

A Collaborative Approach for AEC Industry Digital Transformation: A Case Study, the School of Liscate



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Abstract In the digital transformation process of the construction sector, the Client has a crucial role involving all the stakeholders and organizing workflows with a digital platform that ensure the flow of information in a fluid and coherent way. Collaboration becomes a key factor in making the process work the best way and supports BIM throughout the building's lifecycle. For this reason, the Framework Alliance Contract has been applied, for the first time in Italy, on a case study (the new School of Liscate). The construction process has been supported by a collaborative platform linked to the BIM model that allows the traceability and real-time control of the consistency and accuracy of project information.

Keywords Framework agreement · Information management · DMS · LoIN · Transparency

1 Introduction

The possibility of developing a perfect mechanism of competition and the allocation of resources in a market is subject to the occurrence of a condition of symmetrical information. To achieve this objective, the information must respect the characteristics of completeness and accessibility without any costs among parties. Unlike the hypothesis mentioned above, information is commonly considered as an economic good and for this reason, they are not accessible at no cost (Halac et al. 2012). Moreover, it is probable that not all the necessary information is available during economic transactions. It is, therefore, possible to define the existence of asymmetric information when, within an economic process, information is not entirely shared among parties in the same project (Sultan et al. 2008). This attitude allows a few agents involved to possess a greater amount of information compared to the competitors, on whom they would have a competitive advantage.

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The presented theories can be adapted also to the real estate sector and to the AEC sector. In these, both parties require fair compensation for the service they intend to offer. In this way, collaborative contract theories lead to a review of the process structure (Lahdenperä et al. 2012; Alwash et al. 2017; AIACC 2014; McKinsey 2017) and the inclusion of multiple contractual parties leads to a different view of the project (Serpa et al. 2016). However, in many cases, individuals tend to apply opportunistic attitude, without considering the benefit to the project. This approach produces neither a global gain nor the team and the project is damaged by selfish behaviours (Lenferink et al. 2013).

2 State of the Art of Collaborative Approaches

In recent decades, some project delivery systems (AIA 2007) have claimed to bridge the gap between design and construction. In this context, some collaboration contracts have been developed in many countries (e.g. United States, United Kingdom and Italy), they have mainly the same characteristics although born in different legislation (Mosey 2019). Due to their structure and composition, traditional contracts inevitably create (i) a conflict of interest that cannot be resolved and (ii) impose a strict division among stakeholders. These new working frameworks, on the contrary, allow achieving the final through a mutual agreement among parties. These relational approaches are based on several theories (Smith 2011; Sacks 2016), which have concluded that the optimal method of project implementation is an integrated approach that applies Lean principles (Suttie 2013). Collaborative relational contracts (RPDAs) apply these theories to align the interest of different economic operators allowing the optimization of the final result (Jalaei 2014). In such a revolutionary context, the use of information modelling allows applying what the contractual, sociological, psychological and economic theories support. Without a contractual change, the full application of information modelling and collaboration results difficult, even more, when BIM methodology is applied erroneously to opportunistic contracts (Raisbeck et al. 2010; Sacks et al. 2010; Singh et al. 2011).

The researchers investigated different contractual typology in a worldwide scenario (Di Giuda et al. 2017), among them researchers individuated the one closest to Italian legislation. This approach provided a solid base to adopt RPDAs in Italian legislation. The Framework Alliance Contract FAC-1 is a flexible meta-contractual model, in which parties are given the opportunity to consider efficiencies in the supply chain that make the flow of information more transparent and reduce the overall cost of performance. The Client could use the standard to create a collaboration, legally valid, among their sub-consultants and/or sub-contractors. The higher level of transparency and increased responsibility, towards both the Client and other Collaboration Components, required by each private operator in the pursuit of collaboration, are counterbalanced by the economic compensation provided. FAC-1 is a contract that regulates and manages the inter-relations among different contracts and, namely, the relation among parties, which are not directly associated over a contract. In addition,

FAC-1 is intended to build a solid legal framework for the BIM use in the construction sector. It allows to develop a positive interaction between the different design teams and to connect the different phases of the work construction. FAC-1 approach invites the participants to submit their Collaboration Proposals and enhances the professional expertise, thereby exploiting economies of scale and achieving cash or other benefits.

The research aims at understanding the practical benefit of a digital approach managed through a Relational Project Delivery Agreement in a real case study. The project allows the researchers to discover the limitations and difficulties of the approach.

3 Research Methodology

The proposed methodology starts analysing, according to ISO19650-1 (ISO 2018), the need of the public administration. The further step of the process consists in extracting the objectives and specific needs of the organization. According to the organization workflows, the researchers prepared both a contract procedure to fulfil the common procurement and a platform to manage the portfolio information.

