

Searching Ways of Accelerating the Necessary Changes in the Production Process of the Built Environment for a Sustainable Future

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Abstract: This paper has the goal of presenting the main characteristics and challenges of the process of developing and disseminating solutions which aim to minimize the environmental impacts and improve the environmental performance of the CIPC (Construction Industry Productive Chain) in the mid-west region of Brazil. Over the past eight years many applied research projects have shown that the bottleneck slowing or preventing the evolution of CIPC in Brazil is the lack of political will, be it at the municipality, state or federal level and a desintegrated agenda. Exacerbated political interests added to a lack of capacity for integrated and efficient management of available resources and programs implementation curtail the continued and integrated technological development and as consequence it has delayed the effective evolution towards sustainable technological paradigms. With no political will, the steps toward change are slow, inefficient and dispersed, as demonstrated by an analysis of the development, implementation and diffusion of four projects which focus on the sustainability of processes and products of the built environment.

Key words: Built environment, sustainability, planning.

1. Introduction

The current technological paradigm in the CIPC (Construction Industry Productive Chain) which is responsible for the production of the built environment in Brazil still embraces a logic which insists on ignoring its environmental impacts.

Among the main innovation enhancing factors highlighted by the innovation theory, it can be mentioned the strengthening of the learning system of different agents acting in the CIPC, enabling absorption and evolution of technological paradigms.

The strengthening of the learning systems is a function of the interconnection of agents, actions and instruments, which allows for synergetic integration of responsibilities, expertise, solutions and resources, which must be shared among the public, private and third sector and the academy. This paper has the goal of presenting the main characteristics and challenges of

the process of developing and disseminating solutions which aim to minimize the environmental impacts and improve the environmental performance of the CIPC in the mid-west region of Brazil. When structuring applied research projects few criteria are required: the agents involved must have complementary and synergetic goals; it is necessary a well-structured and coordinated process, continuous feedbacks in order to allow adjustments and a well-defined strategy focusing on the continuity and evolution of the installed process.

Over the past eight years, many applied research projects which have been coordinated by the Lacis/UnB (Laboratory for the Built Environment, Inclusion and Sustainability of the University of Brasília) have shown that among the bottlenecks which slow or prevent the evolution of CIPC in Brazil, it can be mentioned the lack of political will, be it at the municipality, state or federal level, is revealed by a disintegrated agenda

among government institutions and levels.

In the last decade, CIPC in Brazil has expanded greatly due to favorable economic conditions, government programs, such as housing and infrastructures programs and big international events programed to take place in the near future.

This scenario has created great opportunities of absorption of sustainable technological paradigms. Nevertheless, exacerbated political interests added to a lack of capacity for integrated and efficient management of available resources and program implementation curtail the continued and integrated technological development and as consequence it has delayed the effective and fast evolution towards sustainable technological paradigms.

With no political will, the steps toward change are slow, inefficient and dispersed, as demonstrated by an analysis of the development, implementation and diffusion of four projects which focus on the sustainability of processes and products of the built environment: Construction Waste Management Program (2003), Center for Studies and Research in Sustainable Penal Facilities (2007), the Solid Waste Observatory (2007) and the PISAC (Park for Innovation and Sustainability of the Built Environment) (2010).

2. Simulation

The application of the principles of innovation and systems theory in the development and testing of methodologies which can accelerate paradigms shifts allows advances in the structure analysis aimed at strengthening of the learning systems of organizations [1]. These advances lead to extending the lens of analysis focused on the concept of innovation and identification of vectors which can influence their emergence and evolution.

Johnson [2] offers an approach that emphasizes the complexity of the interconnection of the vectors that influence the emergence of innovations and in his analogy using the coral bank scenario confirms the importance of collaborative networks.

The ability for survive of coral reefs, is not a result of the survival of the fittest, but the ability to reinvent solutions from the results of exchanges and interactions that allow the discovery of new ways of survival. This is the definitive explanation of the paradox of Darwin: “The coral reefs found many ways of survival because of the way they share” [2].

By applying this analogy to the context of learning organizations resources, expertise and responsibilities sharing and integration can be considered as a major factor for the innovation process.

From this perspective, the central premise underlying the proposed analysis presented in this paper is that human organizations are in many respects analogous to living organisms and the application of certain metaphors that help in understanding the problems faced by their solution. Organizations are systems of relationships and are embedded in a broader system defined by its external relations.

