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INCREASE IN COMPETITIVENESS IN A CONSTRUCTION COMPANY THROUGH THE IMPLEMENTATION OF THE COLLABORATIVE CULTURE AREA

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Abstract: In the Spanish construction sector, the interaction between the different stakeholders in the achievement of a construction project is traditionally characterized by the transaction between the parties. Whether between Owner or Promoter and Builder, as well as between Main Contractor and Subcontractors, the contracts usually reflect an exchange of services with their economic counterpart without further ado. A transaction that does not transcend specific needs generated by a project, which defines the product object of the execution to which the contracts refer. In addition, the person responsible for its execution has not participated in the drafting of the project, nor has the person promoting it commissioned it duly supported by a solid program of needs. The same culture is also present in the hiring of the Designer, and labor relations in construction companies. In the first case, an economic transaction for the definition of the product, in general, without having a market study, hoping that the technical competence and professional experience of the designer are sufficient for a definition aligned with the demand. Meanwhile, in the second, the fulfillment of a working day is expected for the salary received. A reality that, by itself, does not generate motivation and commitment beyond contractual rights and duties. The transaction without further ado, and the instability of the economic framework situation, alternate the negotiating power of the contracts, at times to the contracting party, and at others to the contracted party, depending on the behavior of the binomial demand and supply, giving all the prominence to the tension between the parties due to conflicting interests. Confrontation is not a favorable environment to respond to the challenges facing the construction sector: improve its competitiveness, and increase its productivity. Current strategies, such as the implementation of the BIM methodology, tools framed in the Lean philosophy, digital transformation, among others, are based on the need for collaboration among all to achieve their objective. In this scenario, construction companies have an opportunity to improve their competitiveness by promoting a culture of collaboration on a multilateral basis. In this work, a methodology is presented so that construction companies can lead the collaborative culture in the construction sector with the implementation of the collaborative culture area in their organization chart. The axes of collaboration proposed by the methodology cover the integration of internal and external agents to the company, starting with the creation of differential value in its internal culture, and spreading it towards clients, suppliers and other technicians in the sector such as designers, and members of the facultative management of the works, thus generating a new need, in which their collaboration is a success differential to minimize variability and increase profitability in construction projects.

Keywords: Collaborative culture, BIM, Lean, Contract

INTRODUCTION

The success of the execution of a project is measured with the degree of fulfillment of the economic, temporal and qualitative objectives of the same [1]. The management of the execution of construction works is usually characterized by the high degree of variability that they are subject to, both the construction processes and the management processes, thus housing an extreme complexity in the coupling between planned and carried out, since, in contexts of uncertainty, the risk of distancing between the real result and the objective increases [2].

The development of new information structuring models, and their implementation through computer tools for the construction sector, offer an opportunity to improve the management of construction projects [3]. This is an incentive to motivate the development of applications that automate the processes of operational programming and monitoring of production activities in construction projects. It can even be said that it is vital for construction companies to take on the challenge of adapting to constant technological changes in order to remain competitive [4]. On the other hand, today, the main causes of the low permeability of Information and Communication Technologies (ICT) in the construction sector are still the subject of some research [3]. The tools available for the sector usually present partial solutions exclusively applied to a process and not to the project as a whole, this being the main reason that a lack of integration is detected in the existing management tools in the management of projects in the sector. of construction [5][6]. It is necessary to transform new technologies into useful tools [7] to consolidate the competitiveness of companies [8].

The "Building Information Modeling" (BIM) methodology and the "Lean" philosophy, which have been developed separately, and are currently presented as two complementary tools to deal with the complexity of the product and the process in the sector AECO ("Architecture, Engineering, Construction & Operations"), in Spanish, Architecture, Engineering, Construction and Operations. Recent research has identified several unique interactions between BIM functionalities and Lean processes [9]. The "Lean" philosophy is also complemented by the Location-Based Management System (LBMS) which is the latest generation of programming by areas [10], and its general emphasis is the planning of productivity [11]. Their implementations require changes in the ways of working, and that is more difficult than simply implementing a new technology. Substantial changes require long-term efforts and a stable business and work environment.

Traditionally, the owner, or promoter of a project, in the construction sector, carries out the contracting by separating design and construction. First, the designer is hired, and after the completion of the drafting of the project, it is tendered for the contracting of the construction company. A way of contracting that generates extra costs and lengthens the terms [12]. Among the different contracting alternatives that coexist in the sector, Project and Work contracts stand out, as well as that of Delegate Promoter, generally carried out by an Investor Promoter to a builder. In both cases, the builder assumes control over the drafting of the project, and can also play the role of Promoter in the second, and even Designer if it has a technical staff trained to do so, therefore, it can shorten deadlines with the overlap of phases.

In relation to the ecosystem, both extremes could be considered, all under the same umbrella, that is, the same company assumes the roles of Promoter, Designer, Builder, Marketer, while on the other hand it would be fully segmented, each activity is carried out by an actor different. In construction projects fully developed by a single company, the interactions between the actors are considerably simplified, since each activity is the responsibility of a different company, in addition to the contractual casuistry, there is the complexity of integrating the information, which in In both cases, the prior definition of a standardized structure with the philosophy of single data, integrated, in real time, with broad functional coverage, and adaptable to all the members of the ecosystem that is considered [13] is needed, and that its implementation is facilitated. spread and access.

RESEARCH METHODOLOGY

This research uses the action research approach [14]. In practice, it is the simultaneity of solving the real problem while expanding scientific knowledge, as well as improving the skills of the actors involved. It generates a collaborative environment in constant feedback that facilitates the understanding of the processes of change of the social system in an acceptable ethical framework [15].

Construction and management engineering clearly needs a research approach that combines the objectives of both applied and basic research, contributing to the solution of practical problems and the creation of new theoretical knowledge at the same time. Action research meets these criteria because the researcher analyzes the current situation, identifies the problem, engages in introducing some changes to improve the current situation, and evaluates the effect of those changes, and reflects on the process and outcome to generate new knowledge [15].

