

Post Occupancy Evaluation as a tool for Better Quality Low-income Housing

The Federal District's Vila Tecnológica Project – Brazil

Renata Cunha Borges Ralid

Architect and Urbanist

Federal District Housing and Urban Development State Secretariat, Brazil

Introduction

Despite the importance of the construction sector to the country and its economic significance, its productivity sector context relating to housing has been characterized on the past decades by utilization of back warded technologies, waste of material, and low quality of the final product if compared to other developed countries and even if compared to other economy sectors.

Many low income housing projects developed in the past, had been almost completely modified or rebuilt, showing inadequacy of the designs to reality and a high level of dissatisfaction of its users.

It can be considered today that the industry of the civil construction comes acquiring a similar character to that occurs in other industries, or either, the new products (material and components) to be placed in the market, must possess a minimum performance in its phase of use, in general equal or better that other products already in the market – the conventional ones (those that have the same function). By this point of view, it is considered that the construction (inside of a process of technological innovation) and housing as a final product should have a compatible performance and quality attending to diverse requirements of its users.

The development of programmes that stimulate changes and upgrading in the productivity levels, introduce technological innovations, and quality of housing design and products should be highly considered for the modernization and improvements especially for low -income housing projects. Besides that, there must be developed also, quality standards not only for materials performance, but also for the whole building system in use, including the user's needs and preferences for the future development of the building materials industry and low-income housing projects in Brazil. The paper will present the case of Federal District's Vila Tecnológica Project and the use of both Technical Requirements Evaluation and Post-Occupancy Evaluation (POE) as a tool for upgrading productivity levels and quality of low-income housing projects using innovative technologies.

Motivation for the Choice of Study

As a member of the research group arcHtec – architecture, housing and technology from the Sao Carlos Engineering School -University of Sao Paulo, during my graduation course, for four years I've participated in the development of the performance and post occupancy evaluation for the Vila Tecnológica Project in the city of Ribeirão Preto.

As a professional I'm currently working for the Federal District Local Government at the Housing and Urban Development State Secretariat in the implementation of the Federal District Vila Tecnológica Project. It is a personal challenge now to participate on the actions taken and be on the other side, now considering all the difficulties and obstacles for the implementation of the project and to emphasise for the local government the importance of the implementation of the evaluation process, data collecting, follow up, feedback and continuity of the process.

Background

Historical Background

In the early 90's a National Programme called PROTECH- Programa de Tecnologia do Habitat was created for developing and upgrading the technological aspects of the low income housing building process. The strategy of the programme was to build demonstrative cores of houses constructed using innovative building technologies for low income housing in different cities around the country called – Vila Tecnologica Projects. The Vila Tecnologica Projects consisted were a housing exhibition where around 100 housing units were build by different companies using innovative building technologies.

The original idea was that these exhibition cores would, by one hand display technologies examples to the society that would generate examples of solutions for the housing problem and by the other hand, act as experimental fields where Building Companies, Government, Universities and users could work together to develop simulations of technological and environmental solutions for low income housing.

Although not all the cores planned were built due to political changes in the government, two of them, the Vilas Tecnologicas of Curitiba and Ribeirão Preto (two cities in the south and southeast of Brazil) had great importance as demonstrative cores and as experience fields where universities, local government, companies and community could work together to develop methodologies to evaluate these new building technologies.

Many of the technologies used to build the housing units weren't ready to be used massively in housing projects so, it was necessary that they should be evaluated, not only their performance but also the units in use. Although most of the building components of these innovative technologies were already tested by laboratories, the building process, the design and the unit performance in use weren't evaluated until then. So, it was necessary to develop a methodology of evaluation that would not only evaluate the materials performance at pre-occupancy stage but also the post occupancy evaluation of these housing projects to determine desirable and undesirable materials, properties of the building systems used and of course, the design of the dwellings.

