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"CLAIM IT " – EFFECTIVE DEFECT MANAGEMENT SOLUTION DURING CONSTRUCTION

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Abstract

This paper addresses the issue of defect management in building construction and efficient removal of defects, backlogs and client changes to the project.
Introductory part of the paper opens to the reader the issue of Defect Management in construction, which includes the basic characteristics of defects in building construction. A separate part is dedicated to the problem of backlogs and claims.
The aim of this paper is to present the proposed solution in the form of software named ''*Claim it!*'' which is formed by a combination of mobile software application for smartphones and a web application that is accessible from a computer. The user therefore has the possibility to record defects and backlogs to the actual plan at the construction site while further processing can be done later from the office. This paper also includes a chapter devoted to the system's methodology, including a record of independent events and communication scheme between the investor and contractor in defect removal, backlogs and claim management.
The main contribution of this paper is to present the software ''*Claim it!*'' as a comprehensive and effective tool in Defect Management for building construction.

Keywords

backlog; claim; construction; Defect Management; Lean Management

Nomenclature

LM – Lean management

PC – Personal computer

SW – Software

IT – Information technology

Introduction – Current situation

Trends and recent development

After a relatively long period of economic recession, during which the Czech construction market has experienced decline and stagnation, the current trend has moved towards stabilization and even moderate growth (3.4%). Minor improvement is expected in the upcoming construction season (+ 2.7%).

Improvement of the situation promises to increase the number and also the volume of launched tenders for construction contracts within the public sector in particular. The planned investment volume compared to the same period last year increased by more than 50 %. There has also been an increase in the volume of contracts assigned to individual builders for implementation. This fact has lead to the investment rise by 35 % more than when compared to the volume in previous years.

With the sudden production boost in construction, there has also been noticeable increase in the capacity utilization of construction companies which are currently moving to their highest value since the crisis began - 88 %. In particular, companies engaged in railway constructions, which have been reducing their capacity in recent years are now beginning to feel the lack of internal capacity and are therefore more likely to fully or partly contract work from external suppliers.

Currently, railway construction has far greater potential than road construction. This is mainly due to the less intensive investment preparation needed. Having said that, it is mainly the investment preparation in road construction that is currently lagging behind the most. For this reason, it is necessary to assume difficult fulfilment of investment plans in the next few years to come. [1]

IT in construction

As in many other industries, also information technologies represent a significant role in the construction industry. However, compared with other sectors, the construction industry is for computer and information technology very specific.

This is probably mainly due to the following anomalies:

- A significant number of seasonal workers.
- Projects are almost invariably carried out in the field, outside the factory.
- Overall computer literacy is due to a significant number of workers lower than in other sectors.
- Specific requirements for computing equipment used in the field / on construction sites - equipment must be durable and of sturdy construction.
- Often improper computing equipment for work on site.
- Unwillingness and distrust of middle-aged and elderly to learn new tools and methods.
- The construction almost always lacks the background with a good Internet connection, a quality telephone signal and accessible place for power equipment.
- Short battery life in portable computing devices (in particular, notebook, smartphone and tablet).
- Low quality level of created applications that are being prescribed by companies to be used.
- Lack of systematic in the introduction of new software and methodologies - due to previous negative experiences with software and methodologies are all the new gateways seen as a "necessary evil" and hence automatically dismissed without trial, regardless the quality and efficiency of processing tools.

- IT systems in construction companies are not taken as tools to facilitate and streamline the work. There is an opinion: "We build", "The main thing is to build", "We are a building company, not an IT company".
- Due to the complexity of building production, the vast quantity of products, suppliers and customers, each project is unique and includes a large amount of data.

The above and other anomalies cause the construction industry to have fallen behind other sectors, especially with regards to the use of information technologies. This further hinders the development and application of innovative technologies, methods, tools, materials and machinery. Widening gaps in IT across sectors then reduces project collaboration across multiple industry sectors.

As a result, the situation described above has a significant potential for the development of information technologies in construction. At the same time it is a challenge for professionals possessing not only the IT knowledge but also have a serious know-how in the construction field.

