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CONSULTING ENGINEERS
OF IRELAND

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National Tourism Development Authority



FUTURE TRENDS IN THE CONSULTING ENGINEERING INDUSTRY

May 2019

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Future Trends 2019 Task Force



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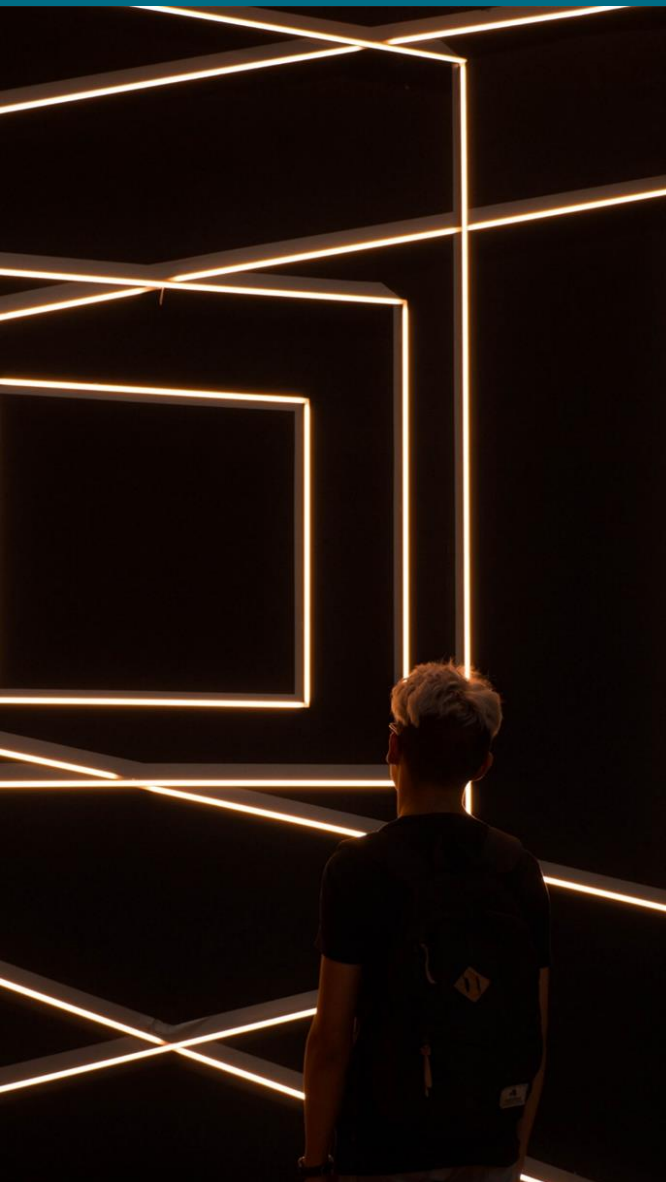
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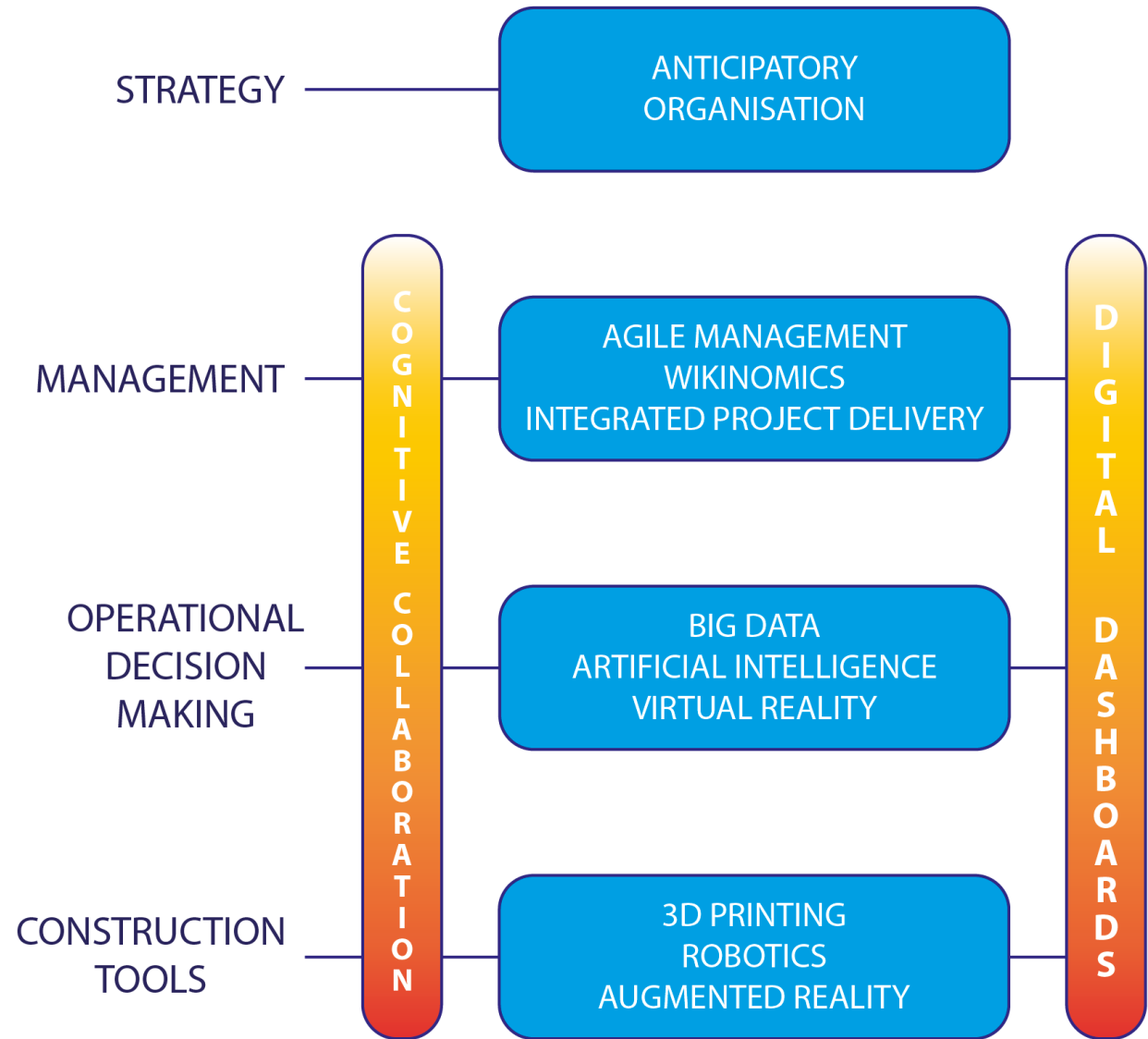


