Available online www.jsaer.com

***Journal of Scientific and Engineering Research*, 2019, 6(12):190-195**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

An Analysis of Digital Graphic Data Management of Recife Constructors

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Abstract The data organization of a project is fundamental for a better communication between professionals. Consequently, many offices develop their own methodological procedures for organizing electronic information. Therefore, the Brazilian Association of Architectural Offices (AsBEA) has developed a set of recommendations, based on international standards, to standardize digital documentation. Thus, this paper aims to answer the following question: how the AEC (Architecture, Engineering and Construction) market in Recife is being managed, and more specifically, if the standardization of AsBEA is being used? The research takes as its object the digital graphic information (developed in CAD technology) of the Recife based constructors.

Keywords Data management, design process, graphic representation, architectural design, AsBEA

1. Introduction

The organization of project data is fundamental for better communication between professionals in the area. It is an aspect of the project's nature: the complexity that involves the simultaneous visualization of the constructive elements [7].

In order to organize these ideas, many offices have created their own methodological procedures for organizing electronic information [7]. In this sense, the Brazilian Association of Architecture Offices (AsBEA) has developed a set of rules, based on international standards, including ISO13567, which aim to standardize this digital documentation [12]. These standards are contained in a freely accessible manual available online[1]. Also, according to Ruschel and Bizello (2011) [12], this manual was developed due to the need for sharing between different offices that must meet a standardization performed in CAD systems, besides following a series of compatible and standardized documents and spreadsheets. In addition to this standardization, the manual contains recommendations for changing work processes.

Given the above, the paper takes as research problem the following question: how is the AEC market in Recife managing the digital graphic information of its projects? The research takes as its object of study the digital graphic information (developed in CAD technology) of the builders based in Recife.

When dealing with project information management we can highlight the following works: Giacaglia (2001) [7], Panizza (2004) [11], Ruschel and Bizello (2011) [12] and Andrade (2012) [1]. However, only Panizza (2004) [11] and Andrade (2012) [1] directly investigated information management in offices, either from a specific project as a case study or through didactic issues, while the others studied just the theoretical field. In this sense, the work is justified by the need to investigate, in depth, the digital information management of architectural projects in construction companies in the city of Recife, considering that much of these researchesare developed in the south-southeast axis of Brazil.

The hypothesis is that builders adopt specific work processes based on the AsBEA[1] and ISO 9000/9001 manuals, as information needs to be shared between various partners.

[1]Available in http://www.asbea.org.br/manuais

2. Theoretical Foundation

Computer graphics has changed not only the architectural representation, but also the way of design, going beyond the new possibilities of representation or optimization environments in technical and executive drawings.

Among the several computer graphics systems, Computer Aided Design / Drawing (CADD) is one of the most used in architecture, engineering and construction (AEC) offices, especially after the conception phase [12].

Computer Aided Drawing (CAD) technology was initially applied to software based on Euclidean and Descriptive geometric relations. Also known as geometric CAD, this technology was the one that is best adapted to the market because it is more generic, allowing its use in several project areas [12].

The information generated throughout the project process is the link between the participants (internal and external) and also allows the verification of project goals, proposals and solutions [1]. Efficient information exchange acts directly on the quality of the project in all its phases [9].

The messages, throughout the project process, can occur orally, writing, numerically or graphically in any media and from anyone involved in the project [9]. In this research, we are interested in those of a graphic nature because, according to Andrade (2012), this is the information that, from symbols and codes, enables the communication of an idea. They are used at all stages of the design process and can be made through drawings, models, perspectives, etc.

Throughout the twentieth and twenty-first centuries, computer graphics was developing and today it can be said that it has gone through three main moments: the electronic drawing board, digital construction model and virtual reality. It is important to note that these moments currently coexist.

In the first, computer graphics was restricted to an improvement of traditional designs [5]. Ayres and Scheer (2007) [3] characterize this software as electronic drawing boards, as they are still linked to the graphic relations of hand drawing and are restricted to the optimization of work processes.

In the second moment, et al (2007) [5] associate computer graphics with three-dimensional conversion of constructive parameters and modelling in a digital environment. In the third moment, we have the presence of cyberspace, together with virtual reality techniques, in the design of the projects.

The term CAD can refer to two concepts: computer aided drawing or computer aided design. From a literature review, the term CAAD (Computer Aided Architectural Design) is used for better conceptualization for computer aided design [12].

Given the rapid technological evolution, information management does not seem to have kept pace. Fruet and Formoso (1993) [6], based on research with technical managers of companies, affirm that the diffusion of information is one of the items that needs to be improved in organizations, since the lack of integration and even communication between the involved in a given project, is one of the main causes for rework during the execution of the job.

In addition to the technological evolution, there was an evolution in the representation and information of written documents that complement the graphic part of the project. Documents such as meeting minutes, works, specifications, among others. Due to the large volume of documentation generated during the process, new functions within the architecture and engineering niche have emerged, such as project compatibility.