In the Ribeirão Preto's Vila Tecnologica project, the ArcHtec research group from University of Sao Paulo developed beyond the Evaluation of the Performance and Technical Requirements, a Post Occupancy Evaluation. POE was used as a tool to identify the dissatisfactions of the users, and the interventions that had been made so that it can be possible to find out where the generator factor had been born: in planning, design process, components or building process. The evaluation developed was considered a pilot project because, for the first time, data was collected and evaluated since the building process started and until after the families occupied the dwellings. The information about the housing units was analysed combining the data from technical requirements, the questionnaire applied and physical aspects of the dwellings after its occupation, such as extensions, internal modifications, building materials used and the use of internal spaces (furniture dimensions, storage, etc.)

Post Occupancy Evaluation (POE)

POE is one of the methodologies to evaluate the build environment performance. It differs from other current methodologies because it considers not only the technical aspects (project and construction data) but also consider in a very important way aspects related to use, operation and maintenance of the build environment considering the standpoint of the occupant(s), *in loco* having as main goals:

- Provide the action required (or intervention) that would to propitiate the improvement of the life quality of users.
- To produce information in the form of data base, to generate systemize knowledge on the build environment and relations between environment and behaviour.

Post Occupancy Evaluation (POE) is recognized and valued as a process that can improve, and help explain, the performance of the built environment". It has been defined as "the examination of the effectiveness of designed environments for

human users"¹ It can be thought of as a report card that assesses what is good about a building and what is not. The results of this examination are both replicable and useful. The results are replicable, because they are obtained by a systematic process and research methods. They are not only useful to occupants of the building, but to the owners and architects as well; who can apply this information to future projects. A POE can be simple or complex depending upon factors such as the type of build environment being studied, the amount of time dedicated to the project, and the information that the creator seeks. Methods that have been used in completing a POE include interviews of building users, questionnaires, and observation of environmental activity, checklists, and methods of recording the physical setting, such as energy output. While there are a variety of different methods one can use in conducting a POE, the basic purpose is to assess the building's successes/strengths and failures/weaknesses from the standpoint of the occupant(s).

The value of a POE is to improve how buildings are constructed by reducing design and maintenance costs, enhancing occupant satisfaction, comfort, and performance, and to increase the payback organizations yield from their investments. In order to achieve this goal, a POE must be meaningful to both the researcher and the audience. If the POE is indeed meaningful, the results may help to explain why some buildings seem to attract more people than others and why some seem to work more efficiently and seem to fit the occupants' needs better than others do. Answers to these questions can be key in the design of future projects, including the renovation or upgrading of existing build environment. It is thought that having information about what contributes and detracts from occupant satisfaction, as well as overall building efficiency is useful in making a better quality-build environment.

The definition of build environment

The build environment is defined in a wide way referring to the micro and macro surrounding, such as the building, the covered or open public space, the urban infrastructure, the city or even the region. Any build environment or joint of constructed environments, independent of the complexity and scales, is might be evaluated. The build environment has a vital cycle that can be divided in two stages or phases:

Production (short duration) In which is included the stages relatives to the planning, design and construction of the building.

Use (long duration) when the build environment has a full social use, its efficiency is measured by the satisfaction of the community.

QUALITY HOUSING PRODUCT = User's Requirements (PERFORMANCE) + User's Satisfaction

User's Requirements (PERFORMANCE):

If treating Housing as a product, the performance must take care of to the standards and minimum requirements of habitability for the user, to a compatible level with its features, or either, take care of to the Performance Criteria (which are: structural security, security against fire, security in utilization, against intrusions, estanqueidade (to gases, liquids and solids), higrotermical comfort (temperature and humidity of air and the walls), acoustic, tactile comfort (texture, humidity and temperature of the surfaces, static electricity), antropodinamic comfort, hygiene, maintenance, durability, and economy (initial cost and maintenance).

User's Satisfaction

The satisfaction of the user can be measured through two ways: as a clear declaration of items that they comfort it or for the claim of the existing problems in the unit. The variables that foment the satisfaction of the users are orderly in decreasing importance:

- 1 Enough internal spaces for the activities of the family
- 2 Rooms and materials that facilitate to maintenance
- 3 Visual and acoustics Privacy in relation to neighbourhood
- 4 Enough privacy inside of the unit
- 5 Pleasant internal forms
- 6 Attractive external appearance of the unit, supplying individual characteristic

¹ http://www.denison.edu/enviro/barney/poe_intro.html

Federal District's Vila Tecnológica Project

The national Program – PROTECH, due to political changes in the national government ended in 1994 and many of the demonstrative housing cores – The Vilas Tecnológicas weren't built. The Federal District's² Vila Tecnológica was among those that were planned but weren't constructed.