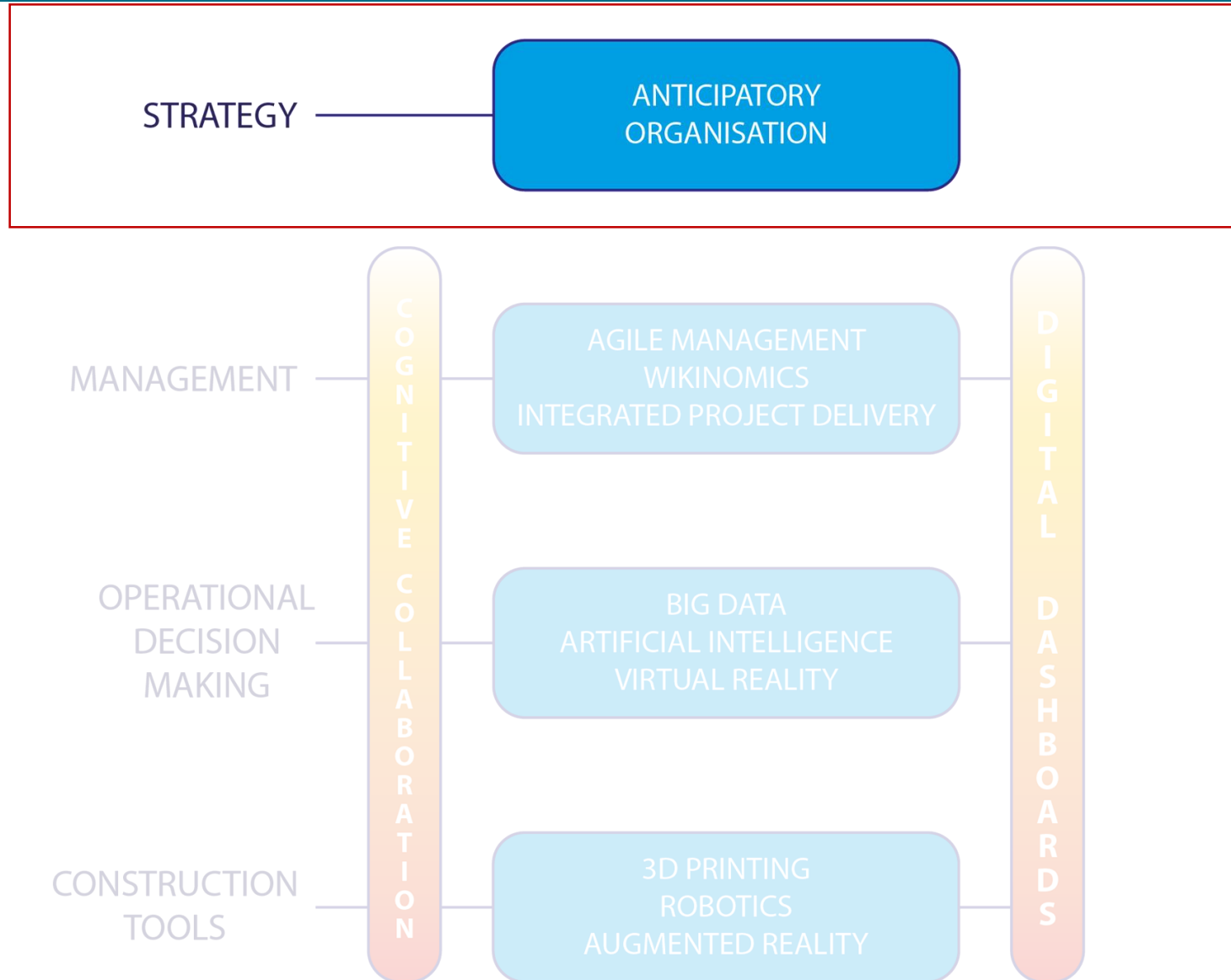
Examples from 2018 edition

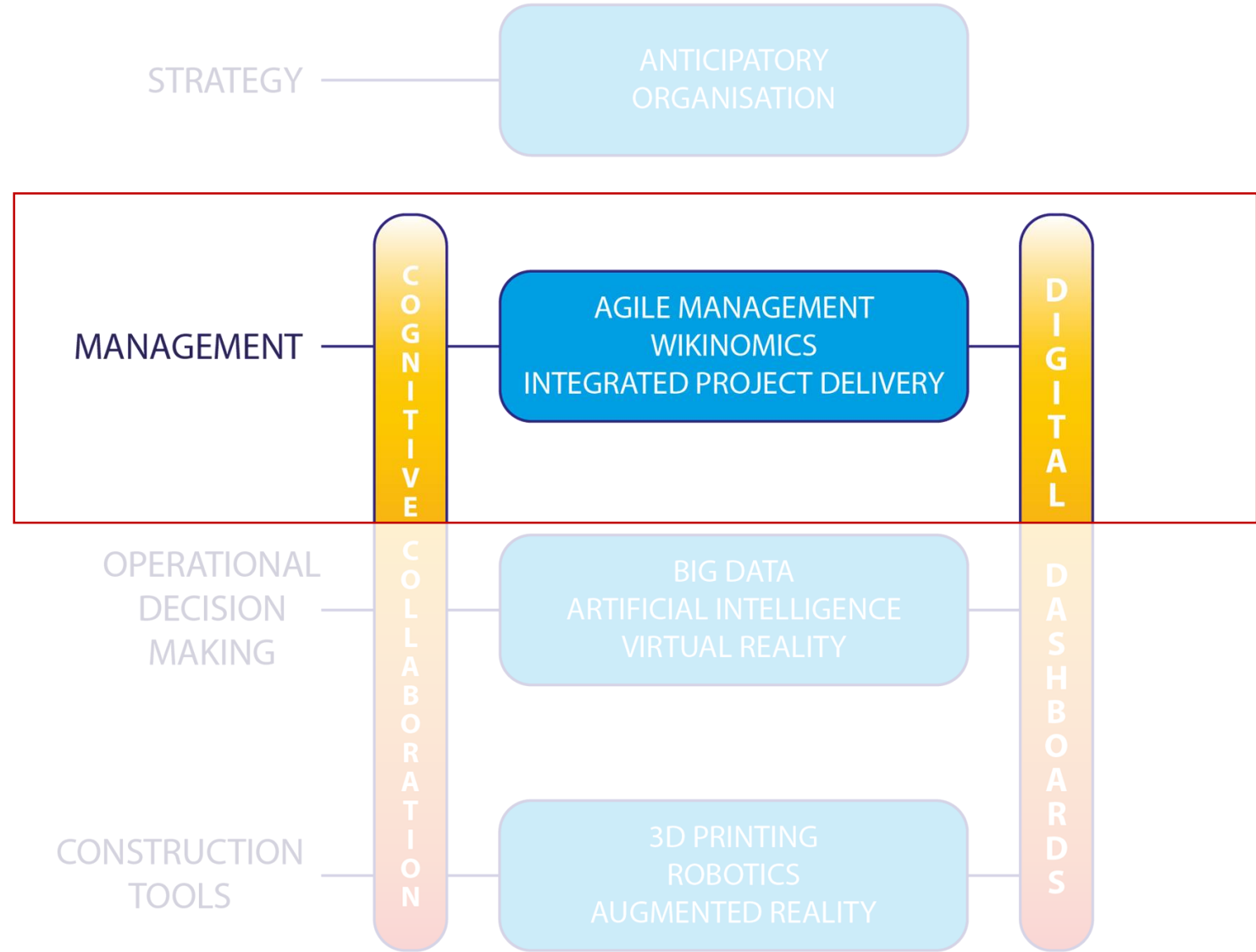
In the 2018 booklet we looked at the principle trends in the engineering industry.

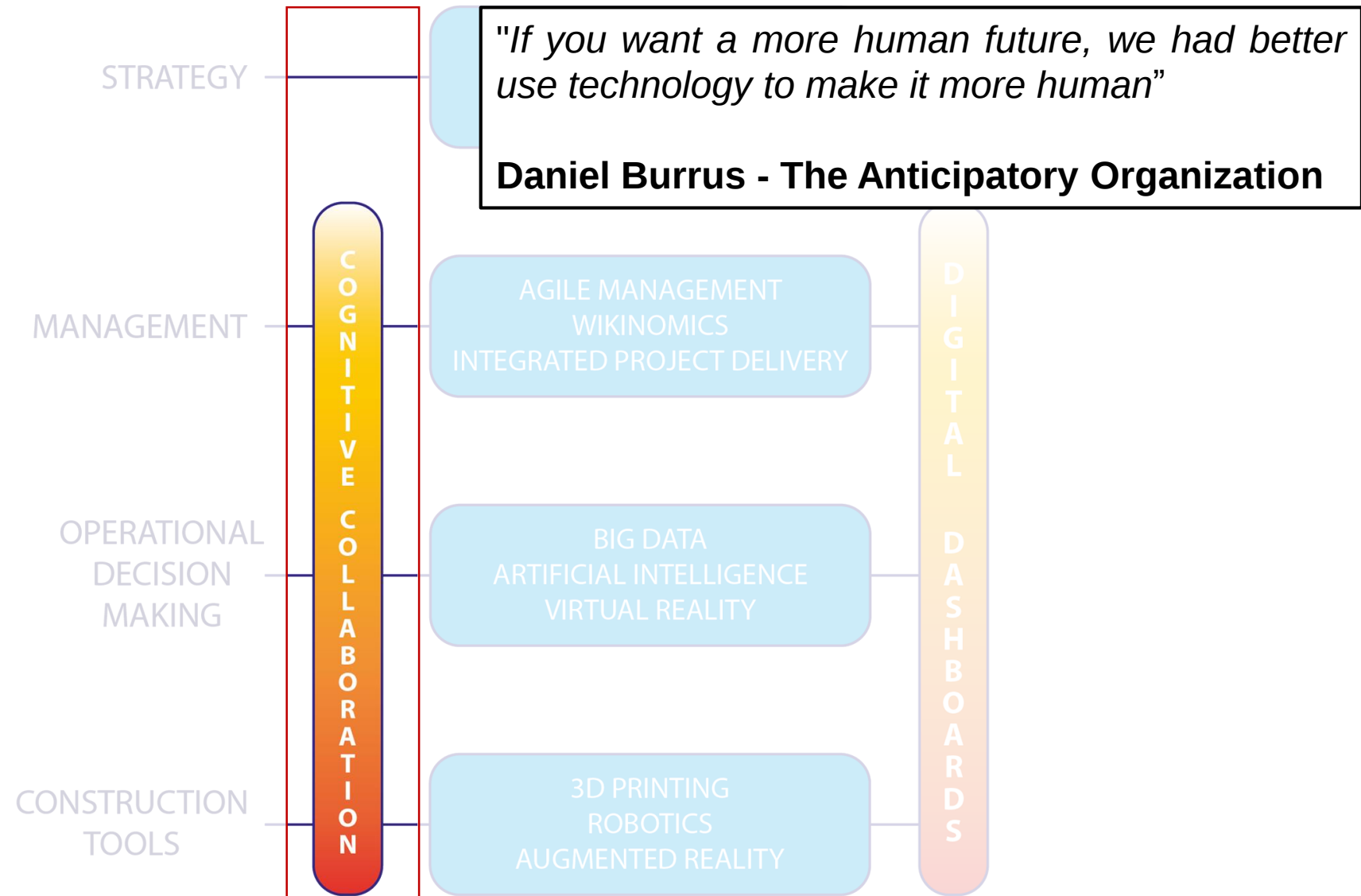
Now let's focus on some operative examples:

