

How Smart Building Materials are Disrupting the Industry

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WHAT ARE SMART BUILDING MATERIALS AND WHY SHOULD I CARE?

Smart construction materials, also known as intelligent materials, active materials and adoptive materials, are those that have the capability to respond to changes in their condition or the environment to which they are exposed, in a useful and controlled manner.

They have applications in the design of our homes, skyscrapers, shopping centres and large infrastructure. Their various uses include vibration control, noise mitigation, safety and performance, environmental control, structural health monitoring, transforming efficiency, comfort, and safety for people and assets while also reducing the impacts of natural disasters (e.g. – earthquakes, wind, and rain).

The reason attention should be paid to this emerging trend is smart building products help in the efficiency, and effectiveness, of our built environments, lowering resource demands and exhausting natural solutions, like sun and wind solutions in energy. This makes them more attractive to planners, designers and engineers compared to traditional products that are unable to interact with their surroundings.

The economic/financial benefits of these products are so profound that Companies are trialling and using successful smart building products for applications in areas like energy storage, a building's workings (via sensors) and in applications we never thought possible, storing data and providing real-time insight. This enables building managers to improve their understanding of their building's opportunities, risks and capabilities. An example of this is [Vicinity Shopping Centres](#) here in Australia that is trialling projects like solar glass which can harness sunlight and be stored for use in internal lighting etc. which was developed by Western Australian company, ClearVue PV.

MATERIALS THAT ARE CHANGING AND DISRUPTING THE INDUSTRY

There are numerous technologies, and means through engineering and science where construction materials are being made smart, enabling better management of the state of a building and how people are affected in buildings. Some materials include: Solar Glass, Air Cleaning Bricks, Smart Paint, Carbon Fibre Rope, Illuminating Cement, Cooling Bricks, Self-Healing Concrete, Programmable Cement, Smart Wallpaper, and Shape Memory Alloys (SMAs).

EXAMPLE: SELF - HEALING CONCRETE / SMART CONCRETE

- Cracks in concrete have been a long-standing problem in the construction industry. A small crack often becomes larger and wears away the structure over time.
- Self-healing concrete can be used to solve this challenge. It consists of living spores and water capsules within the concrete mix.
- When damage occurs, the capsules crack open and mix with water. This mixture produces calcite, a material that fills the damaged area and later solidifies in place.
- By using self-healing concrete, structures such as tunnels, buildings and bridges will cost less to build and maintain (over time).
- Smart concrete plays a vital role in the construction of road pavements as a traffic-sensing recorder, and also melts ice on highways and airfields during snowfall in winter season by passing low voltage current through it.

EXAMPLE: ILLUMINATING & PROGRAMMABLE CEMENT

- Illuminating cement is a new material that will influence road construction in 2019.
- This cement traps light from the sun during the daytime and releases it at night. Illuminating cement creates a glowing surface that allows builders to save on lighting costs.
- This material can also be used to light swimming pools, footpaths and roadways; reducing dependency on street lighting.
- In an effort to make concrete structures more durable, programmable cement can be used to achieve water and chemical resistance. Programmable cement is essentially a form of cement that can be designed to achieve less porous and more chemically resistant shapes.

CHANGING THE CONSTRUCTION BUSINESS MODEL

- When considering the use of new construction materials, it is important to consider both the new innovations available on the market and the costs of implementing them in a project. What might seem initially costly, may over the long-term of the construction or building's life outweigh that cost.
- Smart materials like programmable cement and the like, enable the viability of a building to be prolonged. The embedded smart materials will indicate when they need to be replaced as well as identify efficiencies for long term cost savings.
- For all projects, accurate cost estimates are essential to ensure costs are adequately allowed for, and profitability maintained. Smart building materials ensure that over the life of the building or structure, that a record of updates and equipment changes needed can be planned for rather than being applied ad-hoc and inconsistently.
- The use of connected, smart materials, and associate equipment (automation systems, IOT, AR, Big Data etc etc.) enhances productivity by shortening construction times and construction maintenance, by lowering costs, and reducing risks onsite. As the use of these new material increases, there will be a profound effect not only on the cost of construction, but in many aspects of the way the industry operates (legal requirements, human resourcing, and wages). So, we are likely to see the current construction business model changing and allowing the industry to work smarter, faster and more profitably for everyone in the supply chain.

COSTS OF MATERIALS AND COST TO THE ENVIRONMENT (PRODUCT LIFECYCLE)

- Terms such as “recyclable,” “recycled-content,” “biodegradable,” or “organic,” all suggest a more sustainable use of resources, but all focus on a limited set of environmental impacts.