Although the national programme didn't exist anymore, the idea of the Vila Tecnológica Project remained as an interesting project for the Federal District's Local Government, which decided to build it using its own financial resources.

The Capital was initially conceived as an administrative centre for the central government, and although the main political strategy for changing the capital from Rio de Janeiro was to link the north and the south and to develop the middle of the country, its original plan was conceived mostly as a physical plan (The Pilot Plan)³, and social issues as economical development weren't contemplated.

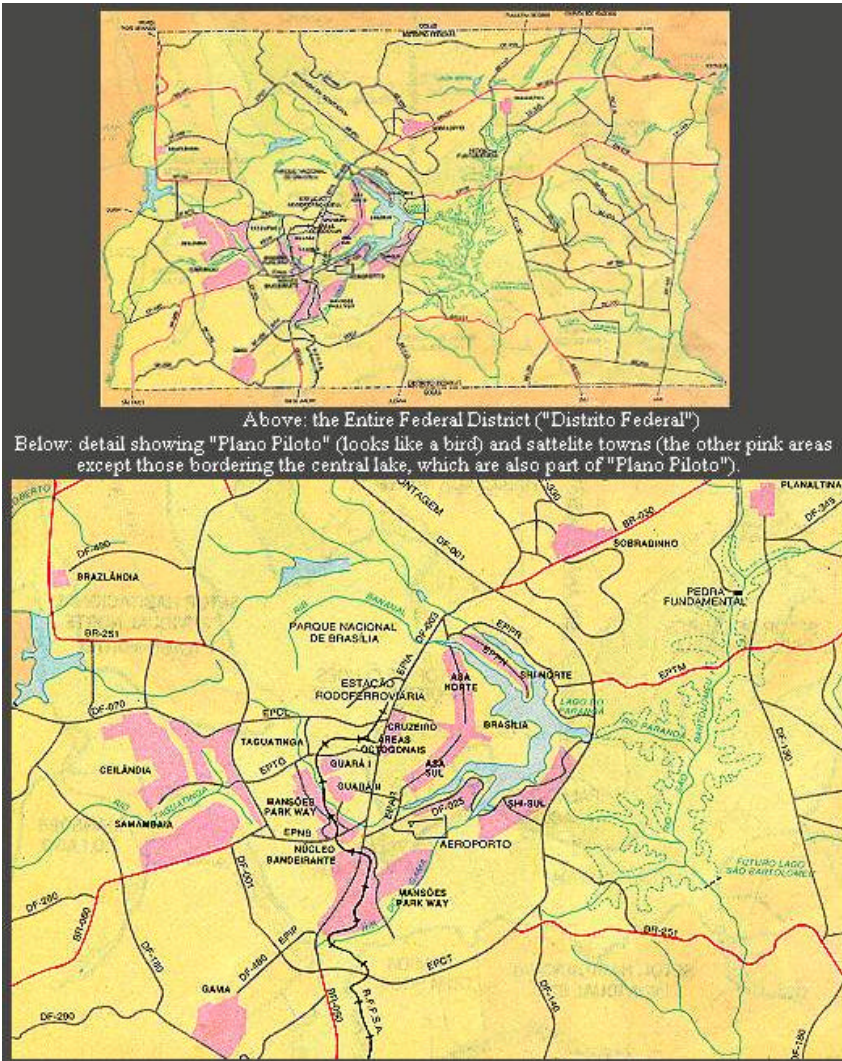


Figure 1: Maps showing the Federal District, the pilot plan and satellite towns

As housing and urban development are directly linked to the improvement of job opportunities offer and the the private sector plays an important role for the improvement of the housing offer and regional development, the Federal District's current Housing Policy aims to stimulate the partnership with the private sector to implement housing reducing costs and improving its quality in the Federal District.

