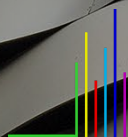# Linked Data for a construction big data platform

Davide Simeone
d.simeone@webuildgroup.com
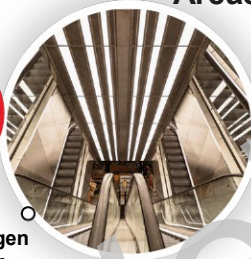
11th Linked Data in Architecture and Construction Workshop (15 - 16 June 2023)

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Webuild is a global player in the construction of large, complex infrastructure

1st Italian Contractor

Global Leader in Water sector[1]

4 Business Areas

Sustainable Mobility

Copenhagen Cityringen Metro
Denmark

Clean Hydro Energy

Snowy 2.0 hydroelectric Project
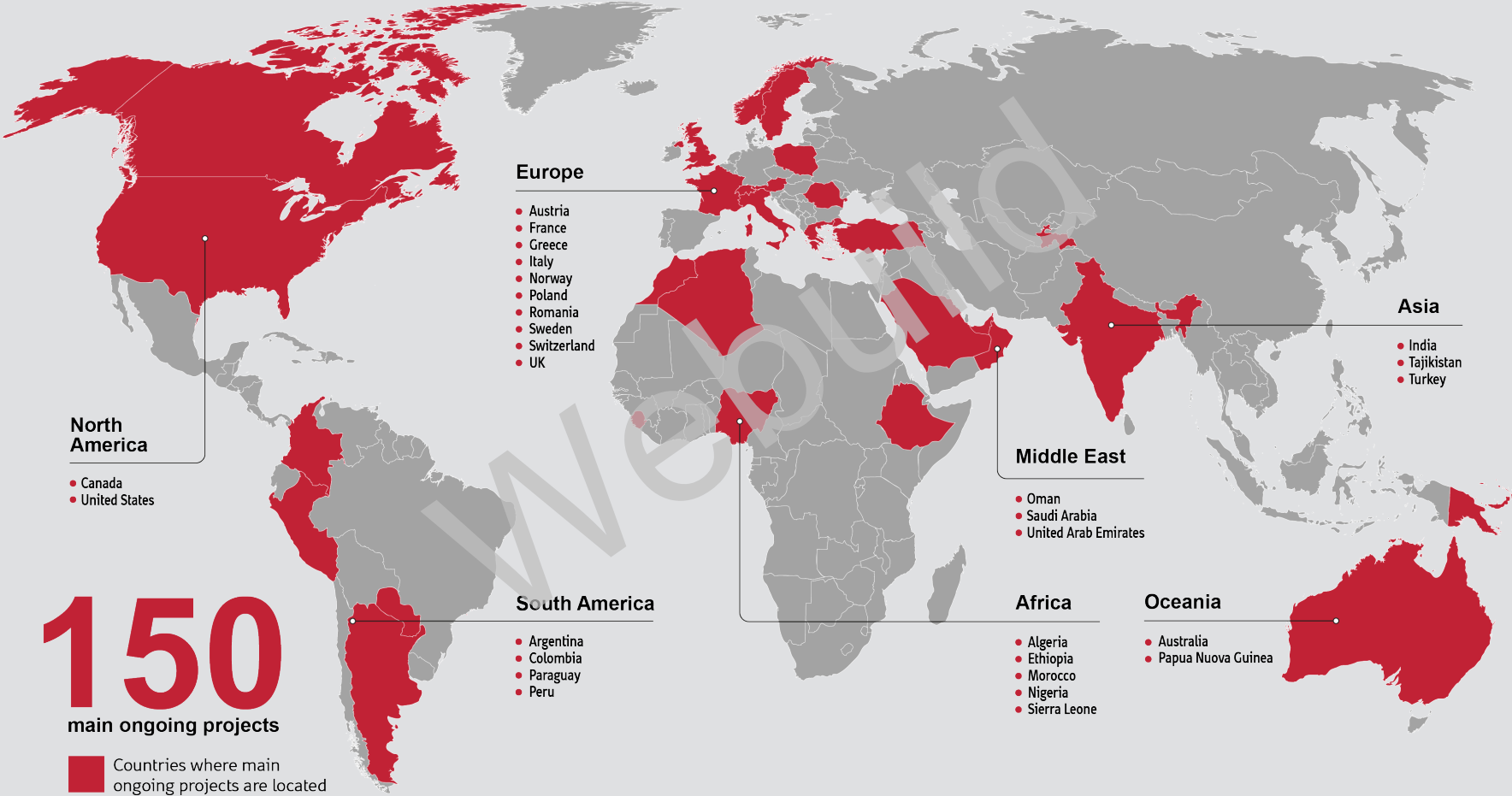Australia

