals (Sagiv and Schwartz, 2007). At the societal level, cultural values develop in order to respond to basic challenges, thus societies differ because of the different reactions to common challenges. Analogously, cultural values at the organizational level develop in response to two basic challenges: adaptation to the external environment and integration of their internal system (Schein, 2010). The relationship between society and organizations is twofold. Organizational cultures tend to develop compatibly with the societal culture, because organizations need to

get societal approval and justify their activities as expressing the societal culture in which they are nested (Sagiv and Schwartz, 2007). On the other hand, individuals affect organizational culture, both intentionally and unintentionally, through the promotion of values, personal views of what is desirable, practices and the design of physical settings (ibid.). Similarly, organizational culture shapes the behavior of its members, because they usually conform to the organizational culture in order to avoid problems in the workplace (Cheung et al., 2011).

According to Abeysekera (2002) culture in the construction industry is about the "characteristics of the industry, approaches to construction, competence of craftsmen and people who work in the industry, and the goals, values and strategies of the organisations they work in". In a few words, it is about what is done, how and when it is done, who is involved and why things are done in a specific way (Ankrah and Proverbs, 2004). The definition of all these elements is a potential source of conflicts in an industry that is well known for its adversarial and antagonistic aspects (ibid.), its strong masculine culture, a highly competitive and inherently unsupportive climate (Worrall, 2012). In this context, it seems clear that cultural issues at the organizational level are even more critical than in other industries. Moreover, the peculiarities of contracting and procurement phases, and the transfer and implementation of innovative approaches and practices from other sectors (Ankrah and Proverbs, 2004) call for a special attention to cultural problems. Unfortunately, for a long time, their importance has not been recognized, and culture has been kept as a "black box", used to justify the failures of the industry (Tijhuis, 2003). With regard to this, Ankrah and Proverbs (2004) advocate that understanding how culture affects the competitiveness, profitability and performance of organizations within the industry can help with the process of implementing changes in culture and organizational structures.

3. Research methodology

This section of the paper presents the research methodology designed to answer the research questions. The approach chosen for this research is based on the integration of two software packages, e.g., Leximancer and NVivo 9. Since the two packages perform the analysis with completely different logics, they have been employed for different aims, and in separate and sequential moments of the research process. The twofold content analysis approach was chosen as the most appropriate method to answer the following research questions: 1) How does culture, at the personal and organizational level, affect the application of LCM in construction? 2) Can culture be addressed as a relevant barrier for the widespread use of LCM? 3) Who are the main actors that hinder the adoption of LCM tools?

3.1 Content analysis as a research tool

According to Neuendorf (2002), CA is a summarizing, quantitative analysis of messages that relies on the scientific method (p.10). CA allows to acquire, summarize, and reformulate the information developed in a body of texts, in order to 'narrow the range of possible inferences concerning unobserved facts, intentions, mental states, effects, prejudices, planned actions, and antecedent or consequent conditions' (Krippendorf, 2001:25). Thanks to its flexibility of use, CA has been used in a vast array of fields, such as marketing and media studies,

literature, cultural studies, sociology, and psychology (Palmquist et al., 2005). Despite the numerous existing approaches, the general rules of CA are the same across all disciplines. Key factors in the evaluation of CA as a suitable research tool are the objectives of the assignment, the available data, the type of required data, the kind of analysis required, and the resources needed (GAO, 1996). The methodological rigor helps the researcher to give CA the conformity to the rules of good science: reliability, validity, replicability. The operative process of content analysis can be basically split into four phases (Neuendorf, 2002): 1) problem definition; 2) selection of the sample; 3) coding; and 4) analysis of results. Coding can be done either by one person (single-rater coding) or a team of people (multi-rater coding), and manually (pencil-and-paper approach) or with the aid of computer programs (CAQDAS). The coding is done according to a coding scheme, that has to be outlined by the researcher preferably before the activity starts (deductive approach). The scheme needs to be consistent with the formulated research questions, and has to be flexible and open to new ideas and patterns emerging from the analysis of the texts.