IDENTIFICATION OF THE NEED FOR THE METHODOLOGY

In the construction sector, also known by the acronym AECO, a construction can be divided into the design, construction and use phases, where by company profile, design is associated with Architecture and Engineering offices, construction with the Construction companies, and in use the Maintenance and Conservation companies act, being necessary for this, that a Promoter company has promoted the undertaking to obtain a benefit through the commercialization or exploitation of the same. The construction project, traditionally, includes the design and construction, and the most common is the contracting, by the Promoter, first of the design, and then contracting the construction company for its execution through a tender to which it invites builders participate.

In construction companies, the reception of an invitation, or the identification of an opportunity, to submit an offer in a bidding process for the execution of works, triggers a series of processes from which it is possible to sell their services, and even after- sales in the event that it is awarded the contract. Unlike other sectors, awareness of the need for sales orientation in construction companies is very scarce, if not non-existent, and the lack of commercial culture prevails due to its absence in all processes, starting with the generation of an offer, which in addition to a technical component must have a very strong commercial one, and which deteriorates even more in the production processes where the demands for results on the interlocutors, of the contracting companies (Promoter), and contracted (builder), make it difficult much more.

The way in which, in a company, the different collaborators turn to meet the needs of customers, whether internal or external, is highly conditioned by the existence of a business strategy that promotes it, and by the knowledge they have in relation to to the other areas of the company, in addition, an understanding and awareness of their individual contribution in achieving the strategic objectives is needed, and clarity of the procedure to be followed in each situation. The deployment of the organization's strategy through integrated processes in a global map, and the strengthening of a common culture, favors that all collaborators can carry out their activities in accordance with the objectives defined by the company. The implementation and dissemination of a culture of its own in the company makes it possible for everyone to share a set of ideas, practices and values in common, aspects that are necessary to align the company's strategy in all its areas. The implementation of a collaborative culture between the different areas of a company

is closely related to empathy between the different branches of knowledge, since it is essential to understand the existing needs, in addition to one's own, to make deliveries that respond to the recipient's expectations, that is, your client, the scientific literature shows how the development of empathy is important in work teams [16].

The need for interaction between agents from different organizations adds another degree of complexity to the challenge of establishing collaboration. The simple objective of establishing fluidity in the exchange of information can be compromised, just barely, by problems of interoperability between systems, although it would be the least of the obstacles, since it is a question of finding a technological solution, but it is much more difficult create empathy between the different companies, especially if each of them has not yet developed it internally. The success in the implementation of the BIM methodology, as well as the tools The Last Planner ("Last Planner System"), or Collaborative Contracts ("Integrated Project Delivery") within the framework of Construction Without Losses ("Lean Construction") depends on the degree of collaboration between the agents and an environment of transparency and trust.

Naturally, it is expected that the promoter of an undertaking, the Promoter, will become the main actor in the process of transforming existing forms of work in the construction sector. However, the largest percentage of the cost of a construction project is the construction processes managed by the main contractor, as shown in figure 1, generally a construction company, and this is where the opportunities for improving economic competitiveness are concentrated. of a project compared to the others, and also coincides with the one with the greatest margin for improvement due to the high waste of its processes. The need to improve productivity and optimize the consumption of resources in the achievement of construction projects depends on a greater integration of the design and construction phases to guide decision-making on the definition of the product to the demands of the market, and to the economic impact of the defined construction systems.

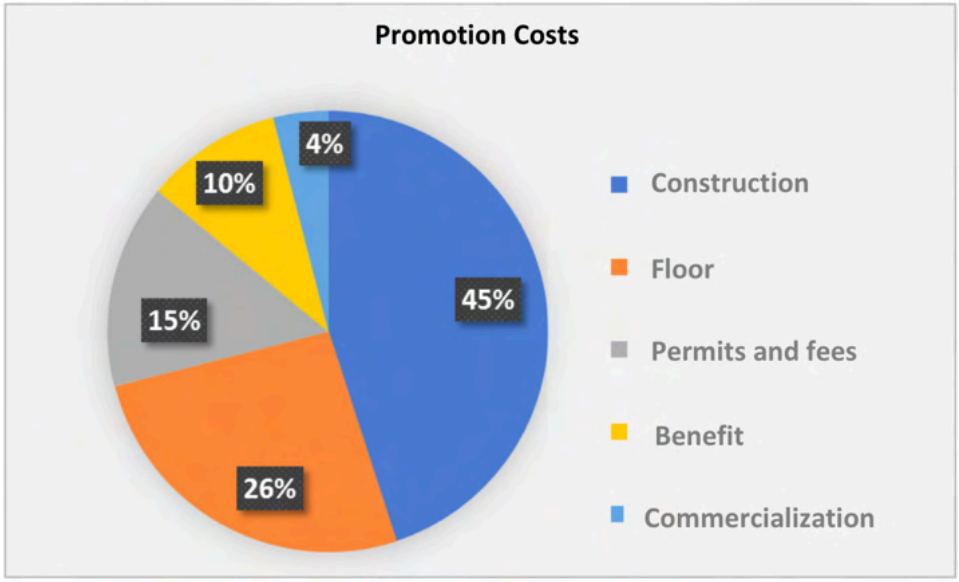


Figure 1: Percentage distribution of Promotion Costs (Own authorship).

In some companies in the sector, Promotion, Design, Construction and Marketing activities coexist under the same umbrella, although it is not the most common and, moreover, in some cases, impossible to achieve, as in public investment. However, bringing together all the activities in the same company does not guarantee, by itself, the coordination of the flow and transmission of knowledge through the different areas, but it does reduce the complexity of the ecosystem. The Promoter, not always, is an actor with experience in the construction sector, and in many cases, just an investor in the project, so it cannot be expected that from the conception of the undertaking the deployment of a strategy can be guaranteed. integration between agents. In the case of professional developer companies, with solid knowledge of the sector, they usually bet on squeezing construction costs through a tender that stipulates the maximum material execution budget. The Architecture and Engineering offices, for their part, have the technical knowledge, and are in a good position to propose the transformative action, but in addition to being passive agents, since they depend on an agent promoting the undertaking, they also need to rely on the experience of construction companies that have appropriate information systems for effective collaboration in the drafting phase of the project, since it is essential to have real execution data in decision-making for the definition of construction systems. Construction companies, in relation to a new undertaking, are actors that also react, or join the initiative, and not promoters, but the economic weight of their contract in the distribution of total costs, enables them to create the need for that their participation from the very beginning, or in very early phases, be decisive for the greater competitiveness of the project, as long as they have the proper capacity to retain knowledge of the works carried out and a good system to access information transversally to compare solutions used in the different executed projects.