Lean management (LM)

Especially due to the onset of economic recession that has fully penetrated the Czech construction industry by 2009, numerous construction companies started to think about the efficiency and slimness of their production. Due to the decreasing number of construction contracts and the declining volume of construction outputs, many companies were forced to apply various austerity measures such as common dismissals and other activities in order to contend with the unfavourable situation in the market. However, this situation had also called upon a new search for innovative tools and methods in order to save company's expenses. This problem has been partly solved by so called Lean Management as a utility.

Lean management or Lean manufacturing comes from the English word "Lean", meaning slim, lies in the analysis of production and non-production processes of the company for the purpose of identifying activities that have significant reserves. By using the so-called "Lean" tools one can modify the unproductive activities for greater efficiency, possibly even discharge them completely and replace them with new, more efficient operations. The outcome is called "Lean Manufacturing", which eliminates wastage. [2]

Diagram below depicts a project demands on resources by comparing project driven in a standard way (blue, left) and project managed by the right combination of Lean management methods (green).

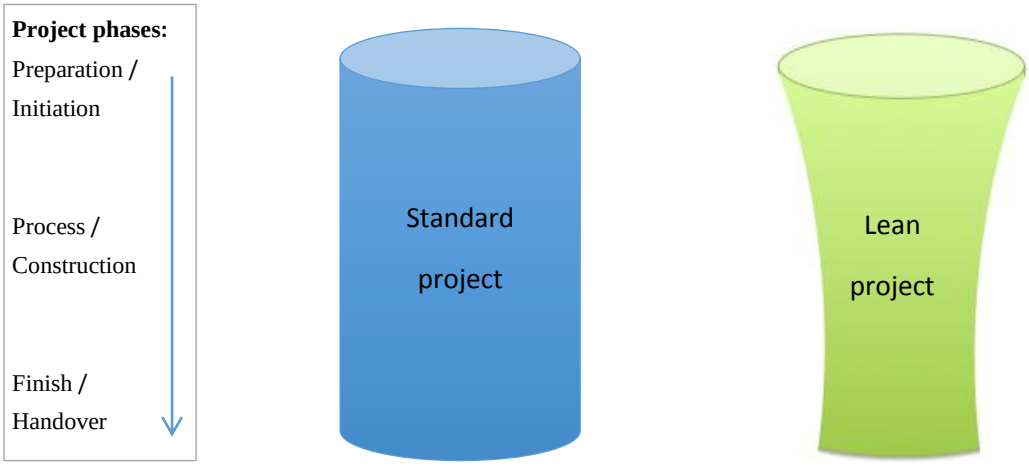


Figure 1: Project demands on resources [3]

As it can be seen from the graphical diagram above, managing a project through the mix of Lean management methods in the initial phase is as resource-intensive as the standard project. However, shortly after the project source intensity decreases significantly. The assumption for such development is the right choice of professional solutions and methods that are being applied in practice by great number of employees while being accepted by sub-contractors and above all common sense and logic wins over inefficient processes.

It is therefore incorrect idea to use each tool or method blindly to all projects. Construction projects are as unique as humans, so also the combination of used tools can always be different.

LM is not just a set of Lean tools; it is mainly the approach / methodology for the production which aims to minimize downtime, losses, costs for maintaining the high quality and maximization of customer satisfaction. This is not a new methodology, as it might seem. The basic principles are based on the logic reasoning that has been applied in various periods and companies throughout the past up to the presence. The very basics of the LM are attributed to the founders of Toyota, which probably first formulated the relevant methodology and tools. Toyota has long been a role model for other carmakers. Today, this approach has spread across industries and is no longer the prerogative only for the machinery industry.

Philosophy and methodology of LM offers the opportunity to use a number of tools and techniques. LM Software tools can be divided into two basic categories as described below:

- **Current / conventional tools**
  - E.g. MS Excel, MS Power Point
- **Advanced / Special tools**
  - E.g. *Claim it*! [4]

While the current / conventional LM software tools such as MS Excel Spread sheet is easily accessible to an ordinary user with own license and ability to use it well, the availability of advanced LM software is much more complicated for the end user. However, both two software categories have their place in the market, are indispensable to each other and equally present a number of advantages and disadvantages. It is our assumption that for a consumer to use the conventional instrument to a Lean business model, it ought to be possible for the required tool to be created by the use of simple functions.