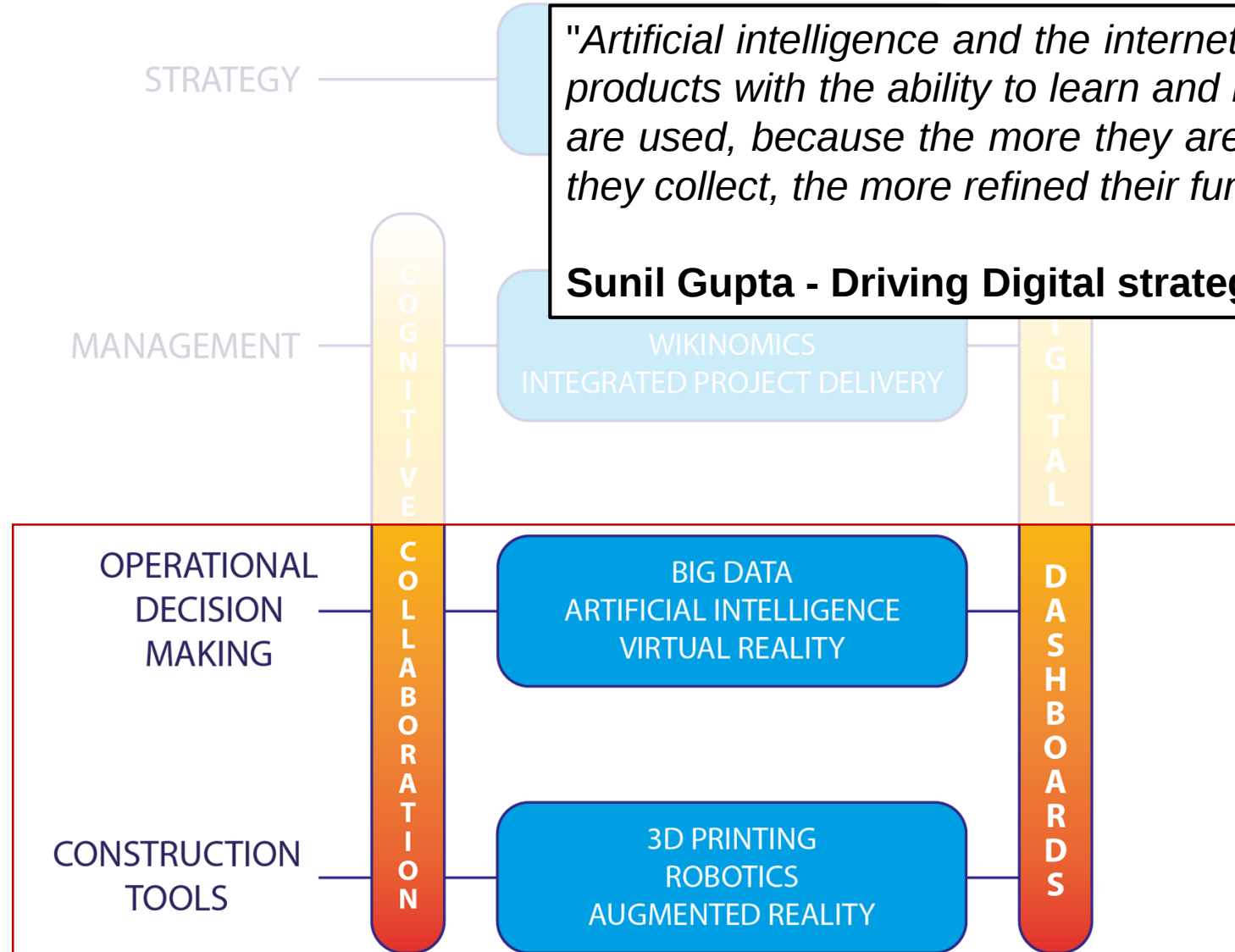
- Collaborative Engineering and Networking 
- Construction Tech Trends 
- Blockchain Technology 

