2nd Quarter 2019 Issue 129

bulletin

Quarterly Magazine of Consolidated Contractors Company

Lean Construction & Workface Planning

CONTENTS

SAMER S. KHOURY

PRESIDENT ENGINEERING & CONSTRUCTION

2019: A TURNAROUND YEAR

We expect 2019 to be a Turnaround Year for CCC as we are seeing a shift in our market in three directions:

1. From civil infrastructure to oil and gas projects.
2. From several small projects to focused mega projects.
3. More focus on Africa and the CIS countries rather than the GCC.

We have to make use of this year to get better prepared for the years to come in the following four fields:

1. Health, Safety and Environment.
2. Quality Control and Commissioning.
3. Productivity and Control.
4. Cash Management.

We are taking steps in all the above fields to be able to perform better on upcoming mega projects and, in this issue of the Bulletin, we have focused on productivity and improved control tools, such as Lean Construction and Workface Planning.

I am confident that with our updated internal processes, spirit of innovation and dedicated staff, we shall achieve both better performance and improved results in the years to come.

Samarkand Utilities Transformation Plan

Uzbekistan

The agreement is to make a proposal for an investment plan to upgrade and modernize road and water utilities of the city of Samarkand. The Abu Dhabi Fund for Development (ADFD) will finance this plan through a concessional loan. This plan will include:

- The resurfacing and/or expansion of existing roads, construction of new roads and bridges in the city as planned by the related concept road masterplan.
- The renewal and extension of drinking water, sewage, rainwater networks of the city as planned by the related water masterplan.

The upgrade of Samarkand water systems will be accompanied by a significant package of services to support SUVOKOVA (Samarkand Water Company) in operating new assets in the best conditions. During this stage the consortium will define and estimate the full scope of the project that is expected to exceed $ 300m. Funding for the project has been allocated and approved by ADFD.

- The client is Samarquand Viloyati Hokimligi.
- The consultant is Khatib and Alami.
- The project was awarded on 16 April 2019.
- The project start was 22 April 2019 for a duration of six months ending on 22 October 2019.

M. SOUFYAN co-edited by A. PAPADOPOULOS

The Process Approach

Introduction

Since the introduction of the “process approach” and the “system approach to management” principles in the 2000 version of the ISO 9001 standard, many questions have been raised by organizations and individuals in order to understand the concept of process/system approach. Even today after many years of having introduced this concept, several organizations fail to understand and implement the “process/system approach to management” concept.

What is a Process?

A process is defined as a set of interrelated or interacting activities that use inputs to deliver an intended result. Processes use resources to transform inputs into outputs. They are interconnected because the output from one process often becomes the input for another process.

What is a System?

A system is defined as a set of interrelated or interacting elements.

Examples of Technical Systems

Engineers have been familiar with technical systems, their constituent elements and processes since the beginning of the engineering profession. For example: cooling systems, heating systems, firefighting systems, water systems, gas systems and so on. For illustration purpose, let’s consider a simple HVAC system.

HVAC consists of a few integrated systems that can be defined in the following manner:

Cooling System consists of:

- Evaporation Process
- Condensing Process
- Thermal Expansion Process
- Piping

Heating System consists of:

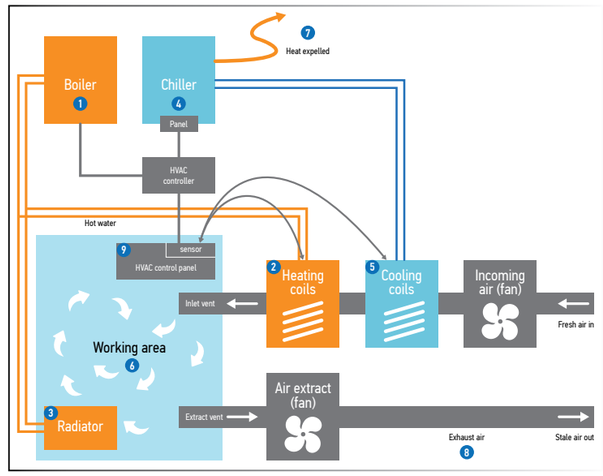
- Boiler Process
- Process Piping.
- Heat Exchangers

Water System consists of:

- Heat exchangers
- Process piping and valves

Air System consists of:

- Heat Exchangers
- Ducting system
- Air handling unit



Each of these systems consists of sets of processes integrated to provide final output to customers. Each process has input and output; the output of one process is an input in the subsequent process.

Process ‘Steps’ in Everyday Products & Services

A process relates to a set of steps and decisions involved in the way work is completed. We may not realize it, but processes are everywhere and in every aspect of our life. A few examples of processes include:

- Preparing breakfast or lunch.
- Putting petrol in a car.
- Changing oil in a car.
- Cleaning a hotel room.

It seems that preparing breakfast or lunch may be very simple, however, from a process point of view, preparing breakfast or lunch involves a complex sequence. You can ask yourself, how many times you were dissatisfied with a lunch ordered in a restaurant and you left and never came back.

Let's have a detailed look at the steps or requirements involved in preparing a main menu for a restaurant:

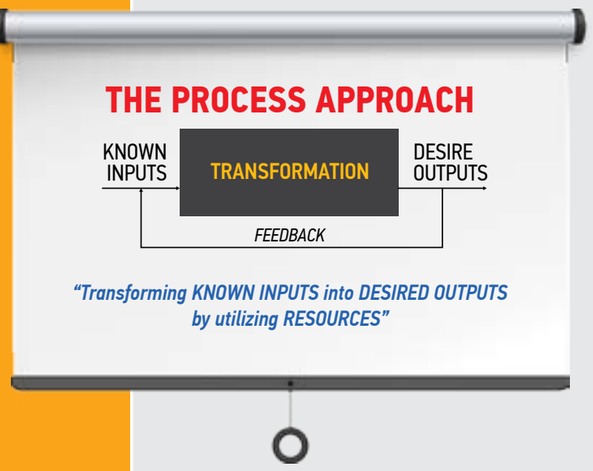
- Recipe or methodology that can be a written procedure or based on the experience of the cook (knowledge, information, method).
- Ingredients / materials that are resourced from many places worldwide and timely selected and preserved for the purpose supplied by external provider. Also, there is energy input (Process Inputs).
- Qualified and competent employees, including cook, helpers, waitresses and so on (Human Resources).
- Tools and equipment for cooking purpose (Resources).
- Kitchen facilities with proper work environment including hygiene standard (Infrastructure, environment).
- Finished meals (Process Output).

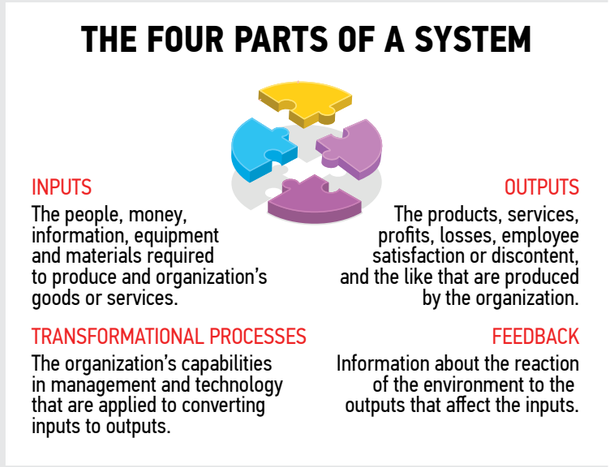
Finally, to complete (and actually initiate!) the process cycle we have a customer as the most important factor. Your customer decides if your process is successful or not. The customer is the ultimate judge of the process effectiveness.

Combining the "Process Approach" & "System Approach to Management" Principles

The process/system approach to management is a concept which views a company as interconnected systems that consists of several business sections. Each system can be broken into processes that include input, resources, knowledge and a set of tasks and activities.

Systems are associated with transformation processes that provide value to customers.





The Process Approach in the 2015 version of ISO 9001 is made clear by the statement: "Consistent and predictable results are achieved more effectively and efficiently when activities are understood and managed as interrelated processes that function as a coherent system".

The Process Approach in ISO 9001:2015

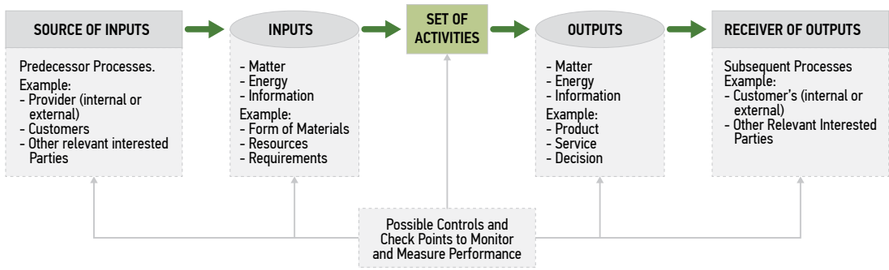
The Process Approach involves the systematic definition and management of processes and their interactions, so as to achieve the intended results in accordance with the quality policy and strategic direction of the organization.

Management of the processes and the system as a whole can be achieved using the PDCA cycle with an overall focus on risk-based thinking, aimed at taking advantage of opportunities and preventing undesired results.

The application of the process approach in a quality management system enables:

- Understanding and consistency in meeting requirements.
- The consideration of processes in terms of added value.
- The achievement of effective process performance.
- Improvement of processes based on evaluation of data and information.

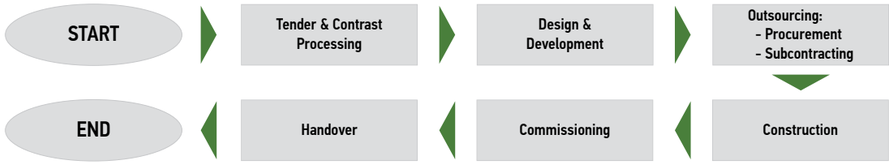
The figure gives a schematic representation of any process and shows the interaction of its elements. The monitoring and measuring check points, which are necessary for control, are specific to each process and will vary depending on the related risks.



The Process/System Approach in our Quality Management System

The ISO 9001 standard promotes the adoption of the process approach when developing, implementing and improving the effectiveness of a quality management system, to enhance customer satisfaction by meeting customer requirements.

In order to explain further the process approach concept in relation to management systems, we are going to consider the overall systems of the organization.



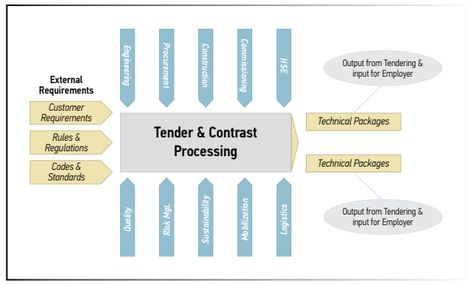
The 'Construction Organization' as a Set of Systems

A typical construction organization consists of the following core systems:

- Tender & Contract Processing.
- Design & Development.
- Procurement.
- Construction.
- Commissioning.

1. **Tender & Contract Processing**

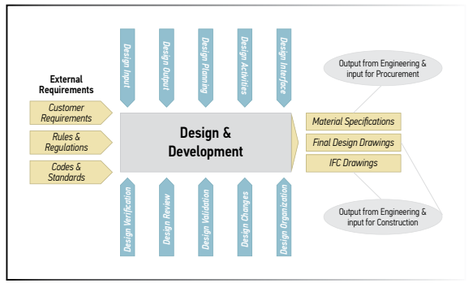
Tender & Contract Processing is a core system for any construction business. Any system / process has input and output; in the case of tendering, we have external inputs (customer requirements, rules and regulations, codes and standards). However, we also have internal inputs and requirements by the organization. Such internal inputs are vital for successful operation and equally important as the external inputs.



The outputs of this system are technical packages and commercial packages that are forwarded to the external customer (i.e. the client) for further processing.

2. **Design & Development**

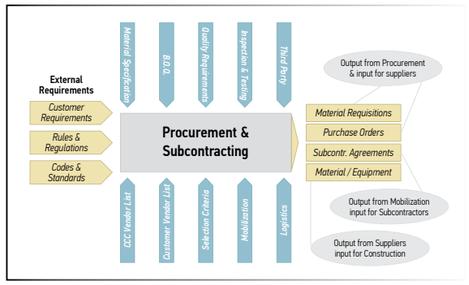
The second complex system in the organization is design and development. Many times, this system as required by ISO 9001 standard is commonly misunderstood even by some major design organizations. Usually, the external inputs and outputs are well-defined for most organizations. However, the applications and the methods of processing to reach the final design outputs are often not clear.



According to the ISO 9001 standard each design is subject to major processes; these are: Design review, design verification and design validation. These processes are the core of the design and development system; they must be clear to all engineers and must be evidently implemented.

3. **Procurement & Subcontracting (i.e. externally provided processes, products and services[1])**

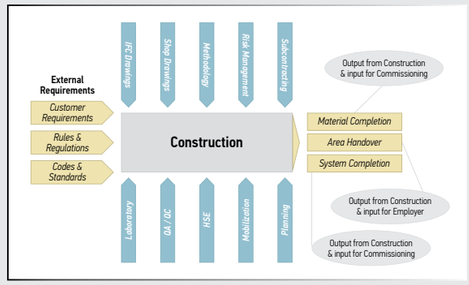
The third complex system is the procurement of materials and equipment, and the subcontracting of works. It is very important for any construction project to have the required materials and equipment as per the requirements of procurement schedule in line with construction plans. At the same time it is equally important to decide on the subcontracting strategy, then plan, negotiate and control outsourced services.



There is always external inputs related to customer requirements and regulations, however, the main inputs come from engineering in the form of materials specifications and from QS in the form of B.O.Q. There are respective sets of outputs that finally result in materials and equipment delivered to site and in accepting outsourced works.

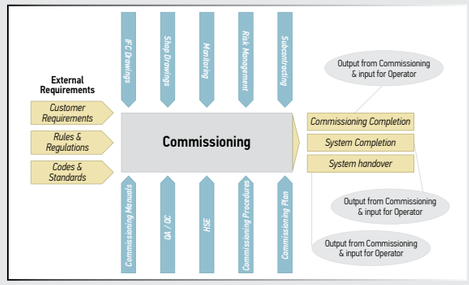
4. **Construction**

Construction is the fourth complex system in any construction organization. For construction to succeed it is not enough to have complete readiness of the construction team; we need also to have successful engineering systems and successful procurement systems operating in proper coordination. In many cases, construction fails due to lack of design drawings or lack of materials and equipment, or problematic outsourcing. All these systems must be coordinated and must work effectively in order for the organization to deliver the final product.



5. **Commissioning**

Commissioning is considered the fifth core system in the organization. Usually in oil and gas 'mechanical' projects the construction contractor is not responsible for commissioning. However, in 'civil' projects, commissioning is the construction contractor's responsibility. MEP works and other special systems are subcontracted to specialized subcontractors; however, the overall responsibility of all the systems belongs to the main construction contractor. Although specialized subcontractors may produce their own manuals and procedures, it is preferred for each 'civil' project to have an overall commissioning manual consolidating all the requirements and explaining the overall philosophy for commissioning.



Benefits of the Process Approach for the Organization

Understanding and managing interrelated processes as a system contributes to the organization's effectiveness and efficiency in achieving its intended results. This approach enables the organization to control interrelations and interdependencies among the processes of the system, so that the overall performance of the organization can be enhanced.

1. *This is the standardized terminology used as per ISO 9001:2015 par.8.4, referring to outsourcing, i.e. "not part of the organization". Procurement & Subcontracting are (processes, products, services) externally provided.*

F. SHAWWA

Lean Philosophy

Its Origins in Car Manufacturing

Imagine if you had the power to finish your work in less time, with less effort, at less cost and with minimum errors, getting it right the first time and still delivering what was expected.

Imagine if you could achieve these things for your company all at once - would you? Of course you would want to, but you might still think this is fairytale thinking: nice to imagine but impossible to achieve. Yet by the early 1960s, two decades after a devastating Second World War, a little-known company called Toyota managed to do just that in its business of car manufacturing. In the process, it beat established big players and mass production giants like Ford and General Motors at their own game, changing the global approach to manufacturing methodology forever. What Toyota managed to pull off was to put manufacturing on a highly stringent diet. So how did Toyota initiate this global paradigm shift? It is helpful to first look at the historical context, starting with the original pioneers in the car industry.

Ford Model T production line in 1908

Background

Decades before Toyota, Henry Ford of the Ford Motor Company had upset the nascent car industry at the time. He did that by pioneering the mass production method for making cars. Back then, according to *The Machine That Changed the World* by Womack and Jones[1] (a widely used reference on the topic and a highly recommended read), carmakers were small operations producing only a few hundred units per year. They utilized skilled craftsmen who hand-made the cars and their parts, often building them to a customer's specifications. The parts did not meld perfectly, so the craftsmen had to machine them into shape to fit them together. No two cars were the same, even based on the same design. And since the skills needed to make cars were widely available, many small carmakers sprung up across Europe and North America. Some, like Aston Martin, survived the mass production revolution and continue to this day. But for most, Henry Ford's new methods meant that they could not remain competitive as demand for cheaper reliable cars skyrocketed.

One of Henry Ford's most influential acts was to use interchangeable parts, so that the workers simply put them together. When he perfected the process, little or no machining of parts into shape was required. This one concept made mass production possible. His other enhancement that is more associated with mass production was the moving assembly line.[2] Over the years, Henry Ford employed a string of other techniques that refined the process further, reducing the time required to produce a car. An assembler's "cycle time" went from 514 minutes to 2.3 minutes after introducing interchangeable parts, and to 1.9 minutes after the introduction of the moving assembly line. The boost in productivity and resulting cost reduction were astonishing. At one point in the early 20th century, thanks to his new methods, Ford was the lowest-cost car producer.