So that construction companies can apply to lead the transformation of the interaction model between the actors in the AECO sector, this methodology is proposed that places collaboration based on transparency and trust as the basis of the culture in the company so that it can expand, as a natural philosophy of its work model, to all other external agents involved in the project.

PILLARS AND OBJECTIVES OF THE METHODOLOGY

The methodology that has been designed is based on 03 main pillars: Strategy, Processes and People. These elements complement each other and establish a transversal coherence throughout the organization, since the Strategy defines a common mission, which is deployed through the Processes that provide a script so that the People, who integrate, represent and form the Culture of the company, can develop their activities aimed at maximum Productivity through the optimization of the use of resources to achieve the Sustainability of the company over time.

Figure 2 shows a simile of the Toyota Production System scheme, which in this case represents La Casa de Coanfi, defined within the framework of the Coanfi Method, name of the methodology adopted in the construction company in which it is developed. action research. In this figure you can see how the 03 pillars are based on the existing knowledge in the company, which is constantly questioned through critical observation to identify opportunities for improvement and optimize the use of resources, always in an environment of trust.

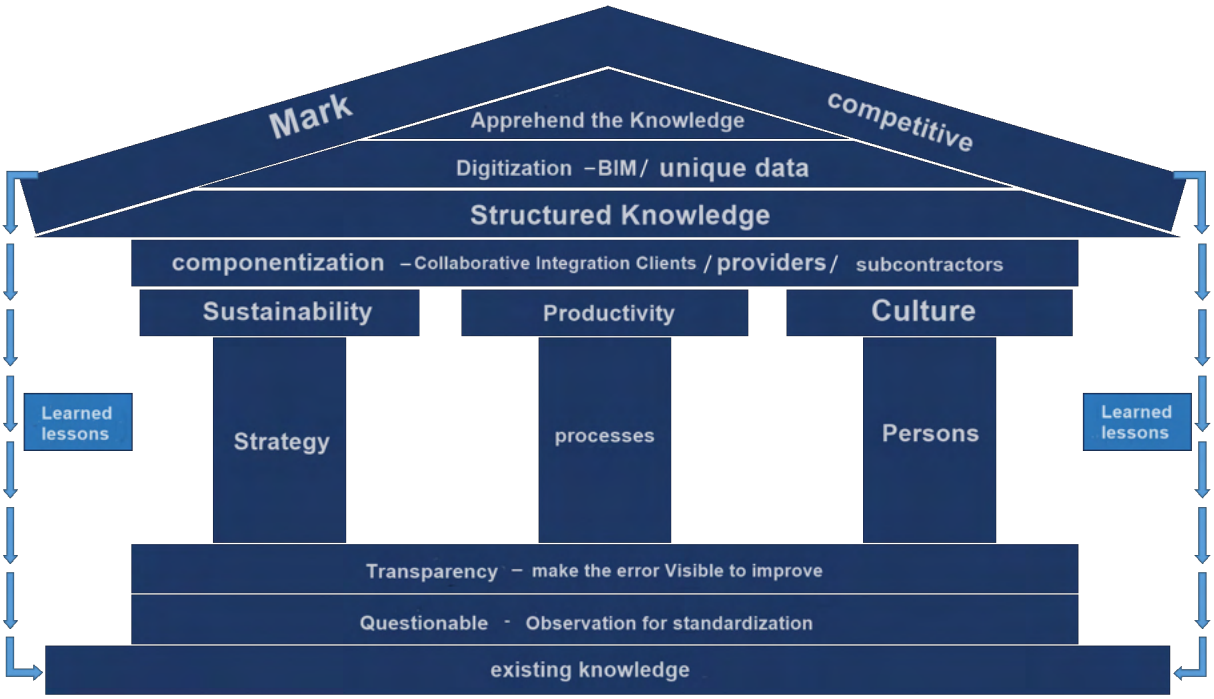


Figure 2: The House of Coanfi (Own authorship).

and transparency so that errors become visible, and thus enable the investigation of their causes and the consequent correction of the procedures that have made them possible, in a clear application of concepts of the "Lean" philosophy. These pillars support Sustainability, Productivity, and Culture, which, in turn, support the objectives of the Methodology.

In order to transform the construction company into a Competitive Brand, the objectives of developing the Componentization - Collaborative Integration, the Structuring of Knowledge, and the implementation of the Unique Data Philosophy to retain knowledge in the organization are proposed. In order to build the Casa de Coanfi, a collaborative culture must be generated at the beginning of the company, and then spread this culture to customers and suppliers through the contagion of a natural and own culture.

OBJECTIVES IN THE IMPLEMENTATION OF THE METHODOLOGY

As in any construction project, the foundations are essential for the construction of any structure that is desired to endure over time. In addition, in parallel to the construction processes, the execution of a foundation implies removing the existing base, the ground, to introduce new elements so that it can support the construction, and in the same way, the Existing Knowledge in an organization, which it is the existing base, it must be stirred so that new concepts can be established that will give the correct support to the Pillars of the Methodology. So it is essential to define an integration process between the different areas of the company to generate transparency, trust, and organizational empathy to be able to question, in a healthy but firm way, the way in which we currently work, whether it is based on formally

defined procedures or by unwritten unwritten rules, or even by the booklet that each teacher brings. On the other hand, we must not lose sight of the fact that the foundations must be in accordance with the magnitude of the load, or be compatible with the scope of the project, so we must begin to dimension the house from the roof, that is, what are the objectives of the company, and define a clear Strategy that makes it possible to achieve it, breaking it down into temporary partial milestones to correctly establish the dimension of the necessary foundations.

