
INFORMATION SYSTEM FOR DYNAMIC UPDATING OF THE PLANNING WORK

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ABSTRACT

From the needed of a planning and a effective control for the successful execution in constructions site of enterprises, this paper presents a proposed of a information system for dynamic updating of the planning work. This system intends to provides the sound development of the routine activities in civil construction companies. Considering the problem of education differences between the workers in the construction site and also the informality of the trainings, communication must be not only organized and structured, but, also, affordable. Therefore, a communication scheme is needed between the office and the construction site staffs, in order to make information available and let it be exchanged in an accurate way by the teams involved in the enterprise. This will allow to make decisions and define processes in proper timing. Nowadays, this task is accomplished manually, causing information to be always lagged regarding the situation of the work, due to the time required to acquire and process information. Using currently available technologies in order to obtain a user-friendly, interactive control panel in the construction site to transmit information with dynamic update, a use of a panel with multi touch screen technology was proposed, which allows to access information easily, by touching the panel with the fingers. In order to adopt this technology, the proposal defines the tree structure of an information system for management and control of construction site information, including the documentation of projects, teams and workers data, schedules, updates and related information. The system yet aims to enable the technique of the balance line - a graphic technique that links space and time to organize tasks - using information technology. This will promote an easier interaction between the user of the system on the construction site and the users in the planning and management office. So, this paper proposes the development of an information system capable of dynamic updating of the planning considering what just happened on the construction site.

Keywords: planning work; information system; line balance, communication, multi touch screen; panel; technology.

1. INTRODUCTION

At companies and organizations from civil construction sector - builders, developers, project offices - there are a lot of activities which are developed at the same time such as projects, design, planning and design compatibilization. Each of those activities depend of different and skilled staff. An initial planning is necessary to organize the staffs and the activities, as well as to control them. This control is intend to monitor the work of the teams, such as what changes are needed to be made and the failure to complete tasks, both for internal activities in the office and in the construction site. This will be achieved through appropriate software to organize the schedule, work scope, documents and project planning. Activities control involves the planning and management office and the construction site where needs the information available to users timely to be used. The purpose of this article aims to meet the expectations of the construction industry about the information exchange.

2. OVERVIEW

2.1.Planning and control - how the process occurs (manually)

The problem is from strategic level to operational level. There is a large space to be filled between planning and control work because the companies still need a person to only capture the information about the work at the construction site, in other words, update information panels about replanning and capture data from panels - where workers responsible for the activities disclose their status. These operations are done manually, despite the allocation of office work (containers) on the construction site to facilitate communication.

At civil construction sector, the major products – of companies that do designs and manages work on the constructions site – depend of computer systems used to administrative activities, designs and communication activities such as spreadsheets, word processors, databases, CAD software, planning and managing software, and other. However, design stages have high level of automation while the work is almost handmade in the constructions stages, even when it exists a lot of information systems that manage all the information generated to civil construction (Nascimento; Santos, 2003).

Currently, the capture of information on the construction site depends of the availability from the responsible person – that can be located in the office work (container) or can be in the projects and/or management office – who will follow up the work activities progress regularly. In any case, the information will always be caught up in the current situation, because the time used to capture information, process them and pass them to the office responsible for replanning, and include them in the lineup is enough to construction site be in another work situation. This update can take days, even with the help of planning and control systems that link the office and the construction site through mobile devices.

2.2.Learning and understanding of users

While the training of designers and planners – architects, engineers and technicals – has a lot of parts to promote their qualification – such as technical and college courses, the training of others involved in the production process activities – workers in charge of the building construction – is superficial or nonexistent. Both – planners and workers – are considered users of the systems and technology for works management, but as there different educations levels, this difference should be considered in choosing the communication form.

In most cases, the process of learning by employees occurs informally on the construction site to acquire technical knowledge in order to develop construction activities, where a worker teach another so precarious and in an unsystematic way. This type of learning is not the most appropriate training way, especially when there is a need for specifically training prior to new techniques in construction processes (Cattani, 2003). However, a readjustment of training demand a cultural change and a long-term project to change an entire learning process that is already realized in a long time – what could be studied in other research. Because of this, there is a need to implant a user-friendly system available to all users – the most economic and practical way to organizations and workers.