An important milestone in our story is this: Ford's innovative setup meant that the more he produced, the lower his costs fell - simple "economies of scale". So he put all his energies into producing as many cars as he could. According to The Henry Ford archival organization, **"Ford could easily sell all he could make; but he wanted to *make* all he could sell."**[3] The pursuit was to produce, produce, produce, and there was little time allocated to stop and think about what needed fixing and how to do certain things better in their process. The drive to lower cost and to make cars available to the masses often happened at the expense of high quality and the personal preferences of customers. In 1909, Ford uttered his famously ironic line: "Any customer can have a car painted any color that he wants, so long as it is black".[4] Other manufacturers, such as General Motors, then applied refinements to these management methods and, by around the mid-1950s, mass production entered its golden age.

At that time, you may have thought that mass production was the endgame, especially since many other manufacturers including in other industries had started adopting its model. But, in fact, not all was well; serious cracks began to appear in mass production. Toyota recognized them when it tried to implement Ford's system. The company's perceptive engineers understood that the system of mass production would not work in the company's favor. That realization was for the better of everybody.

Toyota's Solution

Toyota did not see mass production as well suited for its situation because, at the time, its markets were small. It could not produce large quantities, nor realize savings from economies of scale. Mass production as practiced by Ford and others also involved a lot of waste in their operations. Toyota was forced to find other ways to produce its cars efficiently and at lower costs. It was a small and inventive company, in a perfect position to shift the entire paradigm.

Ford Highland Park plant in 1913

Through much trial and error over approximately two decades, Toyota managed to develop and perfect a set of techniques that helped it achieve just that. Eventually its techniques crystallized into a system of work and philosophy called the Toyota Production System (TPS),[5] which sought to help it **to be productive while delivering the products the customers wanted**. Keep in mind that Toyota never set out to create a system of production or even a "philosophy" of any kind. It only sought to solve problems it faced at the time. **It did that with flexible and innovative people who were willing to ask questions, imagine, and experiment**. The saying "necessity is the mother of invention" firmly applies here.

Toyota's system of work or philosophy achieved the following changes for the company:

- It developed a **culture of respect**. People are not seen as mere resources. This element is the catalyst that makes the other elements work better.
- From the early days when the chief production engineer, Taiichi Ohno, witnessed much *muda* (wastefulness) in the mass production process, Toyota's focus was on **eliminating waste**.
- It set into motion the idea of incrementally tweaking its processes (*kaizen* in Japanese), even when these were running without issues. This is **continuous improvement**.
- To do that, it both valued and relied on its production workers' **hands-on knowledge and experience**. Contrast this with the mass producers who wanted workers to perform one or two simple tasks and not think about much else. It is important to note that Toyota's workers participated willingly, mindful of the **job security** the company offered as per the union agreement. For business to succeed, it was clear, the **commitment and communication had to go both ways**.
- This developed into a **culture of problem solving** that encouraged **identifying issues when they occurred**. Large notification boards (called *Andon* boards) in the factory highlighted where a problem had occurred, whereupon

workers scrambled to help their colleagues resolve the issue.

- The company went as far as doing something counter-intuitive: it gave workers the power to stop the production line on their own in order to seek help in fixing a problem. This is applying the *Jidoka* method. The team helping to resolve that problem then took time to **analyze the root cause** so that the defects or errors were avoided in future. **The team's focus was on doing the work right, the first time**. Imagine if all employees in any company had the audacity to stop the 'production line' in their own work. Would that enhance the **sense of ownership and shared responsibility**, rather than disrupt it? Contrast this with how mass producers focused on producing as many units as possible. To ensure that production was never interrupted, any time a car had a defect the workers redirected it to a separate "rework area" where other teams fixed all defects. Often a defect was buried behind other components that had to be removed to reach it. They then fixed the defect, and put everything back again.
- The factory notification (*Andon*) boards and signs mentioned above are an example of Toyota's using visual tools, which improve workers' awareness.
- Toyota also realized that housekeeping - maintaining a **clean and organized workspace** - resulted in reduced wastage because it makes the workspace itself more visible and also appealing to those working in it.
- It recognized that products and parts **inventories were a waste**, so it minimized or eliminated them. Toyota had to rig its operations carefully to achieve this. It experimented and ultimately devised a system involving a number of components. One of those was the so-called pull system: production was driven by client demand and parts were not produced until a car was ordered. So the demand "pulled" the production activities and ordering of parts. This contrasts with a "push" system where you make the product, often based on forecasts, and then try to market it. The pull system required close coordination with parts suppliers and negotiating contracts that were fair for both parties. Toyota worked with suppliers to integrate their operations into its own, **sharing production information and benefits**.
- What about fluctuations in market demand? How could Toyota – or anyone for that matter - control them so they did not undermine its production setup? A demand trough would create so much waste in idle time, and a surge would overburden production lines. In fact, Toyota did manage: It ensured its sales teams remained in touch with clients, often making house calls. When they sensed demand was low, they worked longer hours to bring in orders. Toyota also could resort to offering deals to boost demand. In the end, it succeeded in minimizing those troughs and surges and **smoothed the flow in its production by actively tackling market demand**, among other things.
- Consider that inventory is a "safety net" to ensure the materials are available for any production activity when needed. By removing inventory, Toyota **removes that safety and exposes the capabilities of its overall process**, testing whether it is coherent and robust even without waiting inventory. The process thus had to be sophisticated enough to ensure that parts arrived at their assembly stations **just in time**. In conjunction with that,

A classic picture of Taiichi Ohno, considered the true architect of the Toyota Production System

Lean Philosophy: Its Origins in Car Manufacturing

FEATURE

Cars at Toyota's Kaikan plant

Toyota perfected a process for signaling when to reorder parts - this is the famous *Kanban* card system that others the world over later adopted as a scheduling method.

Toyota's system beat mass production. It produced cars in less time, less effort, less cost; and they had fewer defects in them than anybody else's cars. However, in contrast to the mass producers, it achieved all that while producing relatively small batches of a large variety of vehicles, to suit market needs. Researchers have studied Toyota's business philosophy and its methods extensively, and have derived its theoretical basis. In 1988, a researcher called John Krafcik gave it the name that we are familiar with today: **lean production**[6] ('lean' being a reference to holding little or no inventory). Lean, therefore, is about giving the clients what they want while minimizing waste in our effort to do so.

While the company's formula was never kept a secret, for many managers all over the world some aspects of it seemed counterintuitive and they needed years to understand how and why it worked. Fast forward to the present, many in the car industry, ironically including Ford itself, have already figured out Toyota's philosophy and adopted its methods. In fact, businesses in a multitude of industries have done the same. One such industry is construction, and with it of course is CCC.

The concepts in the bullet points above and their highlighted words are part of my Lean Construction and Improved Leadership (LCIL) team's daily journey as we work with our projects to apply this philosophy: we use boards as **visual tools** to manage production and make it **flow smoothly and predictably**. We **"stop our production line"** to highlight issues, analyze root causes, and fix problems that arise. We **clear constraints** and foster **cross-discipline coordination** to avoid idle times and wasted man-hours. We live and practice these concepts every day.

1. *Womack, Jones, and Roos (Nov 1990). The Machine That Changed the World*
2. *Ford Motor Company. 100 Years of the Moving Assembly Line. Retrieved from https://corporate.ford.com/articles/history/100-years-moving-assembly-line.html https://media.ford.com/content/fordmedia/fna/us/en/features/game-changer--100th-anniversary-of-the-moving-assembly-line.html*
3. *The Henry Ford archival organization. Henry Ford, Founder, Ford Motor Company. Retrieved from https://www.thehenryford.org/explore/stories-of-innovation/visionaries/henry-ford/*
4. *Ford, Henry (1923). My Life and Work*
5. *Toyota Motor Corporation. Toyota Production System. Retrieved from https://global.toyota/en/company/vision-and-philosophy/production-system/*
6. *Holweg, Matthias (2007). The genealogy of lean production. Journal of Operations Management*

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The Unique Challenges of Productivity in Construction

Before we explore the usefulness of lean in our industry, it is important to point out some difficult operational challenges that are unique to construction projects:

1. Unlike a smooth-running production line, construction projects are **temporary production systems**.[1] They involve a learning curve. Workers must reorganize how they will work together, from scratch, every time a new project begins.
2. They involve **one-off designs** for constructing what are essentially prototypes.
3. The projects usually happen **outdoors**, not in a factory's controlled environment, and involve a static production location. On a construction project, the workers and materials go to the production location, unlike a moving production line where the product in process moves through stations, arriving to the workers who can predict their exact tasks.
4. Construction projects are **complex**, involving many activities to be executed together in a relatively short period. Furthermore, each activity feeds into another, with teams interacting with or handing work-in-progress over to one another ("interfacing") to complete the work. Delaying one activity impacts all subsequent activities.

As a result of these characteristics, construction projects are susceptible to disruption. The ensuing chaos often involves "putting out fires" and later calling on capable individuals ("superheroes") to intervene. At that stage, it is usually too late and the concerned project has already incurred heavier costs than planned. When we also consider the industry's thin profit margins, we realize how miraculous it is that construction companies remain in business.

The difficulty stems from the fact that the construction industry controls productivity in a specific way. A simplified view of the construction process is that of a series of "transformations": for example, raw materials and effort converted into components. Those transformations are value-adding activities and are linked through non-transformation activities that are typically non-value-adding activities, such as the transportation of raw materials, movement of people, inspections, and even waiting. For example, crews arrive and depart one after another to build a component, inspect completed work, or just wait for their turn to complete a task. Researcher Lauri Koskela discussed these transformation and non-transformation activities in the context of the flow of project work in his 2000 publication.[2] He concluded that there were issues with how the construction industry managed production, and his conclusion held the keys to a solution. I address two important such issues:

The first is the industry's almost exclusive focus on the "transformation" aspect of production when measuring productivity, while ignoring the non-transformation aspect: transformation activities matter to the client and are the core of what contractors do. That explains why the industry focuses on measuring their productivity.

The lean construction system's commitment to plan process helps engineers clear constraints early, thus contributing to the smooth flow. Here is a planning meeting with project and site engineers, planner and lean coordinator. At BSNP in Oct 2018.

The Unique Challenges of Productivity in Construction

FEATURE

Production Worksheet

Project:	BSNP	Area:	K1	Discipline:	Civil- Shuttering & Concrete	Project Week:	87	Week Ending:	Fri 04-Jan-2019

Activity	Elements	Operation	Area / Grade	Quantity & Man-hours	Unit	SATURDAY 29-Dec-2018 Target	SATURDAY 29-Dec-2018 Actual	SUNDAY 30-Dec-2018 Target	SUNDAY 30-Dec-2018 Actual	MONDAY 31-Dec-2018 Target	MONDAY 31-Dec-2018 Actual	TUESDAY 01-Jan-2019 Target	TUESDAY 01-Jan-2019 Actual	WEDNESDAY 02-Jan-2019 Target	WEDNESDAY 02-Jan-2019 Actual	THURSDAY 03-Jan-2019 Target	THURSDAY 03-Jan-2019 Actual	FRIDAY 04-Jan-2019 Target	FRIDAY 04-Jan-2019 Actual
Shuttering	UP4 Wall 6	Shutter Dismantling	Ansari	Qty	m2	30		30		30		60		60		60			
				Man-hrs	Hours	54		54		54		54		54		54			
		Shutter Dismantling	Mumtaz	Qty	m2	15		15		15		30		30		30			
				Man-hrs	Hours	27		27		27		27		27		27			
		Shutter Dismantling	Faysal	Qty	m2	34		34		34									
				Man-hrs	Hours	69		69		69									
		Shutter Dismantling	Surrender	Qty	m2							60		60		60			
				Man-hrs	Hours							54		54		54			
Concrete	UP4 Wall 4	Pouring	Ram	Qty	m3	75		75				75		75		75			
				Man-hrs	Hours	36		36				36		36		36			
		Pouring	Gunapathy	Qty	m3	75		75				75		75		75			
				Man-hrs	Hours	36		36				36		36		36			
		Curing	Ram	Qty	m2					54									
				Man-hrs	Hours					36									
		Curing	Gunapathy	Qty	m2					54									
				Man-hrs	Hours					36									

The production worksheet is the main tool in a lean construction system's production control. It enables the establishment of the desired "smooth flow", doing so by involving engineers in collaboratively setting daily targets every week. Good targets set by the site teams bring us closer to this smooth flow.

For example, we make sure that a worker is busy fixing steel or setting up formwork, or that cranes are lifting materials and setting them into place. **We are concerned about man-hours and machine-months, and rightly so, but that may not be enough**, because both the transformation and non-transformation aspects collectively affect the "flow" concept in production. Making the flow of work less variable, i.e. smooth and predictable, reduces waste in the process. When it is not, we suffer waiting times and disruption to the schedule activities - the transformations. The non-transformation activities have an impact on our work and productivity, yet the construction industry often does not measure them and chooses to ignore them altogether - after all, how many management reports explicitly consider waiting times?

The second issue is the industry's focus on "project management" as opposed to "production management". **Project management** is higher-level and looks at subordinates' output, as measured by productivity and man-hours used, for example. Importantly, it leaves out the details of how actual production occurs, treating it as the problem of the site teams undertaking it. **Managers do not bother looking at the tasks**, they look at the project as a black box - they give site teams the output objectives and care more about that than how the teams do it. Unfortunately, in doing so the construction company gives up the opportunity to do what is in its power to undertake the work effectively or learn how to fix issues. **Production management**, in contrast, involves **control at the task level**. This affords the managers the opportunity to do what is necessary to make sure tasks are done well, addressing reasons why they are not, and learning from the process.

1. *Ballard, G., & Howell, G. (2003). Lean project management. Building Research & Information*
2. *Koskela, Lauri (2000). An Exploration Towards a Production Theory and its Application to Construction. VTT Technical Research Centre of Finland*

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Lean production can play the savior here. It has two essential ingredients that make it adaptable across industries. First, it addresses **the human element** by considering both the customer and those working in production itself. It advocates a culture of mutual respect, teamwork, communication, and coordination, among others. Second, it tackles the **elimination of waste** in processes - activities can be wasteful no matter the industry. Beyond that, it can explicitly utilize both project and production management just mentioned.

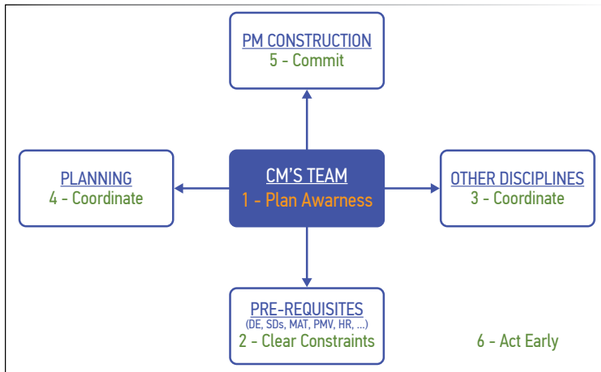
But what exactly prompted many construction firms, including CCC, to choose to apply the lean production system in their business? The answer is that the construction industry has been facing **stubborn, chronic profitability and productivity issues**. According to consultants McKinsey, among others, while productivity has nearly doubled in manufacturing, in construction it has remained flat.[1] Koskela addressed this trend in his famous paper back in 1992, suggesting that the construction industry should apply a "new production philosophy" based on the Toyota Production System (TPS).[2] In a construction context, the word "production" refers to the act of constructing a building or other structure, often component by component (columns, slabs, pipes, retaining walls, and so on). In that sense, it shares many similarities to production in manufacturing, despite other differences. In fact, Koskela's 1992 paper was the first recorded instance of someone discussing lean production in a construction context. "Lean construction" thus was born, and the first use of this term occurred in the following year at the first meeting of the International Group for Lean Construction.[3] The lean philosophy of TPS offers promise, but there is a price to pay, and that is changing mindsets and how companies manage their work.

Construction projects have a **secret weapon** in the battle for better productivity and profitability: the contractually agreed schedule (programme) which tells us exactly when we are supposed to carry out our work. We know the "demand" for our work through to the end of the project. It is like looking into a crystal ball into the future, a luxury that other businesses including Toyota do not have. By being organized enough, an effective lean construction system can use this to maximum effect. If we do, we can reduce variability, smooth the "flow" of work, and boost our productivities, as Toyota did.

Lean construction systems may differ from one company to another, but aim to achieve essentially the same thing. Ours at CCC has as a core with three essential and synergistic components. We call them:

1. **Commitment to plan** (looks ahead three to six months).
2. **Production planning and control** (looks ahead one to four weeks; follows up daily).
3. **Continuous improvement** (happens at every opportunity).

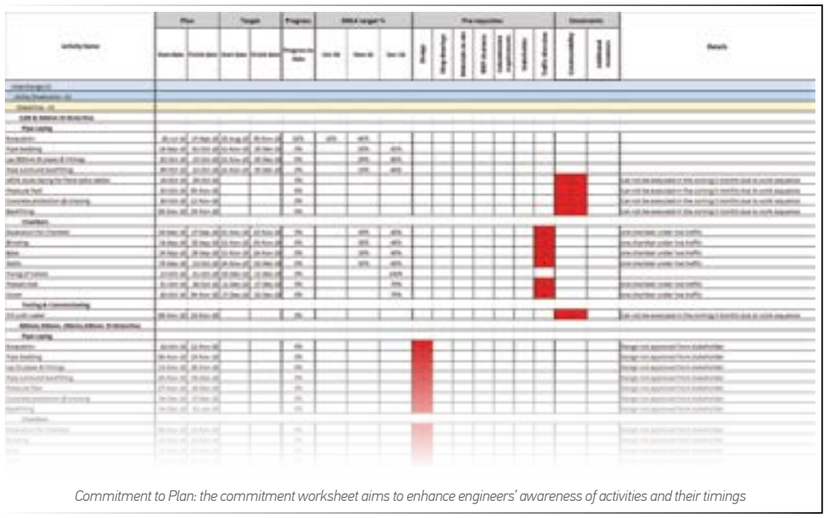
The **commitment to plan** process allows project engineers to think about upcoming activities early - at least a few months into the future. They do this exercise each month. In addition to enhanced awareness, it allows the engineers to clear obstacles to starting (and finishing) their activities on time. It also enables cross-discipline coordination. After each Construction Manager's (CM's) team has determined what they can do, the CM makes a formal commitment to the PM about the work they will do. Making the commitment itself has an important psychological benefit, helping all involved uphold the exercise like a contract.



