Case Study Report

Data Exchange Standards in a Construction Site

1) Challenges

What *data sources* were used?

The data sources from the case study were the seamlessly integrating future and existing measurement and sensing technologies (such as LADAR, GPS, RFID, total stations, temperature sensors, strain sensors, etc.) with construction software and other hardware that would improve productivity, quality, and safety, as well as prepare for future sensing and automation challenges (such as deploying fully-automated machinery on the jobsite) (Kamel S. Saidi, 200).

What is the *size* of the data in the study?

The *size* of the data in the case study varies from tera bytes up to petabytes.

That is, approximately how much *data storage* was required?

Approximately, the case study required 5 Peta bytes of data storage.

1. Who *owns* the data?

   The data in the case study is owned by National Institute of Science and Technology(NIST) under the line of Building and Fire Research Laboratory, that is involved in a wide range of scientific, engineering, and investigative work for the building and fire safety communities (NIST).

2. what *data access rights*?

   Bases on the data access rights and policies of NIST, the data had constraints such as Authentication, Authorization and access control requirements across all relevant systems, ability to centrally manage the authentication and authorization information across all relevant systems, automated ability to monitor all use of all relevant systems and to detect unauthorized use of any system or data automated monitoring and analysis capabilities that feed business security, policy and reliability efforts authentication, authorization and access control mechanisms that meet business security requirements (NCCOE, 2014).

3. what *data privacy* issues?

Data privacy refers to who can access the consumer information in a business relationship. The issues that were faced in the case study was the Privacy Framework which is a voluntary tool for organizations to better identify, assess, manage, and communicate about privacy risks so that individuals can enjoy the benefits of innovative technologies with greater confidence and trust. This is solved using the Request for Information (RFI) that solicits information regarding organizational considerations for privacy risk management, the structure of the Privacy Framework (Kamel S. Saidi, 200).

what *data quality* issues?

Quality in data has always been a problem on any platform or in any industry, this is because the data considered has always been mediocre. Some of the data quality issues were, is the data missing any important linkages, were the links of data duplicated? is any data is out of date or incorrect, is any data misused or unused?

2)

a. What *organizational* challenges did they face? (ConstructConnect, 2018)

1. **Over-Extension:** Increasing demand may drive general contractors and sub-contractors to take on larger or more projects than they have the capacity to handle. This not only acts as a huge safety risk, but over extension can also exacerbate defects and site accidents.

2. **Lack of skilled workforce:** The construction industry offers a lot of opportunity for employment but most of it is restricted to manual jobs. Due to the low wage expectancy of workers, who mainly come from the rural areas in search of work, contractors still follow traditional work practices.

3. **Technology Adoption:** Countless studies and surveys over the years have shown that business owners continue to underinvest in technology, despite their acknowledgment of the many benefits that technology can provide to running their business and managing construction projects.

b. What *technical* challenges did they face?

1. **Sensor Planning:** It defines interfaces for queries that provide information about the capabilities of a sensor and how to task the sensor. In this case study, problems came up while handling the feasibility of a sensor planning request. This led to facing reserve/commit of a request, update, cancel or inquire about the request (Open GeoSpatial, n.d.).

2. **Object Recognition:** Object recognition is a computer vision technique for identifying objects in images or videos. This has been a major technique while dealing with 3D objects in the construction site. The problem was could be analyzed using the feature indexing, spatial occupancy techniques and implementing the subgraph isomorphisms (USF).

3. **Integrated Living Project Models:** Lack of individual discipline interactions with the central model of construction site, disorganized configuration management, lack of heterogenous intra-discipline tools that can be made more organized using the enhanced visualization of design and construction processes based on multimedia, virtual and mixed reality, simulations, video, etc (Kamel S. Saidi, 200).

3) "**Stakeholders**"

a. Who are the people/organizations with an interest in the conduct and outcome of the study?
The people/organizations that were involved in the case study with an interest in the conduct and outcome is the **National Institute of Standards and Technology** (**NIST**), a physical sciences laboratory, and a non-regulatory agency of the United States Department of Commerce. Its mission is to promote innovation and industrial competitiveness. NIST's activities are organized into laboratory programs that include nanoscale science and technology, engineering, information technology, neutron research, material measurement, and physical measurement. NIST offers $300 million in basic repairs for construction, 39 million Mammograms per year are traceable to measurements made in NIST facilitate construction management (WhiteHouse, 2019).

4) **Requirements**, resources needed

a. What HW/SW resources did they need to conduct the project?

Construction measurement and sensing technologies and project information management software (PIMS) – such as scheduling and estimating software, 4D CAD that allows visualization of the facility design and its changes over time and allows computer-based analysis of constructability, cost, productivity, and other project performance variables dependent on an integrated analysis of time and space. Some of the technologies involved were seamlessly integrating future and existing measurement and sensing technologies (such as LADAR, GPS, RFID, total stations, temperature sensors, strain sensors, etc.) (Kamel S. Saidi, 200)

1. Were resources commercial or internally developed?

   The resources that were used in the case study were commercially developed.

b. What people/expertise resources did they need to conduct the project?