3.2 Content analysis in the research design

The four-phase approach proposed by Neuendorf was slightly modified to fit the research design of this study. First of all, 6 phases were identified. The coding phase was split into two sequential sub-phases, automatic concept mapping and computer aided coding. The combination of unsupervised concept mapping and manual text coding responds to the logic of mixed methods, and serves the following objectives: 1) clarify the relation between the two content analysis approaches; 2) find complementarity, similarity, or dissimilarity of the findings; 3) improve the research method by using one approach to inform the other; 4) obtain triangulation of convergent data, and 5) discover paradoxes and contradictions. Moreover, an additional phase was added, i.e., the classification of the sources according to different criteria. The ultimate goal of this task was to appreciate similarities and differences in the coding, with respect to the type of source, the research method, the main focus of the paper. An explanation of each phase is presented in this paragraph, while the last phase is presented in a separate paragraph to give relevance to the discussion of results.

4. Content analysis phases

4.1 Phase 1: Problem statement

The identification and discussion of the barriers for the implementation of LCM in construction is a fairly complex task, due to the number of actors involved and to the different aspects that involve them. Most literature sources indicate technical issues such as the inappropriateness of the existing tools, the lack or scarce quality of input data, or the lack of standard methodologies, as the most important barriers to the wide adoption of LCM. This may be absolutely true if only designers, managers or decision makers were responsible for choice of using LCM-based techniques or not. The coexistence of a wide variety of actors with their own cultural and professional background makes it clear that a deeper reading of what literature tells us about this topic is necessary. Thus, the use of content analysis seems appropriate for this purpose. According to Hofstede et al. (2010), individual and organizational culture are pivotal to understand why collaboration in projects does not

always work properly. Since culture derives from the social environment in which the individuals develop their personality, shared assumptions, values, and practices are often a matter of contrast between people coming from different cultural backgrounds.

4.2 Phase 2: Selection of the sample

The texts for CA were selected through searches in all the most common electronic libraries accessible from the University of Washington and Polytechnic University of Bari facilities, e.g. Academic Search Complete (EBSCO), Web of Science, ScienceDirect, Engineering Village 2, and so forth. Since CA is extremely time consuming, the selection of the sources was accurately planned. Firstly, a thesaurus dictionary was created for each main keyword: *LCM (LCC, LCA)*, *barriers*, and *use*. The thesauruses were successively enlarged thanks to the suggestions given by the automatic computed coding performed with Leximancer. Secondly, the search in all the databases was conducted using the Boolean connectors AND and OR to combine keywords. The keywords were searched, only in English, in all fields (title, abstract, keywords, full text, references). Besides digital literature databases, grey literature was searched on the internet: reports on European projects, Master's and PhD's theses were been included in the body of texts as sources of valuable information.

4.3 Phase 3: Unsupervised concept mapping with Leximancer

Leximancer V4 is a semi-automatic CA tool that analyzes textual documents and displays the extracted information visually in a conceptual map (or cloud). The maps provide a bird's eye view of the coded material, represent a means of quantifying and displaying the conceptual structure of text, and thus allow to explore interesting conceptual features (Leximancer, 2011). Leximancer V4 (online portal version) was chosen among others for several reasons. First, the resulting conceptual map is the combination of two CA approaches, i.e. conceptual and relational analysis, with words, concepts, themes, and relationships displayed in the same space. Secondly, it automatically extracts a dictionary of terms (thesaurus), which is constantly updated, for each concept. Third and most important reason, in Leximancer words that appear in the same circle (theme) indicate concepts that are frequently used together, thus are strongly correlated. This means that the program helps to figure out the relationships between concepts in terms of magnitude and direction, and thus draws the patterns among the different elements included in the text. To summarize, the aims of this phase were 1) to find keywords for the second and third rounds of search in literature databases and web search engines; 2) to identify the main concepts and the relationships between them (automatic relational analysis), and 3) to guide the coding scheme for the unassisted content analysis performed with Nvivo 9.