Commitment to Plan Process: Key Players and Interactions

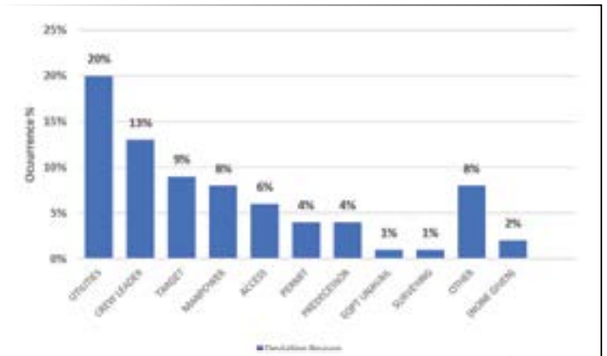
Production planning and control is the most visible part of the process, by design, because it shows the site teams their day-to-day progress. This weekly process involves setting targets for the next few weeks. The team does this after taking stock of their accomplishments in the prior week. **The objectives here carry over from the commitment to plan: enhanced awareness of the plan**. There is also a daily accountability meeting, in which the crews check how well they did and if they did not accomplish targets, they can discuss recovery immediately. This meeting is an opportunity for continuous improvement.

Finally, **continuous improvement**, which is the reason we undertake the "rituals" in the first two processes. This happens at any time as needed; the idea is to make it an ongoing part of one's work.



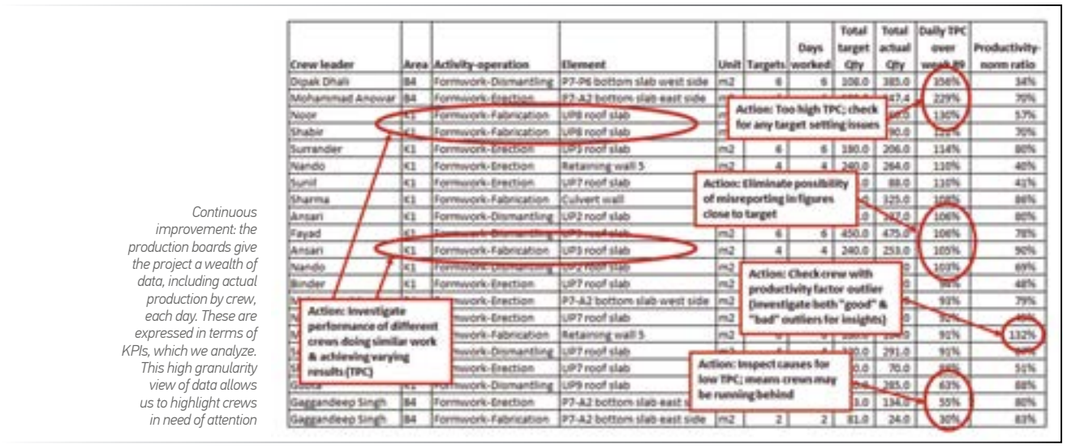
Commitment to Plan: the commitment worksheet aims to enhance engineers' awareness of activities and their timings

For each process, we distinguish between **before** and **after** an activity begins. We tackle the "flow" by clearing constraints, fostering coordination, and improving awareness - before the activity. All this helps to reduce variability and smooth the flow of work, so that the site teams carry out "transformations" on time and with all the resources available. After the activity, we can analyze what we did and improve on it or avoid issues that occurred, for example if the activity started late.



Production Planning and Control: a Pareto Chart showing deviation reasons for why we could not achieve our daily targets. All these represent opportunities for improvement - hopefully permanent if we address the root causes

1. *McKinsey & Company (Jul 2015). The construction productivity imperative. Retrieved from: https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/the-construction-productivity-imperative*
2. *Koskela (Sep 1992). Application of the New Production Philosophy to Construction. Center for Integrated Facility Engineering*
3. *Ballard, G., & Howell, G. (2003). Lean project management. Building Research & Information*



Continuous improvement: the production boards give the project a wealth of data, including actual production by crew, each day. These are expressed in terms of KPIs, which we analyze. This high granularity view of data allows us to highlight crews in need of attention

F. SHAWWA

CCC Case Study

Recent Implementation of Lean Construction

Our recent implementation of lean construction processes at the Al Bustan Street North Project (BSNP) in Doha, Qatar, provides a helpful case study. BSNP was a design and build highways project involving, among other things, an expressway system with four interchanges. It is part of the preparation for the 2022 World Cup in Doha, so Ashghal, the client, was anxious to complete it on time. When my team and I arrived in early 2018, as often happens on projects, we met old colleagues and new faces who felt familiar because we all belonged to the CCC family. At that time, the design was not yet complete, or at least not fully approved for construction. Yet the project team was so enthusiastic about achieving progress that they took it upon themselves to carry out work. In the process, they experienced some abortive and redone works while the design was fluid.

Upon arrival and initial assessment, we realized that because of the design situation, the project was not ready for the production planning and control system. Our new lean construction system, which we referred to as the "Revision 2" had to wait. Instead, we launched the continuous improvement process with an initiative by Oussama El Jerbi (General Manager, area Qatar). It aimed to encourage site teams to propose methods and tools to improve their work. After a waste awareness orientation, the teams set out to work on their ideas and contributed savings totaling more than QAR 12 million (USD 3.3 million).

After that, the project manager for construction, Rashed Shawwa, saw benefits in the **commitment to plan process** and asked us to implement it. Finally, we would implement a Revision 2 Process. It was the product of our lessons learned; we had designed elements of it on our office white boards, and it was ready for the limelight.

The implementation got off to a slow start, as we tweaked some of its elements for real life operations. But with it we had our first glimpses of the much anticipated "culture change" from our lean initiative. This process relied on resolving constraints before an activity was supposed to start. We realized many activities could not start because of issues they had. Initially, the engineers valiantly "committed" to undertaking *all* their activities. We knew this would not be possible for all the activities, and we knew this would only hide the constraints. So we challenged them with "Are you sure you can accomplish this? There are these issues." What we wanted them to do is try a different approach: **Instead of having the engineers pretend they could hit the target, we encouraged them to launch a resolve-or-escalate mechanism**. We told them clear all the constraints you can; if you can't, then escalate them to your supervisor; if he can't, he will escalate them to the Construction Manager; and so on until it reaches Rashed. This process improves the chances that someone could tackle the snags. "If you cannot control it, take its burden off your own shoulders." It worked. I heard a member of the planning team proclaim, "this is the first time I heard [the] site [team] discuss their problems!" We had discussed this strategy with Rashed beforehand and he was enthusiastic about the process and immediately saw what it targeted.

A crew leader at junction B5 reporting progress in the daily accountability meeting

Not only that, but we noticed early on that some engineers had been struggling with the three-month look-ahead schedule PDF file from Primavera. To deal with that, we created an easily readable format that enhanced awareness. The commitment to plan process also allowed the teams that interfaced with one another to know each other's plans, for example, the excavation and the utilities (pipe-laying) teams. At the beginning, they did not discuss plans much, but then we forwarded the excavation team's proposed plan to the utilities team. The engineer was so pleased with the outcome that he asked "Why didn't we do this before?" He was now able to create his own plan. With time, our **commitment reliability** KPI started increasing as the engineers got the hang of the exercise. I was elated to witness the culture change. A small one, but real nevertheless.

Project Manager, Construction R. Shawwa (left) addressing engineers including M. Seder and lean coordinator T. Abdulsamad (right) at a production board on BSNP

Meanwhile, the Athens office was anxious about the lean initiative. Samer Khoury wondered how we were starting to apply lean to actual projects. Up to this point, our work on the ground had involved other things and we waited for the green light to implement our concepts fully, including the "production boards" of our production planning and control process. Then one day we received instructions from Antoine Haddad to **"launch the lean boards"**, a call I still remember, along with the adrenaline rush. It was like he instructed me to fire all weapons and launch the war. "Guys, Tony wants boards everywhere!" I told my lean coordinators, Tarek Abdulsamad and Mitri Karam. They were excited and relieved; within minutes of course reality set in as we contemplated our checklist for things to be done to achieve that: training, data gathering, organizational charts, activities running, site walks to set up production boards, norms to be gathered, worksheets to be designed, crews to be assigned, and so on. Yet after waiting for many months, we finally had a clear signal to proceed. We were ready to go; the full Revision 2 was to see daylight at last, and we had to set it up before Mr Haddad visited BSNP. We worked at full speed, doing a "full implementation" without the external lean consultants, having made changes to their system to make it even more value-added. So we wondered what they would think of that. Months later, I called our consultant at Drees & Sommer and told him about the changes we made to suit the site conditions; he was fully supportive and encouraging.

Success! We set up seven boards, thanks to Tarek's monumental efforts. Oussama had committed to providing six lean champions. Mitri, Tarek, and I worked in tandem, simultaneously orienting the new lean champions while setting up the new system and handling administrative matters. It was a major challenge but also a satisfying one. At the time, we simply did not comprehend the volume of data that the production worksheets would generate. We handled around 12,000 pieces of data per week on everything from target and actual quantities and man-hours to elements and activities and project norms used, reasons for deviation from target and participation. **The production boards were sensors on the site - they measured what was happening with each crew on each day**. They told so much.

Lean Champion R. Al Zamer addressing crew leaders at junction B4's production board

However, we soon experienced implementation issues that demoralized the lean champions. I asked them not to miss the point. **If we could see problems, then the system is working as intended, because we can fix problems only when we know of them**.

Lean philosophy is about planning your work, doing it, checking how well you have done it, and then evaluating how you can improve it. The "PDCA" cycle was in action at BSNP. At the beginning, the lean champions observed that not all engineers were leading the daily meetings, as they should. Some were not setting their targets effectively or on schedule. At that time the production boards were in full swing and we had to be patient as the engineers adapted to the new process and that was our opportunity to help. The site teams also had to shift some crews to do other work than planned, for example to satisfy last-minute client requirements. This disrupted the "smooth flow" we were after. The crew leaders could not come to terms with putting a "zero" for actual quantity achieved next to the target, after all their hard work. We understood this; the changes were not their fault. We still needed to address the root causes preventing our smooth flow.

BSNP was our best project in the lean initiative, but we still have a long way to go. The project team accommodated us and were supportive, but we could tell that many times their minds were on more immediate challenges on site. The lean production system has not yet changed "the way we work", nor has it fully pervaded the site teams' minds. Nevertheless, the engineers have experienced promising improvements and many of them are beginning to understand its benefits. I am sure that in the next iteration we will achieve even more productivity successes, on our journey to making CCC a lean enterprise.

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Z.HADDAD / S. KECHICHIAN

LCM Digital®

The World's First Innovative Cloud-Based Platform for Digital Scheduling and Efficient, Lean Construction Process Management

Given CCC's driven record in visual project controls and its award winning 3D-based planning and site management tool for Advanced Work Packaging (AWP) and Lean Site Management - C3D Planner; along with its prestigious knowledge of BIM, CCC was approached by Drees and Sommer, an international project management consulting company as well as Lean Construction Management (LCM) experts, to develop in partnership with them a new cloud-based platform for efficient construction-planning and execution management - LCM Digital®.

Development of LCM Digital commenced in November 2017. With a vibrant vision in mind for both partners, a Beta release was launched towards the end of April 2019, and a go to market release in July 2019 will be available on various platforms and browsers for PC, Mac, iPad, Android, etc. LCM Digital is the only platform available in the market that addresses the high customer demand for online collaboration and disruptive planning tools.

Check out the video at: *https://youtu.be/s7NY0L4QA60*

Lean construction as well as AWP advocates intensive site interaction down to the level of trade supervisors. It is only natural that the use of tablets and/or smart phones be emphasized. LCM Digital is the first step in transforming C3D Planner into a cloud-based, relatively light application.

LCM Digital is based on the lean construction management method, which is abbreviated as LCM®. Using the traditional lean principles of the look ahead schedule (LAS), LCM Digital allows for the preparation of the 4-week look-ahead and distribution of this LAS as daily cards in the Kanban Board in both electronic and printable versions. In order to make the transition smooth and reduce the resistance on site, LCM Digital doesn't impose the digital/electronic version for site management. LCM Digital was also designed to cater for sites that have 'offline' locations and need LCM Digital for workshops and site management. Whether it's the cloud-based platform accessible from the web or LCM Digital's mobile app, both allow for 'offline' use and immediate synchronization once back online.

With CCC being one of the biggest Building Information Modeling (BIM) advocators in the Middle East, LCM Digital is also being developed in an intelligent way that will allow for an easy link to BIM, making it the first platform ever to do so. By linking Lean and BIM, we speed up the population of the schedule, produce a more realistic duration for each operation by providing accurate quantities in the 3D Model, and by linking to the budgeting system, we are able to do earned value analysis based on actual progress collected from site (coming 2020).

LCM Digital offers high value during the planning process as it is based on the best of both construction know-how and the Takt Time Approach of Lean Principles. 'Takt time' is a term used in manufacturing to describe pacing work to match the customer's demand rate (just-in-time). 'Takt time planning'

is similar to the line of balance (LOB) planning methodology used typically in pipeline and road construction planning. These projects have crews executing the work one after the other and try to maintain the same production rate for all the crews so that these crews never collide with each other thus maintaining a laminar flow of work (Figure 1). LCM® Takt planning has been proven in over 450 projects over the past 12 years, improving project performance - there is no other product as comprehensive and with full services as LCM Digital.

LOB Planning has proven much harder to implement for more complex construction projects. LCM Digital has developed a standardized approach to assist the project team to divide the project into components (Zone Type) that have similar execution methods and approximately similar durations.

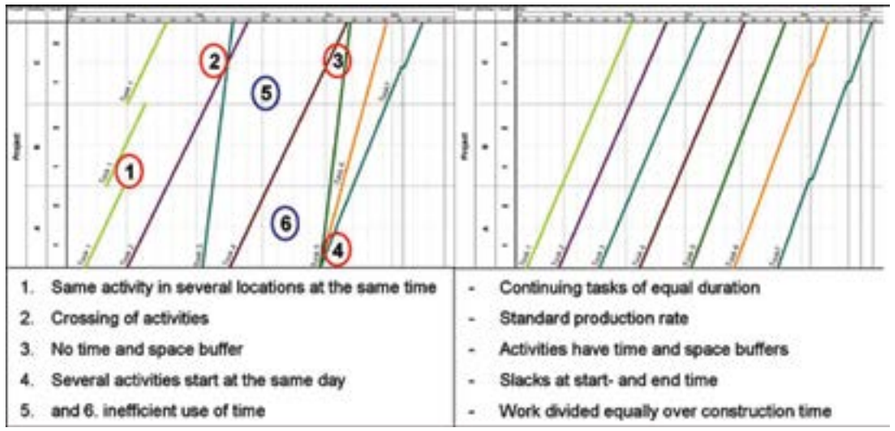

Figure 1: *We have changed the size of the crews to maintain the parallel lines*

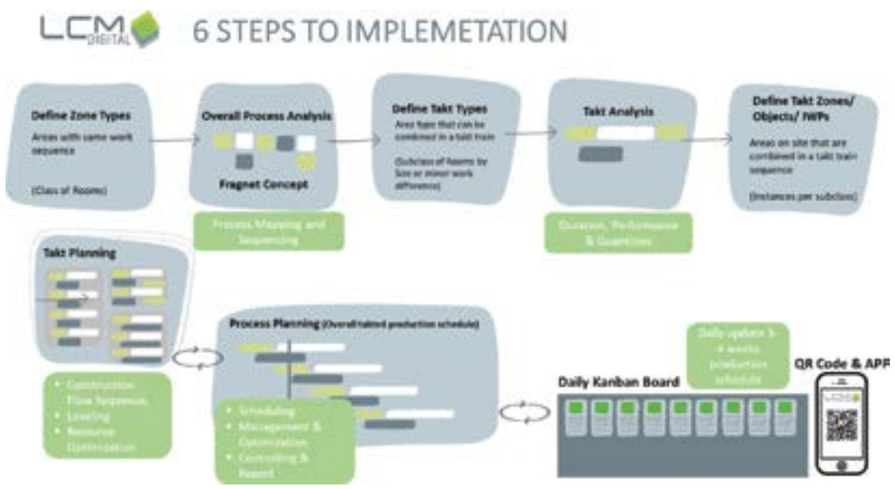

Figure 2: *LCM Digital's 6 steps to reach the automatically generated Process Plan*

Planning

LCM Digital standardizes the process by dividing the project into components (Zone Types) that have 3 things in common:

- Similar execution methods (Fragnets) (Figure 5).
- Same phase (Foundations, Structural, Open Spaces, Rooms, façade, and hand-over).
- Approximately similar durations.

Deciding on how to divide the Zone Types in a project does not follow a definitive approach and highly depends on the project teams' construction methodology. Two examples will be provided to show how the concept and process can be applied flexibly to suit the projects' needs.