Figure 3 shows the flow of activities to achieve the implementation of the methodology in the company. The flow reflects 05 objectives that are sought to be achieved in the implementation of the methodology. The first seeks, transversally throughout the flow, to establish a model of participatory activities with a collaborative orientation in a discussion space in which integration is promoted, and the concepts of transparency and trust are reinforced through different workshops. transversal throughout the implementation of the methodology.

In the second, it is proposed to define the scope of the implementation through a Collaborative Strategic Planning Workshop and another to obtain the Map of Phases and Processes with their respective planning for the development of the processes in each of the areas of knowledge reflected. in the documents of General Planning and Planning by Areas. The third objective, which is developed from the "Lean" Tool Workshops to the obtaining by areas, of the Process Flow through the repetitive sequence that is applied to each one, which is composed of the Optimization-oriented Observation, Definition objective process flow, Collaborative Workshops defining action plans, Development Action Plans, and Obtaining the Process Flow, it is planned to lay the foundations of the processes and establish a development / implementation

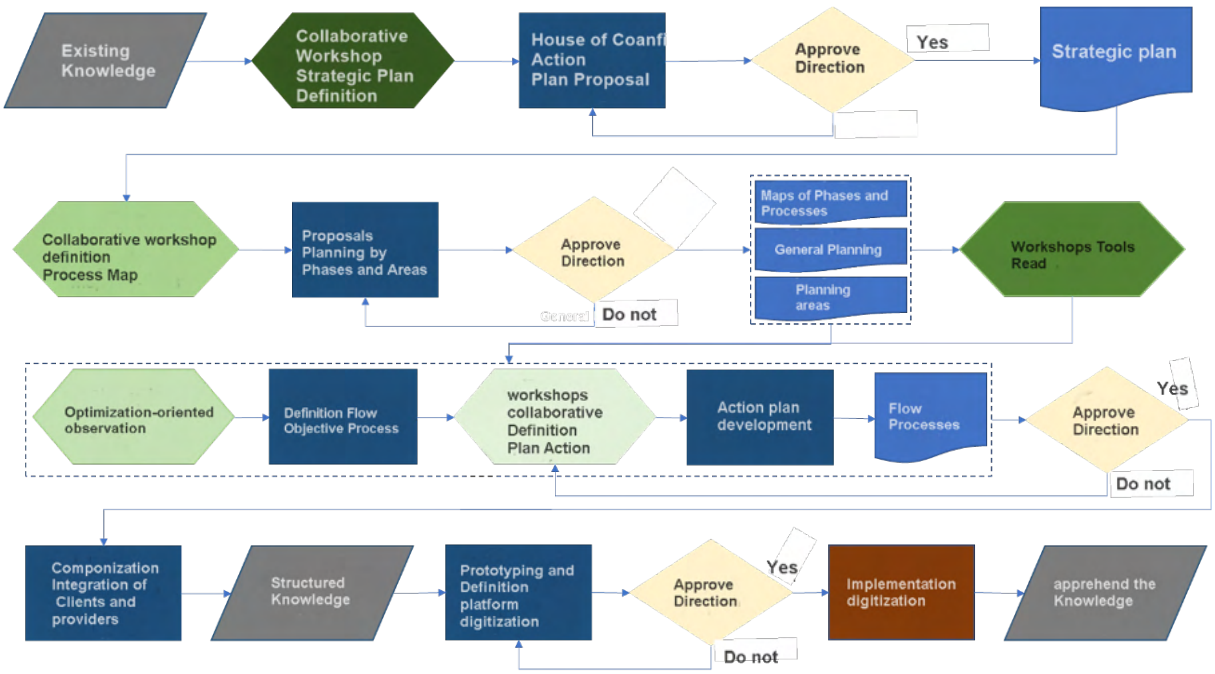


Figure 3: Flow of implementation of the Methodology (Own Authorship).

sequence that favors collaborative work between clients and internal suppliers through the organization, that is, between the different areas of the company, and at the same time, autonomously, so that the groups of people trained can continue working in order to question and improve their work processes.

As a fourth objective, it is intended, once the three pillars have been developed, that is, the Strategy, and its deployment through the Processes, and with the due collaborative environment for the involvement of People, thus generating a Sustainable, Productive, and a collaborative Culture of its own, in this final phase of the methodology, the aim is to consolidate the structuring of knowledge with the integration of external agents to the company such as clients and suppliers through Componentization.

Obtaining the Structured Knowledge allows the implementation of the fifth objective, which is the complete Digitization of the ecosystem to facilitate tools to access information in a timely manner necessary for the internal decision-making processes of the company and transparent to the other external agents involved in the Project, as well as the consequent retention of knowledge as an asset of a more competitive organization.

COLLABORATIVE CULTURE AREA

The traditional management structure of construction companies based on departments usually contributes to an important tightness in the flow of information between the areas of knowledge of the company, with a consequent generation of work. Companies lack a holistic perspective and the same tasks are often repeated to generate similar documentation, that is, the different departments that manage the project in its study, technical office,