The difficulties of workers that participate of trainings are about access to equipments and not about the content and learning (Cattani, 2003). From that, when using user-friendly equipment and system, there is a interest from the workers to exchange information. It is important that there is facility in the use of the equipment as for learning and assimilation of information in order to generate knowledge.

3. JUSTIFICATION

3.1.Relevance of communication and information transfer

The communication and how it is done determine a project and enterprise course. Communication is exchange of several kind of data, such as: verbal information (which can occur by telephones or personally) and documents exchanges (with the use of data that constitute this information).

Setzer (1999) define “data” and characterize “information”, “knowledge” and “competence” – definitions which are part of communication – to show the difference between those terms. Data is a sequence of symbols quantified or quantifiable, such a text – legible or not – where letters are quantifiable symbols, pictures, sounds or animations. These are syntactic mathematical entities and can be fully described through a formal representation. Each other can be linked, stored and processed by a computer. Information is a informal abstraction and can not be formalized by logical or mathematical theory because represents something significant, such as a phrase that means something to someone. Information can not be processed and to do this it is necessary to reduced it to data, so the information representation – as data – can be stored in machines, because data is purely syntactic and information has semantic, which is impossible to introduce in a computer, contrary to misleading term such as “programming language”, “memory” and “artificial intelligence”, since without semantics, computers do not think. As an example to understand the difference between information and data, a schedule table can be used: if the table contents is a known language, it is information; but if it is an unknown language, it is data (Setzer, 1999).

A project which contains data and information to be disseminated to those interested or involved in the enterprise must be accessible to all of them. The execution of tasks and the accurately processing of information flow accurately are essentials, being a critical factor among all the processes in the construction industry for the success of the enterprise/project. The integrity of transmitted information is relevant to make decisions and to process the execution – or not – of each case. Those decisions are important to prevent damage and rework by decisions of hasty or by lack of necessary proper communication, what can cause diseases in construction, delays in deadlines, low productivity, low quality and increased costs (Nascimento; Santos, 2003).

Currently, information technology is used to manage enterprises (Nascimento; Santos, 2003), and the technology knowledge and the communication must be available and accessible to all technology users, regardless of users education and qualification. Data and information exchanges by the users communication needs an easy technique for be available for users, independent of knowledgement and competence.

4. CONCEPTS

Using the technology that is currently available, the manual process usually realized of collection and transfer of information can be facilitated and optimized with resources and equipment to improve the activities. There are a lot of tools and resources used to develop of projects. This kind of technology is focused in the constant update of project – simultaneous engineering – after the completion of projects, the work is coordinated and controlled manually – like presented previously. Although there are systems developed for work control, they are made to specific use by competent professionals and with previously knowledge – such as a mobile devices and other resources that require specific training or practice – not being possible to be used by any person intuitively as proposed by this paper (below). With the currently available resources, the need of intermediaries to send information from construction site to the office and from the office to construction site becomes necessary. While panels are already used in construction sites, there is not a quickly way to exchange information because the transfer still occurs manually. The interactive control panel can resolve the time lag problem – linked to the construction site and to the office with an interactive touch panel.

4.1.Line of Balance

Line of balance is a graphical technique with simple application. By its linearity in the tasks development – repetition of procedures during the work - can be viewed on a space-time graph that show the unit and when the task will be executed at this unit. This graph supports and improves the productivity and quality of construction site, and indicates the activities sequence by repeating units of work (residences, floors, apartments, road kilometers, etc.). Lines are balanced by the elimination of activities conflicts by change of activity origin or by altering the team(s) rhythm (Junqueira, 2006).

The techniques used for programming, planning and implementation of project are, usually, networking techniques including critical path method and others, which are basis for many computer programs for project management. Due to lack of information about the real durations – in this methods – the plans may not be very detailed throughout the work, because the programming is done to deadlines and to availability of resources, where a construction simulation is made to request materials, which usually does not match the real work situation on construction site, questioning the credibility of the control system. Mendes Jr. and Heineck (1998) proposed the use of Line of Balance technique as a way of programming and production control in the works, taking the advantage of continuity in the teams works and the easy visualization and understanding. In the Line of Balance method there is no buffers inserted in the programming, which is done continuously, where teams are never idle – what happens in the critical path method – avoiding waste.