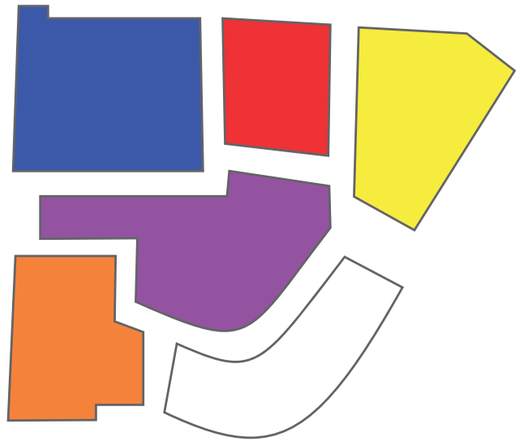

Figure 3: *Example 1 - A Zone Type is an Apartment*

In the first example (Figure 3), the floor is split into 'apartments' which means that the work content and execution methods are defined for the whole area and do not go down into smaller areas such as rooms. Let's assume the typical area for one area/apartment is 300 square meters. To achieve the 300 square meters, we can have one area composed of one large apartment (approximately 300 square meters) and another area is composed of 2 medium apartments (total combined area is approximately 300 square meters) and a third area is composed of 3 small apartments (total combined area is approximately 300 square meters).

In the second example (Figure 4), the floor will be split into 'room types' which means work content and execution methods are done per room. A floor can be split into room types like 'Wet Rooms, 'Dry Rooms, 'Utility rooms' and 'Balconies'.

Figure 4: *Example 2 - A Zone Type is a Type of Room*

Figure 5: *Finishing Fragnet - A fragnet is the sequence of work to complete all the operations in one zone type and phase*

LCM Digital®: The World's First Innovative Cloud-Based Platform for Digital Scheduling and Efficient, Lean Construction Process Management

FEATURE

Site input is received from trade managers who will detail the required discipline crew composition and sequence of operations needed to achieve the Takt pace. If the BIM model is available, the BOQ's for that room will help ensure that no operations are missing and further refine the scope of each operation. Additionally, the trade manager will also identify and detail the constraints that need to be cleared before the work can be done. These constraints are called stability criteria.

Figure 6: *Stability Criteria*

Constraints are assigned to construction, procurement, engineering, site supervisors and subcontractors who are responsible for clearing these constraints. Defining those constraints and clearing them in time is the basis of lean construction/just-in-time principles and must be taken very seriously by the top management of the project (client, engineer, contractors and sub-contractors).

The next step is to generate the actual instances of the Zone Types, also referred to as the Takt Zones. For example if the Zone Type is a 'Wet Area', the Takt Zones will be the kitchens and bathrooms in that building. The next step is to define the sequence of work to be done using Trains (Figure 7). A train is a set of trade crews responsible for completing some or all Takt Zones within an area/ sub-area of the project. Usually a train will be composed of Takt Zones having the same Zone Type but the system is flexible and allows for different strategies in construction planning and execution. To speed up the construction process, the building can be divided into more areas and have a similar set of trains circulating within each area. A special feature of note is the ability to create intra-train constraints such as the completion of the façades before completion of the tiling in the outer rooms since the façades are anchored under the tiling, and so on.

Figure 7: *Takt Train containing crews of different trades passing through a takt zone (Apartment/Room)*

LCM Digital, based on the above information, will generate the Process Plan (Figure 8) which is the detailing of work that needs to be executed by each crew in each Takt Zone (Apartment/ Room) on every day of the project. LCM Digital provides the flexibility of regenerating the process plan to cater for problems faced in project execution. This iterative approach allows for robust change management capabilities. LCM Digital also allows for manual modifications of the process plan and maintains the changes even when the process plan is regenerated.

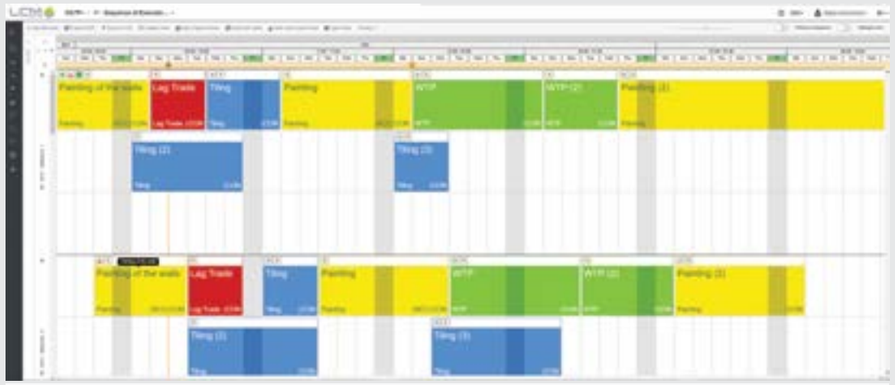

Figure 8: *Generated Process Plan*

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Production Management

LCM Digital will print a daily job card for every crew for the next 4 weeks (Figure 9). These can be used on a typical Mechanical Kanban Board (Figure 10): alternatively the digital planning board (coming soon) can be used instead. The Kanban board shows the Takt Zones on the left hand side and the cards on the right hand side. Each card is color coded to show the trade it belongs to. This allows for the trade manager to easily spot and pull his own cards in the area he needs to work. The card also has a QR/Barcode code to allow for progress collection using the LCM Digital Mobile App (Figure 11, Figure 12).

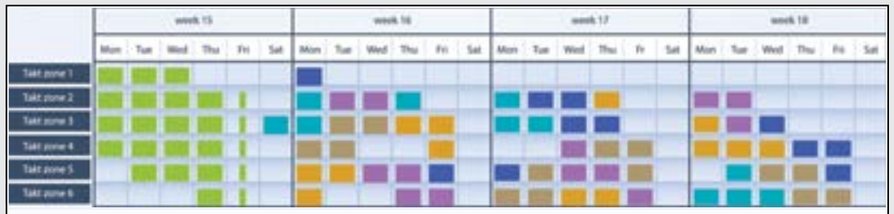


Figure 9: *Kanban Board - notice that week 15 has all complete steps except for one and this will move to the next week if it is not done within this week*

Figure 10: *A Mechanical Kanban Board*

Figure 11: *Collecting progress using Mobile and QR Code*

Figure 12: *Collecting Progress using Barcode reader*

Figure 13: *The 3 strategic steps of LCM Digital*

LCM Digital can be used both online and offline with a smartphone, tablet or computer. A rich dashboard with standard reports, complete data import/ export capabilities, and progress approval cycle will be coming soon. The innovative platform thus acts as an interface between human experience and digital data, and is used to deduce standard processes, identify inter-dependent elements, and indicate the next steps in the process and assist in finding any possible risks and planning mistakes. This leads to genuine online collaboration, more effective meetings, and stable and transparent deadlines and processes.

Next steps… Where do we see LCM Digital on Mechanical Projects?

Currently CCC utilizes its lean-based software - C3D Planner - for AWP Implementation at several oil and gas projects in the UAE, Muscat and Kazakhstan. What differentiates these projects is the large number of components that are better handled by C3D Planner as opposed to the LCM Digital. CCC and Drees & Sommer are committed to move these capabilities to LCM Digital soon.

The strategy is to create Construction Work Packages (CWP) - multi-discipline and multi-phase geographically defined divisions of the project, for example a section of a pipe rack. This CWP is in turn divided into Installation Work Packages (IWP) that are Mega discipline (Phase).

These IWPs are:

1-Underground, **2**-Structural Steel, **3**-Piping, **4**-Electrical & Instrumentation and **5**-Handover.

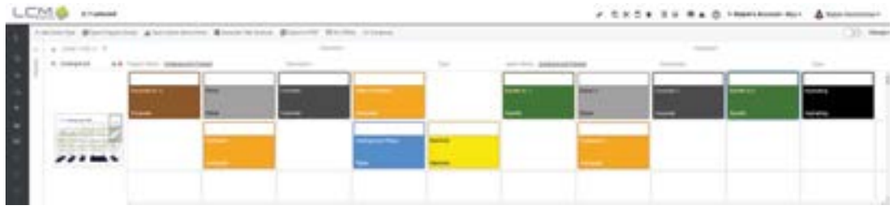


Figure 14: *A typical Fragnet for Underground facilities*

It's evident that we will have five trains circulating throughout the project, each train will correspond to one type of IWP and will go from one section of the pipe rack (CWP) to another completing its own phase. So there will be a train for underground, a train for structural steel, and so on. Each train will be composed of the crews that are needed to complete the work in each of these IWPs. Naturally, we assumed that the CWPs/IWPs were created to have the same scope of work as the aforementioned Takt Zones.

CCT has developed a series of tools to further optimize the planning of complex construction projects especially if it is too hard to use the Takt Principle i.e. variability in scopes prevents the LOB Principle. Please read the article in the next Bulletin **'To Takt or not to Takt… that is the question'**.

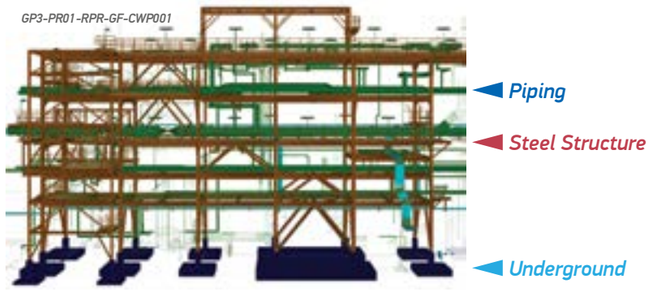


Figure 15: *Construction Work Package - a section of the pipe rack (structurally sound section)*

For more information on LCM Digital, contact Salpie Kechichian (Dubai, Tel: +97142750107) or send an email to information@lcmdigital.com.

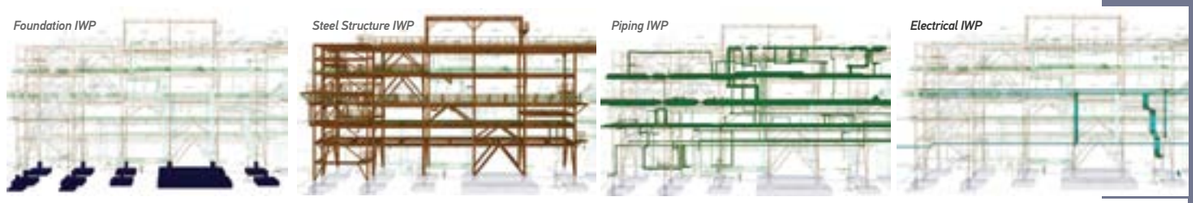


Figure 16: *Installation Work Packages*

The Beginning of a Journey

Back in July 2017 I was requested to go to Atyrau on an urgent basis in order to participate in the tender clarification meeting with TengizChevrOil (TCO) for the ME&I Blue Project in Tengiz.

My involvement in the meeting was specifically about how CCC would carry out the workface planning (WFP) activity at the project.

I heard nothing more about this until May 2018 when I had another meeting with TCO but this time it was about defining the number of people required to successfully execute the WFP.

Based on the scope of work, an agreement was reached to have a team of 20 workface planners.

Finally, in September 2018 as part of the early execution preparation team, the team mobilization started.

The Workface Planning Department got involved in the schedule preparation, the engineering deliverables, the field engineering preparation and CCC supplied material. All of this was not done intentionally, such involvement being a by-product of the workface planning activity.

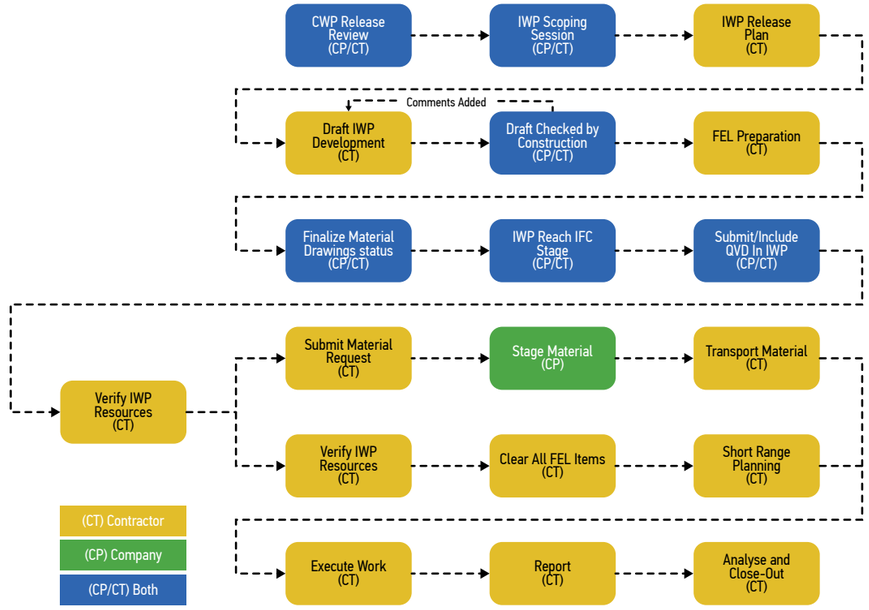
How WFP Got Involved in the Schedule

Originally the schedule was prepared to meet the basic contractual terms with TCO. When the WFP activity started to kick-off, the activity related to the first 90 days of work were identified. Naturally the preparation of Installation Work Packages (IWP) would be based on these activities. The challenge was how to guarantee that the IWPs would cover all of the scope of the first 90 days activities.

A meeting was held between CCEP and TCO where it was agreed to ensure the project schedule contained enough properties and levels of detail to allow a smooth link between construction activities, corresponding BOQ and corresponding workface planning.

The second challenge was the engineering deliverables. There is a myth in the construction industry which considers that the complete capital project is represented in an intelligent 3D model that delivers state of the art visual reports, alerts, constructability and so on. Unfortunately this is never the case. In this project, 80% of the scope is not modeled in 3D which includes for instance the five gas turbines, the slug catchers, the pig receivers and the buildings. In reality the only modeled parts were the base plates, stick built structural steel and Fluor designed piping.

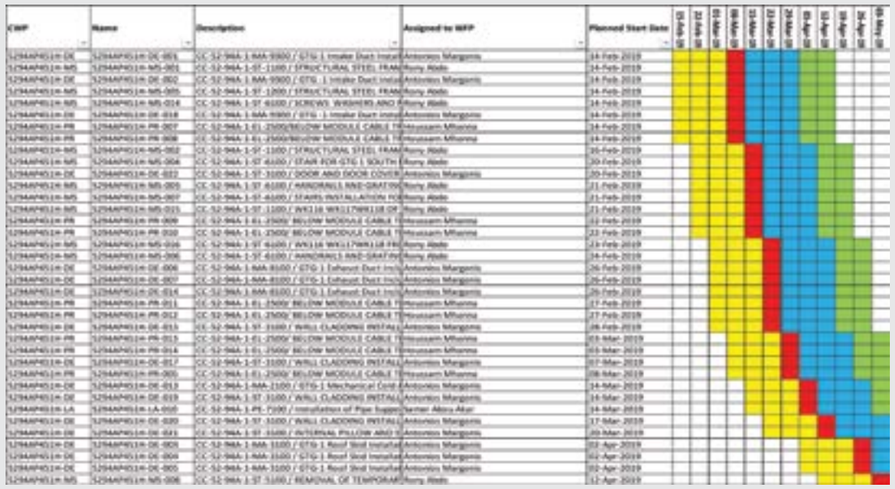
This workflow elaborates how the WFP team needs to work.



In the CWP release meeting the client and CCC met in order to identify the maturity of design and availability of material for the packages that need to be installed after three months. These CWPs are issued as bulk release where the list of drawings is forwarded to the WFP team to study prior to the release meeting. Once the releases are agreed upon, the CWP list of drawings is issued to CCC via document control.

In the scoping meeting the WFP team meets with the construction manager responsible for the released CWP and agrees on the sequence of work and the sizing of the installation work package. In this meeting the WFP engineer needs to make sure that construction requirements are without compromising the schedule WBS or the BOQ level of details: we even added the schedule activity to the IWP title to simplify the reference. Normally if this is not taken into consideration, reporting progress and preparing payment application becomes difficult.

When the scope is agreed, the WFP team prepares a schedule of IWP releases. The typical timeline for preparing an IWP from draft till it become a constraints free IFC is around two months.



In order to underline why having a 3D model is important, let us look at how the IWP is prepared with a 3D model and how it is without one:

- With a 3D model, the workface will open the model, select the object that he needs to package, for instance a structure, and the system will find all installation drawings, material take-off, produce material requests, progress steps, resources, man-hours, constraints. In short, the workface planner can concentrate more on clearing site constraints rather than searching for drawings. A typical IWP in this case needs around one hour to produce.
- Without a 3D model, the workface planner identifies the CWP, searches for the drawings (he will definitely need to identify missing ones as he goes through the references), the material take-off needs to be checked against stores and generated, progress steps need to be added, man-hours calculated, progress steps added per item. A typical IWP in this case needs a full working day to produce.

When preparing the front end loading checklist it is normally challenging to get the level of detail right: too much detail and the checklist becomes just another document that the site engineer fills in to keep you off his back; too little detail and we might miss a critical constraint that could stop the job. A number of meetings were conducted between the WFP and the construction management and an average of seven line items per stakeholder totaling 60 per IWP was agreed to be a manageable checklist.

STAKE HOLDER	NUMBER OF LINE ITEM
Construction	8
Construction Documents	7
Manpower	4
Material and Tools	16
Plants and moving Equipment	8
QC	3
Safety	21
Grand Total	67

It was also agreed to remove generally cleared constraints from subsequent IWPs. For instance, if a welding procedure or a grout method statement is clear, it will not show up in any future IWP.