Figure 1 shows one of the concept maps developed by Leximancer, after setting 50% theme size and 70% visible concepts. The map settings can be changed anytime to suit the researcher's needs. In this case, this setting was chosen because it allows a comprehensive reading of the themes and concepts, without compromising the visibility of the picture. The map was studied with a top-down strategy, going from the themes through concept seeds words. First, the themes were studied in terms of color, size, position in the map space, and overlaps. Successively, the most interesting themes were studied by clicking on the

concepts in the map and analyzing the statistics used to create the map, mainly the co-occurrence rates and frequency ranks of concepts. As visible from the map, the most relevant themes were “Costs” and “Building”. This can be deducted by their red color (not visible in the picture due to editing reasons), their bigger radius (the radius indicates the connectedness of the concepts grouped into the theme), their central position in the map space, and the number of other themes they intercept. Furthermore, the 10 highest-ranked concepts in terms of co-occurrence were identified in the map, in order to understand the existing relationship between them. Ten combinations of concepts were identified. Besides the most predictable connections (the couples *Construction-Project* and *Life-Costs* remind the search parameters for the choice of the literature sources), some interesting patterns were observed. For instance, the couples *Building-Use*, *Cycle-Use* expressed the importance of buildings operational and use phase, while the couple *Design-Cycle* expressed the value of the design phase. These relations are reinforced by the mutual correlation among the concepts *Energy-Building-Use-Cycle-Design*, that can be read as the strong influence of the design phase on the performance of the building across the life cycle, especially in the use phase.

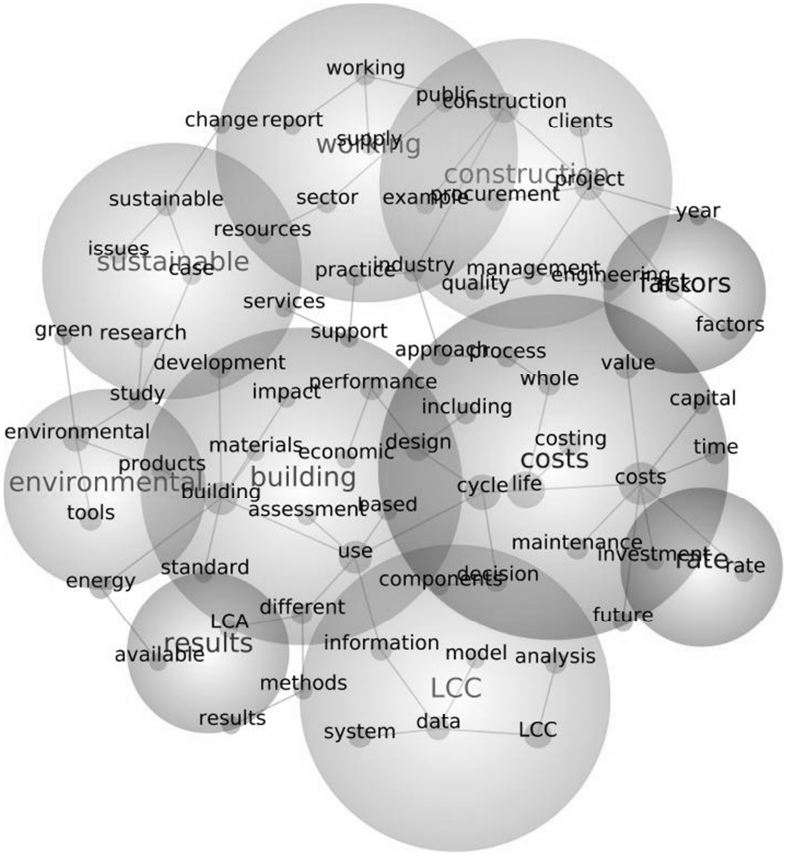

Figure 1: Concept map in Leximancer (Theme size 50%; 70% visible concepts)