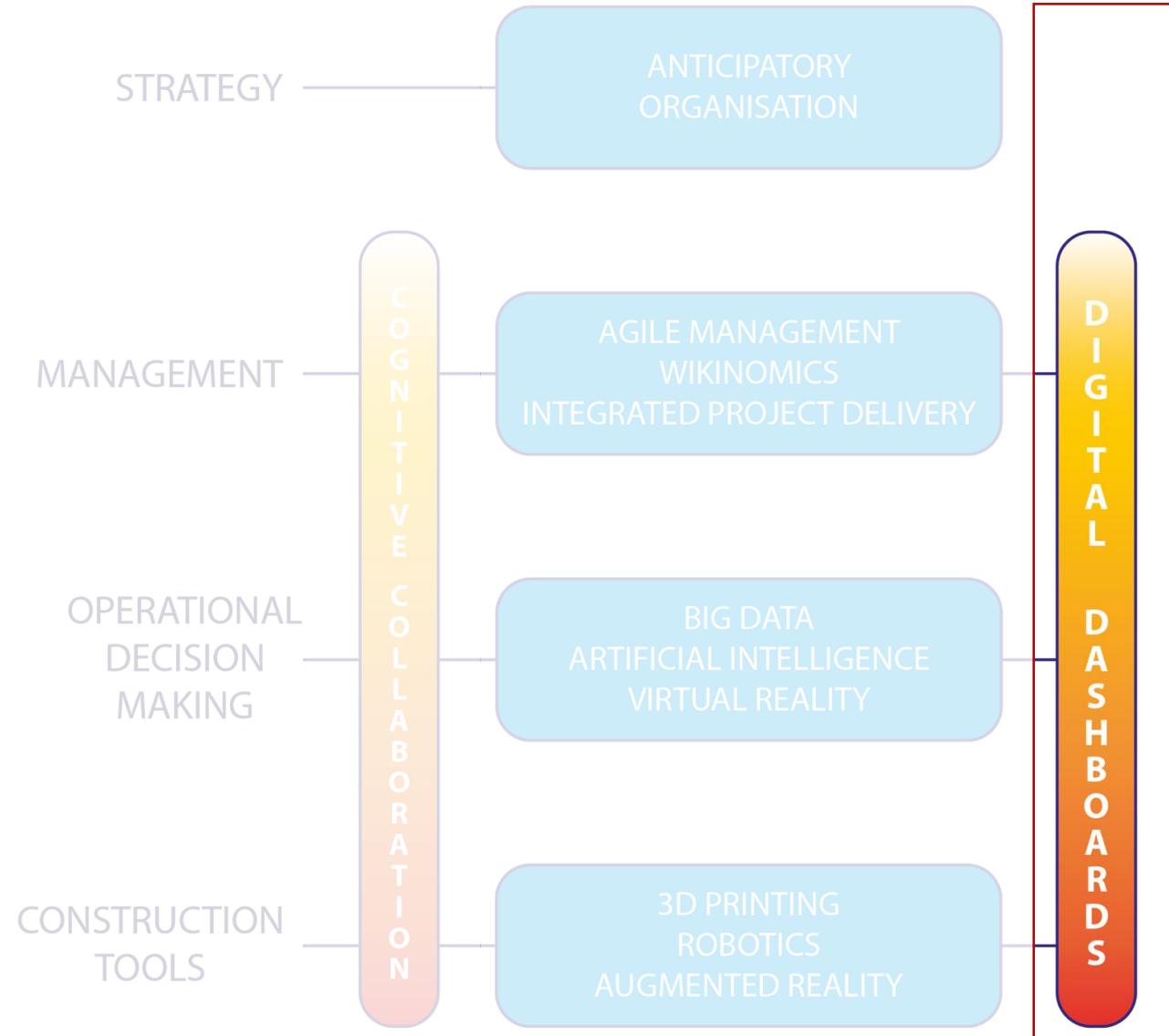












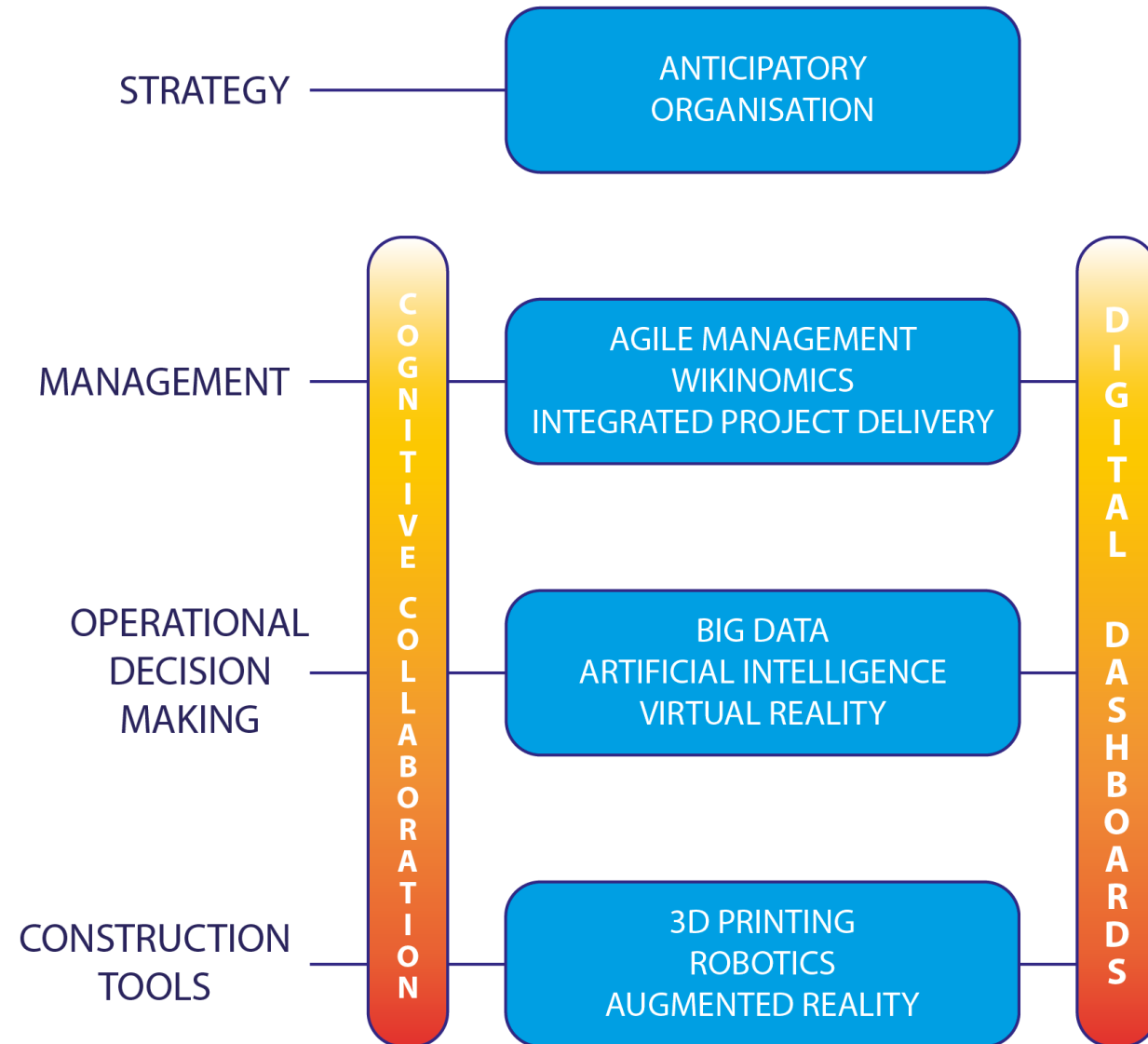


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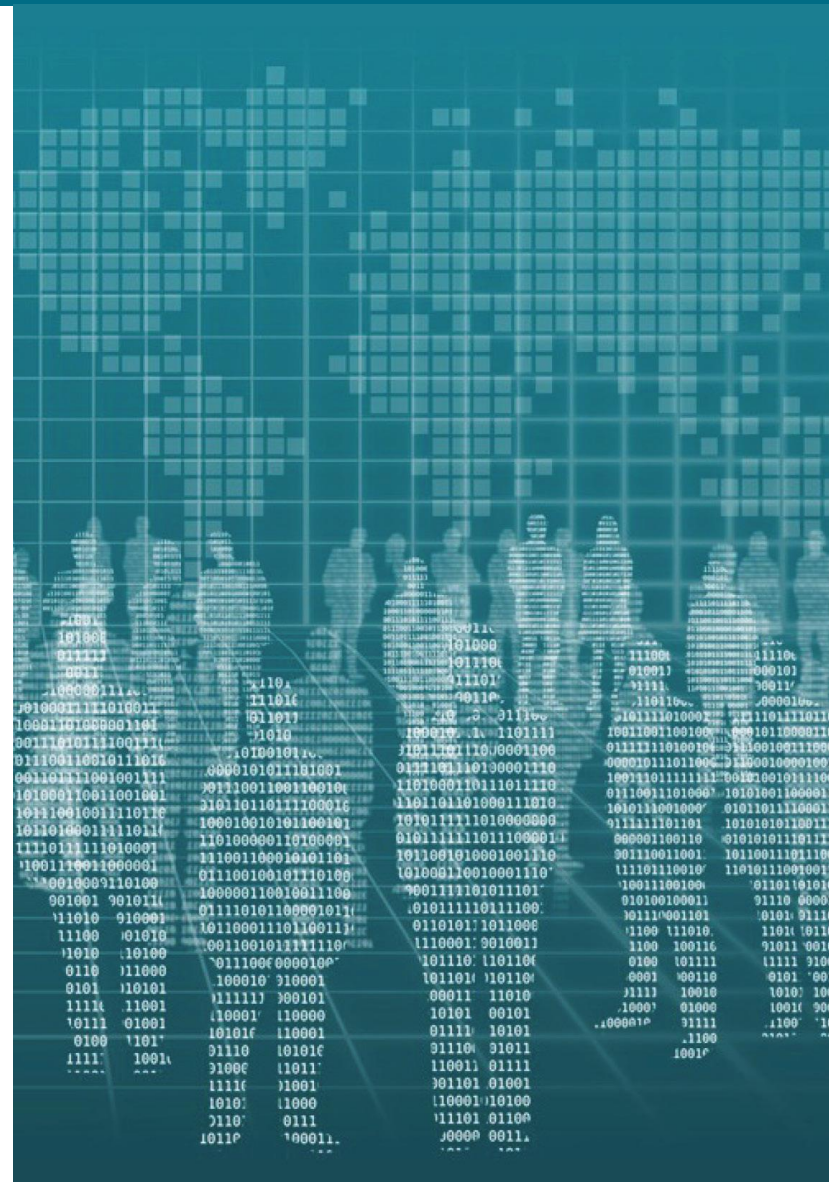
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AGILE MANAGEMENT, WIKINOMIKS AND IPD

"Agile management is about working smarter rather than harder. It's not about doing more work in less time: It's about generating more value from less work." (Stephen Denning)

Agile Management



Traditional management practice assumes that the world is:

- deterministic
- predictable
- orderly
- certain

But in today's digital age we accept that the world is:

- probabilistic
- unpredictable
- disorderly
- uncertain

For Stephen Denning traditional management applies detailed command techniques that lead to:

- centralization
- coercion
- formality
- tight rein
- imposed discipline
- obedience
- compliance
- optimal decisions that take place later
- a focus on harnessing ability at the top

In a word, Bureaucracy.

But in today's accelerated world we need a mission command approach characterized by:

- decentralization
- spontaneity
- informality
- loose rein
- self discipline
- initiative
- cooperation
- acceptable decisions that are made faster
- focus on harnessing ability at all levels

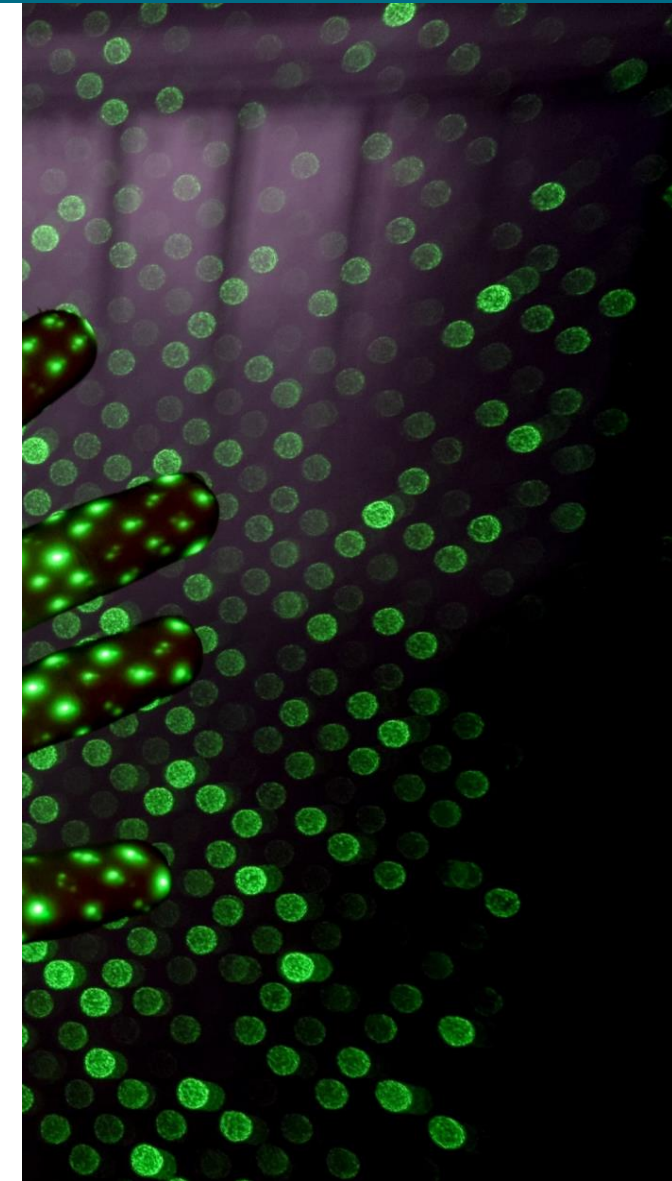
In essence, Agile Management.