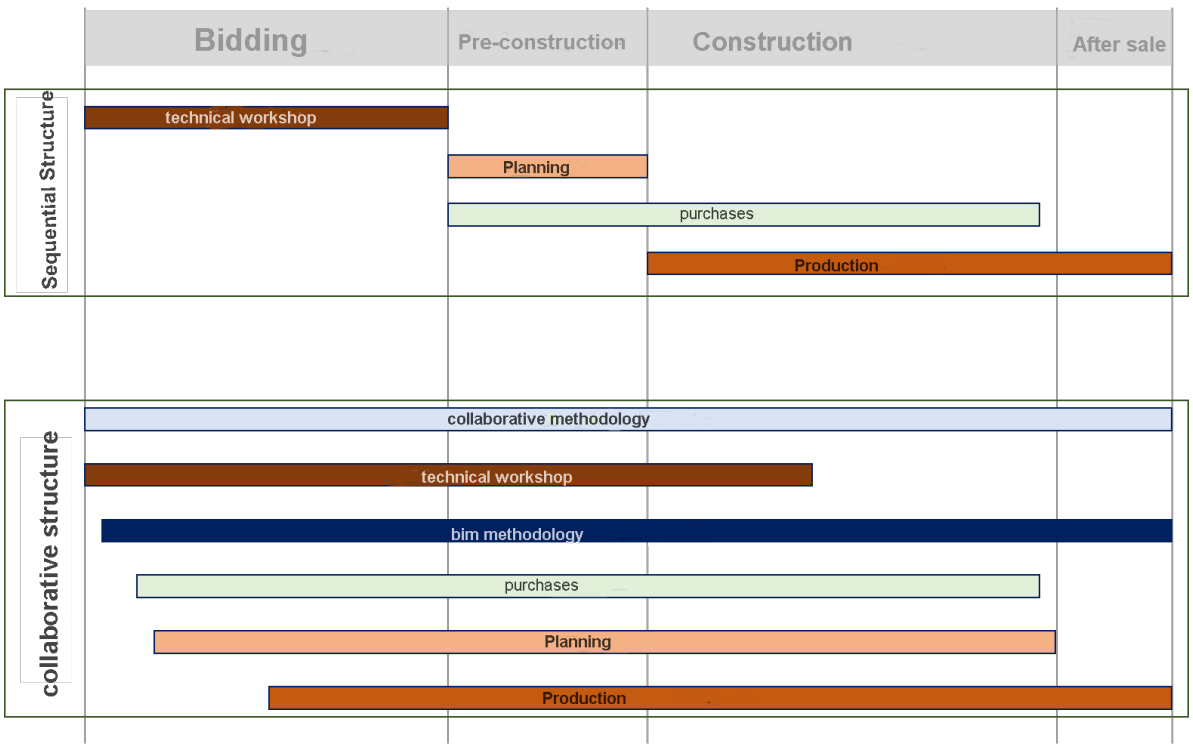


Figure 4: Differences between traditional and collaborative organizational structures (Own Authorship).

purchasing, and production phases need to extract information from the project, and to For this, they develop their own procedures and formats, thus generating an assignment of total hours dedicated to the project that is completely unnecessary. For the creation of an organizational structure based on collaboration, it is proposed to blur the borders between departments and phases of the project to give prominence to the areas of knowledge and the interaction between them.

Figure 4 shows the differences between a sequential and a collaborative organizational structure. Three differentiating elements appear in the collaborative structure: the adoption of a collaborative methodology that holistically defines the roles of each area of knowledge in each phase, the use of the BIM methodology as a transversal platform that favors the exchange of information, and a greater overlap between areas of knowledge in the phases in a collaborative work format to generate the necessary documentation.

Analyzing the Tender phase in isolation, in the sequential structure the same department would have to generate the offer by studying the project to carry out a technical report, check the status of measurements, plan, and contact suppliers to define the cost of the project, then if the contract is awarded, and even if information transmission mechanisms are established, the departments that need to plan, buy and execute the project (production), will study and carry out the same activities again, but if a collaborative structure is implemented, a better quality offer by having the different areas of knowledge to contribute their specialized experience, and furthermore, if the contract is awarded, each area of knowledge already has the necessary information to carry out its activities in the successive phases of project execution.

The collaborative methodology is transformed into a new area of knowledge in the organization that has the main objective of ensuring the application of the methodology in all the defined processes, and promoting the constant critical observation of the processes in search of continuous improvement through groups of people trained in tools within the framework of the Lean philosophy for this purpose.

FOCUS ON COMPONENTIZATION

Componentization proposes actions in two opposite directions, one towards the project, and the other towards subcontracting, but necessary to form a standardized and integrated construction process without prior participation in the design phase, and this differentiation is important because the structure of interaction between the different agents is easier in the ecosystems that contemplate the development of the design and can promote the standardization of construction systems with greater ease because all areas of knowledge have easy access to intervene in the design phase and the project is born with a structure of common information for the management of the sale/ production, the subcontracting activities, and the cost/proformas of suppliers.

The definition of an integration system between the different agents in a collaborative format makes it possible to eliminate traditional tasks in the execution of the works that do not add value to the product, even, on the contrary, generate unnecessary costs in light of the proposed methodology. Managing the achievement of quality, deadline and cost objectives in the execution of the project becomes a complex mission due to the high variability of many concepts to be managed, highlighting among them the state of measurements of the project's work units and the actual quantities executed, the

use of human and material resources foreseen in the breakdowns of the work units and their coherence with those obtained after the purchasing process, the differences between the different measurement criteria of sales, contracting and after what is invoiced, all resulting from a non-existent structuring of the information in the projects. In addition, to eliminate variability, it is necessary to change the transactional model between the interested parties to a relational model based on transparency and trust.

The first sense of application of the componentization is in relation to the drafted project, that is, towards the client, the development of a database of work units grouped by chapters, or by subchapters where appropriate, with maximum atomization is proposed. of work units. The fragmentation of the work units allows a collection of components to be created through which the scope of any project that is submitted for bid by the company can be assembled, and in the event that the scope of the project includes an element that does not exist in the collection, the necessary components are registered in the appropriate group (chapter / subchapter) to later use it in the assembly of the scope.

Figure 5 shows that for each Work Unit of the Client's Project there is a one-to-many relationship with the Work Units defined by the construction company in its database after the implementation of the methodology. The necessary attributes of the Work Units of the Client's Project are the description of the Work Unit itself, and the associated Quantity, that is, it defines the scope of what must be executed. Based on this information, the bidding construction company will define, after studying the documentation received, which are the atomized Work Units of its method that define the scope of each Work