Surprisingly, none of the emerging concepts addressed the term “barrier(s)” and its synonyms directly. This occurrence may be explained as follows. First, the sources are extremely dense in content, therefore the topic to be studied is often not central to the paper. Secondly, since the program creates concepts through the statistical evaluation of correlated words, there are few words expressing the concept “barrier”. This confirms the initial difficulty in creating the thesaurus for the literature search. Third, the concept of barrier may be

“nested” into other emerging concepts, such as “change”, “issues”, “risk”, “resources”, or “support”. This reinforces the consideration that the topic has numerous underlying issues, which were revealed thanks to automatic CA. All things considered, the use of unsupervised concept mapping was highly beneficial because: 1) it provided new keywords for the second and third stages of literature search; 2) it offered an overview of the main topics of the selected papers, 3) it highlighted the relationships among emerging themes and concepts, and 4) it confirmed that the topic requires a deeper level analysis that go beyond the semantic level of words. Without the use of Leximancer, the manual coding activity would have been done merely using the keywords “barrier(s)” or “obstacle(s)” as guides to identify the most important text passages, skipping the whole text (word search approach). This would have probably resulted in an incomplete reading and understanding of the text, and thus in an unreliable and ineffective content analysis.

4.4 Phase 4: Classification of the texts

In the fourth step, all the sources were uploaded in NVivo 9 (QSR International) and classified. The aim of this step was to distinguish the main features of each source, in order to use them as means of comparison in the analysis phase. The sources were classified according to a list of attributes: *Industry* (building construction, infrastructures, or both); *Inquiry* (literature review, survey, case study, interviews, or a combination of two or more); *Target of the paper* (LCC, LCA, or LCM approaches); and *Type of sector* (Private, public, or both). For each attribute, a value “Unassigned” was given when the attribute could not be explicitly defined. An emblematic case is the attribute *Inquiry*, which describes the research method that the author(s) adopted to report on the barriers to LCM in construction. For this attribute, the value *Unassigned* was given to the source when the references or citations were missing, and the barriers were simply listed. In this case, it was assumed that the discussion was the result of anecdotal evidence. The analysis of the sources revealed that about one third of the papers refer to previous literature as the main source of information. The papers based on anecdotal evidence covered 30% of the total, similarly to literature. Successively, text queries were used to find out how many sources reported key references and authors, in order to assess the independency of sources. Specifically, Flanagan (Flanagan & Norman, 1983; 1987; Flanagan, 1989; Flanagan et al., 1989; Flanagan & Jewel, 2005) was cited in 23 out of 50 sources; Kirk and Dell’Isola (1995) were cited in 15 papers, Clift & Bourke (1999) were cited in 12, and Bull (1993) in 9 sources. Moreover, these seminal pieces are often cited together in the same paper. Since most of the original sources were not available at the time of the analysis, it was not possible to find out if they had referred to other literature sources or, more likely, they relied on the considerable authors’ experience in the industry. This occurrence reinforce the idea that some ‘shared assumptions’ (Schein, 2010) on the topic may have negatively affected the industry’s ‘occupational culture’ about the topic.

Arguably, the interdependency of the sources may have influenced the results of the automatic concept mapping. Unfortunately, how Leximancer algorithm works is not fully known, therefore this condition cannot be disconfirmed. Nevertheless, a few considerations may help. Firstly, the variety of concepts is so large that the effect of reinforcing one concept to the detriment of others is probably insignificant. Secondly, the program considers the

relations of proximity between words to build the map, thus it is not just a matter of how many times a specific word is repeated, but how close and how far two words appear in the body of text. In third place, the interdependency of sources is an inevitable condition for the body of literature about the topic. There are seminal pieces that represent a sort of “Bible” for the researchers in this field, therefore a situation in which all sources are independent from each other would be unthinkable. Moreover, the unsupervised concept mapping was not used to draw conclusions, but to guide the successive phase. However, further research is needed to highlight this interesting and potentially controversial aspect of the study.