According to research carried out in Lacis, about innovation in the CIPC, the performance of a system of organizations is a function of integration and alignment among agents, actions and instruments. The goal of the method is to map the stakeholders in order to identify their actions and define their level of alignment and integration.

The method of analysis presented in this paper is part of the innovation model study which has been developed by Blumenschein [1]. The establishment of the necessary network, which can allow the required integration of agents, actions and instruments demands the identification of the relevant elements to compose the adequate environment for the development of projects which aim to introduce innovations. Among the main elements, it can be mentioned: legal or operational institutional instruments; compatibilization of institutional values and objectives of the participants’ institutions; compatibilization of resources and responsibilities; and the research of methodologies and technologies which can be absorbed by the participants’ institutions.

Therefore, the method used for the proposed analysis has considered three main steps:

(1) The identification of agents, actions and instruments involved in the development, implementation and diffusion considering the network proposed for each project;

(2) The structure of the process for the development, implementation and diffusion;

(3) The identification of the main bottlenecks in each phase of each project.

3. Analysis

A brief description of each project and respective objectives are presented hereafter, before presenting the agents, actions and relevant instruments for the development, implementation and diffusion of the projects which are objects of analysis in this paper. The main bottlenecks for the diffusion or continuity of the projects are also identified.

3.1 Building Site Solid Waste Management Program (PGM)

The Program for Construction Waste Management is part of the MMP (Material Management Program) which is a result of a partnership with Lacis/UnB, the Syndicate of the Construction Industry in Brasilia (Sinduscon-DF), the Syndicate of the Construction Industry in Goiania (Sinduscon-GO); the CBIC (Brazilian Chamber of Construction Industry); Furnas Central Electric Laboratories; and the Goiania's Municipal Government and the Government of the Federal District. The aim of MMP is to contribute to the management of the materials used in the construction process, in order to minimize environmental impacts from the extraction of raw materials to waste disposal.

The Program for Construction Waste Management aims to prepare the private and public agents to attend legislations and sustainable certifications. In construction sites, it focuses on the responsibilities of constructions site managers and generators of solid waste from construction and demolition. In relation to the public sector it aims to design, develop and implement methodology for the definition of guidelines and guiding

principles for the development of Municipalities Planning for Construction Waste Management; and to develop technologies which demonstrate technical feasibility of the recycled construction aggregates.

Table 1 Building Site Solid Waste Management Program (PGM).

Development/implementation	
Agents	Responsibilities
Lacis/UnB	General and technical coordination
Sinduscon/DF; Sinduscon/GO	Interlocution with the local construction sector; Institutional and operational support.
CBIC	Interlocution with the national construction sector, and the federal public sector; Institutional and operational support.
Municipality	Definition of a place to install recycling plant; Elaboration of Municipal Planning for Construction Waste Management; Application of the construction recyclable aggregate of a pilot testing project.
Furnas Central Electric Laboratories	Research and test of the construction waste recycling.
Actions	
Project and planning development	
Research project for the development of the construction waste technology recycling	
Definition of the project management group	
Main instruments	
Legislation which establishes the obligation, for constructors' firms and municipalities, of the recycling of construction waste.	
Project research and planning	
Cooperation agreement among the participant institutions	
Meetings reports	
Technical reports	
Diffusion	
Agents	Responsibilities
Lacis/UnB	Technical and scientific publications Capacitation program for construction firms
Sinduscon/DF; Sinduscon/GO	Dissemination among the construction firms through technical events and media in general
CBIC	Dissemination among the construction firms through technical events and media in general
Municipality	The implementation of the a recycling program
Main bottlenecks	
The Municipality from Goiania assumed all the responsibilities of implementing the project and worked hard in order to assure its implementation. As the elections came and the party which won the elections was different from the one which had signed the agreement cooperation the project was aborted by the municipality new government.	
The Government from the Federal District never assumed his responsibility with the project.	

3.2 NUESP (Center for Studies and Research in Sustainable Penal Facilities)

The NUESP aims to work in the construction of information that supports the development of the productive chain of penal buildings. Created and implanted as a research project, it is dedicated to the study and development of research on the productive chain of penal buildings focusing on quality, rationalization and sustainability of processes and products.

It has been a project which was supposed to receive financial and institutional support from the BMJ (Brazilian Ministry of Justice). After all the negotiations and the project detailing, the BJM has decided that the project has no importance for their agenda.

