Progress Tracking on Industrial Construction Projects

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Abstract

Tracking the progress of construction projects is important for completing them on time and within budget. This is because it allows the project manager to initiate corrective action when the actual performance deviates from the planned performance. The more often progress is measured; the more timely will be this corrective action. United Group Resources have sought to increase the efficiency of this process. A review of project management practices at the company was undertaken in parallel with a search for industry best practices and review of project management theory. Technologies that facilitate efficient material tracking are outlined, along with their limitations. Methods of using computer modelling and mobile computers to obtain accurate progress measurements are also explained.

1.0 Introduction

United Group Resources, a division of United Group Limited, provides engineering, procurement, fabrication, construction, maintenance and management services for both small and large-scale projects in the resource industry. Competition for construction contracts in the industry is high. In considering construction proposals, one of the criteria that the client organizations take into account is their past history with the company, and in particular the company's demonstrated ability to complete a project on schedule and within budget. While United Group are viewed in high regard in this respect, they seek to improve the efficiency with which they achieve these outcomes.

Project monitoring and control is crucial to the delivery of a project on schedule and within budget. For this reason, United Group Resources has expressed a desire to optimise their processes and systems for tracking the progress of construction projects. A review of project management practices at the company was undertaken in parallel with a search for industry best practices and review of project management theory. A range of technologies were reviewed for their potential to facilitate more accurate, timely and efficient progress measurement for United Group projects in the short term. Implementation of these technologies on real projects is still being investigated at the time of writing this paper.

1.1 Project Outcomes

The primary outcome required by the client is the development and/or discovery of "best practice" project monitoring processes that are robust to changes in the project scope. These processes must require less effort to implement than those utilise at present and should be consistently accurate when applied across the range of projects undertaken by the client. The latter will be a challenge due to the variability of client reporting requirements, project team make up, balance of work disciplines, and fabrication support, across projects.

according to the estimated man-hours required, scanning the components as they are installed would provide the project planner with an accurate picture of the progress achieved.

4.1.1 Barcode Technology

Barcode technology is a means of transmitting data optically through free space. Data is encoded on the label as a series of lines and spaces, corresponding to digital 0s and 1s. The reader records this sequence and then interprets the data using software provided by barcode suppliers. 2 dimensional labels also exist, which contain rows of black or white squares rather than lines and have higher data storage capacity.

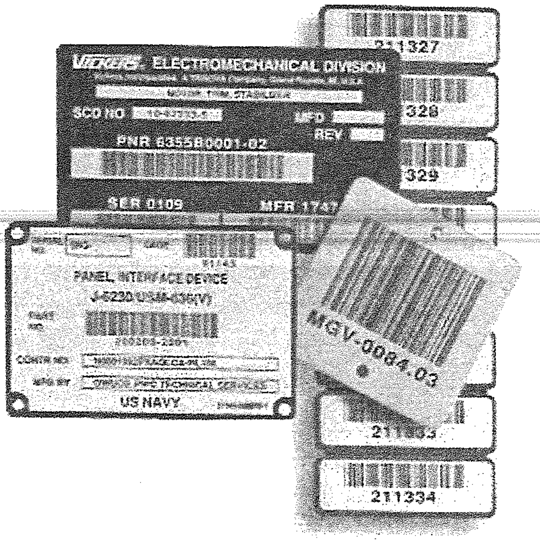

Figure X Range of barcode label materials and layouts

Standard paper barcode labels are susceptible to damage in transit due to contact with other metal components and handling machinery. Other causes of damage may include moisture, high temperatures and chemicals. For this reason durable barcode labels must be incorporated.

Barcode scanning requires a line of site between the reader and label. This means that the orientation of each component must be considered when applying the label, else the label may be obscured from view and the progress of that task would need to be recorded manually.

4.1.2 Radio Frequency Identification (RFID)

Like barcode technology, RFID involves the use of tags and readers to transmit data. The fundamental difference between the two is that RFID systems transmit data via radio waves, which means that they do not require a line of site between tag and reader. RFID tags contain memory, which can store any arbitrary piece of data. The reader reads this data when it scans the tag. It is possible to obtain tags with rewritable memory.

There are three types of RFID tags. "Active" tags are capable of generating a signal that is not obstructed by metal or solid objects. "Semi-active" tags also generate their own signal, but only when prompted to do so by a signal from the reader. "Passive" tags cannot generate a signal, as they do not contain an internal power source. In this case receipt of a signal from a reader induces a current in the circuit board of the passive tag, which can then produce a signal with a very short range; typically not more than 10cm. By comparison, some active and semi-active tags can produce signals up to 100m or more.