These two generic tools need to be customised for the specific project. Namely, all the information, which need to be stored in Information Models and Databases, are breakdown and codified to have a consistency in the data even though they are produced by different stakeholders. Asset information are included in the technical sheet attached to the meta-contract. Best practice guidelines are developed and improved by iterative tests to better perform and fulfil the organization needs and expectation. This approach allows to customise information workflow among parties in a data-driven process (Fig. 1).

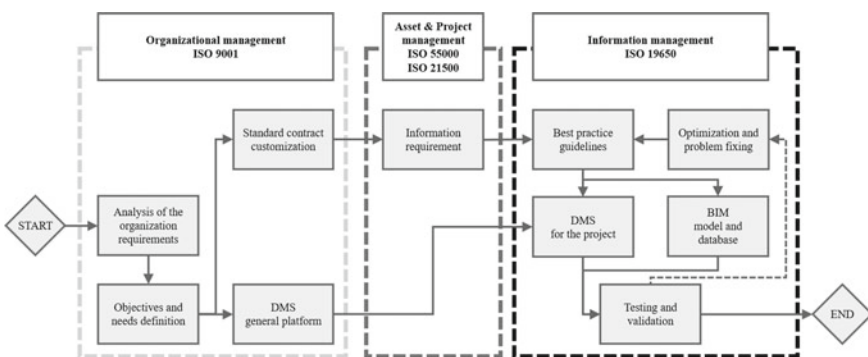


Fig. 1 Methodological approach (image by authors)

4 Case Study: The Liscate Approach

The “Adda Martesana” Municipality applies the Framework Alliance Contract (FAC-1) as part of the project to build a middle school in Liscate (Italy). It is a middle school project for 150 students and 5 M € of construction costs. The school was developed through a BIM approach, showing a high level of complexity (Fig. 2).

The collaborative contractual standard has provided the legal basis for optimising relations among parties and obtaining added value. The client, helped by the scientific consultant, has therefore drawn up a series of annexes which, according to the functions and schemes that support FAC-1, customise the standard contractual model to the specifics of the case. The client aims at including the most important parties of the construction process in order to allow better information exchange.

The agreement aims at including not only the general contractor, but also the Tier 1 of the supply chain according to the specific need of the project. The customization process started defining the objective of the collaboration, set by the client as “monitoring of the time and cost provided for in the Programme Contract and its annexes”. All the features of the agreement were based on that assumption.

The agreement itself was used as the legal foundation to assure and control the information workflow that is essential in a data-driven process. To achieve this result, guidelines have been defined for the use of the platform for sharing information and the information required for the delivery of the model has been established. The DMS and BIM guidelines are annexes of the alliance agreement.



Fig. 2 The Liscate middle school (image by authors)

4.1 Document Management System (DMS) for Construction Site

The DMS platform adopted for the information management allows to have under control, in real time, data on supplies arriving at the site, documents to be approved, materials to be accepted. In order to streamline procedures and control the information flow between the parties involved, a DMS system is set up to serve as a basis for the information exchange. Through this approach, the documentation is automatically sent in digital format to people in charge following the regulatory flow. In the event that the verification should turn out to be negative, the information flow would be followed in the event of non-acceptance of the document. The system adopted in this way ensures a timely inspection of the control procedures on site. The data stored in this way allow the costs management and the monitoring of materials quantities delivered and to be delivered, so as to have a computational knowledge of the state of work consistency (Fig. 3).

A document platform has been set up to control and facilitate the management of the project through a structured information exchange between the parties. In this way, together with weekly coordination meetings, interests are aligned and information asymmetries between the parties are removed. This approach allows the use of always updated and consistent documentation according to the actual needs of the contracting parties. The folders are visible according to the roles assigned to the users, therefore the writing rules vary according to the permissions assigned. Administrators have access and editing power in all folders, as well as site managers. If a folder is not to be made visible only to some users, the inherited privileges must be removed (privileges automatically granted to all subfolders of a directory