2 The Federal District is where Brasilia, the capital of the country, is located.

3 Conceived and designed by Lucio Costa and Oscar Niemeyer.

The Federal District's Vila Tecnológica Project is now one of the Projects of the Programa Inovar (Innovate Program), that is being implemented by the Secretaria de Estado de Desenvolvimento Urbano e Habitação – SEDUH (Urban Development and Habitation State Secretariat) inside the the Federal District's Housing Policy.

The main objective of the Innovate Program, is to guarantee a proper space for the research, experimentation, display for the innovative technologies in area of the civil construction, stimulating and spreading innovative processes, methods and technologies for application in housing programs, mainly in low income housing, that would result in qualitative profits, as a better relation of cost and benefits, when compared with the traditional methods.

Beyond the general objective of the Innovate Program, the Vila Tecnológica Project intends to:

- Evaluate the performance of designs, processes and selected products of the technologies and methods, in that it refers to the quality, executive method and final product;
- Verify the adequacy of the technologies in the solution of the question of the housing in the Federal District;
- Display to the public and private agents of the new technologies that could be most appropriate;
- Display the new technologies that achieved the best performance, considering the quality of the unit and costs;
- Indicate the most appropriate technologies to be applied in the implementation of the Housing Policy of the Federal District,

Strategies

The aims of the project are to stimulate the research and the spreading of alternative technologies that might propitiate the improvement of the quality and at the same time, the reduction in the costs of the construction.

By the diffusion of diversified constructive systems and differentiated typologies, with quality, reduction of wastefulness, reduction of the stated periods of execution of the workmanships and the costs, the Vila Tecnológica, as a pilot project should act as a polarizing and irradiator centre of pertinent information to the housing sector. And also act as an experimental field for the improvement the government actions related to the control, monitoring, and follow-up of the building process and adequacy of the houses for the users.

The Project is strategically located in an area between the Pilot Plan (city core) and some of the most important satellite towns, so that a great number of people could easily reach the area to visit it.

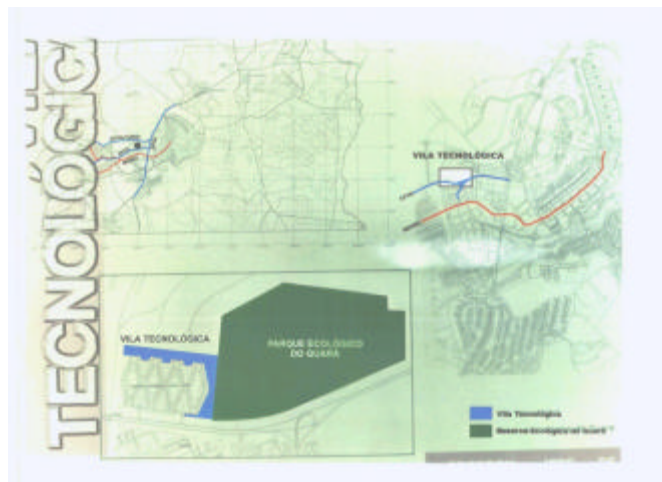


Figure 2: Location of the project

Actions:

- 85 housing units – built by private companies (selected by competition)
- 18 housing units – built by Government Company
- Housing Technologies Centre

For the implementation of the 85 housing units built by private companies there are two different evaluations steps as follow:

1. COMPETITION - Company selection

Fourteen private companies took part on a competition that selected and classified the designs.

According to rules of the competition:

“The technologies will be submitted the evaluations, in the phases of selection by a Special Judge Commission and by a Accompaniment (Follow -up) and Evaluation Commission during the execution of the workmanship and after its occupation. The stated period for the evaluation of the housing will be of 30 (thirty) months, counted from the order of job for the beginning of the workmanship. The technologies proposals will have:

To contemplate the preservation of the environment and the ecological balance;

To be flexible, planning or accepting adaptations and/or extensions in the constructions;

To have proved attributes of minimum durability, good level of higrothermical and acoustic comfort, solutions, prohibitions, security to the fire, resistat to air and the water, inviolability;

To be of easy maintenance

To have qualitative attributes capable to satisfy the necessities and to the values of the community”

It was required of the participants to be enough qualified to be able to participate of the selective process. Professionals and companies of the branch of Engineering, Architecture and of the Industry of the Civil Construction, qualified and that had constructive technology and alternative processes for the population of low income, and, with managerial capacity, for the presentation of proposals.