Table 1: Comparison of software tools Lean Management

Conventional SW tools		***Special SW tools***	
Advantages +	*Disadvantages -*	*Advantages +*	*Disadvantages -*
• Easily available • In the subconscious of a user • Many localizations and language versions • Versatility and variability of tools • No need to buy another licence	• Not specialised for the certain activity • For special activities often required plugin • Often requires a programmer to program applications • No user guide or customer service available for special activities • Company must be familiar with the methodology to create, adapt tools • Difficult updates • Difficult integration with mobile applications	• Specialized functional tool • No need for additional plug-ins • Application is already fully programmed - no need for a programmer • User guide, customer service • Simple and inexpensive update • Easy and automatic connection to mobile devices	• Poor accessibility to users • It is not automatically in the subconscious of customers - necessary to use marketing and education • Relatively dedicated tool • Requires license purchase

Obstacles to Lean management (LM) in practice

As in the case of any innovation, also the introduction or retention of Lean management in the construction business has its own obstacles and opponents, which also partly result from the current situation of IT in construction (see "Current situation", subsection "IT in Construction"). Another source of barriers to implementation and use of new methods and tools are generally rather negative attitude of workers within the construction industry when introducing new methods.

The list below illustrates some of the main obstacles for implementation and maintenance of LM:

- Unprofessionally developed, underdeveloped, untested LM IT tools
- Improperly used Lean methodologies
- Missing effective LM IT tools
- Lean methodologies are not sufficiently adjusted and fit for corporate use
- Insufficient number of staff dealing directly with LM or staff training
- Inadequate training of all employees in a company
- Incorrect interpretation of the basic LM ideas and its related methods
- Lack of internal support and emphasis on LM from senior management, internal company regulations and directives
- Large Group companies are to some extent tied to a single corporate policy of a parent company. Official implementation of custom or self-initiated IT tools is significantly more complicated.

To conclude this chapter it is important to say that development of a professional software solution *Claim it!* falls into the category of advanced / special software tools, and delivers all the above advantages and connection to the Web portal.

Claim it! – Defect Management System Solution

Software application *Claim it!* represents the backbone of an integrated system solution Defect management within construction sites. The system is a combination of mobile applications for smartphones, a web portal accessible from a PC, and a common database application that connects applications to one another. The efficiency of the system operation is supported by the possibility of recording and managing the event (defect, backlog, changes) directly on site while data are being recorded to a database and shared with the web portal application. This solution provides the user with the option of working on the project comfortably from the office or home.

The application can be used both during the construction phase as well as at the stage of part / complete project handover.

Figure 2: Communication scheme interface [3]; [5]

The Main Application Modules

The main part of the application is formed by module for recording events, which includes the establishment of the project including the necessary components (floors) and sections. An essential feature is the ability to record events directly to the image map, which was imported into the application by the user during the project initiation phase.

Another main module is "Addressing the event," through which communication takes place between the investor and the contractor. This section works with the already established projects and events in the form of defect backlog and client changes. The main advantage of using this module is its speed and quality of the submitted detailed description to the supplier with the aim of an early and flawless solution to the related event. This system ensures maximum efficiency of the newly created solution Defect management. Each event passes over the solutions of certain combinations of the following statuses:

- *New*
- *Being solved*
- *To be checked*
- *Closed*
- *Rejected !*
- *To be reprocessed !*
- *Required again !*
- *Irremovable !!*
- *Closed after deadline !!*

I – Investor (user that identifies the event)
C – Contactor (user that solves the even/ eg. removes the defect)
S – event status