In this sense, SEBRAE (1995) [13] points out that: compatibility is the activity of managing and integrating related projects, aiming at the perfect fit between them and leading to the attainment of total quality control standards of a given work, who's the aim is to eliminate or minimize conflicts between the projects inherent in a given work, simplifying the execution and optimizing the use of labour materials, as well as the subsequent maintenance [13].

Thus, companies had to recreate their products and processes in order to innovate and ensure quality productivity. One of the important points to be strengthened is the need to create a culture of "collaboration", not only among professionals, but also between professionals and clients.

In this way Information Technology (IT) assists the design process by allowing more and more detailed and complete information, both inside and outside the company, to be accessed and analysed in less time. According to Nascimento and Santos (2003 apud [12], the information must be shared by all agents, and for this purpose,

communication mechanisms with tools for access to the information by the entire team should be used. Therefore, the quality of the information can determine the correctness of the decisions taken.

To this end, information, and especially its use, become valuable resources to be used by professionals (current and future) and, consequently, by companies. [10]

Despite the recognized importance, Guimarães and Amorim (2006) [8] point out that the market still needs to invest in improving organizational practices and information management. However, Ruschel and Bisello (2011) [12] point out that there is already a slow incorporation into the construction industry of manuals, booklets and work processes developed by various entities in the area.

It is from this perspective that this paper will investigate how AEC companies are incorporating work processes related to information management, in order to verify the current challenges, limits and potentialities, as well as to understand in more depth the specificities of Recife market.

3. Methodological Procedures

The present work is a documentary analysis of the graphic records of medium and large construction companies in the city of Recife. These records are the executive projects of multi-family buildings in CAD (Computer Aided Design) platform.

In methodological terms the research is qualitative and hypothetical deductive because it starts from a general idea for a specific object. It uses indirect (collected information), secondary (produced by third parties) and unwritten (graphic nature) documentation. Regarding the methodological procedures, the research is structured through the following steps: 1) analysis of digital graphic documents, produced in 2D CAD system, collected in the investigated construction companies; 2) comparative analysis between digital graphic documents; 3) application of a questionnaire to construction companies to verify how project information management is performed.

As this is an ongoing research, the questionnaires are still being collected. Thus, we will make use of digital graphic documents and their analysis, referring to the initial research steps.

3.1. Data systematization

From the documentary analysis of the AsBEA manual, a synthesis table (Image 1) was prepared, of the elements deemed relevant at this moment of the research, for the analysis of the graphic records obtained from the construction companies.

This document is divided into 03 sections that cover the organization of information and 01 section related to the graphic part, named respectively: 1) Project Directory Nomenclature System; 2) File Naming System; 3) Layer Nomenclature System and 4) Feather Thickness System. For each section, AsBEA presents a table indicating recommended abbreviations (required) and suggested recommendations (not required) fields. For research purposes, only the mandatory ones were analysed.

In the first section, we have as mandatory items: a) agent; b) phase; c) object; d) review. The agent reflects the origin of the information, that is, a specific field of knowledge such as architecture, electrical and structural engineering, among others; the phase determines at what stage of elaboration the project is in; The object refers to the type of documentation that can be a base, detail or image, and finally the revision indicates the number of file changes, that is, the updated version of the project.

In the second section, about file naming, the required items are: a) agent; b) phase; c) projection plan; d) location; e) review. The agent, phase, and revision items follow the same definition as the previous section. The projection plan item refers to the type of graphical representation produced that ranges from an isometry to general detailing. The location indicates the level of the floor represented as the ground floor, mezzanine or some other specific.

The third section, which deals with Layers nomenclature, recommends two mandatory items: a) agent; b) object; c) annotations and graphical representations. The agent and object items have the same characteristics as the previous sections. The annotations and graphic representations category indicate the explanatory items of a project such as general texts, tables, dimensions, among others.

The fourth section dealing with the Feather Thickness System AsBEA suggests colours and thicknesses for two registered software: AutoCAD® and µStation®. Such information should be fed by the designer based on the Brazilian Standard for Architectural Design Representation (NBR-6492).

Section 01 was not covered, as it is a directory nomenclature and for such analysis, we would need to access the servers of the companies analysed in the survey. About section 04, we did not analyse the thicknesses used for each type of representation, as this is not the purpose of the research. In this section we only look at the management of plans formatting and plotting: plotting environment (model or layout) and feather configuration (CTB file or layer configuration).

The graphic material worked in the research so far consists of 08 sets of projects from 05 different builders, totalling 33 documents.