The proposals presented for the housing unit shouldn't be over R\$ 273.72/m² (around US\$150 /m²)

2. EVALUATION - PERFORMANCE AND POST OCCUPANCY.

Central goal of the evaluation research will be to compare the effect of a program with the goals that it considers reaching in order to:

- Maximize the effectiveness of the programs in the attainment of its ends;
- Maximize the efficiency in the allocation of features for the achievement of the housing programs;
- Provide to the interested parties information in order to magnify the rationality in of decisions taking;
- Provide to the interested parties the possibility of use of new technological alternatives for the construction of dwellings,
- Prevent the replication of errors, feeds in designs, had the ignorance of the facts occurred in environments already in use
- Minimize, or even though to correct, problems detected in the build environment, through the establishment of awareness and maintenance programs;
- Provide appropriate tools so that the involved ones in the housing process can choose the best alternative of execution of the politics.

The project guidelines for the evaluation to be carried on, written by government technicians, were based on the evaluations carried on the previous experiences from the Ribeirão Preto and Curitiba's Vila Tecnológica Projects. The evaluation is divided in two parts: the analysis of the process and product and the post-occupancy evaluation. The evaluation considered the basic requirements for the building components, adequacy of the building system to regional reality and the rationality of the building process and the user's satisfaction among others, which should be analysed using the companies' designs, the data collected during the construction and questionnaires.

Actors

The Local Government

The construction of Brasilia, the new Brazilian capital and the modern movement influence in the 50's had propitiated a great modernization on the building sector during the capital construction.

The change of the capital led to massive construction during the 50's and 60's, and the use of non-specialized workers for that.

The Government Housing Company played an important role in providing housing for all social groups, planning and building the satellite cities where the low income workers were settled.

The Government now faces a new challenge: the economical development. The city initially planned for 500.000 habitants is now a 2 million habitants city and still attracting many immigrants. The government once the responsible for providing most of the work, the urban facilities and housing is now trying to stimulate the development of regional economy.

Private Companies

After the boom generated by the Capital's construction in the 60's, which was build in five years, in the 70's most of the building sector was related to heavy construction – hydroelectric plans, roads and public buildings as bus stations, banks and schools.

During the 80's and early 90's a relative modernization of the construction sector, devoted to the relatively high and middle class, referring to the design quality, building processes and products but no relevant changes in technological innovations and productivity improvements could be observed.

The low-income housing sector is now at the same time a future market to be explored and a challenge, regarding the development of a quality product that would have the necessary marketability and fulfil the user's needs.

Finance Institution: The National Bank – Caixa Econômica Federal

Until the 80's, there was a National Institution, the BNH – Banco Nacional de Habitação (National Bank for Housing), which not only provided the financial resources, but also most of the low income housing projects designs and implementation. After its extinction, another government bank, the Caixa Econômica Federal – CEF, got the responsibility for the housing finance system. The local governments should then be responsible for housing projects, design and implementation, and would get the financial assistance from the National Bank when the local projects would correspond to the national plans proposed by the central government.

As the National programme for the innovative technologies - PROTECH had been extinct, the Federal District's local government got the money from its own sources and although the financial resources weren't provided by CEF for the Federal District's Vila Tecnológica project, it remained quite interesting for both sides to have the CEF involved in the project.

The local government and CEF are now negotiating technical and economical cooperation agreement for the implementation of the evaluation process.

The Users

The families chosen to participate on the project were local government employees registered on the list of the Housing Institute, which agree to participate on the evaluation.

