

# Automation of building construction teams using mobile communications

*Mauro Faccioni Filho, Dr. Eng.*  
*mauro@fazion.com.br*

## **Abstract<sup>1</sup>**

*The paper discusses problems of communication and control in the building construction industry as a factor of delay in the original schedules. A software tool embedded in mobile phones and networked with a central control web service can accelerate voice and data communication between components of building construction teams, especially at small and medium size companies, where the use of technology is not usual and control systems are uncommon or inexistent.*

## **Resumo**

*Este artigo analisa os problemas de comunicação e controle, na indústria da construção civil, como fatores fundamentais em atrasos de projeto. Descreve um aplicativo para uso em telefones celulares que, conectado a um "web service", cria rede de comunicação de dados e voz dedicada aos usuários que formam equipe de campo na construção, especialmente em empresas de pequeno e médio porte, nas quais o uso de ferramentas tecnológicas de automação não é comum e sistemas de gestão e controle de projeto são raros ou inexistentes.*

## **Introduction**

According to statistics from Brazilian government (Ministerio do Trabalho, 2004), more than one million workers are actually employed in the construction industry. When the economy is growing this industry is the first to hire, and on the other hand when the economy must to move more dynamically this is the industry which the government firstly apply its funds. But instead of other industries which are more organized and where companies last for decades, construction companies are local and are medium or small size, lasting for no longer periods. Lack of control methods, no use of technology, delays and schedule overruns are usual. But this is not a developing country phenomenon. The work from Love (2004) discusses the problem

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in Australia and says that “delays and cost overruns are seemingly the rule rather than the exception in the construction industry”. That work (Love, 2004) also presents a critic for the construction industry “for its fragmented nature, lack of coordination and communication between participants, adversarial contractual relationships, lack of customer-supplier focus, price-based selection, and ineffective use of technology”.

Build construction is an engineering industrial activity where the workers involved are, most of the cases, scattered in different places within the construction. Despite the components that are repeated from construction to construction, the main component is always renewed: the model of a work group, the way it works and its management. This management is a task for engineers who must combine a well knowledge about construction techniques and good skills to lead workers aligned to the objectives of their contractor.

To solve part of the problems presented above, and taking advantage of the internet and the actual mobile devices, a web-based program is under development to automate the process of build construction considering communication as the core. The focus is to automate the group voice and data communication as a tool for the engineering management.

## Communication between participants

Communication is a fundamental problem in project management (Hayden, 2004). As the workgroup in the construction project is composed by workers who use mobile phones in their day by day activities, naturally these equipments can be part of a communication platform. But how they will be useful? First of all a directional graph could be designed showing components of a typical construction team from a small company.

A directional-graph (digraph) representation (Wasserman, 1999) could help as a model to comprehend the build construction management, its hierarchy and possible paths between the “actors”. Figure 1 shows this digraph, where on the top is the chief executive and below are distributed the team components, until the operation ones represented by installers, bricklayers and so on. The arrows show the paths between different actors and how the hierarchy is broken when the construction is going on.