The people/expertise that were involved in the case study that framed guidelines were Dr. William C. Stone, leader of the NIST Construction Metrology and Automation Group (part of BFRL), Mr. Kang Lee, leader of the
NIST Sensor Development and Applications Group (part of the Manufacturing Engineering Laboratory), Kamel S. Said, Alan M. Lytle, William C. Stone, researchers at NIST (Kamel S. Saidi, 200).

5) Time

a. What was the approximate project *schedule/duration*?

The approximate project duration was 2 days. It was scheduled on May 29 and May 30 in the year 2003 (Kamel S. Saidi, 200).

6) Results/Findings

a. What *results/answers* were achieved?

Some of the potential results that were achieved as a result of this case study are showing the cost benefit if implementing new technologies that are critical to the owner and how is it overcome, Overcoming the technological barrier to developing a sensor data exchange standard will be easier than overcoming the political barriers, need to model the data exchange requirements during the entire life-cycle of a construction project, the standard should consider both the sensor user and sensor manufacturer points of view, Prioritize the "information" needs on the job site and use the described need as a basis for selecting the initial sensor(s) to target for the standards effort and Consolidate literature on cost analysis of automation in construction.

Was the project *successful*?

Yes, the project was successful that brought together people from the construction industry, equipment manufacturers, and research institutions (among others) to discuss the barriers and challenges to sensor data exchange in construction and the steps required to establish raw sensor data-exchange standards.

b. Were there any *surprises* discovered?

The case study was supposed to be consisted, (Kamel S. Saidi, 200)but the data consisted of multiple overlapping, involving various categorization schemes. The changes to the classification systems of data occurred over time. However, based on the current analysis, the concerns and issues are widely known and are being addressed by the Research and Development SDLC/HDLC(Software Development Life Cycle/Hardware Development Life Cycle).

c. What *lessons* were learned from conducting the project?

The biggest take away from this case study is the use of Augmented Reality/Virtual Reality(AR/VR), that allowed project managers to have detailed insights into the project from end to end and approach the project knowing all the facts. Sensor applications allow the construction team to detect errors or necessary maintenance on equipment before they can impact the project on a greater scale, which cuts repair and labor costs.

d. What specific *actions* were taken as a result of the project?

The specific actions that were taken as a result of this case study is to identify requirements for and barriers to sensor data exchange in construction, to identify and plan the steps required to establish raw sensor data-exchange standards, and to identify future research directions. Such actions included implementing a sensor-based predictive and preventive maintenance technology that enables operators to conduct maintenance on a piece of equipment in the sweet spot, when necessary, but before it has broken down, reducing costs in terms of depth of repair necessary as well as avoiding delays in the project timeline.

e. What *value* to the organization and to the stakeholders was obtained as a result of the project?

The case study that was carried under the stakeholders, National Institute of Science and Technology(NIST), under Building and Fire Research Publications has designed, deployed and implemented construction management strategies and produced the solutions, discussing the developments from admission requirements to the search for industry-wide standards.in the construction.

7) Critique

a. How could the project have been *improved*?

The project could have been improved findings in a final report and by developing a research roadmap. Other methods that could be used to improve the case study using the Algorithmic Trading, it is a computer technology has made it possible to execute financial trades in construction management, including mathematical formulas that is powered by data analytics to reduce the human error. The data in the case study could be supervised efficiently with all the associated risks in an IT outsourcing setup.

8) Explain/define terms

Construction Automation: Construction automation is the automatic centralized control of a building's heating, ventilation and air conditioning, lighting and other systems through a building management system or building automation system (BAS). The objectives of building automation are improved occupant comfort, efficient operation of building systems, reduction in energy consumption and operating costs, and improved life cycle of utilities. This is an example of a distributed control system – the computer networking of electronic devices designed to monitor and control the mechanical, security, fire and flood

safety, lighting (especially emergency lighting), HVAC and humidity control and ventilation systems in a building (KMC Controls, n.d.).

Intelligent Job Sites: A global platform which experts and industry leaders' partner in "Revolutionizing the Real Estate and Construction Industries", it has pioneered the revolution with the goal of bridging the digital divide between design and construction with a secondary purpose Making New York the Capital of Advanced Construction Technologies. The movement has evolved into Bridging the Fragmentation Between the Real Estate and Construction Industries with The Expressway Between Education and a Career (Intelligent Job Sites, n.d.).

Construction Sensors: Construction Sensors on construction equipment not only collect data, but they can direct that data to cloud networks so that it can be analyzed. With this data, the construction company can organize relevant information and discover ways to make the best use of their machines. Actions such as measuring fuel spending and determining optimal equipment needs can create a more efficient company. Sensors also help to track materials through the supply chain, allowing construction companies to monitor the materials in real-time. By doing so, sensors create a more efficient supply chain, improve ability to adhere to the timelines of projects, and foster better communication with clients (GIATEC, 2018).

LADAR: Also called **LIDAR**, **LiDAR**, and **LADAR** is a surveying method that measures distance to a target by illuminating the target with pulsed later light and measuring the reflected pulses with a sensor. Differences in laser return times and wavelengths can then be used to make digital 3-D representations of the target. It provides a robust method for surveying inaccessible surfaces as well as complex geometry. All the major providers of CAD 3D modelling and BIM software have built compatibility that allows their systems to import the point cloud data into 3D visual graphic material (Desigining Buildings, 2016).

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