International Academy for Quality

Quality Sustainability Award
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Attachment 1: Summary for publication

Title: NorDan AB Commercial Selling of 3D Printed Windows in Modern Sustainable Biomaterial Applying PDCA Methodology and Quality Tools

In 2018 and 2019 NorDan AB conducted a highly successful R&D project applying Quality Management philosophy, methodology and tools in order to achieve significant results regarding Sustainability. The NorDan project developed a production technique, material solution, product documentation and marketing concept for 3D printed windows in bio-composite material, with a Scandinavian market product launch in October 2019. The company has gained momentous attention and recognition for their pioneering efforts in 3D printing within the building industry, especially from a sustainability perspective.

Throughout the entirety of the project, the PDCA Cycle (Plan-Do-Check-Act Cycle) was applied in an agile way and with many iterations to make progress towards the overall project goal; to be the first window manufacturer start commercial sales of 3D printed windows in a modern, sustainable material. As an integrated part, root cause analysis and cause-effect diagrams were applied numerous times in order to better understand the challenges in the project and agree on necessary actions to move the project towards its overall goal. Also, the application of the Pareto principle helped the project team to scope the project efficiently and identify "the vital few from the trivial many".

In the PDCA cycle work, it was often found that the 'Plan and Do' phases were relatively easy to undertake. However, the team believed that the real power of improvement and learning came from the work conducted within the 'Check' phase. This is where data was gathered from testing in the 3D printer followed by analysis, which meant that the team could better understand the causes and make a good basis for the 'Act' phase where main learning and action points were concluded, forming the basis for subsequently moving into a new PDCA cycle.

Additionally, during the early phases of the project, NorDan explored numerous options for printing materials, which included the likes of ABS thermoplastic polymer granulates. If NorDan had decided to continue with that specific and readily available material in the market, then the project would have been completed much earlier than it did. However, NorDan's focus on Sustainability directed the project to concentrate more greatly on finding the most sustainable material possible so that the 3D printed windows would remain in alignment with the other products in NorDan's timber range. Introducing the bio-composite materials into the 3D-printing process caused significant variation in the material properties, printing process and the surface finish of the printed product. Moreover, the data-driven and fact-based approach with the PDCA cycle meant it was possible to reach a stable and well-working printing process for circular windows. To ensure that the performance of the 3D printed windows within a building façade was maintained, product tests were performed at RISE using the same testing parameters as practiced with traditional timber products. The test results were very good, and the product was granted approval.

The innovation highlighted by NorDan, with the 3D-printer project, is part of NorDan's 'ecoDigital ready' strategy. This is the trade-marked initiative of the NorDan Group, which highlights the company's commitment to sustainability and digitalisation. As part of this strategy, the company has worked actively with the UN Sustainability Development Goals and have made concrete plans for improvements and initiatives within six of the SDG goals. The following three UN Sustainability Development Goals have been focused on in the 3D-printer project:

- GOAL 9: Industry, Innovation and Infrastructure
- GOAL 12: Responsible Consumption and Production
- GOAL 17: Partnerships to achieve the Goal

Based on the degree of success achieved through this project, the company has launched various additional schemes testing the 3D-printing of entrance doors and square windows. Furthermore, in collaboration with their biggest customer, NorDan AB have established a process for recycling used windows. This highlights the potential for companies in developing new services and business models, within the sustainability remit, that are geared towards customers.

A key learning takeaway for NorDan AB is that Quality Management and Sustainability should be applied at a strategic level within the company. Quality Management is vital to ensure that there is a key focus on customers and high-quality outputs, whereas Sustainability ensures conscious choices are made regarding the environment and resource utilization. Furthermore, Quality Management with its methodologies and tools offers a very strong supporting frameworks in project management execution and fact-based decision making in an agile way.