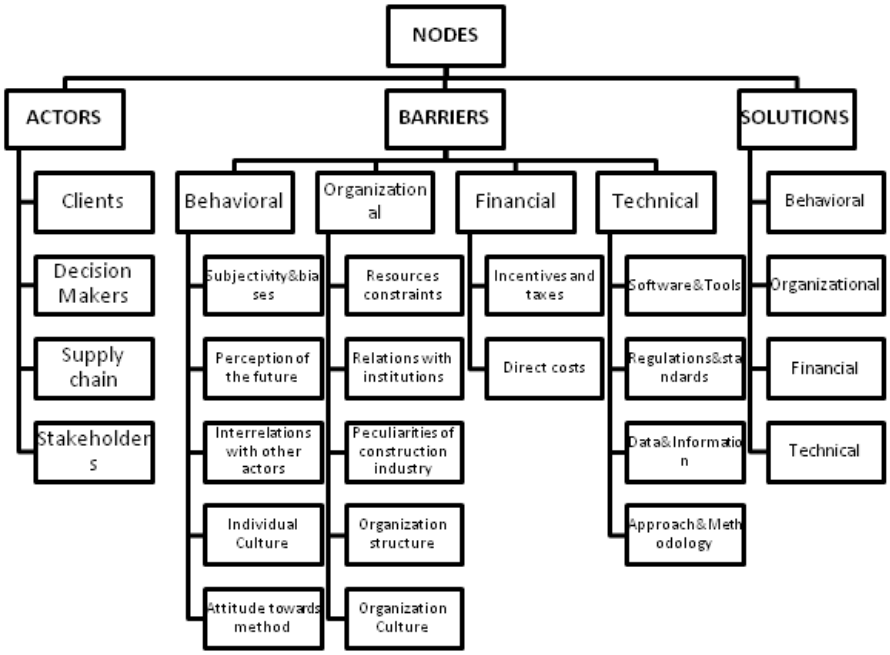

Figure 2: Coding scheme used for content analysis with NVivo9

4.5 Phase 5: Manual computer coding with NVivo9

In Phase 5 NVivo9 was used to perform the manual computer coding. The core of CA is the creation of the coding scheme, i.e., the classification system for describing the content of the text to analyze. The coding scheme adopted in this research was developed out of theoretical literature, with the aid of the conceptual maps provided by Leximancer, that were used to ensure a good level of “creativity” for the coding. The approach to the coding scheme was deductive in its ‘hard’ structure (definition of variables, coding rules, and coding scheme up to the second-level nodes), but inductive in the creation of lower level nodes, which were created, updated, and merged as the coding activity went on. Three sets of interrelated concepts were created and placed at the top of a hierarchical node structure, i.e., *Actors*, *Barriers*, and *Solutions*. As visible in Fig. 2, for each first-level node (e.g., *Barriers*), four second-level nodes were identified (e.g., *Organizational*), which were further split into third-level nodes (e.g., *Resources constraints*). Concepts were coded in the nodes at the lowest level of the hierarchy, therefore the higher levels worked as aggregators. The coding scheme and the coded material were continuously revised, in order to check if the principle of mutual exclusivity of the nodes was respected. As a rule, a concept can be coded at different nodes, but each node must not overlap the others. This condition ensures

the consistency of the coding. Additionally, since the coding has been performed by a single rater, the coding reliability was checked over time by re-reading the documents, randomly picked from the corpus, and coding them all over again (intra-rater reliability). Moreover, a set of explicit recording instructions were developed and eventually updated as the coding activity proceeded, in order to limit the artificial inflation of the reliability coefficient, due to the inevitable closeness to the coding (Krippendorff, 2004; Stemler, 2005).