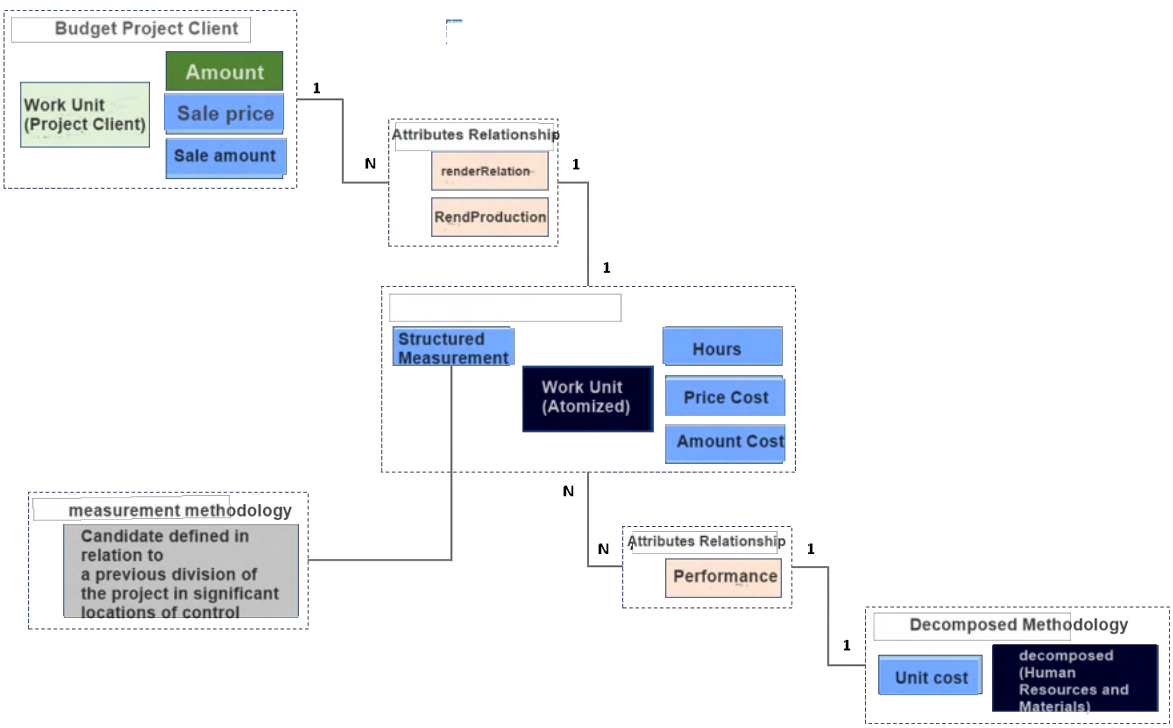


Figure 5: Relationship diagram between the Work Units of the Client's Project, with the Work Units defined in the methodology (Own Authorship).

Unit of the Project, and for each of the Units of Work of your system are associated, the correct Structured Measurement to execute, the Human Resources and Materials necessary with their Performance and Unit Cost to, based on these attributes, calculate the Cost Price per Work Unit, and the Total Cost Amount of its execution, so that after translating the project received into its standardized method of execution, define, between the Work Units of the Client and the previously linked method, thus obtaining the Price and Sale Amount of each one, as well as the total amount with the inclusion of the other standardized concepts in the methodology, of indirect costs, general expenses and industrial benefit.

In relation to the Structured Measurement, its meaning corresponds to reflecting the total amount of a Work Unit through the sum of the partial amounts to be executed in each of the significant locations that the Project has previously structured to facilitate its management. In relation to the Relation and Production yields (rendRelacion and rendProduction respectively), these define the proportion that the production of a Work Unit of the methodology generates the right of Certification in the contractual Work Unit.

In the opposite sense, componentization is used in contracting, towards the supplier, in this case it is used as a reference to help create a supply chain. By having a collection of atomized components, we seek to group these elements into activities. With the aim of going to a model of relational contracts between the construction company and its subcontractors. The main objective is the establishment of successive contracting chains, that is, there is a decrease in the number of companies contracted directly by the construction company, but not with the aim of increasing, or promoting subcontracting on site, and this nuance is important, but yes, to introduce the concept of preparation of assembly packages outside the work to achieve greater standardization and the reduction of execution times due to the parallelism in the execution between activities in the production center with those executed in the workshops for subsequent assembly on site, in which the chained supplies are integrated. To achieve this integration

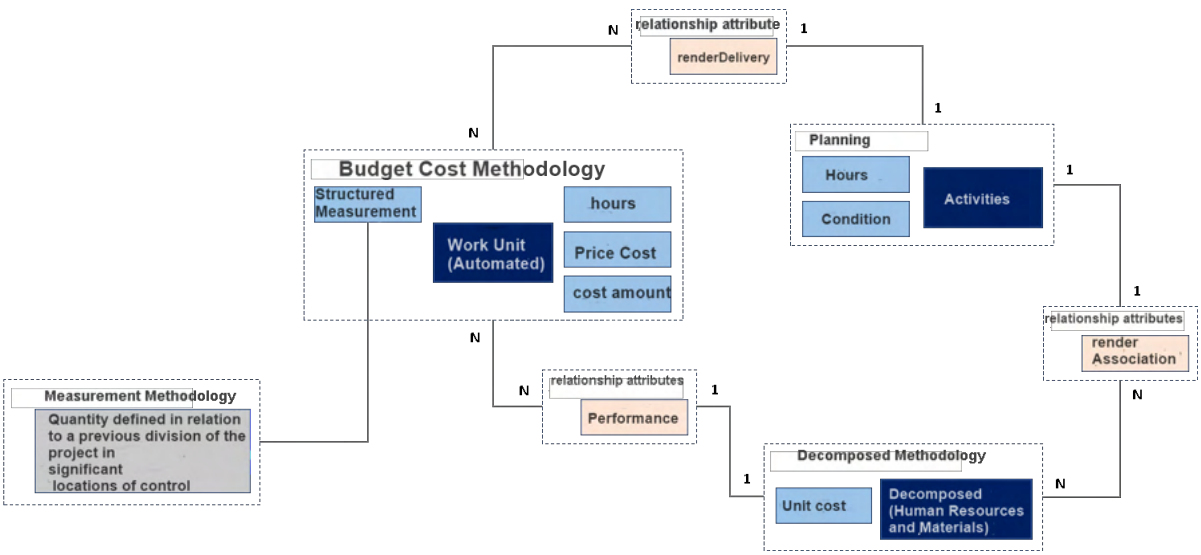


Figure 6: Relationship diagram between Work Units and Activities (Own authorship).

and standardization, the definition of the Activities must be carried out jointly with the group of companies at the first level of the supply chain on the atomized collection of components of the construction company, and thus be able to investigate, develop and innovate through consensual construction solutions in terms of cost, time, predecessors and successors, as well as measurement criteria. Figure 6 shows the relationships that must be created between the Work Units, the Activities, and the human and material resources to enable the structured link between the planned, contracted, consumed and invoiced concepts.