The Line of Balance technique is appropriated for use in constructions with repetitive tasks, such as multi-floor buildings or housing. These kind of constructions involves many repetitive tasks, setting up repetitive or linear construction projects. These constructions are made of units, where each unit consists of several sequential processes that will form a constructive unit (Mendes Jr., 2001). The Line of Balance technique uses production curves (or line flows) that show the duration of activities, where the slope of the curve shows the rate of production activities (constructions units per unit time or time units per productions unit). The processes planning and control aim to maintain the productions rate rope to complete activities in the determinate time, balanced equipments and teams – to reduce cost of repetitive construction units (Mendes Jr., 2001). The Line of Balance identifies all major components needed for work programming and control by answering the questions “what?”, “who?”, “where?”, “when?” to obtain the information about what activity should be executed, which team will be responsible for the service (it can be marked inside of each bar), where the service will be done (in which unit, floor, residence, etc. – represented by the vertical axis of graphic), on what date or time period (represented by the horizontal axis of graphics) (Junqueira, 2006).

4.2. Multi touch screen technology

The multi touch screen technology provides screens to panels, computers and other media that allows the user to interact with the equipment through the fingers touch in a screen, without use of the mouse or the pen. The movement of the fingers send commands to the system by the use of the device. This technology works on the screen using a software that recognizes the multiple touch points through the user hands (Han, 2005).



Figure 1: Examples of multi-touch interaction (Han, 2005)

5. INFORMATION SYSTEM PROPOSED

Based on the need for a continuous and uninterrupted information flow for the exchange of data, part of the purpose of this paper was maintain an integrated system that would links the information for planning and replanning dynamically, which could make the integration between the office and the construction site without intermediaries in order to collect data in the work to transfer it to the office responsible for updating the planning. Information should be available for everyone through tools that manage shared data using information technology that, according to Nascimento and Santos (2003) are the technologies used to capture, store, process and distribute information electronically. In order that information could be managed dynamically between planning and control, appropriated technology was necessary. It was proposed the use of panels for the control of production

that would be available on the construction site of the work with the aim of information exchange between the teams that executed the tasks and the control office directly – without intermediaries and without adding time to transmit the real situation of the work, and without causing constant lag. The programming control is done by graphics showing the scheduled compared with the real. The panel will bring all necessary information according to the activity, team, and what is necessary to pass information to each team and, more precisely, for each member, if necessary, through the touch screen technology – which can be used for more than one person at the same time and interacts with users easily. Touch screen panel just need the finger touch to use – dispensing any other objects or dispositive such as mouse. The graphic part of programming control use Line of Balance – an easy visual system that do not requires high education level to understand. To access the panel, the organization can choose between options to access security such as fingerprint recognition by panel screen or name and password and the panel system can be also used to control the entrance and the exit of workers. This occur because it is linked with office computers through internet connection. This information will be presented on panel by an interface – that could be developed in a next step of this study – to all involved in projects (office or construction site users). This information can be individualized, per team or per work, with information about executed activities and provided activities and documents about the work with control access. The system information is not Building Information Modeling (BIM), but it can accept this kind of documentation of projects in it data base.

5.1.Information system structure (concept)

The homepage of the system, which may contain the organizations information, will provide access to a list of works (construction site) - that will access both works already carried out for works in progress - accessing information of each work individually. In the work description, it will have information such as address, involved organizations, documentation, etc, where all the information have a controlled access. The activities are available and monitorated weekly by a specific schedule about each part and subparts of the work and its activities by the system, where there is also a description of activities with orientations and guidelines to execution – how to do them. The teams are organized per activities, in a schedule with summary of activities carried out in each part or subpart of the work, that will be updated for registration of the executed services until the present date. The system include the teams description, list of professionals and workers, and other information about the work teams, individual information about situation of workers – human resources - and about trainee. These data are centralized in a database in control office. The proposed system will have also a constantly updated schedule of work, the enterprise design, the control of the working hours from the workers by the access identification, other information such as work safety, events, tips and congratulations to employees and other business incentives to keep the staff motivated. The system structure is shown below (Figure 2).