ASBEA TABLE - COMPANY NAME						
			YES	NO	USED NAME	ASBEA SUGGESTION
FILE NAME	PROJECT CODE					
	AGENT (USER)					
	PHASE					
	OBJECT					
	QUALIFICATIVE					
	REVIEW NUMBER					
LAYERS	ARCHITECTURAL SURVEY	AGENTE				
		OBJECT				
		NOTES / GRAPHIC REPRESENTATIONS				
	ARCHITECTURE	AGENTE				
		OBJECT				
		NOTES / GRAPHIC REPRESENTATIONS				
	LANDSCAPE	AGENTE				
		OBJECT				
		NOTES / GRAPHIC REPRESENTATIONS				
	STRUCTURE AND FOUNDATION	AGENTE				
		OBJECT				
		NOTES / GRAPHIC REPRESENTATIONS				
	ELECTRICAL	AGENTE				
		OBJECT				
		NOTES / GRAPHIC REPRESENTATIONS				
	HYDRAULIC	AGENTE				
		OBJECT				
		NOTES / GRAPHIC REPRESENTATIONS				
	AIR CONDITIONING	AGENTE				
		OBJECT				
		NOTES / GRAPHIC REPRESENTATIONS				
PLOTING	TAB	MODEL			LAYOUT	
	THICKNESS SETTING	CTB			MONOCHROME	

Image 1: Information Management Analysis Items

4. Analysis and Discussion

Given the data collected (Table 1), referring to the first section (file naming), AsBEA recommends that it has at least 06 items in the following order: PROJECT CODE - AGENT - PHASE - OBJECT - QUALIFICATIVE - REVIEW.

Considering that of the 33 documents, none has the nomenclature according to the AsBEA recommendation, we can say that the projects analysed have an organizational logic, but it is restricted to the company. From the 06 suggested items to compose the nomenclature, no file indicates object and qualifier. Already the items agent and phase appear, respectively, with 6% and 15% in agreement with the AsBEA manual. At the same time, the project code and revision items appear with a significant 42% each, which indicates a proximity to AsBEA's information management model. Although it is not possible to indicate the reason for this fact, we may argue that it is because these nomenclatures refer to the most current version of the project as well as the customer identification.

Regarding the organization of information within the file, more specifically referring to the second section (layers), we analyse the following fields recommended by AsBEA: 1) agent; 2) object and 3) annotations and graphic representations.

Given the 441 layers raised (Table 2), we find that for the most part, each company already has and uses its own pattern of layer organization. Some closely resemble the booklet's recommendations, but do not follow in their entirety.

Table 1: Survey: File Naming Items

Items	AsBEA standard		Non-compliance	
	Nº DOCS	%	Nº DOCS	%
PROJECT CODE	14	42	33	58
AGENT	02	6	31	94
PHASE	05	15	28	85
OBJECT	00	0	33	100
QUALIFICATIVE	00	0	33	100
REVIEW	14	42	19	58

Table 2: Survey: layer nomenclature

Items	AsBEA standard		Non-compliance	
	Nº DOCs	%	Nº DOCs	%
AGENT	11	2%	430	98%
OBJECT	26	6%	415	94%
ANNOTATIONS AND GRAPHIC REPRESENTATIONS	16	4%	425	96%

Table 3: Survey: Plot Environment

TAB	MODEL	LAYOUT
	20	13
PLOT CONFIGURATION	**CTB**	**LAYER**
	19	14

Regarding the plotting environment (Table 3), we verify if the project board is elaborated in the model or layout environment and how the builders or third parties distribute the plotting information, that is if it is already configured in the layer itself or if CTB[2] files are used.

We can see that there is a disparity between plotting environments, with the model being the preference of most users. And as for the thickness of feathers and line colours, most use the CTB format. Further study of these preferences is necessary since the layout environment (paper space) is more advantageous as it allows the insertion of several scales on a single board.

5. Final Considerations

Given the analysis, we realize that the builders and outsourced offices seek the standard of information, but do not take into account all suggestions from the AsBEA primer. The PE construction company is the one that most resembles such a pattern yet adopts in some elements its own nomenclatures.

Regarding the nomenclature of the Archives, we realize that the items “project code” and “revision” are the most used and we believe that this reflects more a need than an information organization. This inference is due to the fact that both items are used to classify who is the client and what is the final version of the project.

As for the drawing layers, we realize that each company adopts specific acronyms that refer to the AsBEA standard but does not include it in its entirety. Of the items suggested by the booklet, the object element was the most contemplated and the agent the least referenced. This condition does not favour the exchange of

[2]The CTB file in AutoCAD is a file that contains the line thickness and colour settings to be printed in a project.

information, as several agents' work in the same file and this identity is important for reading and understanding the project information.

About the plotting environment, we have only initial considerations as the research is still ongoing. The surveyed items indicate that the model environment is more used than the layout and about the colour and line thickness information, it is more distributed through standard CTB file.

Although AsBEA is still a suggestion, we emphasize here its importance for the interchangeability of project archives because, in obeying its indications, the document has, besides the graphic information, the project management information and agents involved in it.

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