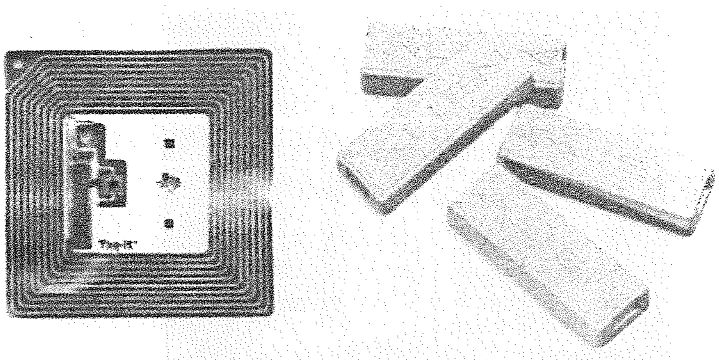

Figure XX Examples of a passive tag (left) and semi-active tags (right)

This functionality also makes the RFID tags considerably more expensive than durable barcode labels. Passive or semi active tags suitable for mounting on metal are priced upwards of $5 each and active tags are upwards of $50. This means that in order for such a system to be economical the tags would have to be reclaimed from each component and reused once that component was installed.

4.1.3 Constraints on implementation

The implementation of a material tracking system would require the compliance of those who would be carrying out the item scanning: the tradesmen and team leaders. They should be made aware of the reasons for implementing such a system to gain their commitment. They must also be motivated to use the scanners appropriately, as a material tracking system is vulnerable to fraud. (It would be possible to scan a component and check off tasks before they have been performed.) It is hoped that because the tradesmen are supervised directly, based on physical work complete, there would be no incentive to record progress incorrectly.

Automating tracking completely, with RFID for example would make it impossible to record the progress of individual operations on each component.

4.2 Facilitating Accurate Progress Assessments with Mobile Computers

The most efficient way to facilitate taking highly accurate assessments of progress is to utilise a mobile computer. The feature provided by a mobile computer that facilitates this is the ability of some plant modelling programs to provide the user with specific information about the installation procedure for each component. The computer would provide the employee with information about all the subtasks associated with a given component, selected on a 3D model of the plant. With this information, and a visual inspection of what has been achieved, the progress assessor would be able to determine and input the progress of the installation. This would then be uploaded to the schedule when the device being docked, making the procedure very timely and efficient.

Equipped with this amount of information, presented in such a form, even a relatively inexperienced person could obtain very accurate data pertaining to the progress achieved. This means the system removes human error from the process of deducing percentage completion.

Such a system requires access to intelligent 3D plant models, which are presently not always available. The computer must also possess the processing power to run the modelling software, enough battery life to survive for the duration of one progress assessment, and be rugged enough to survive the harsh conditions of the typical construction site/ industrial facility.

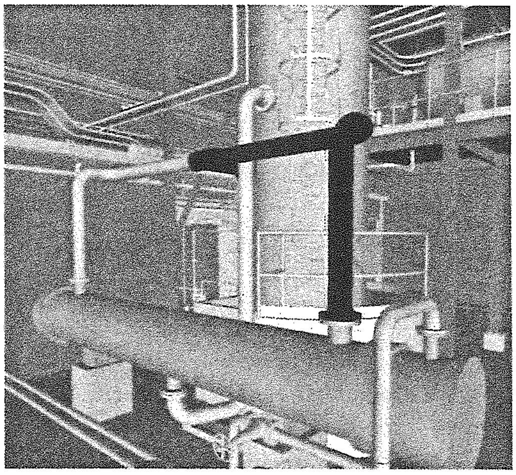

Figure XXX Plant model review software, with selected pipe spool in black

5.0 Conclusions

The construction industry faces significant hurdles to developing flexible and efficient tracking processes. The uniqueness of every project makes it difficult to standardise progress tracking and the time pressures make manual progress assessments impractical.

Direct material tracking technologies such as barcode labels and RFID tags are attractive solutions because they require far less effort that traditional methods of updating progress against milestones. Mobile access to plant models, on the other hand, removes the tradesmen from the progress updating process and allows the user to intuitively enter the installation progress of individual components. All the potential solutions share one characteristic: they provide the ability to access specific information enabling accurate progress assessments to be performed in an intuitive way. Developing this feature will be the primary challenge to obtaining the benefits sought from such a system.

6.0 References

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