AGILE MANAGEMENT, WIKINOMIKS & IPD

“Agile management is about working smarter rather than harder. It not about doing more work in less time: Its about generating more value from less work”
Stephen Denning

“Trying to exploit Technology and data with the management practices that are still pervasive in many big corporations today is like driving a horse and buggy on the freeway. To prosper in the very different world that is emerging, firms need a radically different kind of management.”

“The new management paradigm is a journey, not a destination. It involves never - ending innovation, both in terms of specific innovations that the organization generates for the customer and the steady improvements to the practice of management itself. A firm never “arrives” at a steady state where it can relax because “we are now Agile”. Embracing the new paradigm requires continuous commitment and leadership from management.”...

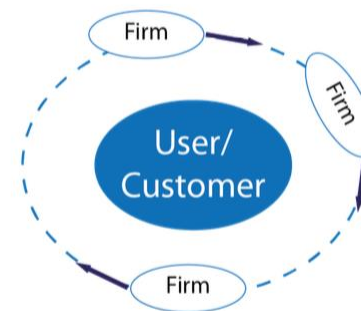
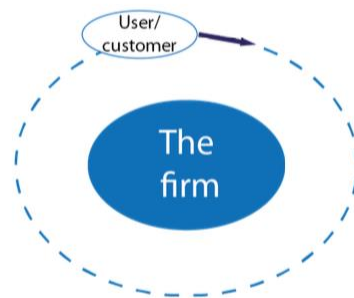
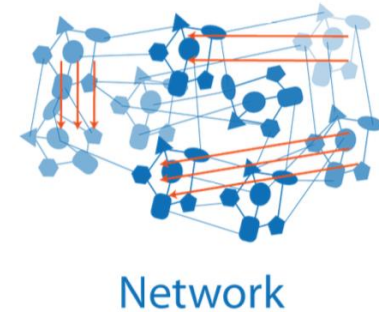
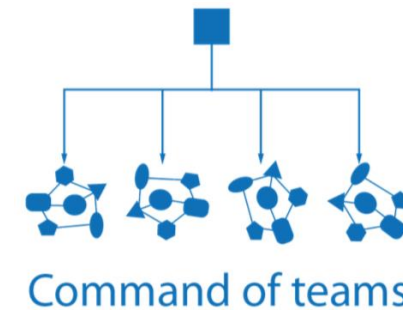


Core Characteristics in the Organizations that have embraced Agile:

1. The law of the small team



3. The law of the network



2. The law of the customer



Why is the engineering industry perfectly suited to agile management?

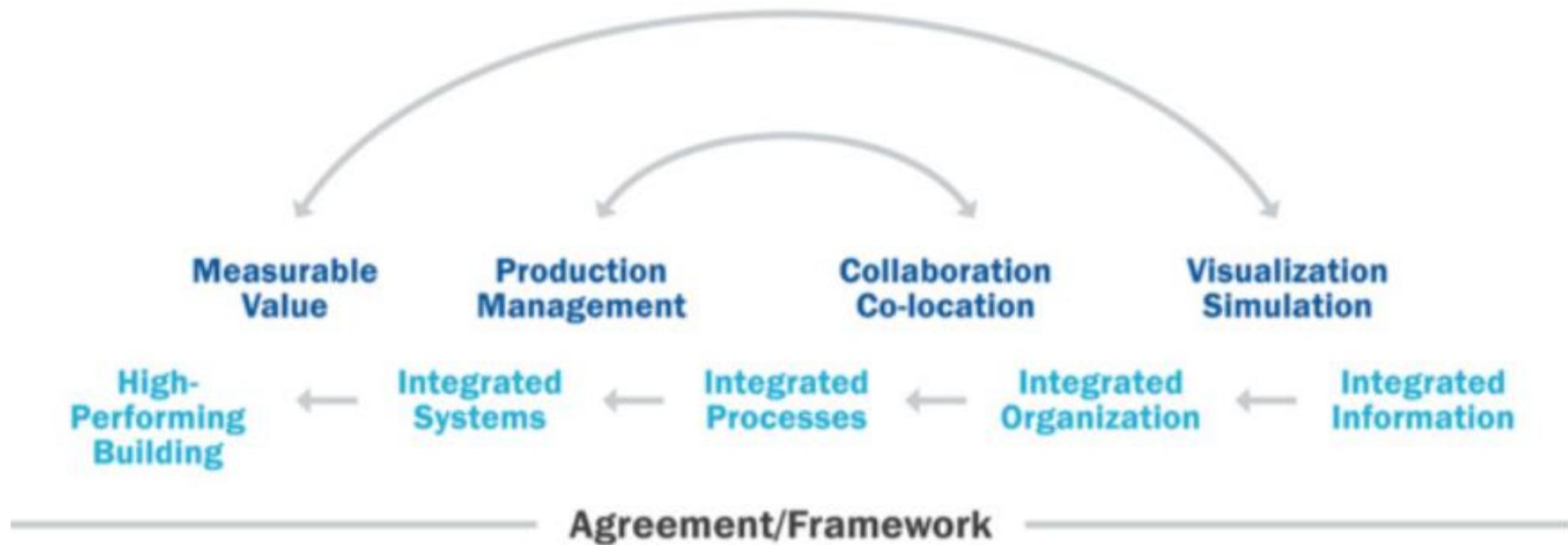
Because the industry operates in an **uncertain ecosystem**;

- The purpose of the engineering company is to design single projects perfectly suited to the law of the small team;
- Every single project needs to satisfy the client, in other words to apply the law of the customer;
- The success of the project depends on the ability to manage integrated information, in essence to apply the law of the network;
- The management in an engineering company needs to be primarily a hierarchy of competence, not a hierarchy of authority;
- In today's digital age, engineering companies need to achieve both execution and innovation disciplines.



Wikinomics

Integrated Project Delivery



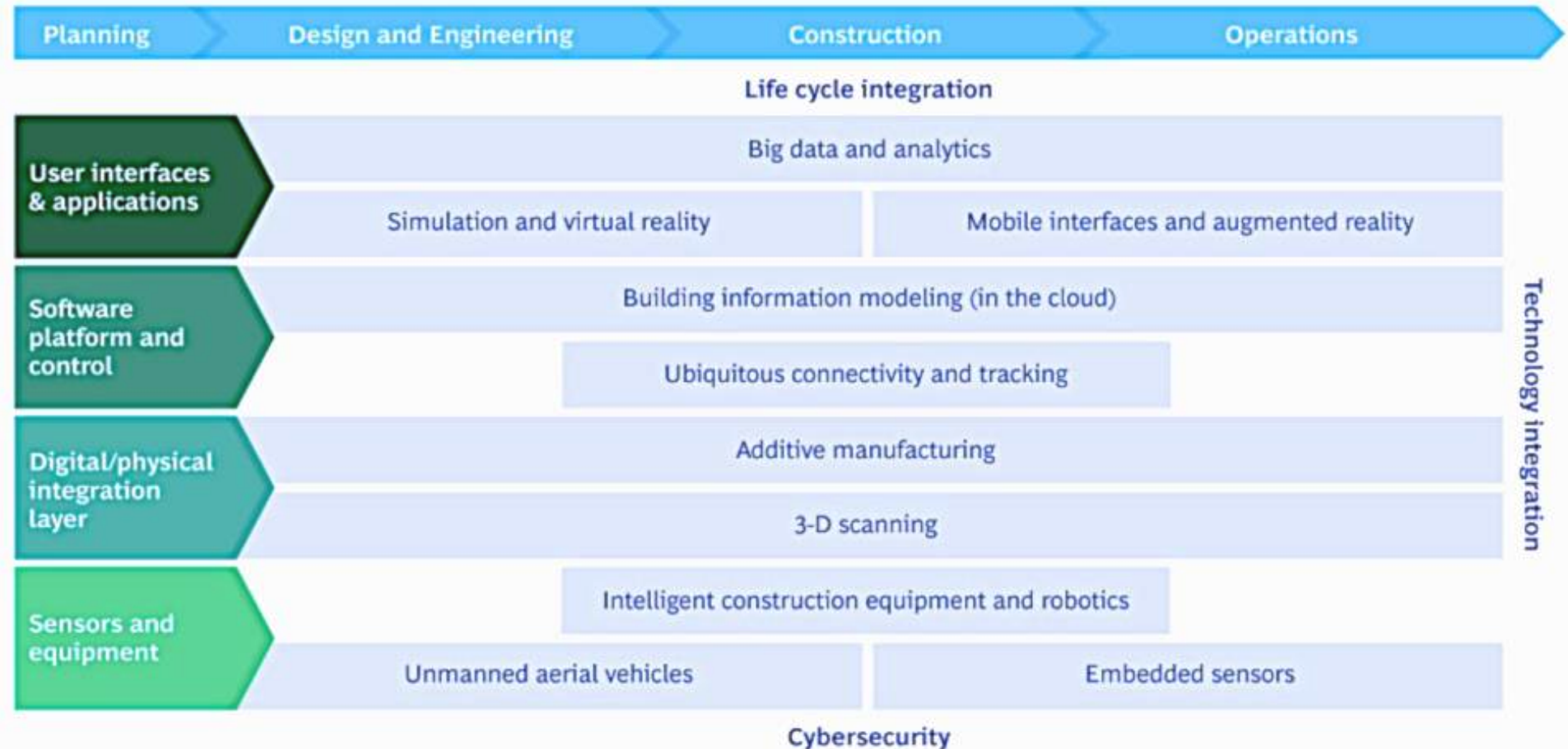
“Building the right building” and “building the building right”
Zigmund Rubel