DIGITALIZATION

After the definition of the Process Map, the development of each of its flows, and propagating the internal collaborative culture to external agents with Componentization, a Structured Knowledge is obtained in the company that is the basis for Digitization. The implementation of Digitization is fundamentally based on two main concepts: the philosophy of the single data and the use of BIM digital models oriented to objects connected to a database for the exchange of information throughout the life cycle of the project in all its ecosystem.

As unique data, it is understood that the data is only entered once in the ecosystem and, from this introduction, the data is propagated to where it is needed, and in the case of using different platforms, processes must be added that solve the interoperability between them, that is, the transmission / reception of the data without manual manipulation. Even in exchanges with actors external to the organization, the reintroduction of the data must be avoided, and yes, its propagation must be facilitated, as, for example, in the case of supplier invoices, its entry into the system must be implemented through automated reading of the data necessary for its processing.

Digitization plays a fundamental role in the exchange of technical information between external agents, whether with suppliers, project technicians, or the Project Manager, with clients and their representatives, since all the information provided must be generated automatically from the BIM model, thus avoiding subjectivity in the generation of reports, such as in the definition of the Measurement Status, which each technician generates a different one even if following the same criteria, and yes, having a standardized report in the organization based on the Structured Measurement defined in Componentization. To do this, a library of BIM objects must be developed that, in addition to facilitating and speeding up the modeling process, guarantees the use of previously tested objects that return the correct magnitude of the work unit they represent. All this, added to the correct structuring of the information, enhances the exchange of information in the different phases of the project, from obtaining the PEM, Budget of Material Execution progressively at the same time that it is being modeled to obtain the Project of Execution, as well as in Pre-Construction, the granulometry of the model is detailed in more detail and Planning is defined so that it can generate information according to the contracting needs.

With the contracting, the association of each one of the necessary resources for the material execution of the project is obtained to the contracted companies, and therefore, the base of the BIM / Lean synergy for the application of the Ultimate Planner in the management of the execution. All this establishes a continuous flow of information that is accessible internally, but also open to other groups of stakeholders in the project. Figure 7 shows this continuous flow, and the accessibility to information.

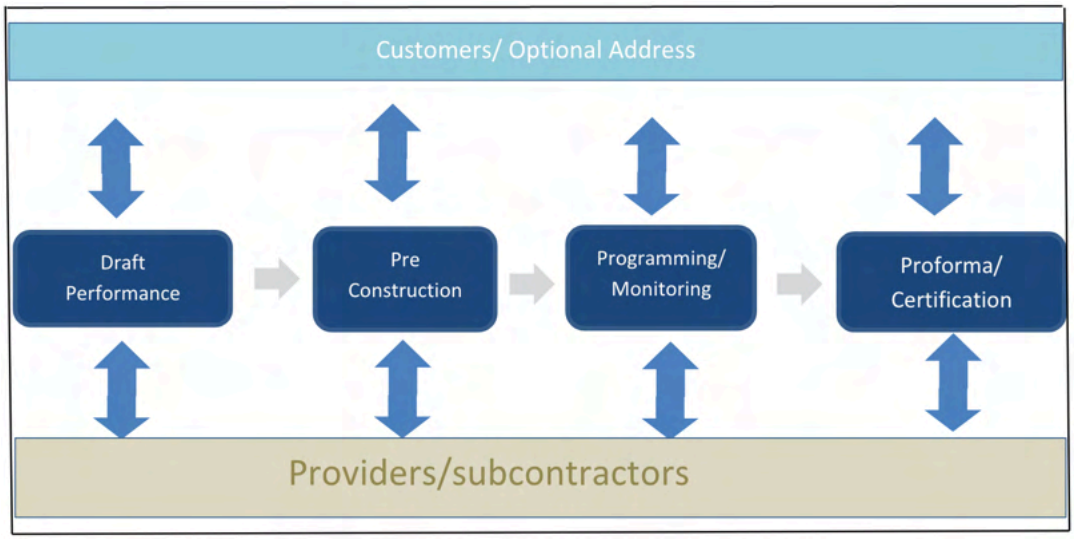


Figure 7: Continuous flow of information and its accessibility (Own authorship).

Digitization integrates 03 basic platforms: process management, information exchange with the BIM model, and ERP ("Enterprise Resource Planning"). All the platforms are integrated through the different databases and the data flow is done in an underlying way at the user level. In the information exchange platform with the BIM model, the work unit they represent is extracted from the objects, as well as the quantity to be executed, and in which location it must be executed. Figure 8 shows the platform window that extracts and groups the information of the objects to generate the material execution budget and its status of structured measurements.

