COMPANY OVERVIEW

COMPANY WEBSITE
www.bamcontractors.ie

Operating successfully for over 60 years, the bedrock of BAM's success has always been an understanding of our clients' needs and a willingness to deliver innovative solutions that ensure cost savings and surpass environmental expectations. BAM Ireland is the top Civil Engineering company in Ireland, and in the top 2 of the country's largest construction businesses. Operating across all construction sectors and throughout the complete project lifecycle, our principal activities are building contracting and civil engineering in the public, private, and PPP sectors. Other activities include facilities management, property development, and rail infrastructure.

It is BAM's mission to build sustainable environments that enhance people's lives by enabling the right people to capitalise on state-of-the-art knowledge, resources, and digital technologies, whilst also providing solutions across the total construction lifecycle for BAM's clients and generating maximum value for its stakeholders. We are a member operating company (OpCo) of Royal BAM Group of the Netherlands, a stock market listed PLC answerable for performance, which has a turnover of €8Billion and employs approx. 23000 people worldwide. At BAM we are building the present while creating a sustainable future for all.

OVERVIEW & BACKGROUND TO THE LEAN INITIATIVE

AUTHOR

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This case study explores how Artificial Intelligence (AI) deploys Lean culture to the construction environment. BAM Ireland recognises the value of innovation and that continuous innovation and improvement through technology is the path to our success in the future. Three years ago, BAM Ireland was selected as part of the pilot for a new software from Autodesk on their then fledgling "B360 Next Generation" platform. During this pilot, BAM Ireland's Digital Construction Team worked closely with Autodesk's developers on the application that has now been released as "B360 Construction IQ", Autodesk's application of AI for the construction industry.

AI is becoming more commonplace in our everyday lives, and it is behind many of the technologies like predictive text that we may now take for granted. Construction IQ utilises "Machine Learning" and "Natural Language Processing" across the BIM 360 platform to identify high-risk issues that impact cost, schedule, quality, and safety, as well as to identify patterns across the project portfolio. Identification of patterns within our projects has enabled us to more readily identify some of the sources of waste in our existing processes and to then act as a tool to monitor any implemented improvements.

LEAN INITIATIVE UNDERTAKEN – LEAN THINKING, TOOLS, TECHNIQUES

Lean Thinking

Lean thinking at BAM Group is being applied in the more traditional context of Lean manufacturing. For example, BAM Nuttall in the UK operate a road sign manufacturing division that runs the full range of Lean tools for their daily operations, including, for example, 5S, Value Stream Mapping, Morning meetings, and Kanban. Additionally, there are several internal Six-Sigma experts, Lean handbooks and working groups. Yet despite our best efforts, the adoption of Lean within the construction industry is still playing catch-up with manufacturing in the adoption of Lean culture.

There is a growing trend toward Design For Manufacture and Assembly (DFMA) – also known as "Offsite Manufacture" – where the construction industry is moving from traditional onsite construction to factory construction, logistics, and onsite assembly, along with all the benefits this will bring. We already utilise offsite manufacture for modular construction, for example in bathroom pods, and companies such as Ikea and Katerra are currently offering complete finished structures as modular solutions.

But we are not there just yet – until we have taken that journey, the majority of our projects are still traditionally built and this means that not all of the Lean tools developed for manufacturing are directly applicable to construction. The Lean fundamentals of removing waste and increasing value are, however, completely applicable, and we must start from these fundamentals to ensure that the tools we implement develop in line with our needs and the needs of our customers.

Tools

In our entry to this publication in 2018, we went through the application of BIM as a means to introduce Lean thinking "indirectly" into the construction workplace.

Through BAM's 2020 Digital Vision for the implementation of a digitally enabled workplace, we have been able to realise the key tenants of Lean thinking to:

- increase the flow of work and information;
- reduce the waste of our traditional practices; and
- continuously improve our processes and the skillsets of our staff and wider supply chain.

In this case study, we focus on how BAM Ireland is using cutting-edge AI technology to build on our current digital experience, to reinforce the lessons we have learnt to date, and to share these learnings across BAM Group.

Construction IQ – AI Pilot

Construction IQ is a web-based application with an accessible graphical interface that displays project information in the form of graphs and prioritised lists. Transitioning from a traditional paper-based system to a digital system reduces much of the waste of transporting, processing, and communicating the information. Where paper checklists for quality and safety were once stored locally on shelves or boxes, or construction issues were kept in a someone's head or notebook, all this information is now instantly accessible and available to the relevant parties online and in the cloud.

One of the often-neglected consequences of such improvements in the reduction of paper is the massively increased volume of digitized data and information that is now captured and available to use. Where information was previously lost through the cracks of the process, it is now captured, and this creates a new problem for the user – what information in this vast sea of information is most relevant to me right now.