Lately it has been integrated to the researches at the post-graduation course, at the Architecture Faculty of UnB, with the graduation course allowing the development of solutions and innovative penal building projects.

Table 2 Center for Studies and Research in Sustainable Penal Facilities (NUESP).

Development/implementation	
Agents	Responsibilities
Lacis/UnB	General and technical coordination
DEPEN-National Department of	Interlocation with the local construction sector; Institutional and operational support
Actions	
Research Project development and planning including the following aims:	
Criminal Architecture—Projects Proposals	
Evaluation of Existing Standards	
Penal Facilities—Theoretical Basis	
Standard for sustainable penal facilities.	
The design and implementation of a National Forum on Prisons in Brazil.	
National Conceptual Contest National for Penal Facilities.	
Constructional Materials Basket for prisons.	
Library Collection on penal criminal architecture.	
Main instruments	
Project Research and Planning.	
Cooperation agreement among the participant institutions, nevertheless, although it had been agreed it was never signed.	
Main bottlenecks	
Although the Ministry of Justice has agreed and participated in the development of the project research, and of the cooperation agreement proposal it has never finalized the negotiation process during four years.	

3.3 Solid Waste Observatory

The Solid Waste Observatory was developed by the (Lacis/FAU/CDS/FGA-UNB) with the financial support from the Secretary of Science and Technology for Social Inclusion from the Brazilian MCTI (Ministry of Science, Technology and Innovation). The Observatory is a knowledge management tool of recyclable and recycled waste, including information gathering, processing, storage, formatting (in various formats graphics, website, thematic geographical maps, tabular, textual reports, cross information from various sources, etc.) and dissemination.

The Observatory allows quick access to relevant and effective knowledge and aims to structure the information about recyclable solid waste management, integrating them into a single place, strengthening the knowledge on the subject and using a tool to store, retrieve, integrate, manipulate, analyze, and mainly involve spatial data to a database text and satellite images, allowing georeferencing technology, information and knowledge management.

Table 3 Solid waste laboratory.

Development/implementation	
Agents	Responsibilities
Lacis/UnB	General and technical coordination
MCTI	Financial resources for the development of the project
Actions	
Project and planning development	
Research Project for the development of the construction waste technology recycling	
Definition of the project management group	
Main instruments	
Project Research and Planning.	
Meetings reports	
Technical reports	
Diffusion	
Agents	Responsibilities
Lacis/UnB	Technical and scientific publications.
	Capacitation program for waste pickers cooperatives.
	Presentation to public and private institutions.
Main bottlenecks	
The Government although financing the project does not participate in its diffusion using its influence power. There is a disintegrated government agenda.	

Table 3 continued

The public sector institutions are not prepared to publish its data and information, due to disorganization or due to cultural resistance.
The expansion of the tool has not been possible due to the resistance of private and public agents who do not want their data published due to a misunderstanding of the real objectives of the proposed tool.

3.4 PISAC

The PISAC is the result of a partnership with public and private agents in Brazil and the UK, involving the BRE-UK (Building Research Establishment), the Brazilian MCTI, the CBIC and the UNB (University of Brasilia), through Lacis.

Based on the model developed by the BRE the PISAC is a research platform that integrates the productive sector, where the industry itself, collectively, can invest in science, research and development, accelerating the process of evolution of the CIPC.

This model also amplifies the impact of public investment and offers the opportunity to strengthen the alignment of government policies, goals, programs and actions.

The PISAC is an institution with the mission of fostering technological innovation, high performance, low cost and sustainable, meeting the current and future demands faced by the construction sector in Brazil, through:

- (1) Establishing network integration of national and international research and technological development of products from a specific demand of the private or public sector;
- (2) Meeting the needs of the construction sector of tests and inspections;
- (3) Testing and certifying material and products of the construction industry;
- (4) Offering consultancies;
- (5) Building capacity, training and technical events;
- (6) Publishing results;
- (7) Creating a platform for the development, management, integration and dissemination of knowledge, composed and supported by a set of tools and actions, and linked to a virtual platform for innovation parks for

the Built Environment of the BRE, oriented to enhance the creation of generation networks, sharing and dissemination of research for the Supply Chain of the Construction Industry.

Table 4 PISAC.