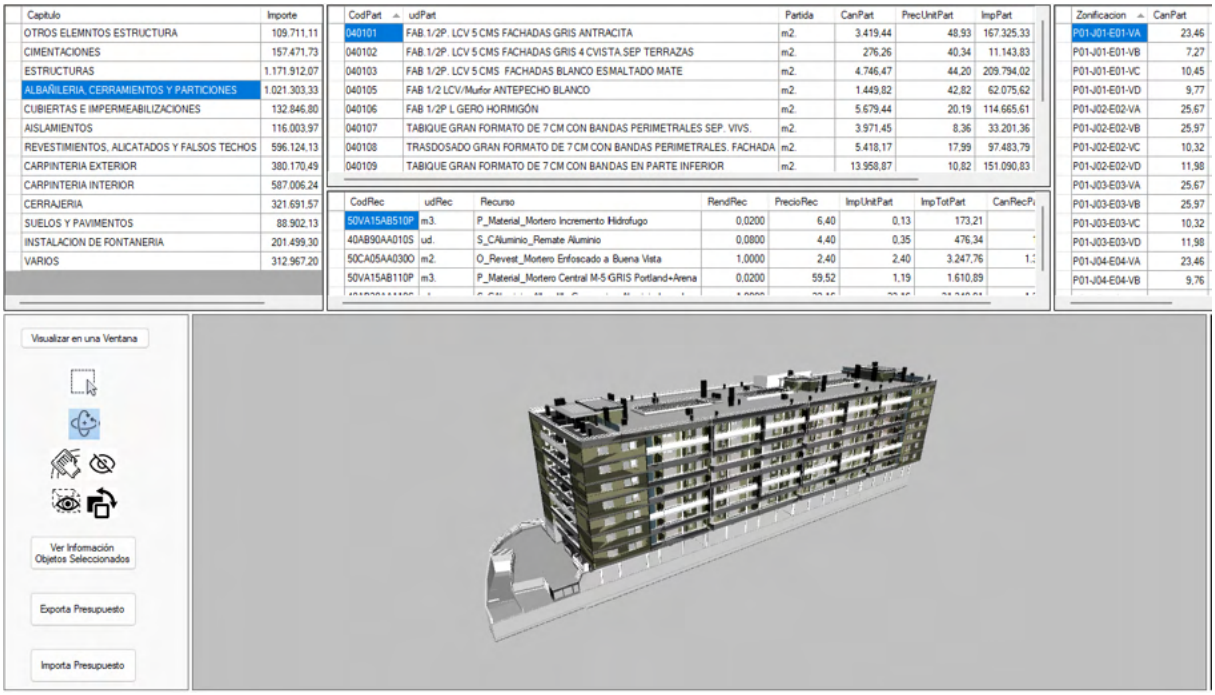
From the BIM platform, it is possible to manage the flow of information from the budget, including planning, and the weekly monitoring of production, automatically generating the proformas that must be paid to the suppliers, as well as the right to collect with the certification. corresponding, all for a certain period.

CONCLUSIONS

The methodology presented supposes for construction companies an important transformation in their construction project management culture, internally, but also a significant change in mentality to build lasting relationships with other agents, mainly clients, suppliers and other technicians involved in the project.

The construction of collaborative relationships based on transparency and trust with external actors implies establishing clear rules so that the information generated internally is open and accessible to the collaborative network for consultation of the data that interests them, that is, this information is builds continuously every week.

The principles of transparency and trust, as the basis of an integration process that envisages empowering the Value Stream Map in favor of relations between the parties, traditionally opposed, and with an excessive burden of overlapping work to verify the adjustment of the information to reality, is more than necessary, but essential to achieve a more competitive sector.



Chapter	Amount
OTHER STRUCTURE ELEMENTS	109.711.11
FOUNDATIONS	157.473.73
STRUCTURES	1.171.912.07
Masonry, cladding and partitions	1.021.303.33
ROOFING AND WATERPROOFING	132.846.80
INSULATION	116.00397
COATINGS, TILING AND FALSE CEILINGS	596.124.13
EXTERNAL WOODWORK	380.170.49
INTERIOR CARPENTRY	587006.24
locksmith	321.691.57
FLOORS AND PAVEMENTS	88.902.13
FOUNTAIN INSTALLATION	201.499.30
VARIOUS	312.967.20

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Figure 8: Budget screen of the BIM platform (Own authorship).

REFERENCES

1. Pellicer, E., Sanz, M.A., Catalá, J. (2004). "El proceso proyecto-construcción" (The infrastructure life cycle). Universidad Politécnica de Valencia (ISBN-84-9705-533-0), 486 pp.

2. Alarcón, L.F. (2014). "Using Last Planner Indicators to Identify Early signs of Project Performance". Proceedings IGLC-22, Oslo, Norway.

3. Hosseini, M.R., Chileshe, N., Zuo, J. and Baroudi, B. (2012). "Approaches for implementing ICT technologies within construction industry." Australian Journal of Construction Economics and Building, Conference Series, 1(2) 1-12.

4. Vicedo, J.C., Pérez, A.H. (2003), Esteban, F.C.L. 2003. "Análisis de adaptación al sector de la construcción de estructuras organizativas y de producción existentes en el sector automóvil." V Congreso de Ingeniería de Organización, Valladolid, Burgos.

5. Botta-Genoulaz, V., Millet, P.A. (2006). An investigation into the use of erp systems in the service sector. International Journal of Production Economics, 99, 202-21.

6. Pellicer, E., Pellicer, T.M., Catalá, J. (2009). "An integrated control system for SMEs in the construction industry". Revista de la Construcción, 8(2), 4-17

7. Jovanovic, B. y Rousseau, P.L. (2006), "General Purpose Technologies" en Aghion, P. y Durlauf, S.N. (eds.). Handbook of Economic Growth, Elselvier North-Holland, Amsterdam, 1182-1226.

8. Torrent, J. et ál. (2008). La empresa red. Tecnologías de la información y la comunicación, productividad y competitividad, Ariel, Barcelona, España

9. Sacks, Rafael, Milan Radosavljevic and Ronen Barak (2010). "Requirements for building information modeling based lean production management systems for construction." Automation in Construction 19(5): 641-655.

10. Seppänen, O. (2014). "A Comparison of taky time and LBMS planning methods." Proceedings IGLC-22, Oslo, Norway.

11. Shankar, A., Varghese, K. (2013). "Evaluation of location-based management system in the construction of power transmission and distribution projects." Indian Institute of Technology, Madras, Chennai, India.

12. Alarcón, L. F., y Pellicer, E. (2009). "A new management focus: Lean Construction." Revista de Obras Publicas, 156(3496), 45-52, España.

13. Argibay, J.A. (1999). "La paradoja del dato único y el éxito de los sistemas ERP." Anales de mecánica y electricidad, ISSN 0003-2506, Vol. 76, Fasc. 5, 1999, págs. 48-55

14. Azhar, S., Ahmad, I., Sein, M. (2010). "Action Research as a Proactive Research Method for Construction Engineering and Management." Journal of Construction Engineering and Management, 136, Special Issue: Research Methodologies in Construction Engineering and Management, 87–98.

15. Hult, M., and Lennung, S. (1980). "Towards a Definition of Action Research: A Note and Bibliography," Journal of Management Studies (17:2), 1pp. 242-250

16. Akgün A.E.; Keskin, H.; Cebecioglu, A.Y. & Dogan, D. (2014). "Antecedents and consequences of collective empathy in software development project teams." Information & Management, 52, 247–259.