Research Institutions Universities



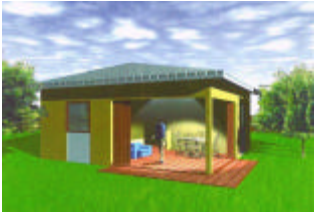



The Cooperation Agreement between CEF and Local Government will contract the Research Institute and/or University to carry on the evaluation process. Although the building site is already being used by local Universities for studies and research.

Design

Description

It was decided by the Special Judging Commission that the first place would build 22 housing units, the second 16 housing units, the third 11 housing units, the fourth 6 housing units, and all the others 3 housing units.

Table 1: Areas, number of bedrooms and walls building systems selected by the competition:

	<p>60,66m²</p> <p>3 bedrooms</p> <p>Concrete panels made <i>in site</i> using steel forms.</p> <p>22units</p>
	<p>48,75m²</p> <p>2 bedrooms</p> <p>Concrete panels using rice rusk for inside insulation</p> <p>16 units</p>
	<p>56,03m²</p> <p>2 bedrooms</p> <p>Isopor and reinforced concrete panels</p> <p>11 units</p>
	<p>55,39m²</p> <p>2 bedrooms</p> <p>Alveolar concrete panels</p> <p>6 units</p>
	<p>55,30m²</p> <p>2 bedrooms</p> <p>Plastic beams made of recycled plastic material</p> <p>3 units</p>
	<p>60m²</p> <p>2 bedrooms</p> <p>Structural concrete blocks made of recycled waste of building material.</p> <p>3 units</p>

	<p>61,43m²</p> <p>3 bedrooms</p> <p>Wooden beam panels</p> <p>3 units</p>
	<p>52m²</p> <p>2 bedrooms</p> <p>Foam concrete jointed blocks</p> <p>3 units</p>
	<p>60m²</p> <p>2 bedrooms</p> <p>Steel structure and brick walls</p> <p>3 units</p>
	<p>42,185m²</p> <p>2 bedrooms</p> <p>Foam concrete blocks</p> <p>3 units</p>
	<p>40,98m²</p> <p>2 bedrooms</p> <p>Foam concrete panels made <i>in site</i></p> <p>3 units</p>
	<p>45,78m²</p> <p>2 bedrooms</p> <p>Foam concrete panels made <i>in site</i></p> <p>3 units</p>
	<p>60,30m²</p> <p>2 bedrooms</p> <p>Structural pre-fabricated concrete panels</p> <p>3 units</p>

Analysis

It has been observed by the Judging Commission that most of the companies did not complete many of the items required in the competition rules and the main item for the decision was the price, which ranged from R\$ 10.000.to R\$ 15.000, around US\$ 5,000 to US\$7,500 by the time of the competition. It can be considered a high price

for a low income housing project, but there must be considered that it is a pilot project, and also that many companies are building a small number of houses. It was also pointed out by the Commission that most of innovations were only observed in the walls components, but the variety of designs and building techniques is not only very interesting for the evaluation tool but also important so that different cases can be compared in the analysis and evaluation.

Despite of that, the effort of the Federal District Local Government should be recognized as the Federal District's Vila Tecnologica project, although it is a local initiative, will be very important to improve the evaluation methodology once developed in the Ribeirão Preto's Vila Tecnologica Project which can be used in for the national improvement of quality regarding to low-income housing.

A certain resistance to the new procedures and even a belief that the evaluation could be carried on only by the Government technicians remained for a certain time inside the Urban Development and Housing State Secretariat. When the companies started to build the houses, the government, due to burocratic inefficiency didn't have the definition of the institution that would carry on the evaluation. It was decided then that all data possible should be collected from the building site: tools, workers, stage, activity, time, so that the basic data about the building process could be collected. There weren't enough technical and human resources, as a local initiative, and despite of that, the basic necessary data has been collected from the building stages.

All the information collected will be given to the Institute/ University contracted to carry on the evaluation process. An agreement between the local government and the National Bank – CEF is being negotiated and has the Ribeirão Preto's Vila Tecnologica Evaluation developed by the ArchTec research group as a reference for the evaluation to be carried on the Federal District Vila Tecnologica Project.