Clean Water

Anacostia River Tunnel
USA

Green Buildings

Al Bayt Stadium
Qatar

117 Years

50 Countries

150 Ongoing projects

60 Offices Worldwide

83,000 Direct & Third Party Workforce

3,396km Tunnels

82,509km Motorways & Roads

14,118km Railways and metros

1,018km Bridges and Viaducts

313 Dams and Hydro Plants

(1) ENR Report, The TOP 250, 22/29 August 2022

FOOTPRINT

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Europe
- Austria
- France
- Greece
- Italy
- Norway
- Poland
- Romania
- Sweden
- Switzerland
- UK

Asia
- India
- Tajikistan
- Turkey

North America
- Canada
- United States

Middle East
- Oman
- Saudi Arabia
- United Arab Emirates

South America
- Argentina
- Colombia
- Paraguay
- Peru

Africa
- Algeria
- Ethiopia
- Morocco
- Nigeria
- Sierra Leone

Oceania
- Australia
- Papua Nuova Guinea

150
main ongoing projects

Countries where main ongoing projects are located

FOOTPRINT

Documents, Norms & regulations, Contracts

Design and Engineering
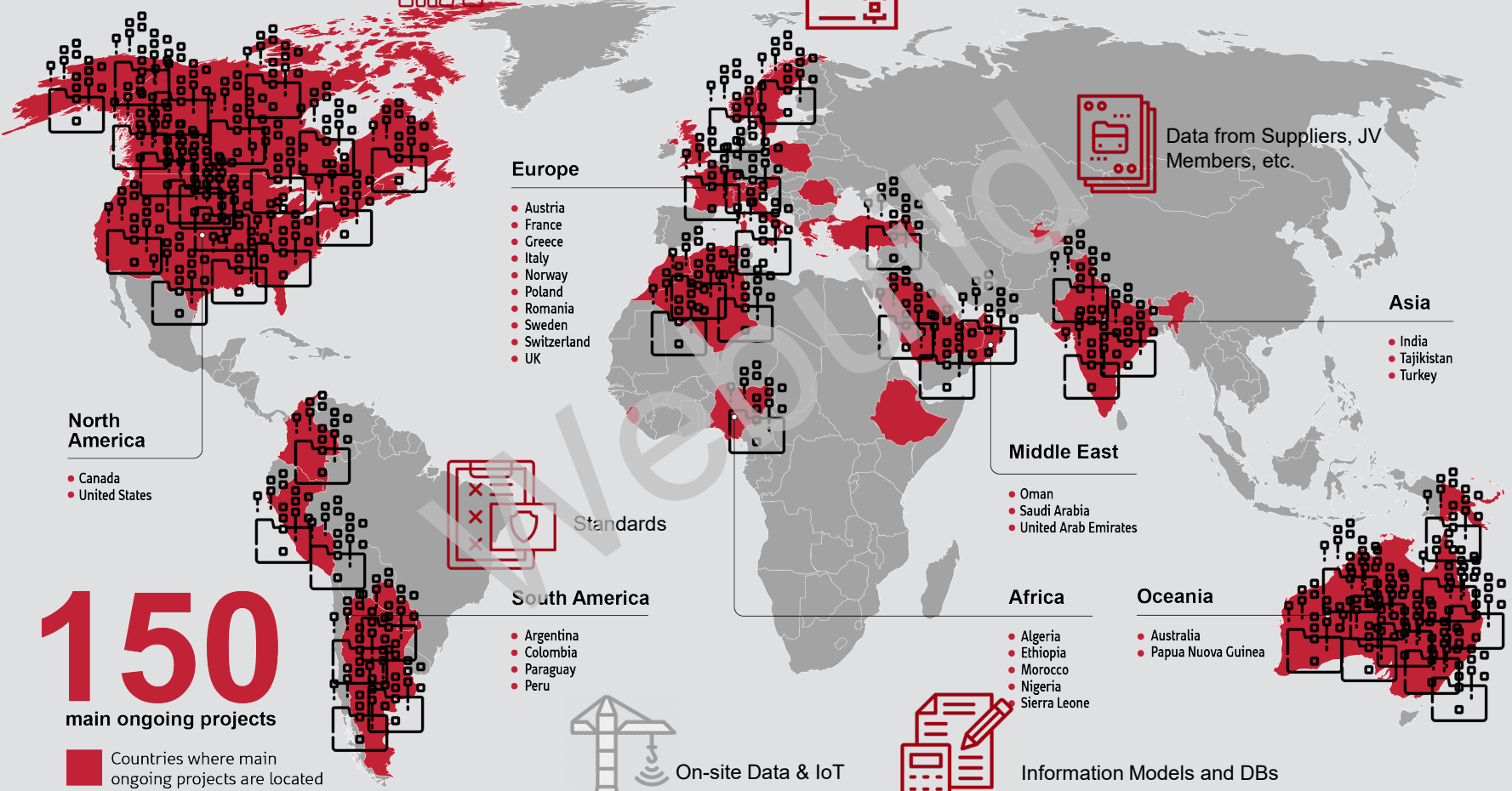
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Data from Suppliers, JV Members, etc.