5. Analysis and discussion of results

The coded material was studied through matrix coding queries and cluster analyses, available in NVivo. In particular, matrix coding queries were employed to analyze the interactions between different nodes (e.g, barriers and actors), and to study differences and similarities of the coding across the sources, according to their attributes (e.g., type of inquiry). On the other hand, cluster analyses were used to visualize relationship patterns, obtained by grouping the sources or nodes that share similar words, attribute values, or are coded similarly by nodes (statistical similarity). The bar chart in Fig. 3 shows the relationship between actors and barriers, as a result of a matrix coding query. As the bar chart reveals, the most relevant actors are decision makers (professionals who are in charge of the different phases in a construction project), with a total of 415 coded references, followed by clients (public and private), with 247 references. Organizational barriers were the most coded, with 43% of the total references, followed by behavioral (30%), technical (24%), and financial. These figures refer to the number of references that were coded both at the node *Barrier* and the node *Actors* (some text excepts were coded at one barrier but two actors).

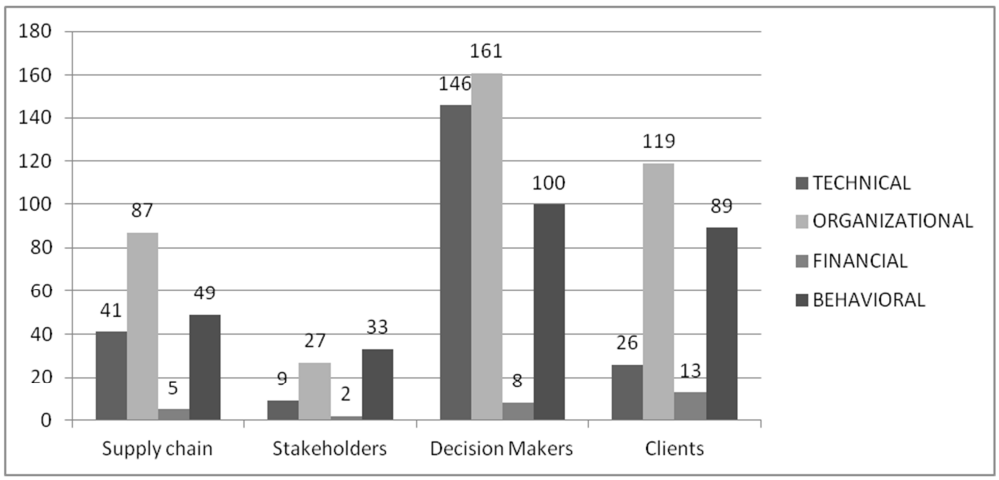

Figure 3: Actors and first-level barriers

Table 1 is displays the results of a matrix coding query between third-level barriers and the attribute *Inquiry type*. The table shows that *Organizational culture* (150 references) and *Approach and methodology* (151 references) were the most coded barriers. Therefore, it seems that technical issues prevail on over cultural problems. What is interesting is that while *Data and information* and *Approach and methodology* were mostly supported by anecdotal evidence and previous literature studies, *Organizational culture* issues mainly

emerged from mixed methods, which involve at least one direct inquiry method (i.e, interviews, case studies and so on). Anecdotal evidence is a valuable source of information if it comes from eminent researchers, but its scientific validity is controversial due to "cherry-picking", and confirmation and recall biases that manifest themselves at the subconscious level. On the other hand, construction industry can be recognized as a strong, universal macroculture, in which shared assumptions and value transcend national boundaries (Schein, 2010). Since "culture is not only all around us but within us as well" (Schein, 2010:9), and everything we think, perceive, or do is culture-bound, anecdotal evidence is also affected by the surrounding culture, thus inevitably biased. All things considered, organizational culture may be considered a "real" barrier, as it comes from a description of real situations, while technical issues, such as the inappropriateness of data or the difficult methodologies, may be considered "perceived" barriers, a sort of "telephone game" in which the origin of the message is no longer available.