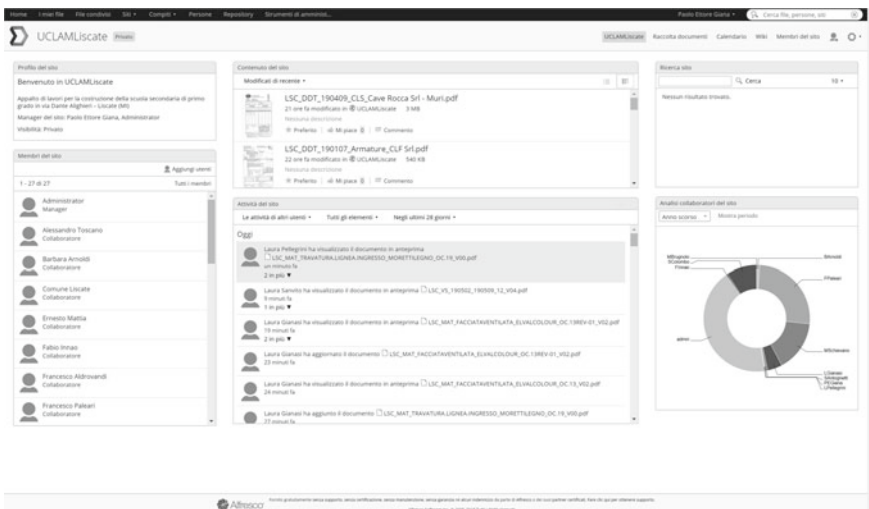


Fig. 3 The DMS platform (image by authors)

depending on the permissions of the directory itself) and locally you can customize the permissions outlined in the previous paragraphs.

For example, a contributor in a folder may have the privileges of a manager, while other contributors may not even have the privilege of seeing such a space. It is better to create user groups with the same permissions, rather than assigning individual permissions to users, so that if you add one or more users at a later time it, being part of a group, will have the same privileges as the other users in the group. The responsibilities in question concern the correct nomenclature of the files inserted and the correct procedures for using the platform.

The scientific consultants set up the DMS with roles and responsibilities for supervising the works on site and then defined a series of procedures to be used before, during and after the construction phase. All these activities must be carried out in accordance with solid procedures and roles defined in the platform management guidelines, where procedures (workflow) are exemplified for each decision-making operation established by current legislation. The solid definition of roles and workflows allows the efficient implementation of the DMS, i.e. the loading, updating, sharing and consultation of documents and information. In particular, the scientific consultants who set up the platform have established, according to the needs of the client, the rules of filing, nomenclature and responsibility, as well as additional information (metadata) related to each type of document.

The process digitization and the use of the DMS guarantee the possibility of managing complex projects, which otherwise would generate a loss of information and a lack of systematic control of processes. This provides a solid basis for obtaining valid, timely and consistent information, not only between the parties but also between different processes. The document management as-built, thus developed, provides for separate procedures and information depending on the type of information. In the case of processes that require verification and validation, as shown below for the approval of materials, the documentation subject to approval is subject to a cycle of internal verification-modification-validation and then to a cycle of external control within the platform to generate only at the end of the same a final report related. If the verification is negative, the non-approved version is archived with the proposed changes and then a new version of the document is produced, which is subjected to further verification cycles until approval is obtained. In the case of documents to be produced (such as, for example, minutes), the documentation is shared, internally verified, approved, recorded and then historicized and digitally archived. In this way it is possible to control the multiplicity of processes that occur in parallel in the management of a complex site.

4.2 Information Modelling Applied to the Project

The level of information required for each delivery of information should be determined according to the responses to which the contracting authority must respond in the design phase or project milestone. These requirements should include the

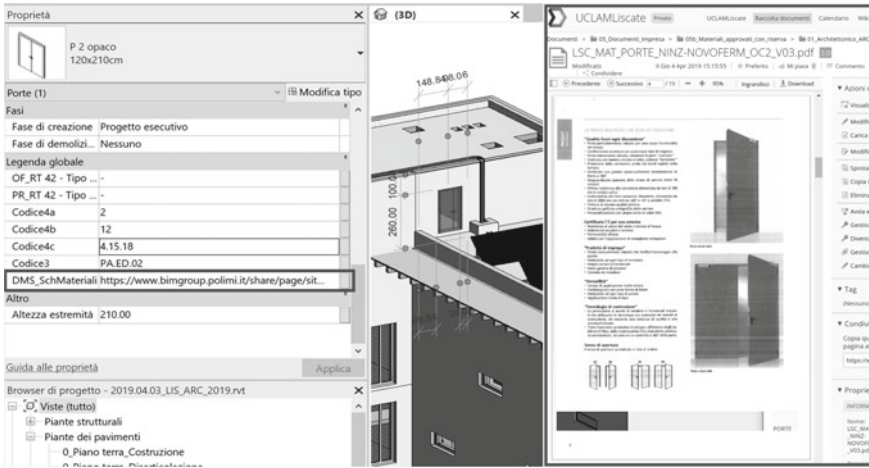


Fig. 4 Consistency and accuracy of information guaranteed by the link between BIM and DMS (image by authors)

appropriate determination of the quality, quantity and granularity of the graphic and alphanumeric information. Once these measures have been defined, they must be adopted to determine the level of information required throughout the whole project or asset. Establishing these requirements across projects, it allows for structured management of the data contained in the models and information databases of the entire real estate portfolio. The level of information required should be determined by the minimum amount of information required to meet the main information requirements, including information requested by other service providers and according to ISO19650-1:2018 standards. For this reason, the client establishes the levels of information per project phase of both technical elements and environmental units (Fig. 4).