Europe
- Austria
- France
- Greece
- Italy
- Norway
- Poland
- Romania
- Sweden
- Switzerland
- UK

Asia
- India
- Tajikistan
- Turkey

North America
- Canada
- United States

Standards

Middle East
- Oman
- Saudi Arabia
- United Arab Emirates

150
main ongoing projects

Countries where main ongoing projects are located

South America
- Argentina
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Oceania
- Australia
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On-site Data & IoT

Information Models and DBs

Research context and motivations

- Multiple Disciplines, multiple projects, large amount of data elaborated in each project
- On-demand information sharing model
- Technical knowledge and data are dispersed and dishomogenously represented
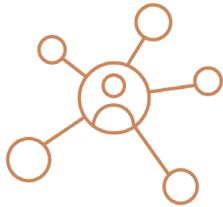
- Accessibility and reuse of Historic Data from projects and tenders
- Centralization of the knowledge base and automation of knowledge exchange
- Provision of interpretative context of data
- Generate value from knowledge produced in projects (control and predict)
- Progressive in the adoption and implementation

R&D funded project: "An innovative integrated platform for advanced production processes in the construction sector" funded by the Italian Minister for Economic Development and Regione Lombardia

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Research objectives

Construction Data Platform

Reference Data model
- Standardized
- Modular and scalable
- Clear and disambiguous
- Adherent to requirements of each discipline
- Context-aware
- Interoperability with platforms models

Handling of large amount of data
- Different environments (construction sites and tenders)
- Cleaning, refiniment, homogenization of data
- Different sources: Platforms, IoT
- Different granularity and aggregation
- Accessibility levels and security

Linked Data

Construction Big Data Platform

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Construction knowledge domains and the adopted reference data models

DEVELOPMENT METHODOLOGY

- Definition of Requirements
- Knowledge domains selection
- Existing Ontologies Assessment
- Development of missing ontologies
- Linking Data
- Data Lake Implementation
- Population, Assessment, Validation
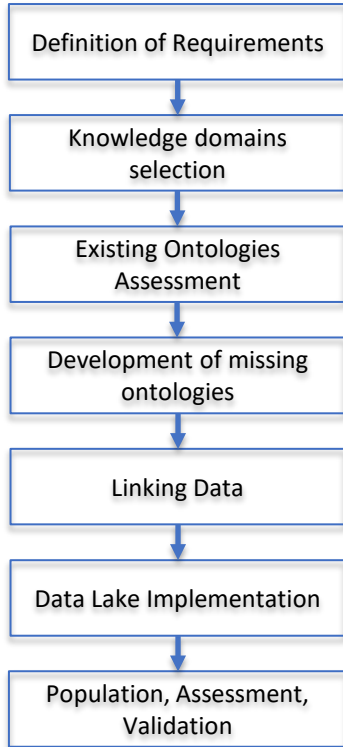
Discipline	Code	Requirement (summarized)
QTO	QTO-01	Distinguish BOQItem, price item and measures
QTO	QTO-02	Versioning of BoQs, Price Lists, measures
QTO	QTO-03	Measurement units based on international standards
QTO	QTO-04	Distinguish materials and quantity typologies
QTO	QTO-05	Measurements/estimations from different information carriers
BIM	BIM-01	Interoperability with IFC
BIM	BIM-02	Identification of quantified elements and attributes
Estimating	EST-01	Include classification systems (CESMM4, NRM2)
Estimating	EST-02	Methods of measurement and/or calculation
Estimating	EST-03	Adopted construction methods
Planning	PLA-01	Relationships with WBS for activities duration
Planning	PLA-02	Possibility to relate quantities and locations
Technical coordination	TEC-01	Quantities aggregation at high-level representation
Technical coordination	TEC-02	Actor providing the quantity value (client, consultant, QTO specialist, etc.)
Procurement	PRO-01	Quantities extracted as per BOQItem specifications

Domain	Reference Data Model	Note
Product (building or infrastructure)	IfcOWL	Other ontologies adopted: BOT, DiCon
Project Framework	Contractor existing model	Revised and aligned with E-Cognos, DiCon
Quantity Take-Off	QTOn ontology	Developed from scratch, aligned with DiCon
Construction Planning	ConPla ontology	Re-use/alignment with Dicon, Construction Scheduling Ontology
Cost Modeling	Contractor existing model	Detailed model interoperable with QTOn and ConPla ontologies

DISCIPLINES

INTEROPERABILITY

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Quantity Take-Off ontology

Construction Planning ontology

Data integration and reuse

Data fruition in VR

Conclusions and future developments

- LD implementation in a general contractor is difficult but a modular approach is a key for success
- Value is not only in the resulting knowledge base but also in the process of creation
- LD can overcome difficulties of top-down standardization
- LD is perceived as critical for the ongoing automation processes in the construction industry (project monitoring, reporting, and execution of tasks)

- Extension of the knowledge base to sustainability and materials handling
- Integration with Digital Twin ontologies
- Development of platforms integrations with the Enterprise Datalake

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Thank you

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