- In today's world there are more pressures on the environment and correspondingly how organisation are seen by the public to be either helping or hindering the issue. It is vital for companies to look at products that will not only be environmentally favourable but cost effective over the long term of the product (product lifecycle).
- Businesses can make better-informed choices with "life-cycle thinking," that is, considering the environmental impacts caused at all of the stages of a product's life cycle. These impacts may include releases of pollutants to air or water; raw material depletion; loss of trees, vegetation and wildlife through disturbance of land and water ecosystems; and Greenhouse Gas (GHG) emissions. The stages of a product's life cycle include extraction of resources, manufacturing, use, and end-of-life management.
- Focusing on just one stage (e.g. waste management) or one effect (e.g. organically-raised or grown) can be misleading in total environmental impact. A broader look at life-cycle considerations can show unexpected or surprising effects – such as high greenhouse gas (GHG) emissions from washing clothes with hot as opposed to cold water (since fossil fuels were likely burned for the energy used to heat the water).
- When looking at materials, it is important to see the long term benefit in many areas, as opposed to the short term "solved an issue now" solution.

IoT (INTERNET of THINGS) USE OF DATA & ITS MONETISATION

- The Internet of Things (IoT) is connecting devices (anything with an on and off switch) to the Internet and/or to each other. This includes everything from mobiles, washing machines, wearable devices and almost anything else that can connect. This can create multi-device platforms with new products and services based on the data captured.
- In order for raw data from construction materials to be used in the right way there needs to be the suitable implementation of systems to communicate with one another.
- The IoT allows for improvements in construction through Remote Operation, Supply Replenishment, Construction Tools and Equipment Tracking, Equipment Servicing & Repairs, Remote Usage Monitoring, Power and Fuel Savings, Augmented Reality (AR) and Building Information Modelling (BIM).
- The applications of Artificial Intelligence (AI) and Machine Learning enables these systems that are connected, to provide consistent verification and validation of data. Thus allowing better decisions to be made about systems efficiency and effectiveness without human interference or bias.
- New knowledge and data will allow operations, quality management or decision making in combination with a smart data management teams onsite to monetise, and use these new assets to their competitive advantage.
- Global Systems Intelligence Services like the Millennium Project developed by the United Nations is a clear example of a GSIS that can be applied to business. The collection of information by systems can interlink to give a better insight in a global context. Multinational companies like Multiplex have the ability, and opportunity, to link their connected services in one nation to all others in which they operate. This allows the organisation to see the cost efficiencies against each nation and make better management decisions on their organisation from a global viewpoint.
- There is much conjecture about the ownership of data from smart products/services and materials. The answer at the moment is: no one owns the bits of data – there is no property right in a piece of data itself. The owner of a smart thermostat does not, for example, own the data about how he uses it. The only thing that is 'ownable' is an aggregation or collection of such data, provided there has been a relevant investment in carrying out that aggregation or collection (the individual user is very unlikely to have made that investment).
- If a shopping centre invests in many smart products that are interrelated and develops an aggregation of the data of how one effects the other and can show things such as cost savings to the bottom line,

environment through non-use of “grid power” then this is a commodity that the shopping centre can sell back to suppliers, as the centre is helping the supplier to understand their product better in real life scenarios.

- In order for the data to be monetised, there needs to be investment on the owner’s behalf in curating aggregated data that will have use to the market.

END OF REPORT

RESOURCES

1. Buildsoft, 9 New Construction Materials to Explore in 2019, <https://www.buildsoft.com.au/blog/9-new-construction-materials-to-explore-in-2019>, Accessed: 26 February, 2019.
2. ClearVue PV, ClearVue's Vision, <http://www.clearvuepv.com/>, Accessed: 25 February 2019.
3. DailyPoint Central Data Management, How to Monetise Data, <https://www.dailypoint.com/2017/12/05/how-to-monetize-data/>, Accessed: 25 February 2019.
4. Gizmodo, 7 New Materials That Could Change How Our Buildings Act, <https://www.gizmodo.com.au/2014/08/6-supermaterials-that-could-change-how-our-buildings-act/>, Accessed: 25 February, 2019.
5. McKinsey Global Institute, Reinventing construction through a productivity revolution - February 2017 Report, <https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/reinventing-construction-through-a-productivity-revolution?reload>, Accessed: 25 February, 2019.
6. Taylor Wessing – Media & Tech Law, Who owns the data in the Internet of Things?, https://www.taylorwessing.com/download/article_data_lot.html,
7. The Balance Small Business, How "The Internet of Things" is Affecting the Construction Industry, <https://www.thebalancesmb.com/how-internet-affects-the-construction-industry-845320>, Accessed: 25 February, 2019.
8. The Urban Developer, <https://theurbandevolver.com/articles/ripe-disruption-5-new-construction-technologies-changing-way-build>, Accessed: 25 February, 2019.
9. United Nations, The Millennium Project – Global Future Studies & Research, <http://www.millennium-project.org/projects/global-futures-intelligence-system/>
10. United States Environmental Protection Authority (EPA), <https://blog.epa.gov/2014/07/29/sustainable-materials-management-a-life-cycle-perspective/>, Accessed: 26 February, 2019.

11. Vicinity Centres, Vicinity and ClearVue install global first, clear solar glass structure, https://www.vicinity.com.au/media-centre/media-and-news/190130_solar-glass-trial, Accessed: 25 February, 2019.

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