This platform, the Document Management System (DMS), is a digital tool applicable to the information management of the site, which allows to improve and streamline the control of the information flow, structuring processes and information which are subject to validation, correction and archiving. The prepared DMS provides a collection of interconnected and persistent data and a series of applications used to access, update and manage the data, which is the data management system. This platform is a tool created and structured to digitally archive the documents of a construction site and monitor the flows of approvals. In particular, it can be assimilated to a database with a (web-based) interface, therefore accessible everywhere, with specific characteristics that allow users to: (i) manage documents; (ii) add metadata to documents; (iii) assign and execute tasks; (iv) manage users and their roles; (v) process data to create benchmarks.

Through the use of the DMS in relation to the methodology and the BIM model, each user can enter data, share, modify, manipulate and display them (depending on the privileges granted to them) in the database so that they follow a pre-established

information flow connected with digital objects. In this way, each user has a pre-defined task, depending on his role in the job, which allows him to access certain information and data, to accept or request changes to instances/documents in the database. A digital management of information allows activities such as versioning (updating of documents with changes tracked in the versions), approval, sharing, tagging.

The connection of the DMS with the BIM model guarantees an as-built document archive, external to the model, but connected to it. This link makes the BIM model updated with all the documentary information connected with the model objects. In this way, guidelines provide stakeholders with the definition of robust workflows for the creation, archiving and updating of documents, which had to be performed by different actors before, during and after construction. The BIM model has a central function in storing attributes related to individual objects (e.g. performance, costs, timing, location, installation dates, etc.), while it is not suitable for archiving documents (e.g. reports, contracts, invoices, etc.). Data is a representation of facts, concepts or instructions in a formalized manner and suitable for communication, interpretation or processing by means of automated processes. The data contained in the model is made available according to the needs and roles within the company, with different reading and writing privileges. The process is completely transparent and traceable. The ability to access data from the web is essential for collaboration, data sharing and for uploading documents directly from the site, properly digitized. The document versioning function helps considerably in the analysis of possible inconsistencies or changes to the documents, to provide the customer (who has permission to view during the construction phase) with the most recent documents and information.

5 Discussion and Further Development

This meta-contractual form permits to increase the coordination of different subjects' activities with greater guarantees of results and with a reduction of unexpected interference, possible over-budget and overrun of time. Especially in complex project, this approach allows an efficient management with multiple subjects' contributions. Collaboration, in such a way, provides an added value in terms of work or service sustainability, site organization and working conditions efficiency, collaboration with the supply chain, reducing re-work. The early involvement of all professionals allows to prevent and/or reduce the mistakes, which must be reported to Alliance Manager that improves project final quality. The alliance members promote transparency in relation to the specific aims and objectives of collaboration. This standard provides the ability of team members to rely on the exchanges of BIM data and setting among different call-off contract the same rule in order to provide data consistently among parties. The use of FAC-1 has not been perceived by the parties as a mere bureaucratic aggravating factor, but as an element to improve collaboration and information exchanges, which aims to solve the relational frictions that traditionally occur.

In this sense, some shrewdness has been included as an activity of collaboration in the agreement to change the approach of the different contractual parties to the agreement itself.

This digital approach to information exchange benefits the control bodies (project management and security coordination office) which, on the basis of the categories and/or subcategories set and the different metadata used, can search for the desired documentation, speeding up the procedures and avoiding information loss in the life cycle of the asset. At the same time, the uniqueness of the information is always maintained regardless of how the research is carried out, which benefits the client in the management of the asset. In fact, the proposed approach facilitates document management by optimizing the archiving of documents and tracking the flows throughout the life of the asset. In conclusion, this approach ensures the traceability of information and information flows, increasing and maintaining the consistency of information that would otherwise be difficult to reach. Moreover, it allows the knowledge of the state of progress of the information flows that take place between the parties, simply querying the platform and the related information models.

At this point, the research provides an approach to the problem of the SMEs of the sector, in fact the collaboration that RPDA established among stakeholders is difficult to achieve and, most of the time, it is unattainable in a traditional process, although the promised success. The new contract improves the processes management decreasing the public administration burden often due to litigations caused by traditional contractual procedures.

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