A Fourth Party Energy Provider for the Construction Value Chain: Identifying Needs and Establishing Requirements

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Abstract: Today's building and energy management market is heterogeneous and complex. Most of the players in the construction market are not in possession of the managerial capability to fully control the dynamics that affect their energy costs in terms of energy sourcing and energy management. Moreover, construction industry needs to rely on a stronger technical and commercial expertise. On one hand, there is a need of an in-depth and extensive level of technical know-how that most of facility managers, property developers and building owners at private and public level scarcely hold. On the other hand, this industry is characterized by a fragmentation within the single tiers of the value chain. In this context, the paper aims at proposing a new vision of the building value chain towards a collaborative network led by a new player, namely the Fourth Party Energy Provider, acting as the "one-stop contracting and managing" operator, integrating resources, capabilities, best available technologies and practices for providing energy-efficient building solutions.

Keywords: Sustainable manufacturing, Construction Industry, Energy efficiency, 4PEP (Fourth Party Energy Provider)

1 Introduction

The construction industry today plays a relevant role in the European context in which it is responsible for more than 11% of the European GDP and with 32 million people employed [1]. Also from the environmental point of view, this industry plays a critical role since the buildings are the major actors in terms of energy consumption (more than 40%) and emissions (about 33%) at European level [2]. In addition, the average age of buildings, which is very high, has a negative impact on the building energy performance.

A more in-depth analysis needs to take into account also the rules provided by standardization organizations. On March 2007, the European Council underlined the need to increase energy efficiency within the European Union to achieve the goal of reducing by 20% the power consumption in 2020. This action plan has identified the significant potential for energy savings effective in terms of costs in construction. To achieve the goal of 20% reduction in energy consumption, the European Union has adopted directive 2010 31/CE [3] through which are set guidelines for improving building energy performance: (i) methodology for the calculation of energy performance, (ii) establishment of minimum requirements in terms of energy efficiency, (iii) nearly zero energy buildings, (iv) certification system of energy performance, (v) system control and independent experts.

Despite the regulatory and standardization efforts, in the construction market most of the players are not in possession of the managerial capability to fully control the dynamics that affect their energy costs, in terms of energy sourcing and energy management. There is the evident risk for them to sustain high financial costs, not neglecting the indirect strong environmental and social impact. This complexity is further challenged by the need to have a building lifecycle management perspective, which stretches over a temporal dimension the structure of a construction value chain.

In addition, this specific value chain is characterized by a high fragmentation and heterogeneity of actors. As depicted in Figure 1, involved roles in this value chain are local authorities, capital providers, developers, agents, materials and equipment suppliers, contractors, engineers, designers, owners and users. Most of the operating companies are SMEs or even micro-companies normally specialized in the provision of a specific technology with often a short-sighted vision of their role within the value chain.

The complexity of interaction among these participants is one of the greatest barriers to energy efficient buildings. All the above mentioned players do have their specific impact on the energy consumption of a building throughout its life cycle.

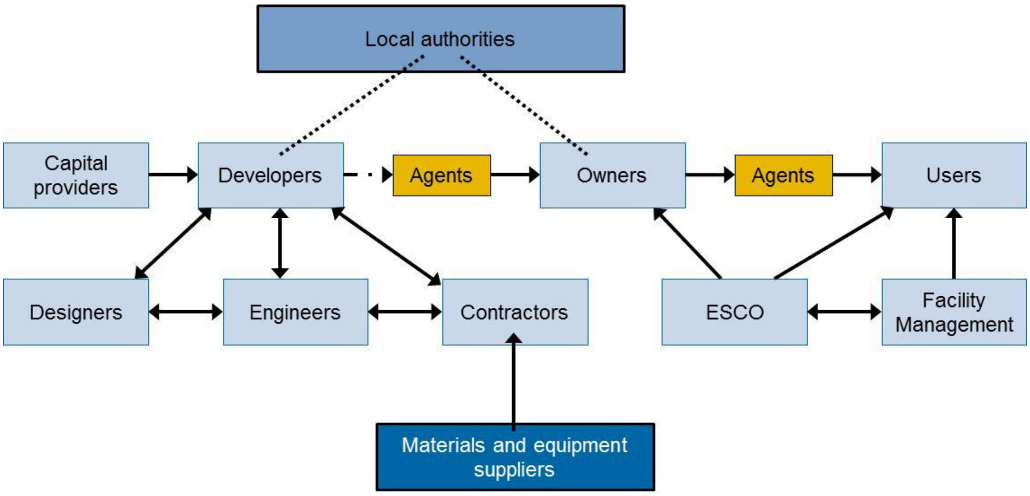

Fig 1. The actors involved in the construction value chain (adapted from [4])

In this context, the paper aims at tackling some peculiar issues of the construction industry, considering in particular:

- which are the current models for the evaluation of the building energy performance during its whole lifecycle (thus not only considering the usage phase);
- the potential role of a new actor, namely the 4PEP (Fourth Party Energy Provider), who would act as the mediator between the constellation of companies operating in a construc-

tion network and a generic client, in order to manage the whole construction lifecycle processes and master the enabling technologies required.