In order to finalize the drawing status in a hybrid system, the WFP engineer needs to first identify the drawing in the client's system and request the drawing to be officially transferred to CCC via document management. This is tracked by adding a constraint referencing the drawing. This happens during the draft preparation; however, when an IWP reaches the IFC state, the WFP engineer must ensure that such a drawing is with CCC and has an IFC revision and then the stakeholder, in this case the document controls, needs to close the open constraint to be considered as cleared.

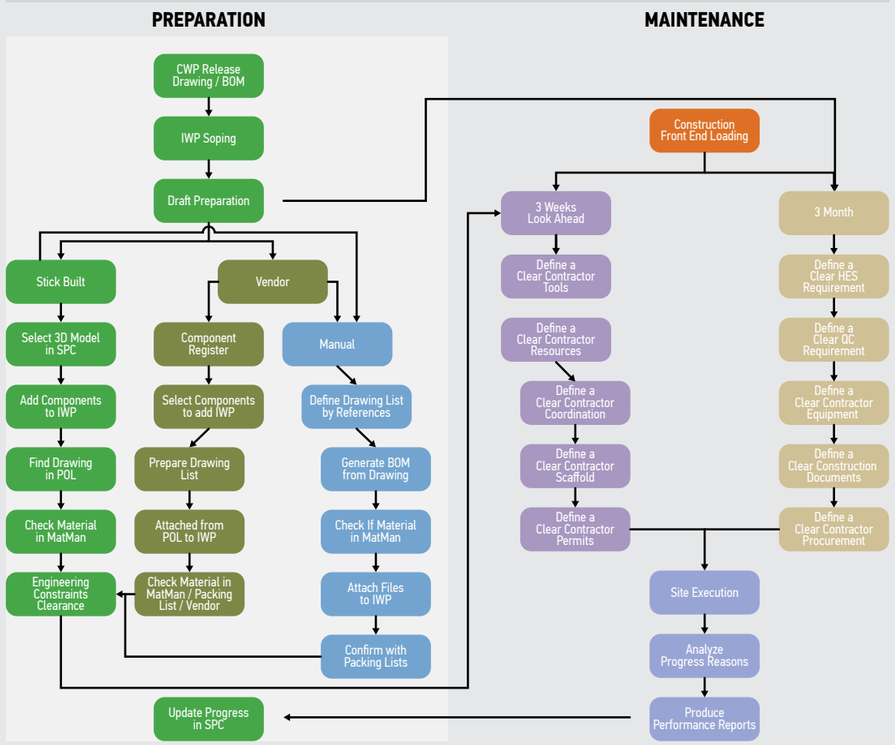
The client's system allows running material checks per IWP. When the draft is prepared a preliminary material check is carried out: depending on the result, if the material does not have a record in the store system, a constraint gets added to address the missing material as it might not be ordered in the first place. However, if the material has a record, the WFP engineer checks whether it will arrive by the time the job starts and if not, a constraint gets added. Only IWPs that have material records are sent to construction for draft approval.

When the IWP is ready to be IFC, a copy of the material request is sent to stores in order to stage the material, book it and provide a pick ticket for site team to pick it up.

In an attempt to minimize the difference between progress produced by the schedule and approved progress by QC, the WFP team requests the Inspection QC forms (QVD, in this project aka Quality Verification Forms) from the client and attached them to the IWP in order to immediately request QC verification over completed IWP.

At the beginning of the contract, CCC and the client agrees on the classification of WFP engineers where they are divided into two categories by responsibility. The first is Preparation and second is Maintenance. The flow chart shows clearly the various responsibilities.

Work Flow Of WFP Team



The client, whose engineering contractor was other than the construction contractor, needed assurance that should the job start as per planned, there would not be any major delays due to engineering, procurement and handover from the under-ground contractor. For this task, the client solicited the expertise of the WFP team where he required the 90 days IWP to be constraint free, as mentioned earlier.

At first, a large number of stakeholders were skeptical as to what added value such an exercise would have over the engineering and planning effort. However, when the WFP team started the exercise, the added values in plural started to surface. We will mention some of the findings that shaped the way the project would proceed.

1. The grouting method statement became a critical document after realizing that more than 60 IWPs are affected and that the rest of the structural activities could not be completed without the installation of the equipment.
2. The welding procedure priorities were dictated by the WFP team. For instance, when going into the detail of the slug catcher installation, they found out that welds are between the baseplate and the equipment.
3. The GTG sequence of packing and the delivery of loose items to site were provided by the WFP team after finding out that bolts, beams and many other structural items were not yet packed.
4. Many missing drawings were identified by observing the references.

This sort of exercise set the rules for the project deliverables for both the client and CCC. Managers across the board were equipped with information that helped them focus on the pressure points in order to be ready when boots hit the ground. All of this information was identified four months prior to the start of construction.

WFP is a very effective project management methodology as it identifies constraints ahead of time which gives decision-makers the time to mitigate issues. However, WFP alone is not enough as it only covers the activities preceding the execution of construction activities.

Contractors across the globe are trying to mitigate this short fall by complementing the WFP management approach with production control, lean construction, construction simulation and others. In this project the client is testing the production control to verify its effectiveness in improving productivity and delivery.

In conclusion, it is to be noted that during the past seven months we have witnessed the power of having WFP prior to the beginning of construction. CCC, with its wide experience in producing field and fabrication drawings, providing estimates and budgets at the lowest level of detail, knowing what resources were used and where even at IWP level, CCC has a unique potential to transform the WFP method into an unprecedented competitive edge.

Advanced Workpackaging (AWP) - Get Ready!

A work package is a portion of the project scope. Typically, a work package has a well defined scope, budget and schedule. We use the work packaging process when we create the project work breakdown structure where one of the lowest levels of control is often referred to as the work package level. Construction managers subdivide the project into series of contracts, often referred to as work packages, too. At CCC, we refer to construction cost accounts as cost work packages. Hence, work packaging is an old well-established project management approach. So, what is this new approach called "Advanced Work Packaging" (AWP)? Why have several major oil and gas and power companies started to mandate the implementation of AWP approach in their new projects? This article provides an introduction to the approach, its key requirements, benefits, and challenges.

To start with, there are four key requirements to properly implement AWP in a project, even small ones, as advocated by AWP advocates.

The first and most important requirement is the open communication and collaboration between all stakeholders (the owner, EPC, suppliers, contractors and so on). The role of the owner is key to building this collaborative relationship between all stakeholders. The owner plays an active role starting from the contractual terms, to set procedures, to his constant participation in resolving conflicts and removing constraints.

Secondly, the AWP approach mandates early definition of "Construction Work Packages" (CWPs) as early as the FEED design phase. This entails agreement on "path of construction" (i.e., overall construction sequence and key milestones). Naming these packages as "construction" work packages means that the emphasis and the main priority is to follow the construction view in subdividing the scope into work packages. Hence, CWPs are a key management level for controlling the project. Typically, CWPs are multi-discipline parts of the scope representing a construction sub-area. The AWP approach mandates project baseline EPC schedule to be "CWP-based", i.e., CWPs definition is at higher level of the WBS and the activities represent the work required to complete each of these CWPs. Moreover, E&P activities should be based on meeting CWPs priorities. The AWP approach requires that Engineering Work Packages (EWPs) are to be aligned with CWPs. The main objective, and the main reason that we should advocate the AWP approach, is that CWPs would not be released to construction unless all key engineering and procurement deliverables are releasable to construction. No longer is engineering progress assessed only by the status of their deliverables but a number of released IFC deliverables that are required for scheduled CWPs. Material delivery needs to be aligned with CWPs release to construction. Definitely, this is not easy and requires significant changes and additional effort and resources from E&P companies to meet such a mandate.

Thirdly, CWPs that at "IFC status" once released to construction need to be subdivided into smaller work packages. These are called Installation Work Packages (IWPs). IWPs are a single discipline set of activities that can be completed in 1-2 weeks under one supervisor (e.g. a foreman). IWPs are the main activities for the 3-week look-ahead schedule. Typically, these IWPs are further subdivided into progress steps.

The fourth and essential requirement for proper AWP implementation is having dedicated IWPs planners on-site (similar to AWP-planners at the EP office). These are called workface (WF) planners. Their duties are commonly referred to as workface planning (WFP). WF planners should have good site experience and coordination skills. WF planners typically report to the construction manager. Their role is to collaborate with the AWP team of the client and other stakeholders in refining the definitions of CWPs; this is why it is recommended having the contractor on-board early. They develop the required IWPs for each CWP and define the required resources, man-hours, time and all constraints necessary to complete each IWP. They work with different parties on clearing various constraints and securing the required resources to complete each IWP within budget and on-time. They need to report on the progress of their IWPs and any issues that are holding their completion or lessons learned. This is quite an extensive

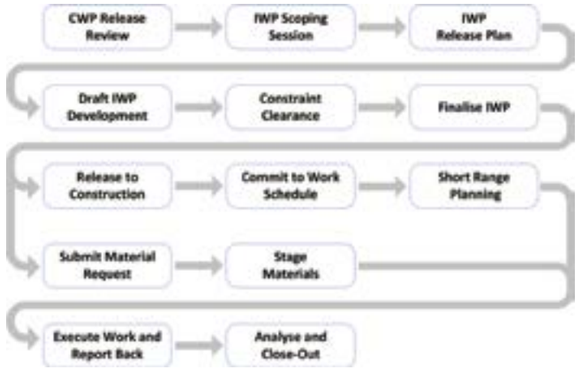


Figure 1: *Workface Planning Process*

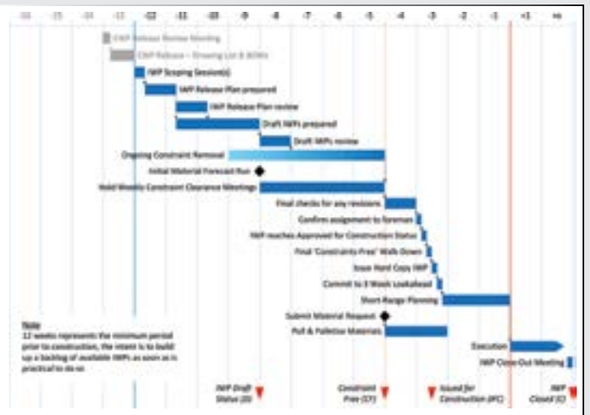


Figure 2: *IWP Timeline*

effort given that each IWP represents work to be completed in 1-2 weeks. In a large project, the number of IWPs could be more than 10,000 IWPs.

The workflow and bar chart (figure 1) diagrams provide an example of the workflow and recommended timing from the CWPs' release to construction to creation of IWPs and their closeout.

The above rigorous approach was originally developed by the Canadian Owners Association of Alberta (COAA) in 2007 after experiencing major financial overruns and schedule delays in many large projects in Canada. The AWP development taskforce team evaluated several management methods including the Lean/Last Planner approach, WBS approach and shutdown planning. They originally wanted to adopt the shutdown planning approach but found it to be excessive to manage the entire project scope. So, people familiar with shutdown planning will observe the close similarities between the two approaches. The approach was later adopted by the Construction Industry Institute (CII) who issued several guidelines for implementation such as RT-272 and RT-330. More information about these guidelines is available in the CCC Knowledge Portal Fanous, *https://km.ccc.gr*.

CII & COAA surveyed the implementation of AWP in several projects and reported significant improvements in safety, quality, cost and schedule. In some cases, improvement in schedule and cost exceeded 10% of the original plan and budget. For skeptical individuals, I would say that AWP is, at a minimum, forcing EP companies to put additional efforts in engineering and procurement trying to ensure that their deliverables are aligned with construction priorities as detailed in the CWP-based baseline schedule. Moreover, IWP planning with close client involvement provides clear evidence to all parties as to what are the real issues that are causing delays and aborted work. It is easy to find out, for example, why a shortage of a certain fitting is causing delays although large quantities of piping have been delivered to site. Moreover, we can easily report on out-of-sequence as well as abortive works. However, we need to do a better job in planning and preparation for subsequent IWPs.

In order to be ready for the AWP implementation, we need to take some basic steps (some of these steps are underway):

1. The CII Guidelines are meant to help organizations to develop their internal procedures and best practices. The CCC Constructions Support Department has recently issued (in collaboration with Information Systems & Knowledge Management Departments) the first CCC Workface Planning Procedure. The plan is to implement it in the next AWP-mandated project to be awarded to CCC. The procedure is available in Fanous for comments.
2. Project organization requires further evaluation to be aligned with AWP/WFP requirements. As we are introducing a new team, i.e. workface planners, we need to have a clear description of their duties and responsibilities, their interfaces with other departments (e.g. planning) to avoid any overlap of duties. The role of various site departments such as field engineering, project control and IT is to support the WFP implementation. The approach also requires other new supporting functions to be added to the organization such as WFP technicians. We suggest including the WF Planning role in the career path for our site engineers.
3. AWP/WFP implementation requires an extensive flow of information between the parties, grouping and subdividing project information into IWPs, linking various data from sources such as engineering, procurement, planning, budget, and quality control. This requires detailed EDI meetings with various parties, rigorous testing of the data interfaces and requires a massive effort and commitment of all stakeholders to ensure that data is easy to integrate and up-to-date.

Above all, we need a powerful system that can efficiently integrate and subdivide scope and requirements, manage constraints, enable 3-week look-ahead planning based on IWPs and report on their progress.

Advanced Workpackaging (AWP) - Get Ready!

Fortunately, CCC has been working for several years on developing C3D Planner software that provides all the needed functionalities. Commitment to C3D implementation has to be made by all parties in CCC.

4. Hold in-house orientations sessions on the AWP/WFP approach and its requirements.
5. Establish knowledge management CoP tasked with enhancing CCC procedure
6. Gather lessons-learned and useful KPIs from current projects that are implementing the AWP/WFP approach with an emphasis on TCO projects being the largest CCC project implementation with extensive client requirements which are aligned with CII recommended practice.

for WFP as well as develop mitigation strategies to address the several limitations that currently exist in the CII's recommended practice. Some of these limitations include managing the transition from a large CWP to small IWPs, integration of prefabrication, detailed management of constraints, improving supply chain integration, integrating testing requirements and so on.

CCC is expecting next year the award of several large mechanical projects. Tenders for these projects mandates the implementation of the AWP/WFP approach. Therefore, we should use the current period to get ready for these projects.

Figure 3: *C3D - Data Integration Platform - List of Interfaces (partial)*

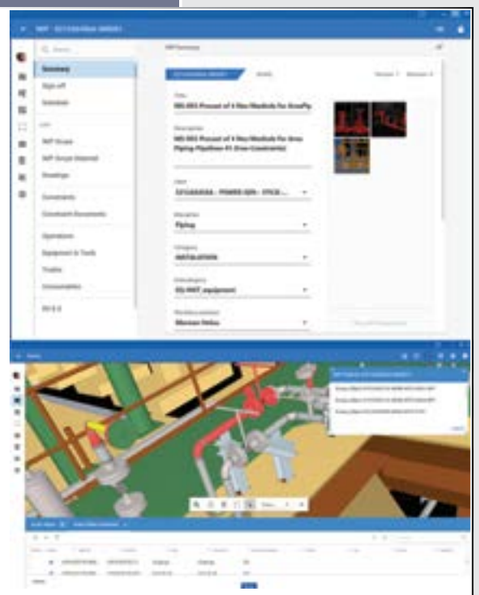


Figure 4: *C3D Planner - AWP/WFP Management Module (to be release soon)*

FRONT END LOADING
CHECK LIST ITEM STATUS
BHP PROJECT OMAN

IWP FOR STEEL STRUCTURE FOR SUNS-61-002

IWP No.:- [redacted] Start Date :- 21-Jan-17
IWP Type :- CS-LOH End Date :- 31-Oct-17
Printed Date :-09-Nov-2018 Man Hours.:- 44039

1	Construction Documents	Method Statement for Structural Steel Erection	3M	CCC	Yes	Available	[redacted]
2	Construction Material	Welding Consumable Availability	3W	CCC	No	Available	NA
3	Construction Tools	CCC Regular Tools	3W	CCC	No	Available	NA
4	Engineering	AFC Drawings IsA / Fabrication / Erection	3M	PDO	Yes	Available	[redacted]
5	HSE	Steel Space & Access Availability from Civil	3W	CCC	No	Available	NA
6	PMV	Crane, Welding Machines, Generators, Manlift Inspection	3W	CCC	Yes	Available	[redacted]
7	Procurement	CCC Material Earth Grounding Braid	3M	CCC	Yes	Available	[redacted]
8	Procurement	PE Raw Material Delivered to Subcontractor (Profiles, Plates)	3M	PDO	No	Available	NA
9	Procurement	PE Fabricated Material from Subcontractor (Cable Tray Cahnnel+ Access Platform+ Ladder/Modular Railing)	3M	CCC	Yes	Not Available	NA
10	QA/QC	[redacted]	3M	PDO	Yes	Available	[redacted]
11	QA/QC	QCP for Visual Inspection of Weldments	3M	CCC	Yes	Available	[redacted]

Figure 5: *Example Constraints List (Partial) Report from C3D*

D. MAVRIKIOS

International Institute of Welding Meeting

Greece

On May 22, 2019 CCC hosted the annual / intermediate meeting of the International Institute of Welding and its Sub-commission XI-E: Transmission Pipelines. The IIW promotes cooperation between researchers, industry practitioners and educators from 50 countries around the world.

The IIW is an organization that promotes innovation, education, qualification and certification of individuals and companies. Through its commissions, it holds annual meetings in various countries globally to share information on new developments and findings of its members.