- BIG DATA AND ARTIFICIAL INTELLIGENCE
- DIGITAL DASHBOARD
- VISUALIZATION AND DEMATERIALIZATION
- 3D PRINTING AND ROBOTICS

Digitalization in Engineering & Construction

Many Digital Technologies Can Be Applied Along the E&C Value Chain



4 principle strategies to capture value

... from available technologies in construction industry

Which one of these answers best fitting your present style?

(Honest answers required, please 😊)

1. No need for change - We delay implementation as much as possible
2. We relay on our partners to create new value
3. We are front runners introducing new solutions
4. We are creating an Eco system with others

... Let's get back to reality!

Our Clients are expecting
GOOD ○ FAST ○ CHEAP

In reality one can deliver two of expected

- **Good & Fast won't be Cheap**
- **Fast & Cheap won't be Good**
- **Good & Cheap won't be Fast**

... if we firmly set goals, it might be achievable with fresh ideas and use of technology?

Data driven decisions – collect real time DATA



BIG DATA AND ARTIFICIAL INTELLIGENCE

How to use and manage big data and artificial intelligence in the AEC industry.

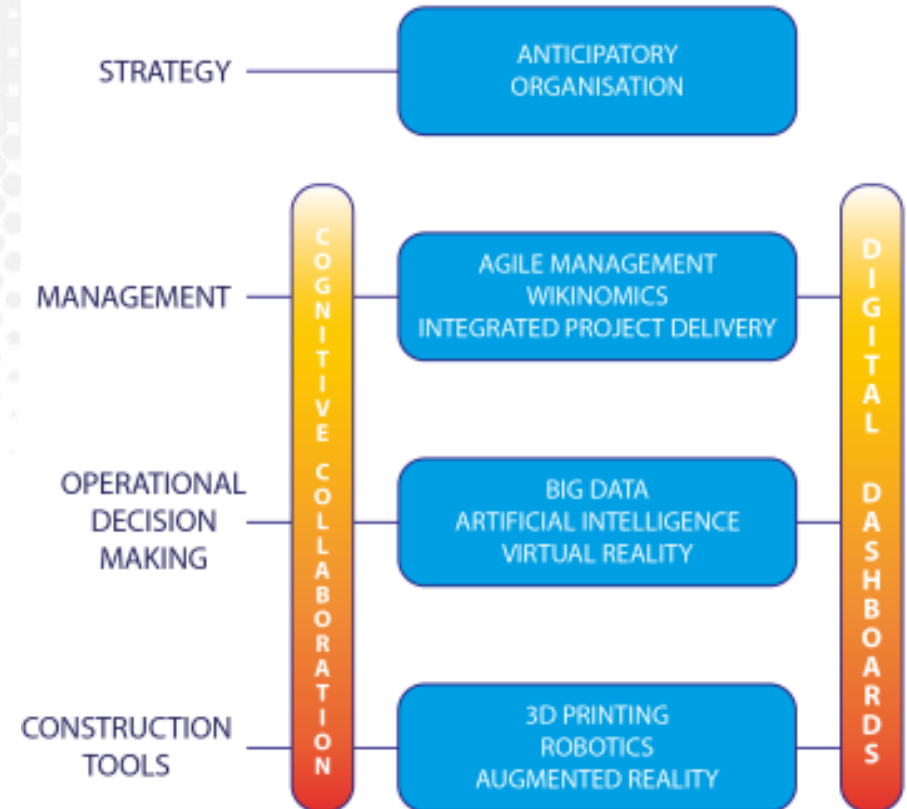
Big Data is invading the planet, and in the field of engineering, just as in every other area of knowledge, **the volume of data** that is **produced** every day in the world, structured or otherwise, **tends to increase exponentially**.

In 2016 alone, about 4 zettabytes of data were produced (one zettabyte is equal to $1000^7 = 10^{21}$ bytes = 1 sextillion bytes), and it is estimated that by 2020 this number will grow to reach 44 zettabytes (90% of which are not structured).

Given this enormous volume of incumbent data, every company will be obliged to equip itself with hardware and software architectures capable of ensuring its **optimal management**. The engineering sector, in particular, will have to adopt powerful data-capable tools that can analyse, process, interpret and fully harness the power of this information, with the goal of **generating implementable design solutions for every kind of project**.

In professional practice, **various problems must be considered**: firstly, regional and **territory-related restrictions** must be identified; thereafter, the multitude of prevailing **local laws** and regulations must be studied for relevance, as well as any **EU directives** applicable to the project under consideration; finally, a complete reference archive should be compiled comprising material produced with all the most up-to-date **analytic techniques** available (orthographic and stereographic photography, GIS, forecast models, databases, geo-referenced thematic mapping, etc.).

The preceding list should also include any **site-relevant risk** or **environmental analyses** obtained from geological, hydrogeological, climatic, pedologic and vegetation studies. It is also necessary to constantly reference the many technical regulations governing the execution of a worthy design project.

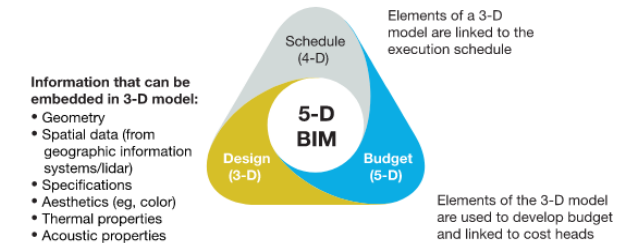


Sustainable & Smart Approach

- **LCC Strategy** – holistic approach for Investment planning, including O&M
- **BIM** – reduce time consumption in design process, better coordination and compatibility
- **IoT** – Site supervision monitoring, predictive and preventive maintenance, O&M and Structural Health Monitoring
- **Blockchain technology** – reliable data transfer and storage, protection of the intellectual properties
- **Collaborative Engineering** – shift from competitive to collaborative, knowledge sharing

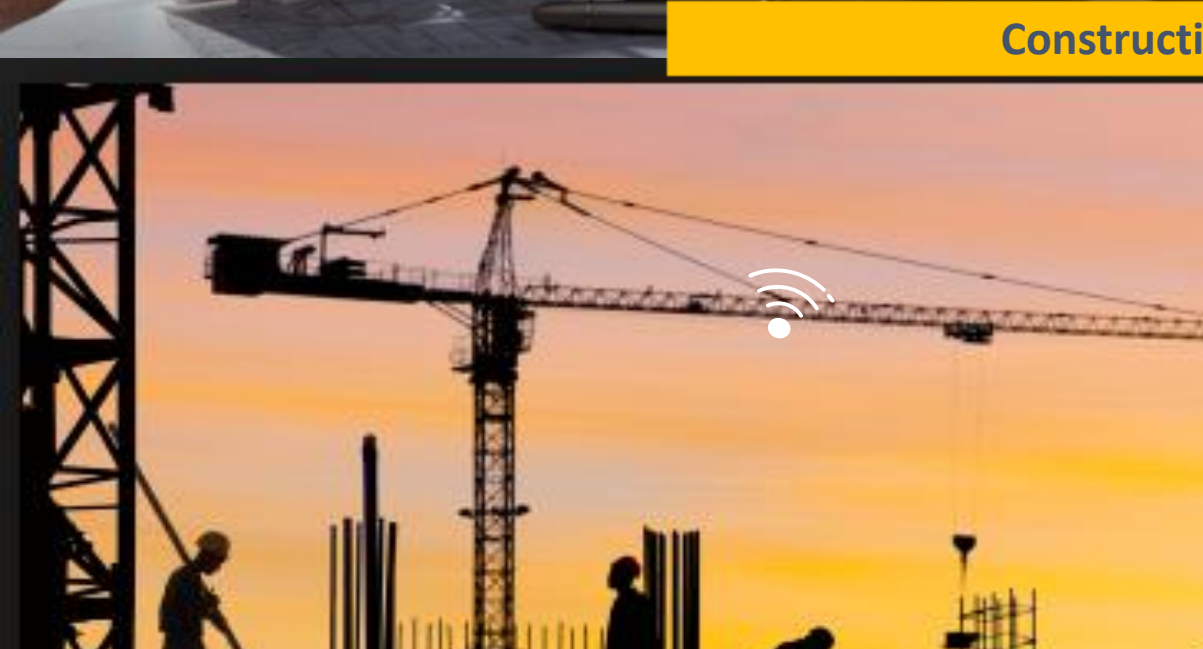


Building information modeling (BIM) is a digital representation of the physical and functional characteristics of a project, forming a reliable basis for decisions during the project's life cycle.