2 Nature of the construction value chain

In the construction value chain, a client has to interact with a multitude of suppliers, each providing a specific competence and accounting for a narrow slice of the overall energy bill. In some cases, the customer selects the manufacturer (contractor), the suppliers of specialist parts and the material suppliers. This raises up several issues since: (i) more independent organizations are involved, often with reciprocal conflicting interests; (ii) there are evident diseconomies in terms of transactional costs, having to relate with a multitude of players; (iii) single decisions are made in different phases of the building lifecycle with different counterparts, thus creating evident inconsistencies; (iv) it is not possible to define a fully comprehensive performance-based contract, but rather local service level agreements with the single service providers [5], [6], [7].
A collaborative value chain approach is needed where the client could be involved from the early moments in co-creating the value of such a relation. Information and material flows relevant to energy efficiency and a comprehensive environmental assessment would be established between the players, and integrated collaboration with a common goal would replace isolated acting and self-optimization. These actors should have a life cycle vision of a building, very often neglected.

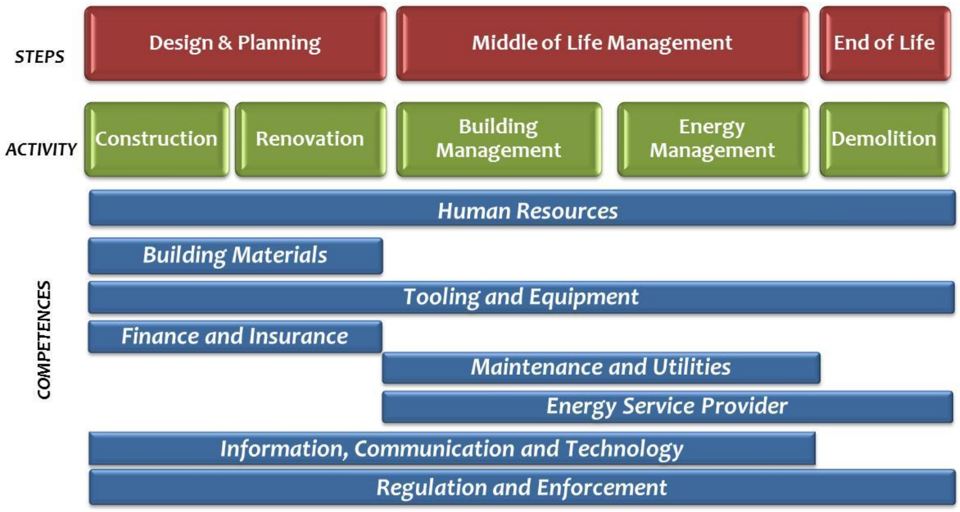

Fig 2. Building lifecycle: main phases and competences required

Two different models are identified in literature in order to perform a lifecycle energetic and environmental assessment:

a) Multi-criteria Indicators models which take into account several dimensions affecting an environmental assessment such as: material and energy consumption, people “energy behavior”, material recycling and re-use, pollutant emission reductions, water consumption. Hereafter the most relevant multi criteria models are reported:

- *BREEAM (Building Research Establishment Environmental Assessment Method)* developed by the Building Research Establishment, which takes into account seven criteria to perform building life cycle assessment: (i) energy; (ii) transport, (iii) pollution, (iv) materials (v) water, (vi) region features and (vii) health; for each criterion a specific evaluation is provided [8]
- *LEED (Leadership in Energy and Environmental Design)* which takes into account seven criteria: (i) site sustainability, (ii) water management, (iii) energy, (iv) materials, (v) internal environmental quality, (vi) innovation in design and (vii) regional priorities [9].
- *GBtool (Green Building Tool)* which classifies a building using four hierarchical levels: (i) performance classes, (ii) performance categories, (iii) performance criteria and (iv) sub-criteria [10].
- *CASBEE (Comprehensive Assessment System for Built Environment Efficiency)* which evaluates the building energy performance in different building phases: (i) pre-design, (ii) design and (iii) post-design [11].

b) Synthetic Indicators models, which take into account quantitative analyses rather than qualitative ones. The most relevant model in this category is represented by the life cycle assessment (LCA) methodology which provides a quantitative assessment of the "consumption" of a building in its lifecycle considering also the design and the end of life phases, traditionally neglected in the construction field [12].