Table 1: Inquiry type and third-level barriers

		INQUIRY TYPE						Coded refs/ node
		Anecdotal evidence	**Literature**	**Survey**	**Case study**	**Interviews**	**Mixed**	
Technical	Software&Tools	6	1	2	0	0	5	**14**
	Regulations&standards	3	4	1	0	0	7	**15**
	Data&Information	37	31	9	12	8	28	**125**
	Approach&Methodology	47	37	16	3	12	36	**151**
Organizational	Resources constraints	3	8	3	0	1	14	**29**
	Relations with institutions	1	6	2	0	0	4	**13**
	Peculiarities of construction industry	41	44	5	3	9	39	**141**
	Organization structure	3	6	3	1	3	9	**25**
	Organization Culture	22	34	24	7	8	55	**150**
Financial	Incentives and taxes	3	0	0	0	0	7	**10**
	Direct Costs	4	4	3	0	1	8	**20**
Behavioral	Subjectivity&biases	3	30	2	1	0	1	**37**
	Perception of the future	5	3	0	1	0	3	**12**
	Interrelations with other actors	8	6	1	5	2	8	**30**
	Individual Culture	6	35	1	0	4	19	**65**
	Attitude towards method	11	13	4	1	5	21	**55**
	Coded refs/inquiry	**203**	**262**	**76**	**34**	**53**	**264**	
	Coding density	**32,32%**	**41,72%**	**12,10%**	**5,41%**	**8,44%**	**42,04%**	

Finally, a cluster analysis was performed among the nodes *Clients* and *Decision makers*, and all the third-level nodes belonging to organizational and technical barriers. The cluster analysis indicated a strong correlation between *Decision makers* and *Approach and methodology* (Pearson's r=.82), *Organizational culture* and *Clients* (r=.81), and *Clients* and *Decision makers* (r=.79). Since the correlation indices are calculated from the co-occurrence and frequency of words coded at a node, here the high degree of similarity may indicate that

1) text excerpts were coded in both nodes, at simplest; 2) the barriers are strongly interconnected; and/or 3) the actors in the construction process share very similar views on the topic. The first occurrence is demonstrated by the strong correlation between *Decision makers* and *Approach and methodology* (r=.82, 80 common refs.). However, this relationship is weaker in the case of *Organizational culture* and *Clients* (r=.81, 61 common refs.), and reveals a contradiction, because *Organizational culture* and *Decision makers* share the maximum number of common references (85) but have a lower correlation index (.76). Moreover, *Attitude towards method* is equally correlated to *Clients* and *Decision makers* (.75), meaning that these two fundamental groups of actors in the construction process may share the same view on the topic, for instance they are both skeptical about its effectiveness and efficacy.

6. Conclusions

This paper briefly presents the results of a content analysis conducted on the barriers to the wide adoption of LCM tools in construction. The analysis showed that organizational and technical barriers were the first identified in the sources, and that decision makers and client are pivotal to the positive outcome of the process of accepting LCM into their mechanisms. What was striking (or probably, not at all), was that technical issues such as problems with data or methodology were less relevant than organizational culture. Organizational values and practices represent a source of richness but also a hindrance to the acceptance of what is "new". Construction industry is traditionally a sector in which the tolerance of risk is extremely low, but this may be less true in countries that feel less 'threatened by ambiguous or unknown situations' (Hofstede et al., 2010). It is not surprising that the first countries to accept and adopt LCC in public procurement score low in Hofstede's Uncertainty Avoidance Index (UAI), e.g. Sweden (29), UK (35), or US (46). Finally, a cluster analysis highlighted a strong correlation between elements that are usually considered detached, such as *clients* and *decision makers*, or *organizational culture* and *clients*. As suggested in the previous paragraph, different actors in the construction supply chain may face the same obstacles in pursuing their objectives, or the barriers are strongly interconnected, as in the case of *attitude towards method* and *organizational culture.* In any case, it seems that it is not merely a matter of how complicated the calculations are, or how difficult it is to find the suitable data to perform an LCC analysis. Cultural issues, at the individual and organizational level, constitute a barrier which cannot be easily overcome with the introduction of a new software tool or a new regulatory framework. Further research will investigate how organizations from different geographical contexts have addressed the issue, and how they have adapted their values, structures, and practices in order to integrate LCM tools into their processes.

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