This is where AI is the right tool to assist in not only filtering through the data to "Sort" and "Set in Order", but also to look for patterns to "Standardise" how the information is displayed. While the 5S work very well within manufacturing, the S of sort, shine, and standardise are the most appropriate for construction from our pilot.

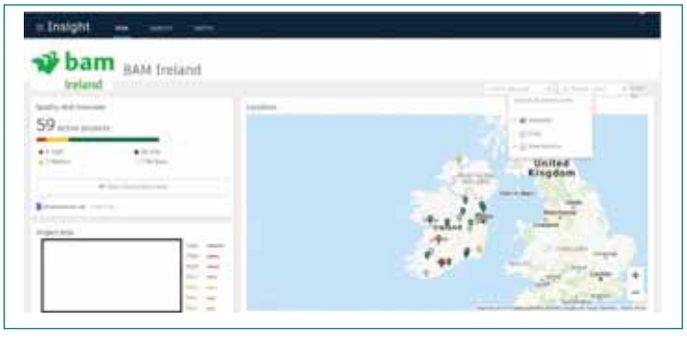

Figure 1. Project Address Issue Data Example

Project Address

Straight "out of the box" Construction IQ highlighted that we had not implemented a standard approach when setting up our projects in the B360 environment. We had not been diligent in entering the address details (they did not seem relevant at the time), the IQ map locations were incorrect, and the projects were incorrectly categorised by 'internal BAM department' or 'project type'. This became our first opportunity to shine our data model by backfilling all this basic information across our projects.

Issues – Impediments to Project Delivery

During a construction project there can be thousands of issues that can affect the delivery of the project, and on a daily basis the management team must prioritise these issues for resolution and to put in place the best resolutions.

"Setting in order" this sea of data is achieved through the dark magic of the AI algorithm. Using Natural Language Processing, the algorithm looks through the text that has been entered by the project team. Where the AI sees words that relate to a high-risk issue such as "leak" or "damp", it associates this as a water-related risk with the potential of water-related damage. It then uses its data model to automatically "weight" the severity of what it finds using the context of the surrounding issue text as a reference and the status of the issue with reference to its due date.

In addition to the automated assignment of the risk, the user can fine-tune the response of the AI utilising their own experience and professional judgment, and from this the AI is trained by their input and updates the data model for future reference to a similar event. This training of the AI – a form of continual improvement – builds a risk profile for BAM within the data model. Over time, this risk profile "standardises" BAM's response to similar issues as they arise and shares the learnings across all of the BAM users of the platform.

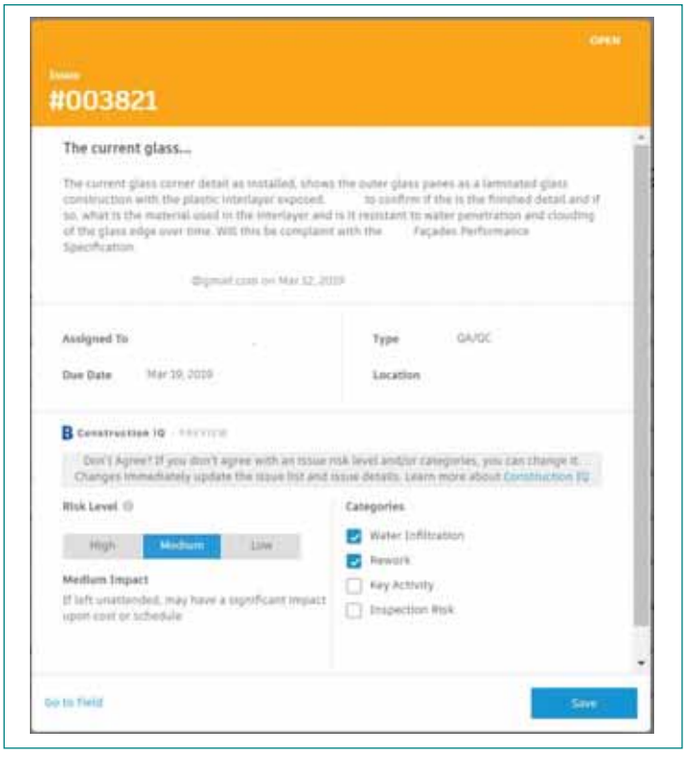

Figure 2. Open Issue Data Example

LEAN INITIATIVE IMPROVEMENTS & IMPACT

Key to the successful delivery of every project is the resolution of issues in an efficient manner. Following the initial basic housekeeping improvement within the project set-up, Construction IQ quickly identified that we, BAM, were the greatest risk to our own success. When we looked at these projects, the number of unresolved issues was uncomfortably high and represented the key to the high-risk factor to BAM.