This meeting was attended by 18 highly profiled welding professionals from leading companies and institutions, to name but a few:

- Arcelor Mittal
- Lincoln Electric
- Swiss Pipeline Authority
- DNVGL
- Pipeline Technique
- Serimax
- Vincotte
- Gasunie NV Nederlandse.

Various topics were discussed with advanced technical value as they represented the latest developments in the industry. Some of these topics covered the fields of advanced welding processes, metallurgical issues in sour service pipelines, the effect of shielding gas composition on weld bead geometry and welding consumables advances.

The IIW meetings provide the opportunity to meet people from major players in our industry and develop opportunities for future sharing of information.

It is worth noting that CCC through our Harry Liratzis presented its own paper while one of the presenters is a committee member of the API 1104 international standard for the construction of pipelines.

N. HUSSEINI

Ramadan Iftar Tours

UAE & Qatar

This year our Ramadan Iftar tours took place in Abu Dhabi on May 8, followed by Doha the next day.

It was a great opportunity to meet the seniors of the various Gulf countries congregated together for such a grand occasion as a Ramadan Iftar.

Many speakers addressed the audiences present, namely Samer Khoury, Suheil Sabbagh, Nazih Abdul Kader, Bahjat Mousa and Ousama Jerbini.

Interesting subject themes were fielded:

- **2019** is a turnaround year; from 2020 our volumes rise sharply.
- **Safety** was as always highly emphasized. Muallem Samer cherishes this heavily as a CCC family value. Treat your employees as family members and protect them as you protect yours.
- **Productivity improvements** of even 5% can make a big difference. We expend millions of manhours annually. Work Face Planning and Lean Construction were encouraged for better controls and productivity.
- **Cash Management:** we have to be firmer on our receivables. A healthy and timely collection improves flow and reduces bank lending overheads.
- The President's initiatives impact innovation, sustainability and creativity. Area staff are encouraged to engage in these initiatives. They are setting the trends for future automation and execution.
- **Projects** pop up where they pop up, not just where we like to live! Therefore, flexibility in relocation is expected and appreciated, given the tight market.

An open discussion followed the presentation of these ideas and they were all frank, honest and pragmatic. Our colleagues realize that we are passing through a seasonal tough time and some employee accommodations and concessions have to be made. After all, united we stand, divided we fall.

AREA NEWS

C C C
Bulletin Issue 129 | 2nd Quarter 2019

DR. M. SHAMI

PMP Exam Prep Review Course

UAE

The CCC Training & Development Department ran a five-day course entitled "Project Management Professional (PMP) Certification Exam Prep" which was held in Abu Dhabi from June 16-20.

35 Professional Development Units (PDUs) from the Project Management Institute (PMI) were earned.

Thanks go to the UAE Area Management, Human Resources and Services for their support and collaboration.

PMP Exam Prep Review Course

AREA NEWS

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V. KEFALAS / L. AGGELOPOULOU

Women in Engineering and Construction

Spotlight on a Timeless Industry Role Model

Diversity and inclusion are important topics across industries and regions. The bottom-line business case for greater levels of gender diversity has been increasingly well-researched and understood. [1][2] Apart from just being 'the right thing to do', having a diverse and inclusive workforce improves organizational performance.[3] To build and maintain a competitive, high-performance organization requires a mixture of experience, skills and perspectives, including gender diversity.

Particularly in the construction industry, another main driver setting the wheels in motion for more gender balance is the massive need for talent.[4] Professionals in the construction sector regularly discuss the shortage of workers: perhaps making diversity a priority could offer a viable solution. Specifically regarding gender inequality in construction, the Chartered Institute of Building (CIOB) reports that women make up only 13% of construction sector employees, a number which has not changed in two decades.

Similarly, according to the UN, a significant gender gap has persisted throughout the years at all levels of science, technology, engineering and mathematics (STEM) disciplines worldwide. Currently on an international level less than 30% of researchers are women and around 30% of all female students select STEM-related fields in higher education, of which: 4% in information, communication and technology (ICT), 5% in natural science, mathematics and statistics and 8% in engineering and construction.[5] Although the same data for the Arab countries are higher (with up to 57% of STEM graduates being women)[6] attracting and retaining female talent in the regional construction industry remains a challenge.[7] This "leaky pipeline" - the gap between the number of STEM-educated women and the actual number of women working as engineers - is also visible in the number of women moving into senior leadership positions[8].

Significant efforts are being coordinated in the MENA region to promote women in engineering and construction and raise their visibility. Companies are establishing specific targets and programs such as an equal male/female graduate intake and mentoring initiatives. At the same time, awards, summits and publications organized by the leading players of the region are raising awareness around gender diversity in the industry and the value women add. As part of these initiatives, exceptional female role models are also being presented as the bright future of the Middle East's infrastructure sector.


ConstructionWeekOnline

The road to gender equality in Middle East construction

The story behind the CW Awards' Rising Star accolade, each of which has to date been awarded to a woman engineer


ConstructionWeekOnline

Middle East construction firms focused on Stem careers for women

Gender imbalance remains an issue in global construction, but regional engineering firms are tackling the challenge head-on


ME CONSTRUCTION NEWS .COM

Women in Construction Series: The need for balance

Middle East Consultant and meconstructionnews.com to begin a series profiling female construction professionals


Riyadh Metro

From the various female role models in engineering and construction, few match the profound global impact and legacy of Zaha Hadid. Described as one of the greatest architects of our time, Iraqi-born and London-based, Zaha Hadid was an iconic and pioneering architect who passed away in March 2016. Her buildings, such as the Guangzhou opera house in China, were hailed as architecture that transformed ideas of the future.[9] Talented, determined and hardworking, Hadid fought her way through as a woman and was the first woman to win prestigious awards such as the Pritzker Architecture Prize and the RIBA Royal Gold Medal. The 'Queen of the curve' had been open about the stereotypes women architects face and the pressure to focus on interior design "people used to think women did not have enough logic and that a woman architect could not take on a big commercial project. I am sure that as a woman I can do a very good skyscraper." When criticized she would ask: "Would they call me a diva if I were a guy?"[10]

Today Hadid continues to inspire through her work and vision. It has also been argued that the rise and acceptance of female architects in the region is due to Hadid's legacy.[11]


Al Wakrah Stadium, Qatar


Zaha Hadid

1. *Credit Suisse Research Institute Reports: The CS Gender 3000-The Reward for Change (2016), The CS Gender 3000-Women in Senior Management*
2. *Research by Columbia University and the University of Maryland on the Standard & Poor's (S&P) 1,500 Corporations over a 15-Year Period (2012)*
3. *McKinsey, Delivering through Diversity*
4. *Middle East Consultant, Women in Construction*
5. *UN, International Day of Women and Girls in Science*
6. *The Rise of Women in STEM in the Arab World*
7. *The Pearl Initiative, Women's Careers in the GCC-The CEO Agenda*
8. *Construction Week, Middle East Construction Firms Focused on Stem Careers for Women*
9. *The Guardian, 'Queen of the Curve' Zaha Hadid dies aged 65 from heart attack*
10. *Business Insider*
11. *About Her, Zaha Hadid Inspire a New Generation of Female Architects in the Region*

CCC CSR
simply because we care

Contribution to CSR Initiative

CCC staff are encouraged to come up with ideas and activities related to CCC's CSR initiatives including Going Green and community involvement events. Please send your ideas, initiatives and achievements to the CSR-CCC email address csr@ccc.net.

Construction Innovation and Academic Collaboration; CCC Kazakhstan Partners with Academia

In alignment with CCC's vision of continuous growth, advancement, and sustainability CCC Kazakhstan is making strides in incorporating cutting edge technological advances and establishing symbiotic relationships between local universities, the public and the private sectors. CCC has initiated partnerships with two of Kazakhstan's top ranked universities in the region; the universities of Nazarbayev and KazGuu. These mutually beneficial partnerships aim to develop cooperation in exchanging business experience in the field of construction engineering and making advances in the engineering field.

Through its partnership with the region's renowned universities CCC seeks to enhance the educational sector and develop curriculums that will address the critical local and international market demands. Civil Engineer, Mr. Sharif Abdelrazeq working closely on the success of CCC's partnership with academic institutions said "we are leveraging our position as a top international company to guide the staff of universities in this process."

On April 18, CCC launched and delivered its first forum series entitled: "Building a Smarter Future for All" to faculty and students of Nazarbayev University (NU) which highlighted innovation in the construction industry. After the opening speech of Mr. Hisham Kawash, the Area Managing Director of Kazakhstan, Mr. Abdelrazeq talked about how innovative approaches and technologies such as 3D Scanning, Internet of Things (IOT), Artificial Intelligence (AI), and Virtual Reality (VR) are reforming the construction industry. Following Mr. Abdelrazeq, Engineer, Mr. Ramzi Abunemreh focused his presentation on the importance of Building Information Modeling (BIM) in obtaining, sustaining and strategically integrating these technologies within the industry. Mr. Zhandos Turmakhanov, an NU alumni was also invited to share his vast work experience with CCC. The presentation was concluded with Mr. Aidos Kuspanov's talk about CCC's interest to recruit top Kazak nationals to work with CCC's global team. The event ended with a discussion and a networking session and which eventually led to the signing of the Memorandum of Cooperation with NU.

Investing in local talent is a mission that CCC in Kazakhstan has been pursuing vigorously and its partnership with universities has facilitated the process of recruiting trainees and providing student construction internships. Since the signing of the Cooperation Memorandum with NU, CCC has been working closely with the university's Career and Advising Center and the Engineering Faculties to recruit top notch graduates to intern and to eventually be recruited by CCC. Mr. Kawash recently launched the National Career Development program (NCD) which aims to increase exposure to international standards, and provide fresh graduates with the opportunity to complete a rotational training in various Departments. This program is in-line with Mr. Kawash's mission to transfer the knowledge and know-how that the CCC has developed throughout the years to the local markets that CCC operates in.

CCC has recruited multiple NU graduates, who are currently working in various departments, as well as having provided internship opportunities for several students. Four NU graduates are completing their two month rotational internship in key departments and activities throughout the ADP project. The trainees, upon obtaining a comprehensive understanding of the overall procedures and responsibilities of key CCC departments are seconded to one of the CCC's areas abroad. When asked about how this approach benefits Kazakhstan, Mr. Abdelrazeq said "We believe that our establishments in the local markets are opportunities for us to share experiences and transfer the international standards to the local markets. We have students who complete rotations, attend seminars, and go on trainings in CCC's projects in Oman, Egypt, and the United Arab Emirates. Our collaboration with universities in Kazakhstan is a milestone in a shared vision of establishing a more resilient and sustainable future for Kazakhstan, the Commonwealth Independent States (CIS) region and the world."

Bridging the gap between the education sector and industry is essential as both are interdependent parts of the economy at large and their working together will provide an engine for local economic growth. Through investing in its relationships and sharing its experiences, CCC continues to find points for tradeoffs with field specialists allowing the disruptive technologies to act as catalysts of development, growth and benefit for all stakeholders involved. The CCC Kazakhstan team has tapped into the tip of the iceberg; the aim is to develop a sustainable CSR based projects that positively impacts both CCC and the country as a whole.

CCC CSR Project will Bring Water for the Village of Mulinda, Mozambique

CCC in Mozambique has recently signed a CSR project partnership agreement with WaterAid Mozambique to improve the living conditions of the people of Mulinda village. The project will provide access to clean water, safe sanitation, and good hygiene practices to 700 people. According to a recent study by WaterAid, 63% of people in rural areas of Mozambique live without access to safe water, and only 10% of people in rural area have access to adequate sanitation.

Situated in the District of Mecanhelas, Niassa province, the Community of Mulinda is a remote rural community where 700 people (146 families) rely on the unsafe polluted water of Muchimazi River located 4 kilometers from the village. The river is the only water source available for village inhabitants, and women and girls have to walk 8 kilometers to fetch water. In addition to being shared with cattle, the water is used for drinking, bathing, washing clothes; a situation which is conducive to the breakout of water-borne diseases such as cholera and dysentery.

The project is being implemented by WaterAid which is a non-profit organization with large experience in the field of Water, Sanitation and Hygiene (WASH).The project objectives are to provide access to clean and safe water to 146 families of the village and to promote healthy hygiene behaviors for the community. Activists from the community will be trained to raise awareness and educate families to build their own latrines and adopt good hygiene practices.

WaterAid has begun the project preparation and has received the government's approval of the project technical documentation, and has launched the tender for the drilling of the borehole. The project is scheduled to be completed in October 2019.

Women's Empowerment - Building Resilience of Young Women Farmers in Minya, Egypt

CCC Egypt has launched its first venture CSR project with Alfanar with the aim of building resilience and self-reliance among women farmers in Upper Egypt. With 28% of Egypt's population under the national poverty line, 24% unemployment among women, yet 65% of Egypt's economy dependent on agriculture, the need and positive economic effect of investing in female farmers in Egypt is compelling.

Working together, CCC and Alfanar (*https://www.alfanar.org/*) will scale Life Vision's (Alfanar investee since 2015) Farmer Field Schools and Farmer Business Schools in Minya to reach 450 female farmers in 2019 - 2020. The project aims to contribute to the creation of sustainable livelihoods for impoverished small-scale female farmers in Minya Egypt, by training women farmers on modern agricultural and business practices thus improving yields and financial returns to their families. In addition, it aims to

work with Ministry of Agriculture staff to scale the Farmer Field school model beyond its current reach.

These schools provide on-site training to disadvantaged smallholder female farmers, helping them to modernize and improve their farming practices, thus reducing inefficiency, improving yields and ultimately increasing their take-home household income. In parallel, Alfanar will work with Life Vision to achieve financial sustainability through the running of its own greenhouse.

Alfanar is the Arab region's first venture philanthropy organization, providing early- and growth-stage social enterprises with funding, management support, training, mentorship and introduction to networks with the goal of scaling their impact and increasing their financial sustainability through self-generated revenue. Alfanar currently works with social enterprises improving education, youth employment and women's economic empowerment in Egypt, Lebanon and refugee communities. Since 2004, Alfanar has invested in 31 social enterprises, impacting over 48,000 families. On average, the

social enterprises Alfanar supports impact 33% more lives and self-generate 37% more revenue over the span of its investment.

The project's implementation period is 12 months and it will officially begin as soon as Alfanar receives the official approval from the Egyptian Ministry of Social Solidarity.

Inclusion of Refugee Children through Art Education - Athens, Greece

Everyone Together at the Museum: *https://www.youtube.com/watch?v=ts2-moD7420&t=1s*

The CSR "Inclusion of Refugee Children through Art Education" Program with the Museum of Cycladic Art was concluded with an exhibition showcasing the artworks of children. At the opening ceremony of the exhibition, held on June 6, 2019, CSR Consultant, Rosie Nasser said: "CCC is very proud of its partnership with the Museum and its support of the Program which has brought together 30 Greek and 30 Refugee Children from Syria, Afghanistan, Iraq, Iran and Pakistan under one roof to learn a new language through art education. Learning a new language through art helps children in the development of their motor skills, language skills, social skills, and creativity. This educational program benefitted both groups of children not only by enhancing their communication skills, and their artistic creativity but has also built their self-confidence."

Through the workshops, the Greek and the refugee children aged between 14 and 17 learned to use the Cypriot-Minoic script to get to know each other, share their stories, and their memories with each other and this has led them to think out of the box and learn more about

each other's backgrounds, culture and life before they met.

CCC's rationale behind its support of the program stems from its commitment to stand by vulnerable groups, especially refugee children who are the most vulnerable groups of people who have to bear the burden of displacement and have been deprived of their basis rights. The Greek children who came from the IB program of Pierce College, and refugee children came from shelters run by Solidarity Now. Not only has this program provided them with some of their basic rights to education but also provided them with the platform to exercise their fundamental right of self- expression, and offered them the chance to interact with children of the same age group without discrimination and beyond stereotypes.

Through these workshops the children had the opportunity to use the Cypriot-Minoic and to learn that its use began in a period of intense economic and commercial activities, and used

by people who speak different languages to communicate, but its use decreased with the prevalence of the Greek alphabet.

Ms. Nasser added: "According the UN Convention on the Rights of the Child, Article 15 states that every child has the right to meet with other children and to join groups and organizations, and Article 31 of the same convention says that every child has the right to relax, play and take part in a wide range of cultural and artistic activities. It gives me great pleasure to say that the achievements of the Inclusion of Refugee Children through Art Education program address these two articles precisely."

Building a Brighter Future for Youth through Photography, Lebanon

Well into its 10 months of implementation, the youth trainees participating in the photography and videography training project, have completed their course work and are developing their photography projects to be showcased in an exhibition being planned at the conclusion of the project.

Palestinian youth in Lebanon especially those living in camps, have been and continue to be the most affected by the difficult livelihood conditions as they continue to be subjected to all forms of economic and social marginalization. Palestinian youth face legal restrictions that limit their rights, including the prohibition to work in 39 professions. The project aimed at empowering them by providing them with the skills needed to venture into their own professional endeavors or becoming freelancers in documentary, photojournalism, and commercial photography (studio, events photography, wedding photography, and portraits).

The CSR project ran in cooperation with Zakira; the Image Festival Association; and which initially aimed to train 10 to 20 Palestinian youth, has attracted 47 trainees from which 6 are Lebanese participants who joined the training as they showed very strong interest in participating. Zakira saw this as an opportunity to foster social cohesion and mitigate rising social tensions between refuges and hosting communities. The training workshops did not only provide a skill but also gave the Palestinian and Lebanese youth the chance to meet, communicate and develop relationships.