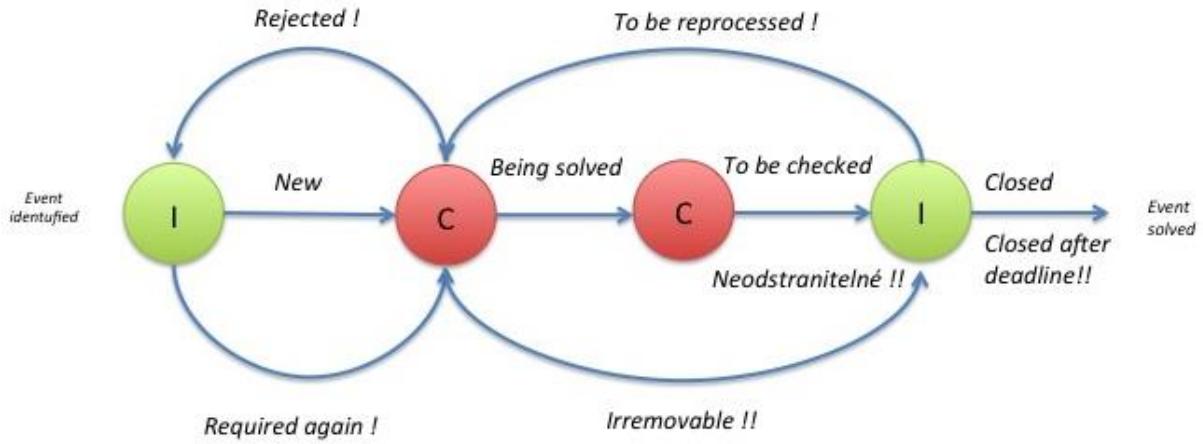


Figure 3: Events Solutions System [3]

Custom Work with Application

Custom Application is very easy and intuitive. Colours and fonts were chosen to design the application in a way that is attractive and dynamic. Yet it was necessary to preserve readability and clarity. The combination of grey, white and yellow colours was chosen as the ideal solution (Fig. 4).

After launching the application, the user is displayed with a login screen (Fig. 5). For security and authentication reasons it is required to enter the user name and password. After entering the correct combination of username and password the application loads the user's profile and displays the main menu of the application (Fig. 6).

Figure 4: Application loading [6];

Figure 5: Login page of the application [6]

Project Establishment and specification

After loading the personal profile, the user finds himself / herself in the main menu (Fig. 6), where he / she being offered input into two main application modules:

1 / Projects - creation, work with them, recording events (faults, unfinished and out claims)

2 / Event solutions - solutions in the project already recorded defects communication with the supplier

By selecting the module "Projects" a list of user-based projects will be displayed (Fig. 7) with the option to filter and sort according to selected criteria. Only with few exceptions, yellow button with the symbol "+" appears on every screen of the application. This symbol represents a function for adding a new element to the list. Following the current position / screen in the application, the user establishes a "new project", "new floor", "new section" or "new event". As it has been already mentioned earlier, by an event is meant defect, backlog or a claim (client change).

After creating a project and completion of detailed information including the address, investor's name and possibility of inserting a photo, the user can create individual sections (e.g. Floor) within the project. The situation is presented in Fig. 8. In the same way in which the user creates a new project can also create new components or units within the actual project. For each part (floor) it is possible can record video in the form of e.g. floor plan, which will be used to set up and determine the exact location of event solutions.

Figure 6: Main menu [6]

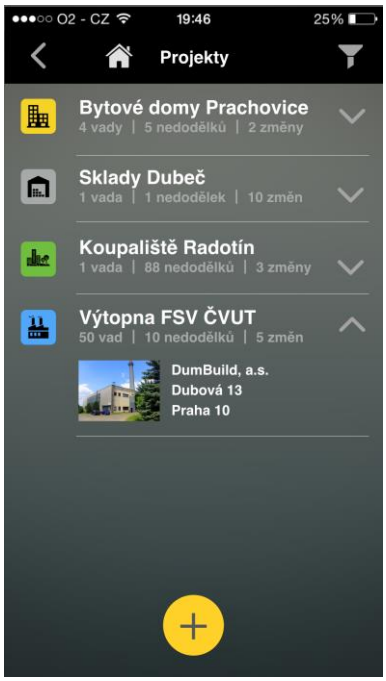


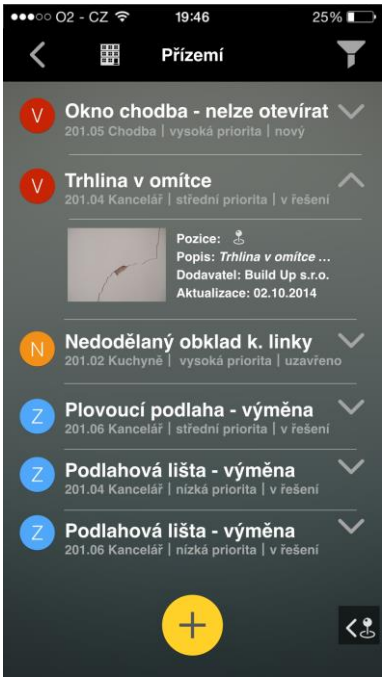
Figure 7: Projects overview [6]