Figure 3: Examples of photos taken during the building process

The project has been very useful to introduce the procedures for collecting and analysing data from the construction process (necessary steps for the evaluation) and also to develop procedures for historical records of the project. The Federal District's Urban Development and Housing Secretariat are also using these procedures to follow-up other projects that have been carried on. The project is so, having a great importance on the creation and/or improvement procedures methods for actions required for:

- Coordinating the implementation of projects,
- The follow-up,
- Analysis and evaluation,
- Feed-back
- Records of the housing projects in the Federal District.

Besides that, there has already been developed academical works using the Federal District Vila Tecnológica as a research object, among them, an Economical Analysis⁴ comparing three of the building technologies used on the housing units.

One of the analysis has pointed out that when comparing the cost variation by the number of units built from two building systems, one using industrialized components (foam concrete joint blocks) and the other the traditional brick house, the industrialized building system cost dramatically goes down when the number of houses is increased, although its initial cost is higher when building a few houses.

The methodology developed by the ArcHtec group, analysed the Technical Performance Requirements combined with the Post Occupancy data, which was subdivided in three major groups:

- *Housing & Urban Facilities*, related to the urban infrastructure and facilities;
- *Design and Product Analysis*, related to the user's Space and function needs, thermal and acoustic comfort, use, maintenance and pathologies of the building systems;
- *Data Management*

The methodology has to be adequate to the purposes of the Federal District's Vila Tecnológica Project and it is recommended that the economical and also a gender analysis should be incorporated to the evaluation, as it has not been analysed in the previous evaluation developed by the ArcHtec research group.

Conclusions and Recommendation

It is clear the importance of establishing the certification and normalization procedures for the building components but also the evaluation considering the building systems, not only the components and considering the users needs as an important tool to the redesign and for the improvement of the build environment quality.

*“The assessment of innovative building technologies for a wider use in low cost housing is not simply a techno-economic evaluation. The social and economic value systems of the target users should be assessed as well. Building officials, professionals and researchers involved in introducing new technologies should be aware of these requirements and therefore, seek ways to integrate them into their trade-off analysis and computations.”*⁵

By this is meant, The Vilas Tecnológicas, the exhibition housing cores, should work as pilot projects where it can be possible for different actors to work together to develop the methodology of evaluation, considering the user's needs, and use it as a tool for the upgrading of productivity levels and quality of future low-income housing projects.

The goal of the evaluation is to create technical and methodological tools, using accessible language, so that the technologies can be decodified and basically understood by users.

Two important vectors should be integrated harmonically so that the first one defines, with absolute clearness, a range of information with the purpose of establishing a technical dialogue between Technology users (inhabitants of housing units) and Technology Producers (Enterprises and/ or Public Departments). The second vector defines the basic lines of Products and Processes development to Technology Producers and Agents related to Housing Policy. The Analysis and Evaluation Project, should, as an aim, sweep a broad range of requirements, exigencies, and patterns related to the technological and architectural behaviour of the housing units which will provide in one hand, subsidies to the Enterprises on redesigning their constructive systems and designs, and on the other hand, provide the basics parameters to the Public Departments on selecting adequate technologies to regional realities.

The Vila Tecnológica, as a pilot project has a great importance but many errors/ mistakes from every step might appear, like failures in the building process or management bureaucratic problems in the government side, but it is important for

4 Souza, Lincon Braga Avaliação Econômica de Tecnologias de Casas Populares na Vila Tecnológica do DF. Universidade de Brasília, 2001. BRASIL.

5 Åstrand, Rachele, Innovative Strategies for Low-income Housing in the Philippines.

future development of the regional building industry and also for the future low-income housing projects by introducing or improving procedures, building a data bank, and the dissemination of innovative building systems for low-income housing. Building demonstration cores so far can be a challenge, but as long as the evaluation process is carried-on together with the project, the methodology can be improved and adequate to the regional reality or the interests involved.

So far, it is very important not to focus on the failures of the specific project, but remind that the most important result of the project is the development of the evaluation tool for the improvement of the future low-income housing projects and also to apply the evaluation to improve the existing building.