In table 1 a review of multi-criteria indicators and synthetic indicators is provided, underlying the main benefits and weaknesses of each model.

Model	Main weaknesses	Main strenghts	Threaths
Multi criteria	• Procedural simplifications • Scoring systems • Using quantitative and qualitative indicators • Unreliable and misleading results • Using a prescriptive legislation	• Results clear and easily understandable • Possibility to carry out self-certification • Very popular model	• Diversification of the results according to the used model • Economic and political difficulties for its application
Synthetic	• Need of a high number of information • Analysis performed by specialists • Lack of data from literature	• Detailed and reliable analysis • Focus on the entire building life cycle • Using quantitative indices • Use of performance norms	• Economic and political difficulties for its application

Table 1: A comparison between Multi Criteria and Synthetic models

From the extensive literature review conducted by [13], although LCA is recognized as an innovative methodology which could improve sustainability in the construction industry, it emerges that there has been a large number of LCA studies which merely deal with a specific part of the building life cycle. Only few of them really encompass the whole life span. In their concluding remarks, the same authors strongly maintain how entities involved in the construction

industry must be proactive in creating environmental, social and economic indicators, which bring about building sector sustainability and promote the use of consistent construction practices.
What is missing is a common platform where all the different actors operating in a construction consortium could have a mutual understanding of their role and their contribution in terms of real added value and impact on the overall lifecycle of a building, not neglecting the involvement of the customer. Without this platform there is the evident risk that any environmental and energetic assessment would be quite myopic to the specific lifecycle phase (i.e. either on its construction or on its use) or peculiar to the instances and objectives of the single operator. In addition, it would be too generic, since it needs to consider also the habits and requirements of the users that will be living in the building during its existence.
What could fill this gap is the definition of a building value framework based on the concept of a business model. In the most basic sense, a business model is the method of doing business by which a company can generate profit. It spells out how a company makes money or gets paid [14], by specifying how it intends to create value to all the stakeholders [15].
Literature definitions about the concept underlying a business model are various and heterogeneous. Quite acknowledged in literature is the Business Model Canvas by Osterwalder and Pigneur [16] which has been tested in various organizations. The model is composed by nine building blocks: (a) *Customer segments*, defines the different groups of people or organizations an enterprise aims to reach and serve; (b) *Value propositions*, describes the bundle of products and services that create value for a specific Customer Segment; (c) *Channels*, describes how a company communicates with and reaches its Customer Segments to deliver a Value Proposition; (d) *Customer Relationships*, describes the types of relationships a company establishes with specific Customer Segments; (e) *Revenue Streams*, represents the cash a company generates from each Customer Segment (costs must be subtracted from revenues to create earnings); (f) *Key Resources*, describes the most important assets required to make a business model work; (g) *Key Activities*, describes the most important things a company must do to make its business model work; (h) *Key Partnerships*, describes the network of suppliers and partners that make the business model work; (i) *Cost Structure*, describes all costs incurred to operate a business model.

Many authors argue that business models are not able to deliver long term goals due to their focus on short-term, internal and financial performance. This is particularly true for the current business models in the energy management and construction area, which are characterized by self-optimization and a strong focus of the individual companies instead of focusing the attention on the value provided to the customer [17]. The idea of the 4PEP Business Model - that will be described in the next section - is to overcome this issue in order to provide a comprehensive business model for the whole construction chain.

3 The proposed model: the 4PEP Energy Provider

This section is devoted to the description of a new acting role in the building value chain: the Fourth Party Energy Provider (4PEP). It represents an integrator that assembles the resources, capabilities, and technology of more organizations to design, build and manage a solution for fulfilling the specific needs and composite requests related to the energy aspects drawn from the construction market, by:

- actively involving the customer in the creation of a value added solution;

- acting on the levers that impact on energy costs (mainly in terms of price and quantity);
- selecting the best available technologies and practices for the specific situation;
- qualifying and selecting the key actors, according to their competences, assigning them a specific role in the emerging construction value chain;
- mastering all the dynamics that affect the building lifecycle;
- being the main responsible in the elaboration, monitoring and accomplishment of PBEE (Performance Based Energy Efficient) contracts, and relative KPIs towards the customer.