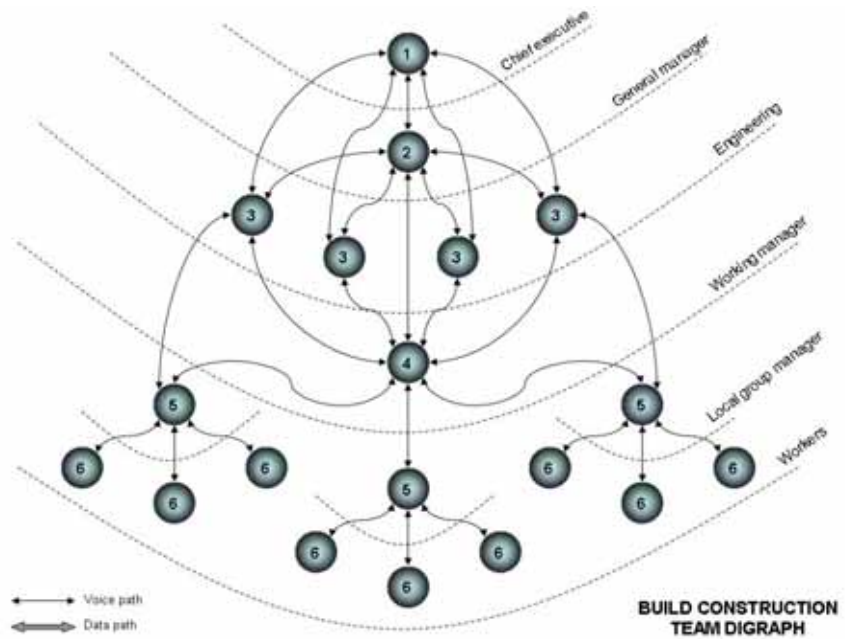


Figure 1 – Voice paths between participants

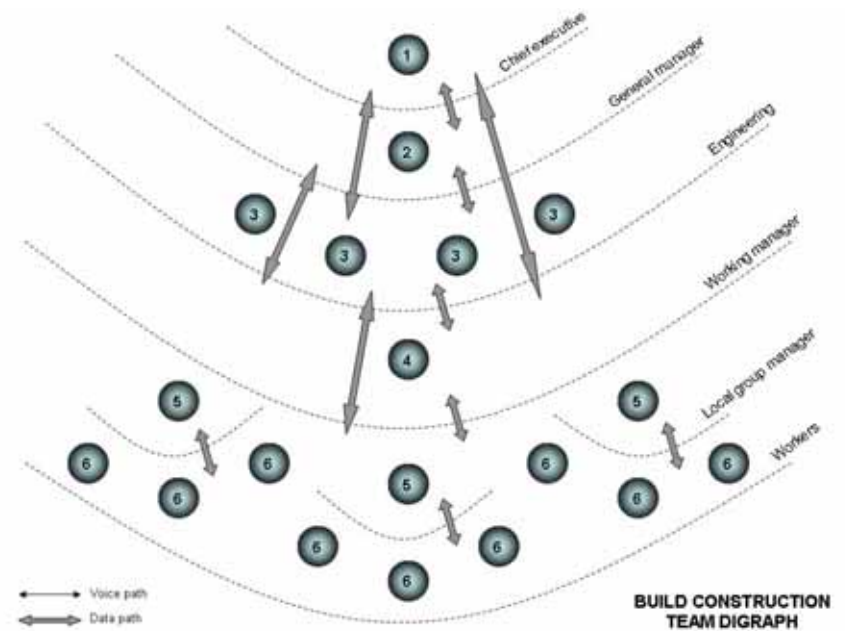


Figure 2 – Data paths between participants

While Figure 1 shows the voice paths, another way to see the relationship between these actors is through the possible data exchange between them. Figure 2 shows this representation, and a different composition appears. The node "4", which represents

the working manager who is present on the shop floor, is a critical actor because his lack could cut important relations.

Whilst voice calls are nowadays usual for all persons, messages with data are not for this kind of construction workers. Use of tools like “short message service” (SMS) or “multimedia message service” (MMS) is just beginning, but obviously will play an important role. To exemplify this use Table 1 shows several circumstances which happen every day in a construction shop floor.

*Table 1 – Typical circumstances at the construction area and related actions*

Examples of circumstances	What the platform does
<ul style="list-style-type: none"> <li>▪ Routine problems are discussed and/or solved with conversations between members of the team</li> </ul>	<ul style="list-style-type: none"> <li>⇒ All identification numbers and time of conversation are registered</li> <li>⇒ Accord to the priorities, conference call is open for other members</li> </ul>
<ul style="list-style-type: none"> <li>▪ Messages must be exchanged between members and between members and the Central Server</li> <li>▪ These messages could contain only text or data, pictures and movies if necessary</li> </ul>	<ul style="list-style-type: none"> <li>⇒ Messages for groups or for individuals</li> <li>⇒ Accord to the equipments and technology available</li> <li>⇒ Central Server can origin messages and alarms</li> <li>⇒ All identification numbers and contents are registered in the database</li> </ul>
<ul style="list-style-type: none"> <li>▪ Instructions must be sent to the shop floor</li> <li>▪ Reports must come from the shop floor</li> </ul>	<ul style="list-style-type: none"> <li>⇒ Specific files are attached to the messages sent from the Central</li> <li>⇒ Questionnaires are sent and return from the shop floor</li> <li>⇒ A production control graphic is loaded online with data coming from the shop floor</li> </ul>
<ul style="list-style-type: none"> <li>▪ Doubts about construction, installation, reception of materials and agenda arise all the time</li> </ul>	<ul style="list-style-type: none"> <li>⇒ Exchange of pictures (MMS) and messages (SMS) helps to clear up the solution</li> <li>⇒ Instructions are sent</li> <li>⇒ Parts of Standards could be sent</li> <li>⇒ Conversations</li> </ul>
<ul style="list-style-type: none"> <li>▪ Deficiency of material at construction shop floor</li> </ul>	<ul style="list-style-type: none"> <li>⇒ Requests are sent to the Central Server and/or direct to material suppliers</li> <li>⇒ Catalogued suppliers receive requests</li> <li>⇒ Alarms/reports are sent to the managers</li> <li>⇒ List of materials is registered in the specific database</li> </ul>
<ul style="list-style-type: none"> <li>▪ Deficiency of workforce</li> </ul>	<ul style="list-style-type: none"> <li>⇒ Requests are sent to the Central Server and/or direct to service providers</li> <li>⇒ Catalogued workman are called</li> <li>⇒ Alarms/reports are sent to the managers</li> </ul>
<ul style="list-style-type: none"> <li>▪ Members are included (or excluded) in the team</li> </ul>	<ul style="list-style-type: none"> <li>⇒ Message is sent to all participants</li> <li>⇒ The network is automatically adjusted, including (or excluding) numbers, IDs and status</li> </ul>

The software platform for automation of building construction teams just use these features as responses for problems and difficulties which appear all the time at production. Table 1 left column presents these common facts while the right column presents actions the software performs.

A “Central Server” must be controlled from the construction company office, where the schedule for the whole production is originated. Tasks then are distributed and the platform registers and acts when necessary.

## Conclusions

Developing countries like Brazil have important construction industry because development passes through new buildings, roads, cities and infra-structure. But this specific industry doesn't use technology as an ally.

This paper presented a software platform under development, which uses mobile phones and web services as a way to improve the communication between members of a building construction team. A graph showing the relationship between these members was designed and acts as a model for to create the features for the platform. The platform focus is to accelerate the communication and to insert quality processes in this industry, especially for small and medium size companies.

## References

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