Further investigation showed that our site teams were dutifully observing and logging the issues as they occurred within the B360 Field site management application.

Unfortunately, this is where our internal process started to fall down and our existing resolution process had become overwhelmed by the sheer volume of the issues being raised. We were recording the issues and then compounding the problems by not resolving them in a timely manner. This in turn created a waste cycle where the over-production of these problems was taking from our resources to focus on addressing the most relevant issues.

Figure 3. Quality Risk Factors Improved

Armed with the Construction IQ overview, we were able to refocus the project teams on closing out the issues, and, as the issues had been sorted, we were able to prioritise clearing the highest impact issues and bulk closing issues that had been closed on site.

Construction IQ Impacts

- AI has greatly reduced time spent analysing site data, leading to more time on site – we have seen a 20% improvement in both quality and safety issue resolution).
- Removing BAM as the main risk to their own projects by understanding the sources of the risk on each project.
- Increasing utilisation of mobile site data capture due to benefits now visible to site teams.
- Increased likelihood of BAM staff identifying serious issues that would adversely impact project delivery.
- Enabling BAM staff to better support the supply chain via focused issue resolution processes and better understanding by the various subcontractors of the risks to the project.
- Better understanding of risks to the project from poor process execution.
- Direct feedback of improvements made to existing process through reduced risk profile.
- Cross-project analysis to ensure that standard processes are being employed.

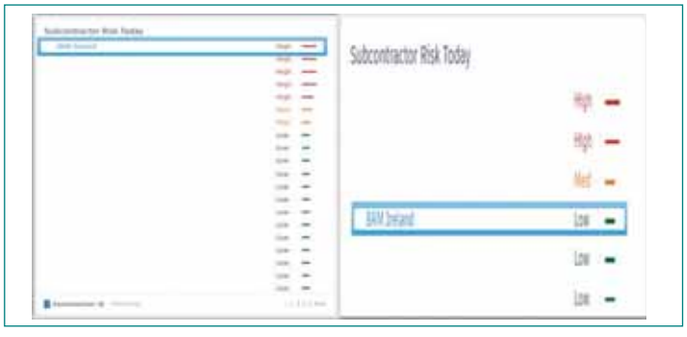

Figure 4. Subcontractor Risk Improved

Real Waste Reduction

- Reduced over-production of information.
  - o Reinforcing the correct process through additional training to the site teams has reduced the numbers of issues that BAM is responsible for resolving.
- Reducing Inventory & Transport by default.
- Reduced defects.
  - o By improving the resolution cycle of issues and closing them out promptly, the compounding of issues has been greatly reduced or removed.
- Reducing Inventory & Transport by default.
- Reduced waiting time as a result of automated reporting.
  - o High risk issues are automatically flagged directly to the user dashboard.
- Reduced non-utilisation of talent.
  - o Talent is no longer wasted sorting through a sea of information looking for the key issues.
- Reduced motion.
  - o Issues are no longer resolved by the wrong party.

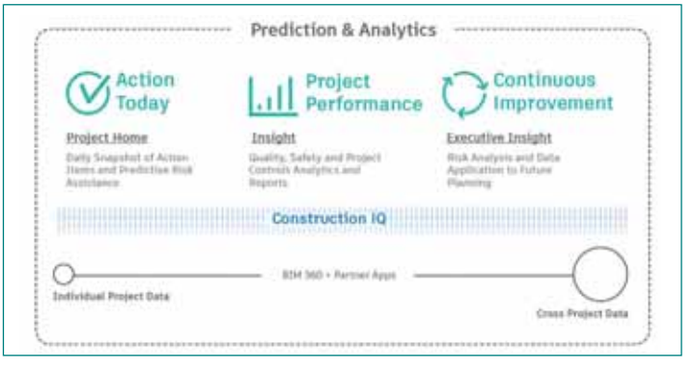

Figure 5. AI Enabling Our Future Now

Future Positive Impacts

BAM Group is currently following on from its 2020 Digital Vision with a program entitled the "Universal Project Approach" (UPA). Under UPA, BAM is looking to standardise how we approach the entire construction lifecycle from design to O&M. Construction IQ, through the Autodesk B360 platform, will allow BAM to continuously assess and improve this approach across all of its operations globally by:

- Re-inventing the way BAM capture information, i.e. reducing the over-production of data captured.
- Exponential growth of effective Machine Learning data model via scaling of Autodesk Forge Platform for the construction lifecycle.
- Introduction of a proactive quality and safety culture.
- Removing unnecessary and time-consuming 'after the fact' reporting.
- Upskilling of BAM staff to better understand benefits and impacts of advanced analytic methodologies.
- Upskilling of BAM staff to better evaluate future technologies and their benefits.

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