Construction Site Monitoring



IoT for Construction Site Monitoring

- Camera surveillance, intruder detection, Workforce surveillance
- Sensors for temperature, humidity, noise , vibration, health & safety risk
- GPS for vehicles, tools, machinery
- Control of idle use of machinery, air-conditioning, fuel level control
- Monitoring the ground in terms of geometry change - sensors can provide early warnings
- Use of aerial drones - best way to track progress and conduct site surveys



Structural Health Monitoring

Infrastructure Owners:

- Extend life of Infrastructure
- Decrease cost of Operation
- Increase Safety

Operators of Infrastructure:

- Efficient O&M
- Preventive Maintenance
- Early warning – lower cost

Designers & Contractors:

- Verification of innovative design
- Lower Risk During Construction

Insurance Companies:

- Easier Risk assessment



Focus on cool construction trends

- **The Cloud** - the process of project dematerialization, the transition from paper to digital media
- **The Platform** - all documentation, notifications and information exchanges must be managed by a specific platform that utilizes the cloud to coordinate all processes in real time by means of a reliable and controlled system
- **The Dashboard** - provides real time information that the team can use to adjust its delivery process midstream // use Plan-Do-Study-Act cycle to continuously improve
- **The Smart Contracts** - executes and enforces its clauses without external intervention. The Blockchain's mission is to manage work packages that are triggered automatically, because the Smart Contracts are actually generated during the initial design phase in BIM.
- **The Internet of Things** – data driven decisions
- **Blockchain Technology** - we can record all construction site events on non-editable media - a Ledger of Things
- **Crowdsourced Justice** - should disputes arise, rather than appealing to the conventional judicial system, justices of the peace or civil arbitration, an alternative could be the crowdsourced justice approach

DASHBOARDS – visualization of the collected data



DIGITAL DASHBOARD

How to organise and manage real time integrated information.

In general, digital dashboards allow managers to monitor the contribution of the various departments in the organization. To gauge exactly how well an organization is performing overall, digital dashboards allow you to capture and report specific data points from each department within the organization, thus providing at a glance views of key performance indicators (KPIs).

Benefits of using digital dashboards include:

- Visual presentation of performance measures
- Ability to make more informed decisions based on data collected
- Gain total visibility of all systems instantly
- Fast identification of data outliers and correlations

Dashboards are usually a series of graphics, charts, gauges, and other visual indicators that can be monitored and interpreted. The success of digital dashboards depends on the metrics that are chosen to monitor.

In his book, *"Integrating Project Delivery"* Fischer writes:

"Decisions in a complex design and construction project are made constantly. As the project progresses and conditions change, the owner and the project team must respond swiftly. And the decisions need to be well informed. Team leadership must have ready access to the latest relevant information including cost, scope, schedule, and quality."

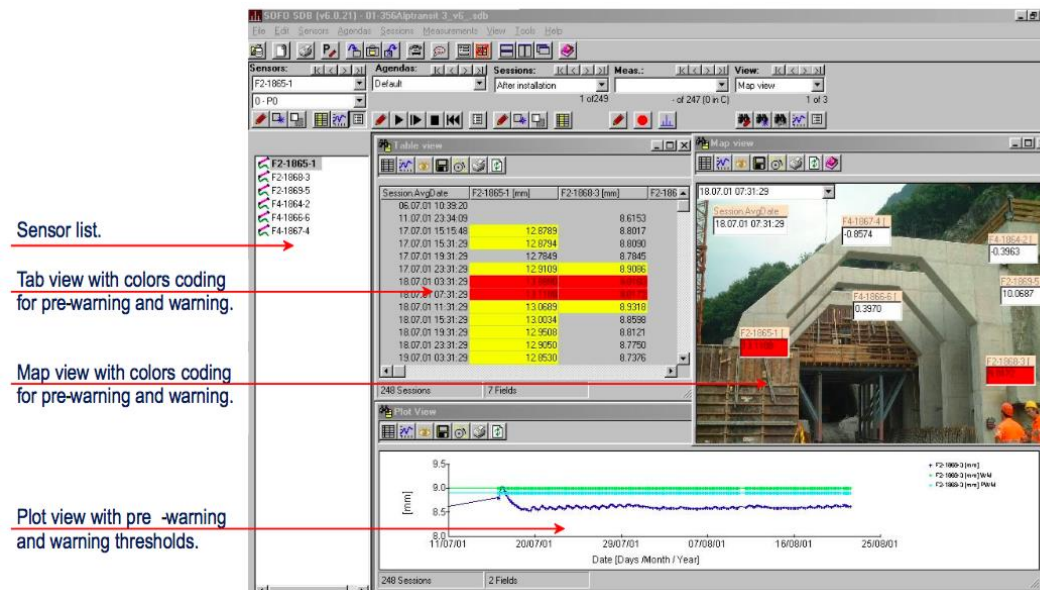
"Integrated information coordinates information from all disciplines to provide an accurate representation of project reality"

Integrated information is the neural system of the management process.

15

- Visual presentations
- Make decisions
- Visibility of all systems in real time
- Fast identification and correlations
- Visual alarming mode

Alarms & Analytical results for structures equipped with SHM solution

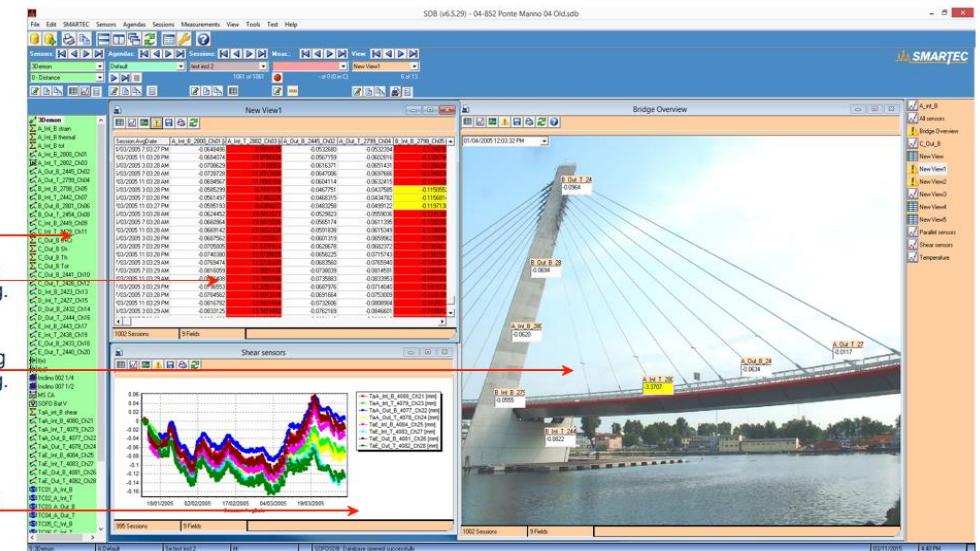


Sensor list.

Tab view with colors coding for pre-warning and warning.

Map view with colors coding for pre-warning and warning.

Plot view with pre -warning and warning thresholds.



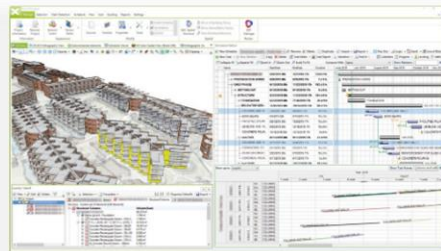
BIM modelling

Tekla Middle East BIM Awards 2018 - DUBAI Museum of the Future



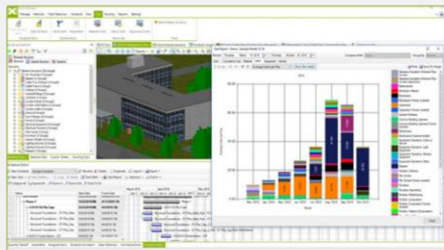
3D BIM

- DESIGN REVIEW & CLASH DETECTION
- BILL OF QUANTITIES
- BIDS AND TENDERING
- BUDGETING
- CHANGE MANAGEMENT



4D BIM

- CONSTRUCTION SIMULATION
- SCHEDULE OPTIMIZATION
- SCHEDULING AND PLANNING
- PROGRESS TRACKING
- PLANNED VS. ACTUAL



5D BIM

- COST ANALYSIS
- PROJECT SCHEDULING



6D BIM

- INTELLIGENT PROJECT DOCUMENTATION INTEGRATION



Key Takeaways

- › Digitalization in Construction Industry starting to develop
- › Efficiency & Cost saving, Better Control, Increased Safety
- › Aging infrastructure – increasing need for risk mitigation
- › Decisions based on real time measurement
- › IoT & BIM powerful tool in expert hands
- › Important to cooperate and co-create with partners – complex and different solutions and expertise needed