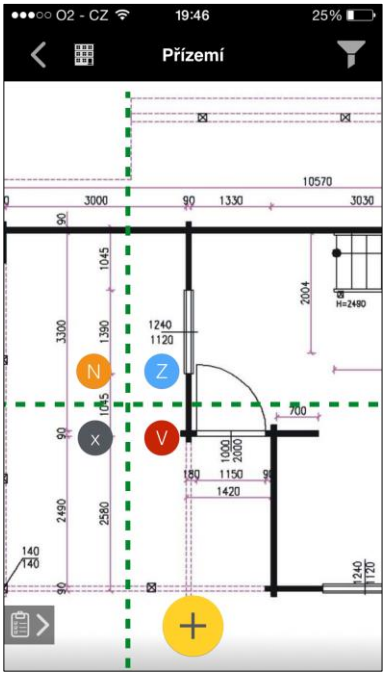
Figure 8: Summary of the projects components (floors) [6]

Event Recording

Recording new events, whether defect, backlog or claim can be done on two different screens of the selected floor.

- The list of events (Fig. 9)
- In the image mapping (Fig. 10)





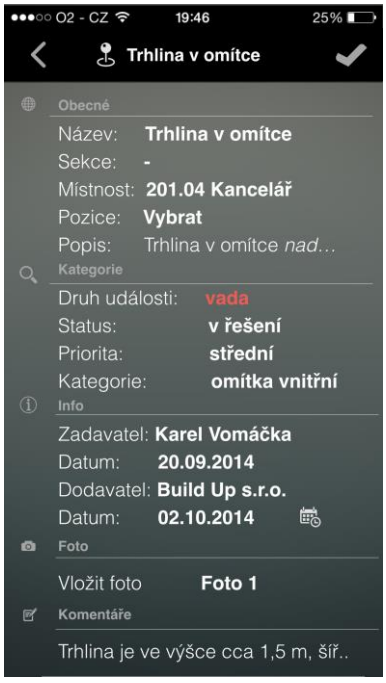


Figure 9: Events overview in the construction part [6]

Figure 10: Recording an event in the image mapping [6]

Figure 11: Event details (defects) [6]

In both cases, event details will be displayed (Figure 11) which are necessary to be completed. The more information about the event is filled or selected, the better the specification of defects, backlogs, or claims. By using a qualitative and detailed description, the user simplifies the whole application procedure and minimizes possible filtering between other events in the course of the event.

Advantages of the Application

In particular, the following features are classified as main advantages of the application:

- No loss of information, data or documentation during communication with the supplier or in the context of a company
- Effective and fast communication between investors and suppliers
- High clarity and intuitive use of the application
- Optimized for use on site / in the field, tested by professionals in practice
- Ability to work Off-line and On-line
- Comprehensive solutions to the Defect management issue within a single application
- Access to applications and data processing from the mobile device and web portal
- Record a large number of events, structured arrangement, capacity to filter and sort events
- Record detailed description of events, incl. adding photos, event locations, history and comments
- View the image map (eg. Floor plan) with graphically highlighted places of event occurrences
- Export event to the form and sending e-mail
- Effective system for dealing with events
- Variable use of the application for investors, general contractors as well as subcontractors
- Professional software for structural engineering

The Target User

The target users of the application and methodology *Claim it!* are primarily direct participants within the construction process. Therefore, the system including all the above-mentioned benefits can be used by:

- Investor
- Developer
- General contractor of construction work
- Contractor and subcontractor of materials and construction work
- Architect

Due to the significant number of entities and persons involved in the construction or implementation of structural units the above list is not final with regards to possible users. Each project is unique and requires an individual approach from all participants. [7]

Conclusion

In conclusion it can be said that the system of *Claim it!* offers easy and efficient way to solve Defect management during construction phase, upon acceptance as well as handover of buildings. The target user is in particular the investor, developer, general contractor and other contractors directly involved within the construction work. Software belongs to a special category of software tools while it can be considered as a tool of Lean Management and Lean manufacturing.

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