The trainees which include jobless youth, students, and housewives have developed photography and video skills and many of them are proficient enough to practice photography and videography. They learned using DSLR cameras manually, and have acquired the skill to develop and execute a short film. Each student chose a topic to work on from their environment; some worked on stories from where they live in Ain el-Helweh camp, some chose Saida, and some decided to go beyond and are working on projects about villages in the South region. The trainees are finalizing their story images in preparation for the exhibition to take placed at the end of the project.

Easter Candle for a Good Cause, Greece

In solidarity with our fellow human beings that need our care and support, CCC employees assisted the Doctors of the World (MdM-Greece) (*https://mdmgreece.gr/en/*) Organization by purchasing Easter candles made by the MdM's volunteers to fundraise for their humanitarian work in Greece. Founded in 1990, MdM is a medical humanitarian non-governmental organization which implements projects within Greece and abroad to provide medical as well as other services to marginalized populations that cannot access healthcare services and medical care. With the 29 purchased candles and the donations provided by CCC employees, MdM will purchase vaccines, bandages, medical gloves and support its mobile units that feed the disadvantaged.

Mrs. Angeliki Mavrikou, Fundraising Officer of MdM in Greece said: "It is so important for people to know that with something like this, they can easily help and support the work of an NGO. Not everyone can be a great donor, or not everyone can be a volunteer, but everyone can find an easy way to show their sensitivity and help people in need. I think this is the greatest-probably-lesson out of these kind of gestures, that we all together, are very strong and the moment we feel happy for what we did, almost at the same moment, smiles are multiplied on faces, that didn't -probably- exist before".

Rebuilding of Houses Burned by Fires in Mbagala Village, Palma, Mozambique

On May 18, 2019 CCC joined other companies in their humanitarian aid to the residents of Mbagala Village whose houses were burned by fire. CCC donated funds to the villagers to buy iron sheets for roofing their houses.

"The best feeling in life is making others in need happy. It does not have to be money, it can be a half hour of comforting a sick person, or taking care of an elderly person, or just simply a smile..."

Samer Khoury

Introducing CSR and CCC's Volunteer Program in the UAE and Beirut

In a series of meetings held at the International Airport - Midfield Terminal Building Project (MTB) in Abu Dhabi, the Opera Grand Tower Project (OGPT) in Dubai, and the City Centre Al Zahia - Roads and Bridges (IWP) Project in Sharjah, UAE's CSR Coordinator, Ms. Dana Mahboobeh, presented the CSR mission and the Volunteering Program to staff members.

The presentation included information about the role and goals of CSR in general and informed CCC's staff about the volunteer program and the volunteer policy which allows each employee 20 hours of time off work to participate in volunteering activities that aim to give back to society and the communities in which they live and work.

In turn, and to enhance the culture of volunteerism at CCC, CSR Consultant, Ms. Rosie Nasser, delivered a presentation about the benefits of CSR in companies, and the procedures and guidelines of the volunteer program to MOB staff members in Beirut.

CSR plans to continue spreading awareness about the personal and professional benefits that employees gain from volunteering in various areas of operation.

CCC Volunteers Create a Happy Environment for School Children - Athens, Greece

On May 3 and in cooperation with CCC's partner Ethelon, fifteen enthusiastic CCC volunteers and their children spent three hours in restoring and beautifying the school of Nea Chalkidona.

To create a happy environment for the students, the volunteers painted the school's backyard

fence in green, planted 20 plants in the front yard, designed and painted two board games; a floor chess game and a colorful snake game with numbers in the school playgrounds. The 2nd Primary School of New Chalkidona is a public school, placed in a school complex and enrolls 224 students aged between 6 and 12 living in the area. The volunteering activity addresses two of the United Nation's Social Development Goals (SDGs): Quality Education and Sustainable Cities and Communities.

When asked about their volunteering experience, all the volunteers felt a sense of satisfaction, and were very content about the end result of their hard work, and how their joint effort made a big difference in the daily lives of children.

CCC UAE Employees Volunteer for Autism

On the occasion of World Autism month, UAE CCC volunteers participated in two volunteering activities one in Dubai, organized by the Dubai Autism Center, and one in Abu Dhabi organized by the Emirates Autism Center. The month of April is Autism Awareness Month, and April 2 is designated by the United Nations as Autism Awareness Day. Every year, and throughout the month of April, Autism friendly events and educational activities take place everywhere to increase understanding and acceptance and foster world wide support.

On April 18, Senior System Developer, Saadeddine Nahlus and Khaled Qubaj, Junior Electric Engineer assisted the teachers of the Dubai Autism Center in the classroom activities, and engaged in art activities with the students of the Center. The mission of the Dubai Autism Center is to empower children with a pathway to independence, through education, speech and communication therapy, and occupational therapy to integrate them into the community. When asked about their volunteering experience, Saadeddine said: "It was truly an eye-opening

experience to learn about autism", and Khaled said: It is an amazing feeling, especially when you see upfront the real struggle that children face every day" he added " I left the Center with a happiness you can only experience through volunteering."

On April 23, and in collaboration with the Abu Dhabi Chamber of Commerce and Industry, and under the Patronage of HH Sheikh Nayhyan Bin Mubarak Al Nahyan, Minister of Tolerance, the Emirates Autism Center organized a Children Sports Championship at Al Jazira Sports Club in Abu Dhabi. The Center is specialized in autism spectrum disorders and provides high quality teaching and care in state-of-the-art classrooms specifically designed to meet the sensory and environmental needs of its students. The Center also works to raise awareness and understanding of autism and promote the rights of all individuals to be treated with dignity and respect.

The sports championship brought together 300 students aged between 5 and 12 years old to compete in various sports such as sandbag ball, distant jumping, and other activities. On the day of the championship, 12 CCC volunteers helped in organizing the event and preparing the venue for the arrival of the students, and during the event they assisted the coaches in providing support to children in the sports competition, and distributing food and beverages to them. The volunteers were quite satisfied about giving back to the community; they said that they had a great experience and they look forward to volunteering in the future.

Senior Quality Coordinator, Georgios Panagiotopoulos (EPSO) said: "it was a unique opportunity to support these great kids, with such an outstanding determination, and I am very much looking forward to the next volunteering opportunity."

CCC Volunteers Clean Saronida Beach - Athens, Greece

On June 7, fourteen CCC volunteers and their children cleaned Saronida beach. The volunteers collected all kinds of waste that could be very harmful for marine life, and learned that by keeping their environment trash free they help protect and preserve marine life, and that each

individual can better the sea's ecosystem by playing their part in keeping the beaches clean.

Marine life, dwelling in the water, is affected by waste on beaches. Plastic pollution alone, affect 100 million marine mammals each year. When the tides rise, they collect items on the beach and take the items out when the water lowers, including trash which directly have negative effects on marine life.

In the two hours spent cleaning the beach, the volunteers collected around 783 harmful waste products such as cigarette butts, plastic packaging products and bottles, plastic cups and plates, paper, cans, and pieces of broken glass, among other harmful products that could trickle into the ocean and directly affect the marine life.

Blood Donation in Sharjah

On April 1, Al Zahia Sharjah project employees donated blood. The day was organized in cooperation with the Ministry of Health and Prevention.

Fun Run Event, Qatar

60 CCC employees (from MDP4 and QRMS projects) participated in the 5km Fun Run event that took place at Aspire Zone in Qatar on April 26, 2019. The 'Workers Fun Run' event is the first of its kind held in Qatar. It was organized by the Ministry of Administrative Development, the Labor and Social Affairs (ADLSA), the International Labor Organization (ILO) and the Embassy of the Kingdom of the Netherlands to celebrate the contribution of migrant workers to the development of Qatar and promote togetherness and good health. The 60 CCC participants received participation medals and free t-shirts from the event management.

CCC's Team Participates in Oman's Cricket Tournament Oman

As part of the Ramadan sports and social activities, CCC's team participated in the Cricket Tournament held between May 6 and 27, 2019, which was organized by the Pakistan Social Club in Oman.

The tournament attracted around 1000 viewers during the week days and around 3000 viewers on weekends who came to support the teams and to enjoy the delicious Pakistani, Indian, Arabic and Continental foods available at different food stands. Apart from the sports, the tournament provided families and kids the space for fun and entertainment. While some came to watch the competition, others came to see the Bazar to shop.

Iftar 2019, Saudi Arabia

The annual Ramadan IFTAR at the Carlton Al Moaibed Hotel was held on May 15, 2019.

Ramadan Clothing Collection Campaign, UAE

In partnership with the Red Crescent in the UAE, employees of the CCC Area Office and the MTB, Al Zahia, and OGTP projects donated 25 bags and boxes of clothing and blankets. The Red Crescent collected, washed, packed and distributed the donations to the needy and under-privileged countries.

Ramadan Food Donations, Oman

Employees from the Area Office, Ghazeer and Mall of Oman projects donated 275 boxes of food.

Food Packages for the Needy, Palestine

CCC employees donated 100 food packages to poor families.

Scanning Stages: Construction Progress Monitoring & Quality Control

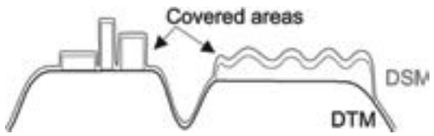
Current approaches for quality control on construction sites are not as effective as they could be in identifying defects early in the construction process. As a result, defects can go undetected until later phases of construction or even to the maintenance phase (Akinci et al. 2006).

Current surveying and quality control approaches are not effective, since they only provide data at specific locations and times to represent the work in place and the data generated are interpreted manually and are not integrated electronically into an integrated project model. This fact limits the abilities to easily identify and manage defects, and actively control and manage construction projects. Frequent, complete and accurate assessment of the status of as-built conditions at construction sites, identification of critical spatio-temporal quality related deviations of work in place and assessment of whether these deviations constitute defects during a construction project are necessary for active project quality control (Akinci et al. 2006).

Recent advances in generating 3D environments using laser scanning technologies and acquiring quality information about built environments using embedded and other advanced sensors provide the capability to frequently gather an integrated and accurate three-dimensional and material quality related as-built data.

Airborne Laser Scanning

Aerial Light Detection and Ranging (LIDAR) is a method which is similar to photogrammetry, but an active sensor is used. The principle of LIDAR is based on an active laser beam which is emitted by sensor to the ground, where it is reflected back. The LIDAR sensor records the time difference between the emission of the laser beam and the return of the reflected laser signal to the sensor. The unique attribute of LIDAR is that many returned beams can be recorded. Therefore, both the first and last return can be acquired at once. Also all intermediate returns are acquired and recorded.



The data recorded from LIDAR is called a point cloud. The digital terrain model (DTM) can be derived from the point cloud by separating last returns and applying specific filtration methods to them. Digital surface model (DSM) is constructed from first returns.

Photogrammetry

UAV Photogrammetry describes photogrammetric measurement platforms, which operate either remotely controlled, semi-autonomously, or autonomously; all without a pilot sitting in the platform and the photogrammetric processing of UAV images. The broad definition covers balloons, kites, gliders, airships, rotary and fixed wing UAVs with the capability for photogrammetric data acquisition in manual, semi-automated and automated flight mode.

The platform is equipped with a photogrammetric measurement system including but not limited to a small or medium size still-video or video camera, thermal or infrared camera systems, airborne LiDAR system, or a combination thereof.

Photogrammetric sensors acquire normal photos. So the data density depends on the quality of the camera, the height of the flight, the speed and the overlapping area between consecutive photos.

Terrestrial Laser Scanning

Terrestrial Laser Scanning is a method for surveying tasks, which allows acquiring easy and fast complex geometric data from buildings, machines, objects and so on. The result is a “cloud of points” (alternatively point clouds) which is thousands of points in 3-dimensional space that are dimensionally accurate representation of the existing object. Each point is determined by the position (x, y, z) and the intensity (i) of the returning signal. The 3D scan data can easily be imported into all commonly used software solutions for accident reconstruction, architecture, civil engineering, construction, forensics, industrial manufacturing and land surveying.

Indoor Mobile Laser Scanning

The Indoor Mobile Mapping Solution (iMMS) is the optimal fusion of technologies for capturing spatial data of indoor and other GNSS-denied areas of all sizes and locations. It provides both LiDAR (point cloud creation through laser sensors) and spherical video, enabling the creation of accurate, real-life representations

(maps, models) of an interior space and all of its contents; every object in the interior space, including desks, chairs, stairs, and doors appear in the plan.

iMMS produces geo-located maps and 3D point cloud data - the real world positions (latitude, longitude, elevation) of each area of the surveyed building and all of its contents are known. Because of its high efficiency and speed, iMMS is very effective for as-built environments of all sizes, including very large spaces with multiple rooms (even those extending over several city blocks).

QA Methodology

The data acquired from the aforementioned technologies are combined with the design model with an objective to create an integrated model, which is dynamically updated during the construction period, for progress monitoring, quantities calculation, QA/QC of the construction (Yue et al. 2006). The current article focuses on the methodologies that have been implemented for better, accurate and more frequently quality control of the construction.

The figure describes the overall procedure of the current approach. The proposed quality control procedure consists of six stages. The first stage involves the creation of the BIM models. The second stage constitutes the identification of the inspection goal. This module involves the determination of the appropriate construction tolerances according to the design specifications.

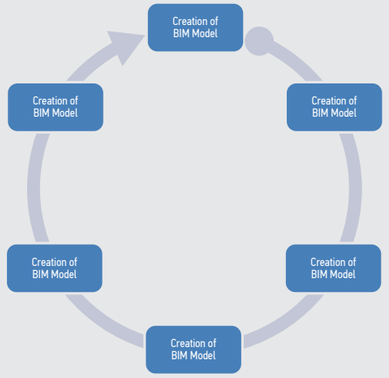


Figure 1: *Inspection planning procedure*

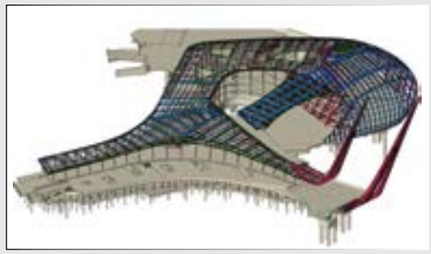
With inspection goals determined, sensor locations and route selection of the scanner is optimized as well as the appropriate scan parameters being selected with an objective to achieve the best measurements based on the inspection goals that have been determined in the previous stage. The process of the point clouds stage includes the alignment of the data collected from different scan position and georeferencing the as-built data into an integrated coordinate system. These stages help in generating as-built data that can be compared with the design model to identify deviations. The last stage is the analysis and the comparison of the as-built data with the design model. Once the deviations are identified, they are compared to the acceptable tolerances, to determine if any of these deviations constitute a defect. At the end of the five stages the report is generated which includes deviation information.

Identification of deviation can be completed by comparing the as-built data acquired by the laser scanner to the given design model. Once the magnitude of deviation is found, it can be evaluated according to construction specifications to define if any detected deviation violates any specification and as a result constitutes a defect (Akinci et al. 2006). If this is the case, corrective actions need to be implemented in order to resolve the defect.

Furthermore, if the pattern of deviation is known, this knowledge can be incorporated in the following construction activities with an objective to avoid the propagation of the deviation which could become a defect in a later stage (Akinci et al. 2006).

Deviation Analysis - Steel Structure Analysis

The objective is to scan the steel structure in order to check whether the steels elements have been installed correctly according to the design. In case of the steel structure, high deviation can cause a displacement of the steel beams in such a way that affect the installation of the adjacent steel elements. Furthermore, the complicated structure of the steel framework requires the minimum deviation with the design in order to avoid any class detection with the following construction activities such as facades or mechanical.



Results

The result of the suggested quality control procedure constitutes a color based deviation model, as is indicated in the Figure 4. The color is assigned according to the value of the deviation between the as-built measured data and the design model. In Figure 2, the areas which are colored red represent the highest deviation with values which exceed 50mm. In contrast, the green colored areas represent the lowest deviation with values which fluctuate between -20mm to +20mm. The positive pattern of deviation is illustrated with red shades while the negative deviation with blue shades.

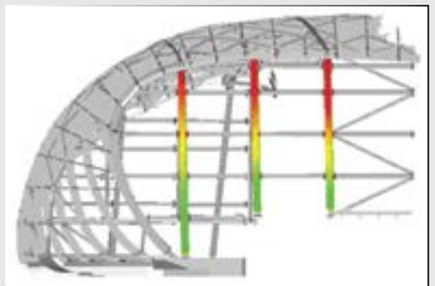


Figure 2: *Color based deviation of façade steel columns*

Figure 3: *Color based deviation of the phase one steel structure*

Furthermore, the suggested quality control procedure allows us to isolate every steel element and to perform cross section based deviation analysis. As is shown the as-built measured data are illustrated with black points while the colored lines indicate the distance to the design model. The deviation of the upper part of the steel column exceeds 50mm in contrast with the bottom part of it where the deviation fluctuates within the acceptable limits (Figure 4).

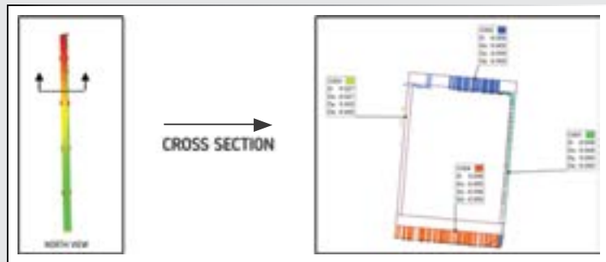


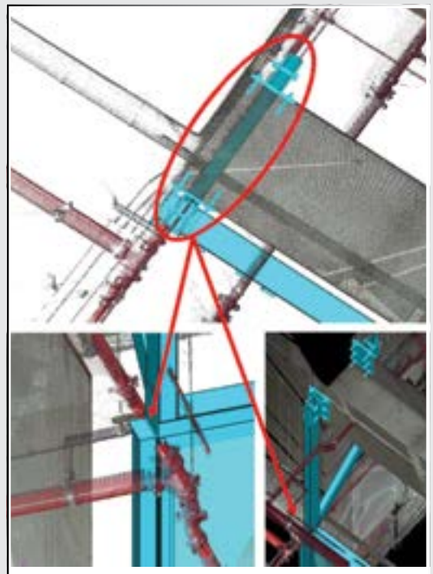
Figure 4: *North view of the steel façade*

Deviation Analysis - Clashing with MEP

This case study refers to three new glass screens that would be erected in LB2, supported on the side of concrete beams. Although the coordination through BIM models and relevant shop drawings were finalized, the subcontractor who got awarded the relevant package complained that the MEP services were positioned too close to the concrete beams and thus obstructed the erection.