The term 4PEP finds its root in the homologous player in the manufacturing logistic context, namely the Fourth-Party Logistics (4PL) provider. The 4PL concept was put forward by the consulting group Accenture. The essence and core superiority of this concept lies in its ability to integrate the supply chain resources, through integrating the most high-quality resources (individuals) of the supply chain. A 4PL offers services considering a 360 degree view, which is not focused only on its ability to implement the recommendations it gives, but on all the technological and managerial options available in the market [18]. In a sum, a 4PL provider manage and direct the activities of multiple 3PLs, serving as an integrator. In this way, a 4PL can leverage the whole supply chain network from an integrated perspective rather than from a specific, narrow perspective related to a single service category.
The main tasks performed by the 4PEP are not fully and consistently achievable if they are not supported by a specific toolbox of processes, methodologies and tools. The 4PEP would fill the current gap by adopting a Business Model Framework for the construction industry with a corresponding subset of tools and methods which empowers it to develop specific business models in order to evolve from offering standalone standard services to integrated solutions.

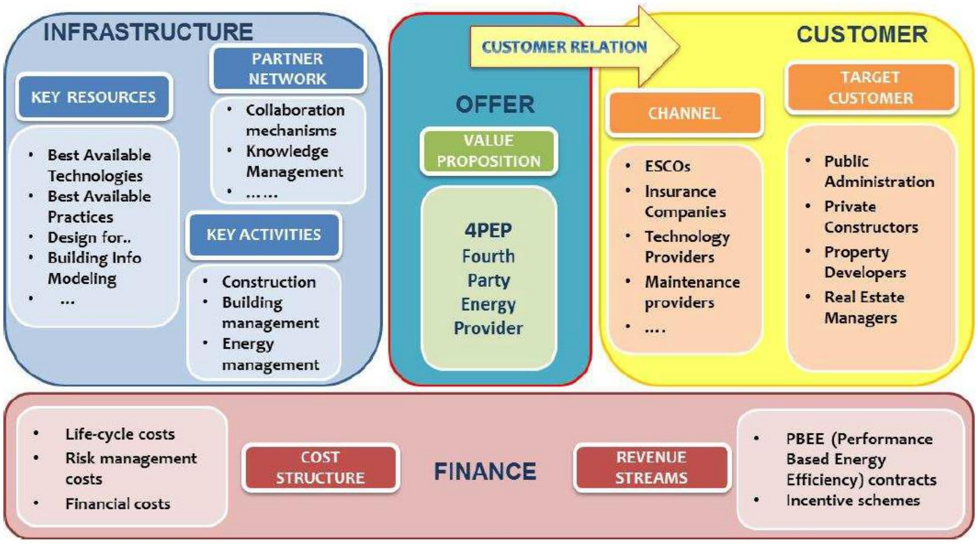

Figure 3: The 4PEP Business Model Framework

As highlighted in Figure 3, the 4PEP Business Model Framework would rely on a specifically designed business model ontology, based on the Osterwalder and Pigneur's canvas, in order to share a common and standardised terminology and with an explicit definition of the relations between the constructs (i.e. from a technological, organizational, managerial, financial perspective) identified as a source of value for fulfilling the specific needs and requests from the market.

The implementation of a 4PEP Business Model Software Platform would be crucial for gaining concrete results of this vision. It would provide the collaborative environment involving the 4PEP focal actor and the different stakeholders in the emerging creation of a customised business model and in simulating its affordability, robustness and durability throughout the whole building lifecycle.

In particular, it would support a stage–gate process, where "gates" or decision points are placed at specific phases of the 4PEP business model development process, and embed in its functionality a dashboard for monitoring throughout a contract lifecycle the main technical and financial KPIs in order to enable a prompt understanding of any deviations from expected targets SLAs (Service Level Agreements) and highlight eventual counter-measures.

4 Conclusions

This papers stems from the consideration that in the construction industry there is a need of an actor integrating competences and companies in this fragmented market. The presence of the 4PEP would quite relevant since it could act as the "one-stop contracting and managing" operator providing a direct and durable relation with the customer. The potential behind this concept is quite evident if we refer to public administrations where the low managerial capability, the multitude of contracts to deal with, as well as the need to maintain a continuous monitoring of their performance can become quite compelling and affect the overall quality of a public-private partnership.

Some issues are also open: (i) which are the main competences and capabilities required for such an actor? (ii) is there a need of new professionals or are these skills already available in some companies (i.e. Energy Service Companies or within the same construction companies)?

Moreover, for this research it is fundamental to focus also on the technology and tools for enabling the business models, in particular:

- Building Technology Solutions: technologies related to building both in design, construction and usage phase (HVAC, advanced material, …);
- energy performance models in order to monitor and improve the performance of the building;
- coordination and collaboration mechanism among the whole building value chain in order to involve the different partners towards the same main objective.

The next steps of this research will be mainly devoted to design the main constructs at the basis of the 4PEP business model and to apply this vision to a pilot study on the renovation of a building stock related to social housing.

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