Introducing procedures methods for the improvement and continuity of the actions and on the government side regarding quality-housing products is a hard work that faces many obstacles such as the lack of technical and human resources, transparency and/or rationality based decisions among others. Although there are many difficulties to be faced, it was very important the Federal District's Local Government initiative to carry on such a project.

It will be very important from now on to establish links with the central government, by the National Quality Programme on the Habitat, research institutions, such as Universities, NGO's and even International Agencies to make the most of the Federal District's Vila Tecnológica Project's potential to improve the quality and adequacy of the low income housing projects.

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<http://www.seduh.df.gov.br>

Example of table of information collected in the building site, for time used on each step, activity of the building process. The first column shows the building stage, the second one shows the activity and the other columns the time spent, related to the housing unit address

SISTEMA CONSTRUTIVO: Painéis Alveolares pré-fabricados de concreto EMPRESA: Petrus
Tempo de Execução

SUBSISTEMA	Etapa	QE 01 Conj D Casa 04	QE 01 Conj C Casa 04	QE 01 Conj C Casa 08
Fundações	Gabarito	7 dias:	G. 1 dia	G. 1 dia
	Aterro		A. ½ dia,	A. ½ dia
	Compactação		C. ½ dia	C. ½ dia,
	Radier		R. 1 dia,	R. 1 dia,
	Instalações hidrosanitárias		Inst. Hidr. 1 dia.	Inst. Hidr. 1 dia.
Estrutura /Vedações	Vedação Estrutural: Montagem das placas.	1 dia	7 horas	7 horas
Cobertura	Estrutura do telhado:Madeiramento.	3 dias	½ dia	1 ½ dia
	Assentamento de telhas.	1 ½ dia	1 dia	2 dias
Revestimento	Assentamento	2 dias	1 ½ dia	1 ½ dia
	Rejunte	½ dia	3 horas	3 horas
Pisos	Contrapiso	1 dia	1 dia	1 dia
	Assentamento	1 ½ dia	1 dia	1 dia
	Rejunte	½ dia	3 horas	3 horas
Esquadrias	Assentamento das esquadrias metálicas (portas e janelas).	1 dia	½ dia	½ dia
	Dobradiças e fechaduras	1 dia	3 horas	3 horas
	Passagem dos conduites	½ dia	6 horas	6 horas
	Chumbamento das caixas de passagem.	½ dia	3 horas	3 horas
Instalações Elétricas.	As guias para passagem das fiações.	½ dia	4 horas	4 horas
	Colocação das tomadas/interruptores / ponto de luz.	½ dia	2 horas	2 horas
	Espelhos de luz.	1 ½ dia	2 horas	2 horas
	Tubulação	½ dia	4 horas	4 horas
	Caixa d' água	½ dia	4 horas	4 horas
Instalações hidráulicas	Aparelhos e metais.	1 ½ dia	2 horas	2 horas
	Ralos	-----	-----	-----
	Caixas de gordura/esgoto(coletores)	-----	-----	-----
Instalações Sanitárias	Caixas de inspeção (C I)	½ dia	2 horas	4horas
	Tubulações	½ dia	3 ½ hora	3 ½ horas
	Gesso	2 dias	2 dias	2 dias
	Massa corrida	1 dia	7 horas	7 horas
Pinturas internas e teto	Lixa	½ dia	½ dia	½ dia
	Pintura	1 dia	7 horas	7 horas
	Cimento- cola (Rodopás)	1 dia	7 horas	7 horas
	Textura	1 dia	1 dia	1 dia

Pinturas Externas	Pintura	1 dia	½ dia	½ dia
	Limpeza	2 horas	1 hora	1 hora
	Lixa	3 horas	2 horas	2 horas
Pinturas das esquadrias metálicas	Pintura	½ dia	3 horas	3 horas
	Colocação de vidros	½ dia	1 ½ hora	1 ½ dia
	Lixa	1 dia	2 horas	2 horas
	Selador	1 dia	2 horas	2 horas
Pinturas das esquadrias de madeira	Contrapiso	½ dia	½ dia	½ dia
	Cerâmicas	½ dia	½ dia	½ dia