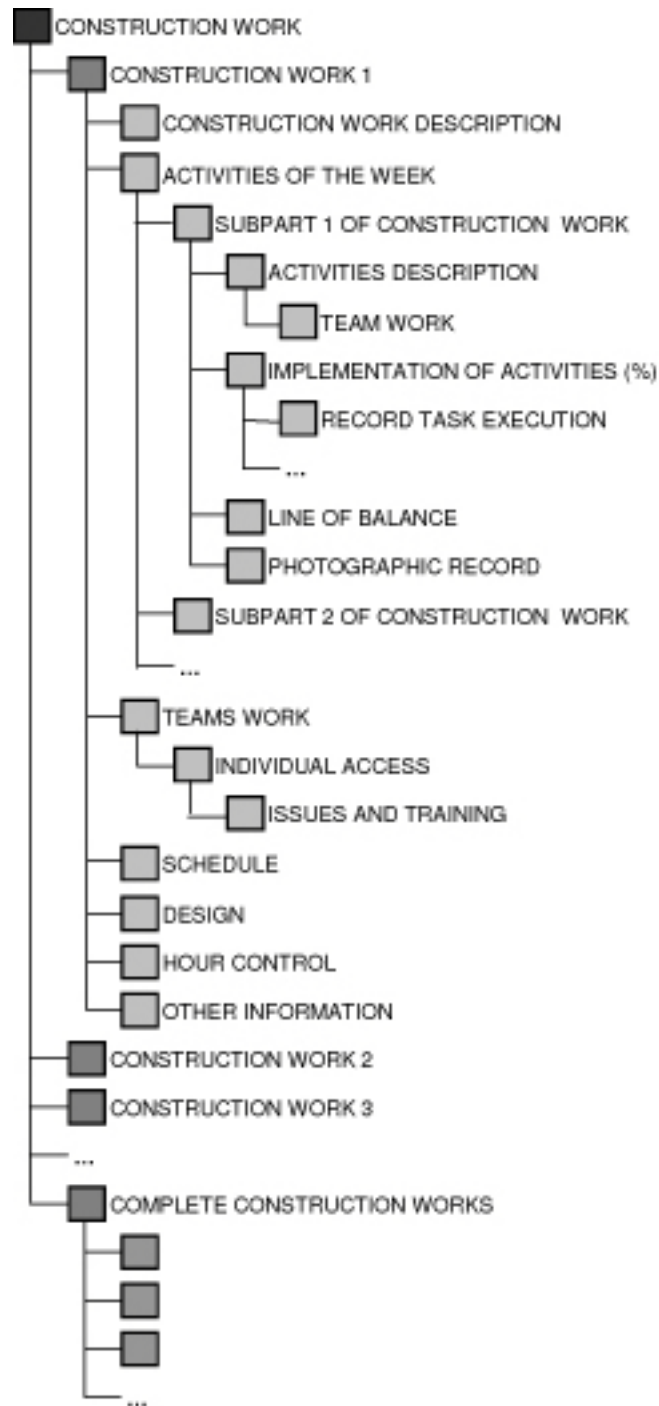


Figure 2: System structure

6. FINAL CONSIDERATIONS

The civil construction sector needs to update resources in information technology to manage their enterprises – the very outdated sector compared to other sectors.

Despite being one of the more traditional sectors of Brazilian and worldwide industry, is one of the least developed. Companies are adopting new technologies and using them even as a competitive factor, but, in most of cases, the technologies are only attached after consolidated. One of the factors that can prevent the adaptation of people to new technology is that many workers have few education and are unprepared if compared with other sectors, falling to reach the efficiency, quality and productivity level of other industry sectors (Nascimento; Santos, 2003).

Information should be available to everyone through tools to manage shared data. In order that the information can be managed dynamically between planning and control, it is necessary the use of suitable technology, such as the use of panels with a information system - proposed in this paper - for the production control, that may be available on the construction site of the work to exchange information between the team that perform the tasks and the manager office.

Get an integrated information system that links the information for planning and replanning dynamically was the proposed of this work and, from this information, a research was done to obtain the need to develop the system linked the panel and the office computers. This need was analyzed and check in direct contact with planners and executors of works.

7. FUTURE WORKS

Future work to be continuing this study, in the order described: study for development of the interface of the proposed system through research and analysis of the graphic needs of organizations and businesses; development of a prototype of system in a multi-touch screens panel with developed interface.

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