Development/implementation	
Agents	Responsibilities
UnB through Lacis/UnB	Liberation of a plot of land to install the project.
	General and technical coordination. Indication of researches that will coordinate and lead the project. Integration of political institutions into the project.
BRE/UK	General and technical coordination. Provide the model for the park operation. Integration of English political institutions into the project.
	Integration of the productive construction English sector into the project. Provide technology and methodology for the development of the project as a whole. Integration of PISAC to the network of BRE innovation parks.
CBIC	Integration of political institutions into the project. Institutional and operational support.
MCTI	Liberation of investment funds to seed the availability of the project.
	Integration of political institutions into the project. Integration of the productive construction Brazilian sector into the project.
Actions	
Project and planning development. Definition of the project management group. Dissemination of the project among the various government levels and construction sector in order to obtain financial support.	
Main instruments	
Project Research and Planning Report. Signature of the cooperation agreement among the participant institutions. Meetings reports.	
Main bottlenecks	
The disintegrated agenda among government institutions. The bureaucratic process of the public institutions. The lack of consciousness of the construction productive sector of the importance of the project and resistance to invest on it.	

4. Conclusion

Among the main drivers to the emergence of innovation it can be mentioned the establishments of networks which allow the exchange of resources

including human, technical, financial and political.

The institutional arrangements are important tools for structuring the network as they act as support to ensure its full development, and it is important that they are used as instruments of documentation made through work plans, including: objectives, goals, responsibilities, resources, products, and schedules.

What is agreed must be formalized by means of agreements or Technical Cooperation Agreements, where each institution contributes to fulfilling a function. The process is documented using the Reports of Meetings, which are the minutes that record the actions, results, placements and are essential tools in monitoring the evolutions of the projects' steps. The process of survival of the network depends on this structure.

The success of network survival depends on the meanings that come to permeate all levels, and operates as a guideline in the process of interaction of the constituent parts of the network. These meanings have their roots in the beliefs, goals, values, and needs of the institutions and their professionals.

The pilot projects have identified some factors and requirements to be met by similar experiences, so they can have more chances to success:

(1) The potential of partnerships as a means of facilitating the operation of complex social systems and organizational networks composing with specific goals;

(2) The ability and efficiency of the network to save application resources and distribute channeled efforts to strengthen the achievement of goals;

(3) The importance of consolidating meanings common to the network agents;

(4) The strength of the legal instruments that push behavior change;

(5) The role of the media in the dissemination and monitoring results;

(6) The importance of providing practical methodologies for introducing new paradigms allowing speed changes;

(7) The recognition of the political-institutional dimension as a critical point to achieve sustainability.

The results obtained with the development and implementation of the pilot projects presented in this paper show that all participating institutions consolidated results within their internal processes, strengthening their knowledge and learning processes which, according to Dosi et al. [3], is the main requirement for the processes of change that can be put into motion.

The change process therefore requires an analytical method that allows not only understanding the interdependence of all the changes, but at the same time unifying the factors that influence this process by influencing their footsteps and their direction [4-8].

Once these forces have been identified, it is necessary to exercise them in practice establishing references and strengthening the learning process so that more learning can take place in a continuous movement of natural evolution, always looking for improvements.

References

- [1] Blumenschein, R. N. 2004. "A Sustentabilidade na Cadeia Produtiva da Indústria da Construção." PhD thesis, University of Brasilia. (in Portuguese)
- [2] Johnson, S. 2010. *Where Good Ideas Come from: The Natural History of Innovation*. London: Penguin Books.
- [3] Dosi, G., Freeman, C., Nelson, R., Silverberg, G., and Soete, L. 1988. *Technical Change and Economic Theory*. Great Britain: Pinter Publishers.
- [4] Blumenschein, R. N., and Barros, O. 2013. *The Project of the Park for the Innovation and Sustainability of the Built Environment* (version 3). Brasília: Universidade de Brasília.
- [5] Blumenschein, R. N., and Ferrari, M. V. 2011. *Technical Report of the Observatory of the Solid Waste Observatory*. Brasília: Universidade de Brasília.
- [6] Blumenschein, R. N., and Esteca, A. 2007. *Project for Studies and Research of the Productive Chain of Penal Facilities*. Brasília: Universidade de Brasília.
- [7] MCT, CGE. 2010. *Livro Azul da 4ª Conferência Nacional de Ciência e Tecnologia e Inovação para o Desenvolvimento Sustentável*. MCT: Brasília. (in Portuguese)
- [8] Viotti, E. B. 1997. "Passive and Active National Learning Systems." PhD thesis, The Graduate Faculty of Political and Social Science of the New School for Social Research, EUA.