The scan was performed under difficult circumstances because there was a lot of dust and paint smell due to the reduced air circulation in the basement and the ongoing blockwall works (chiseling for new openings, plastering and painting and so on).

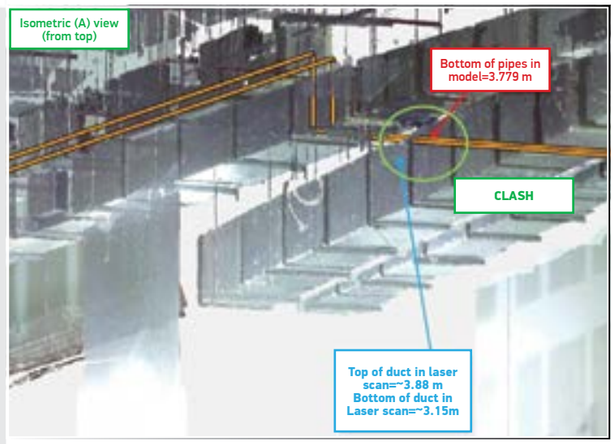
Results



Fire Fighting Pipe is passing through Glass Screen

Laser scanning revealed that the MEP services were positioned, in some cases, too close to the concrete beam. In certain cases their routing physically clashed with the future glass screens and further discrepancies were revealed.

It was noticed that the installed MEP services were in general not complying with the coordinated BIM models. Further study showed that, in all three scan locations, MEP services varied from the approved documents and this caused a number of clashes with future services.



Deviation Analysis - Clashing with MEP

This case study refers to the inspection of the concrete beams. It was revealed that the firefighting pipe, according to the design, is supposed to pass below the concrete beam but the laser scanning survey revealed that the pipe passes through the concrete beam.

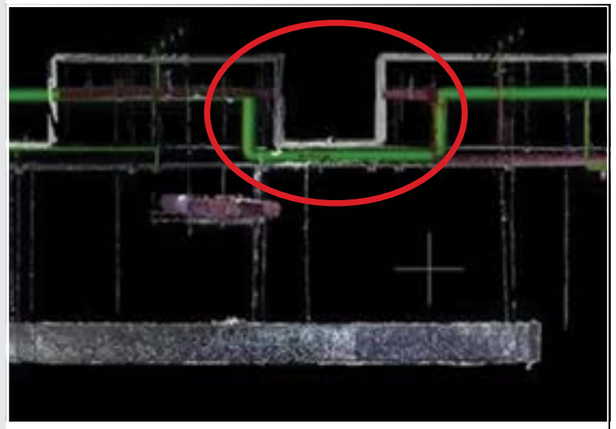
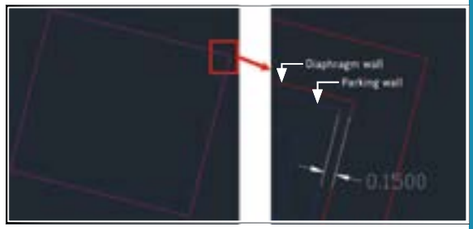


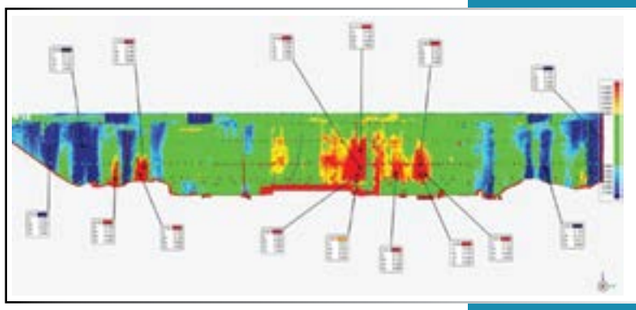
Figure 10: *Clash between pipe and concrete beam*

Deviation Analysis - Foundation Inspection

The objective was the structural inspection of the diaphragm (Dwall) wall in comparison to theoretical position. In this case, the level of tolerance of the deviation from the theoretical position must be minimal since the design involves the construction of the inner wall (or parking wall), along the diaphragm wall, in a distance of 15cm. More specifically, the distance between the inner sides of the diaphragm wall to the outer side of the parking wall must be 15 cm, according to the design.



Identification of deviation can be completed by comparing the as-built data, acquired by the laser scanner, to the given design model. Therefore, we needed an integrated project model were the deviation is depicted in the whole surface of the wall providing the value and the pattern of the deviation in every spot.



The resulting model constitutes a color based deviation model, as is indicated in the figure. The color is assigned according to the value of the deviation between the as-built measured data and the design model. The areas which are in red represent the highest deviation with values, which exceed 150mm. In contrast, the green colored areas represent the lowest deviation with the values, which fluctuate between 0mm and 150mm. The positive pattern of deviation is illustrated in red while the negative deviation is in blue.

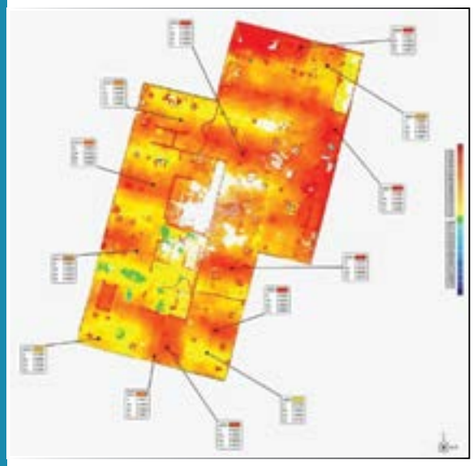
The red areas indicate the areas where the wall penetrates into the parking wall and therefore

must be trimmed. The green areas indicate the parts of the wall where the deviation fluctuates within acceptable limits while the blue color indicates the areas where the wall deviates in the opposite direction.

Raft Foundation Flatness Inspection

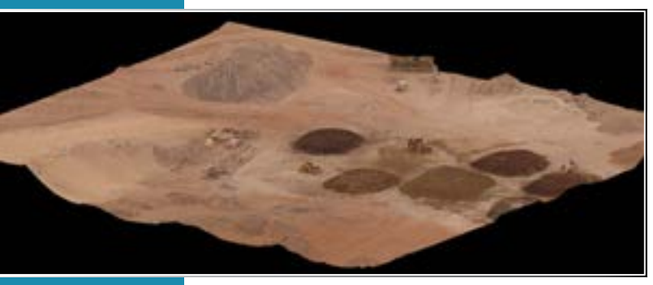
The rafts inspection involves the review of the slopes and comparison of the elevation with the design.

The figure indicates the fluctuation of the slopes of the foundation. The dark red shows the areas where the distance from the theoretical raft position exceed 10 cm while the green indicates the areas where the deviation is lower than 5mm.



Scanning Stages: Existing Condition Modeling

Drone technology was used for 3D digital terrain model acquisition and volumes calculations. A flight 100m above the object was enough for the required precisions. The acquired photos were connected to each other using specific software. The final data was used for stockpile and volume calculations.

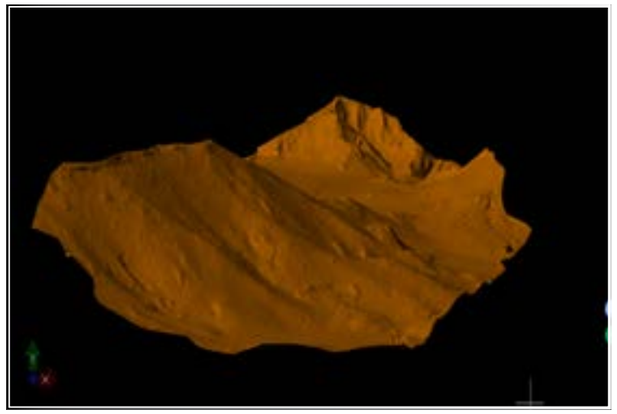


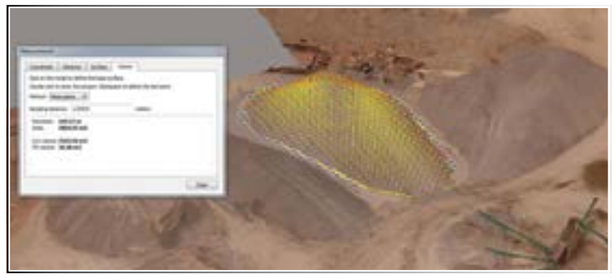
Here is a generated Digital Terrain Model (DTM) illustration generated by processing the point cloud data.

DTM Generated by Point Cloud

Conclusion

The utilization of a laser scanner and advanced geomatics technologies on construction sites can improve the as-built data collection procedure. The laser scanner technology can be used to optimize the project quality control processes since it provides a detailed view of the as-built situation. The as-built data are compared with the design with the objective of detecting deviations. In the case where there are deviations which exceed the acceptable limits according to the specifications, a further analysis is required. The quality control approaches which have been used so far provide information only for a specific location without reflecting the pattern and the magnitude of the deviation between the as-built data and the design. The current approach, employing new technologies in the field of surveying, establishes an automated procedure for extracting quality control report and provides integrated information about the status of the work on construction sites.





W. QAISIYEH

Snagging Portable Solution (SnagIT)

Introduction

Snagging is a process related to quality control and handing over. In both you will have a list of comments to be closed and approved by the owner. In electromechanical projects usually we start following up the snag items (punch list) by location but end up by systems / subsystems to suit the needs of commissioning processes. At civil projects the follow up for the snag items goes by locations and turn key targets. In addition, part of the follow up should go by system and governmental authorities' acceptance.

Typically, each defect listed will carry the issue description, issuer name / organization, action on, discipline, location, classification / hold or not for the next phase, attached documents, photos and expected completion date.

The process of snagging could happen in many different ways, part of it is during the quality control inspection, another occasion could happen as general comments from site engineers, consultants and owners, and the last important occasion is when the project start walkdowns with the target of handing over and completion.

Purpose

The purpose of the new SnagIT mobile application is to reduce or eliminate paperwork, reduce or eliminate the need for computer operators and for faster turnover in closing snag items through the company's QAQC centralized tracking system (ATLAS). The system should help in building a collaborative environment between the QC Department, the construction team, subcontractors, consultants and the owner's representatives.

As a process, the purpose is to have a tool to push the related parties toward the actions required in a fast and seamless way. Simply the list of required steps will include actions like request, done, reviewed, accepted and/or rejected.

For the above mentioned needs to happen instantaneously and within a harsh environment with minimum investment as well as to eliminate running costs is a real challenge. To meet these needs ISD / RASO worked on developing workflows, creating a mobile application that could be used with any type of Smartphone, mobile operating systems (Android, IOS, or Windows), creating references and libraries that would enrich and unify the feedback coming from end users and that allow for building KPIs and reducing miscommunication issues.

Main Features

Mobile/Tablet

SnagIT mobile application could be used with any type of smartphones, mobile operating systems (Android, IOS, or Windows)

Online/Offline

Capture issues/defects and take pictures online or offline

Predefined Reference Data

Map the project WBS on the application. Define the topics, sub-topics and snag catalogue

Workflow

Building a collaboration environment in between QC, Construction team, subcontractors, consultants and owners presentatives

Reporting and Analysis

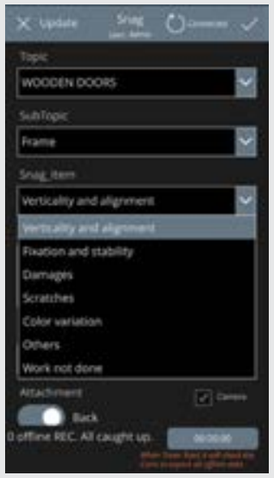
All kind of reports and KPIs are generated to keep the project up to date with the progress

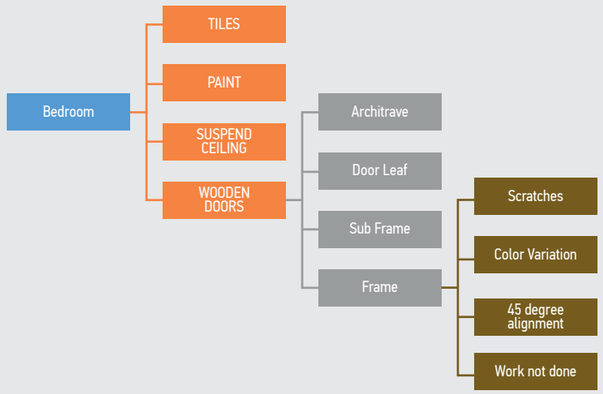
EDI and Integration

Faster turnover in closing snag items through the company's QAQC centralized tracking system (ATLAS)

Data Preparation

1. Define the project WBS (buildings, floors, apartments and common areas, space types and space numbers).
2. From the finishing schedule, we define the topics and sub-topics based on the space type.
3. Pre-defined catalogue for the possible snags / defects.





User Interface

SnagIT empowers the user with a straightforward, customizable interface. The application features pre-defined drop down lists all contained within a single screen.

To issue a snag item, the QC inspector simply selects the building, floor, apartment, and space type. Based on the space type, he can choose from a list of pre-defined topics, sub-topics, and snag descriptions.

Workflow

The workflow and process is customizable based on the project requirements and needs. The workflow shown is implemented at the MRPC project in Algeria.

1. Issuing the snag items by the QC team.
2. Actions and de-snagging by the construction team.
3. Verifying the construction work by QC team.
4. Accepting / rejecting the snag item clearance by the client's team.

Success Story

The SnagIT application is successfully implemented in MRPC Project (Construction of Multipurpose Real Property Complex) which is located in Algeria. The project scope is four towers and 15 villas.

The implementation process at MRPC started from defining the reference data, building the project WBS, defining the finish types for each space type, installing the application on the project servers, downloading the application on the users' mobiles, feeding the system with data, training the project staff, and designing the required reports and KPIs. The full process took three weeks.


RE: SnagIT implementation progress at MRPC project till 11/04/2019

Follow up. Start by Sunday, April 21, 2019. Due by Thursday, April 25, 2019.
You forwarded this message on 5/17/2019 3:22 PM.

Dear

Thank you very for the extra efforts you have made to implement SNAGIT at MRPC.
It is a big help to reduce time and paper consumption.

I would like you to relay what we are doing at MRPC through Knowledge management and produce an article into the next Bulletin issue.

Regards,

Reports and KPIs from MRPC Project:

Snag Progress per Apartment

Snag Progress per Topic

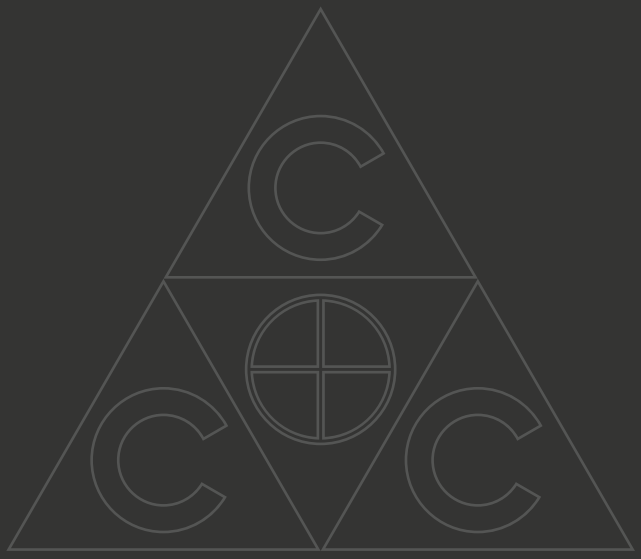
Baby Boys

Salman Ayub (MDP4 Project, Qatar) and his wife Ruksana are thrilled to announce the birth of their son named **Arhaan Maniyar**. He was born on October 31, 2018 in Featehpur, Rajasthan, India.

Yasir Hussain (KAIA Project, Saudi Arabia) and his wife Sabra Khatoon are blessed with the birth of their first baby boy, **Ammar**. He was born on April 21, 2019 in Jeddah, Saudi Arabia and the whole family is rejoicing in the new arrival.

Baby Girls

Shahiduzzaman Titu (Area Personnel, Mussafah, UAE) and his wife Lucky Akhter Isha are pleased to announce the birth of their first child, a daughter named **Tabassum Zaman Evana**. She was born on April 23, 2019 in their native town, Chittagong, Bangladesh. The entire family is very happy.



EDITORS
Samer Khoury
Zuhair Haddad
Nafez Husseini

PUBLIC RELATIONS
Samir Sabbagh

PRODUCTION
Jeannette Arduino
Nick Goulas
Georgia Giannias
Alex Khoury
Samer Elhaj

CCC BULLETIN
P.O. Box 61092
Maroussi 151 10
Fax (30-210) 618-2199 or bulletin@ccc.net
see The BULLETIN on line at www.ccc.net -> News & Media -> Bulletin

The BULLETIN is a publication issued at CCC in Athens by volunteer staff.

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Submissions (announcements, stories, artwork, etc.) are welcome.