Construction tools - 3D print & scan



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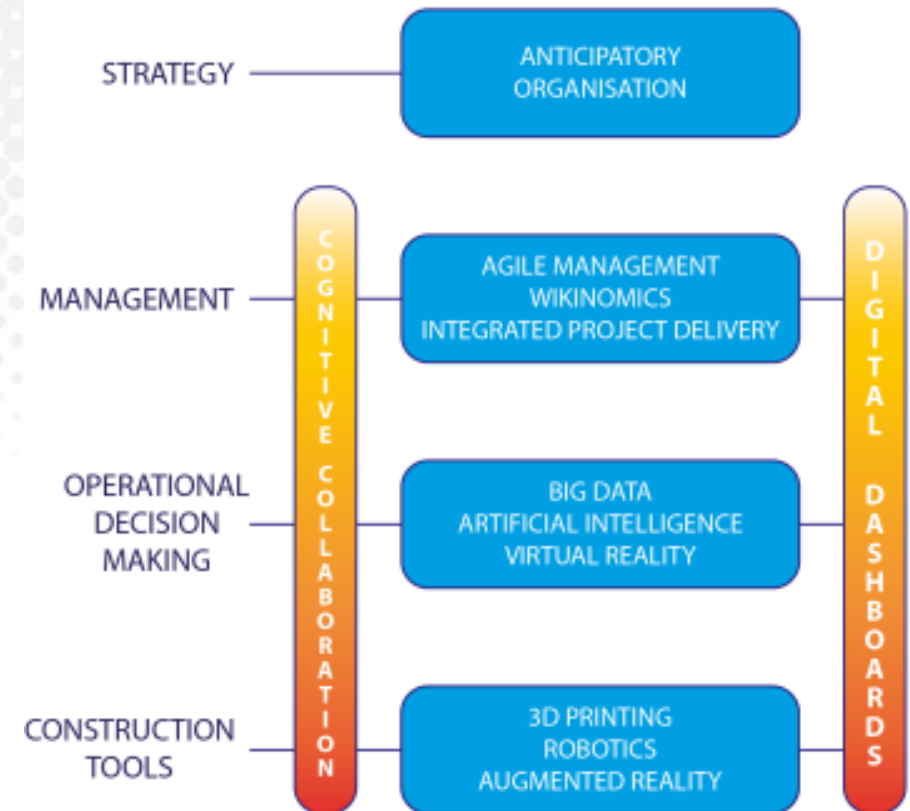
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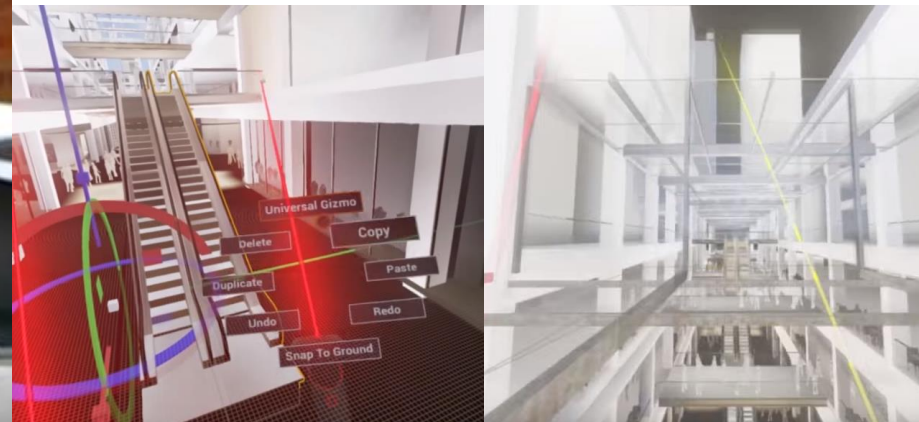
Virtual reality



[Source: Leonard Design Architects](#) * 2016



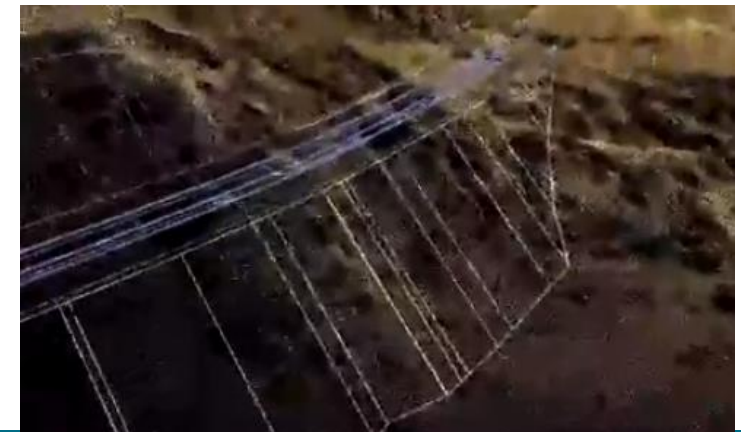
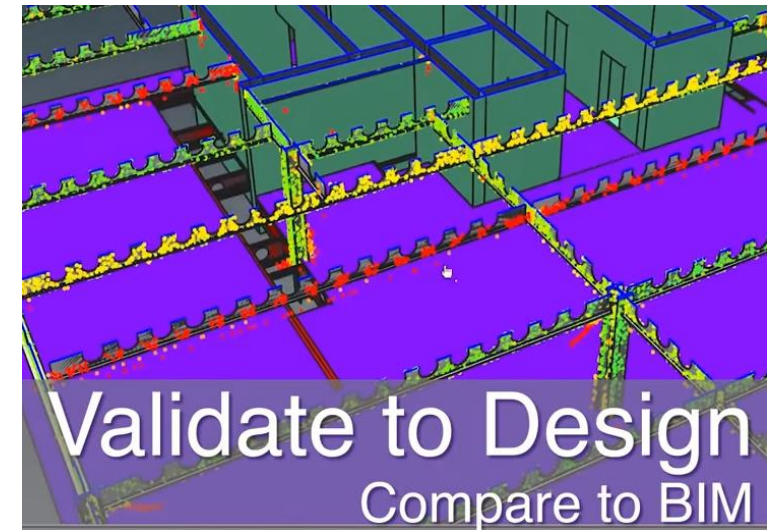
[Source:](#) VR Virtual Reality architecture by [Bryan Howard](#)



3D Printing



#3D Scanning



4 principle strategies to capture value

... from available technologies in construction industry

Take a moment and think about your FUTURE digital strategy style

1. **Lag** – There is no urgency, we will wait and observe ... Mafi mushkila!
2. **Follow** – Instead of own development we will lean on partners
3. **Lead** – We exist to shake and shape our Industry
4. **Collaborate** – Share the ideas and knowledge to progress society

Risk assessment/Challenges

- Intellectual Property Rights
- Responsibility for connectivity, reliability on Broadband & Cloud
- Data protection rights, access limitations
- Security of Data (transmission and storage)
- Liability for smart devices operation
- Availability of Power Supply – no power, no tech!
- Communication and understanding others

PEOPLE in FOCUS – monitor the shifting

- Demographic and social changes including generation shifts in workforce
 - Baby boomers (1946 - 1964) ... *"Been there, done that"*
 - Hardworking, loyal, confident and competitive
 - Prefer "face to face" and detailed meetings or phone calls. Believe that no news is good news
 - Generation X (1965 - 1981) ... *"Wait and see attitude"*
 - Anti authority, self-reliant and have a family focus
 - Prefer clear communication on emails and hate/avoid clichés
 - Generation Y (1982 - 1995) ... *"What's in it for me?"*
 - Digital thinkers, feel entitled, needy
 - Prefer frequent feedback and solving via technology, not meetings
 - Generation Millennials (1996 +) ... still under the scanner ...
 - Noted: does not care to possess, but to use assets and enjoy
- New professions, knowledge, new language and signs



Source and inspiration: Presentation by Liv Kari Skudal Hansteen, Vice President EFCA, June 2016 Efca Board meeting, "What can we as EFCA and associations learn from Sarah Sladek's book 'End of membership as we know it'?"

What we should do?

- Stay calm, and try to understand how to use and control available technology
- Talk to youngsters, even better listen what they are trying to say
- Educate and do the trainings / hints #Collaborative #BIM #IoT #VR #3DScan
- Push necessary standardization in Europe (i.e. Smart cities and communities, IoT, SHM, BIM)
- Find incentives to wake up construction industry
- Create or lobby for funding i.e. Europe to support development of solutions and new technologies implementation in construction industry
- Communicate and do not hesitate to share your ideas



Thank you very much for your kind attention.

The 2019 booklet is available on

WWW.EFCANET.ORG