

# National BIM Digital Platform for Construction (INNOVance Project)



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**Abstract** INNOVance represents the first digital platform in the construction sector with BIM methodology on a national level. It's also a BIM library, a Common Data Environment (CDE) of BIM projects in a contract, for sharing work information, and a data exchange platform for the entire construction sector. The platform operates in accordance with the UNI 11337: 2009 standard and it is the origin of the UNI 11337: 2017 standard group. The project was formed within the research relating to the Competitive Call: Energy Efficiency, Industry 2015, promoted by the Ministry of Economic Development (MISE).

**Keywords** Digital construction platform · Common data environment · BIM library

## 1 Introduction

At the start of the twenty-first century, the acronym BIM was not well known as nowadays. Though, while the academy and the researchers were talking in the wider terms of ICTC—Information and Communication Technologies for Construction—the industry started introducing the new terms of BIM—Building Information Model or Modeling—to progressively substitute the words CAD, Computer-Aided Design, that, despite being already exhaustive of a decisional and management process supported by computers (and this is evident when referring to the way the mechanic industry implemented CAD to support its production process management) was still interpreted—by the majority of the players in the building industry—in a reductive way as CAD, or Computer-Aided drafting: the building constructions field, at that time, is not mature yet to understand the potential of the Computer-Aided Design as a decisional tool to support the whole construction process. The roots of the modern interpretation of the CAD and BIM systems can actually be traced back to the early

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60s and to the activities developed inside the MIT—Labs of the Boston University: many of the concepts are still at the base of the modern CAD-BIM software, such as software-user interactivity, modular design, Object-Oriented modeling, are already evident in the Ph.D. thesis work of Ivan Sutherland, the software Sketchpad (Sutherland 1964). In the same period, the concept of a decisional design and management process supported by computers is developed inside the Architecture Machine Group, founded by Nicholas Negroponte, at the MIT laboratories. Negroponte, with the system Urban5 (Negroponte 1970), envisions the idea of expert systems supporting architects and designers in general in the project decision process. During the same period, devices prefiguring the tools nowadays used to support Virtual Reality and Augmented Perceived Reality are already experimented by the Academy (Sutherland 1968). The acronym BDS—Building Description System (Eastman et al. 1974) appears in 1974 to emphasize the potential of CAD tools to virtually describe the complexity of a building in terms of its geometry and the other data necessary to fully represent it. The first releases of 3D CAAD OO—3-Dimensional Computer Architectural Aided Design Object Oriented—commercial software, appeared on the market during the 80s. Graphisoft developed, in 1982, Radar-Ch also known as ArchiCAD, since 1995 that is be the base of the Virtual Building Environment—VBE—concept developed by the Hungarian company. In 1984, in Germany, Nemetscheck launched the first release of its product Allplan. In France, Gimeor developed Architriion, another tool that had a wide diffusion in the 90s. The biggest software companies, AutoDesk and Bentley, in between the 80s and the 90s developed solutions based on their multipurpose products: AutoDesk has Architectural Desktop built on top of AutoCAD (now AutoCAD Architecture), and Bentley, on top of MicroStation TriForma, launched Bentley Architecture, evolved nowadays into AECOSim Building designer. At the same time, other companies started developing solutions for the building industry, based on the most advanced tools developed for the mechanical industry, creating the necessary conditions for a radical step forward of the building industry, in comparison to the former technologies: it is the case of Digital Project, (Gehry Technologies) based on CATIA (Dassault Systems) and Revit (Charles River Software 97, later Revit Technologies, 2000). In 2002 AutoDesk bought Revit Technologies, and starts pushing, with a heavy marketing campaign, the BIM acronym, making it the preferred buzzword in the building industry.

Despite BIM having now substituted CAD (that anyway, in the proper acceptance, as already highlighted, is as exhaustive as BIM) as a common terminology, this did not correspond to a wider diffusion of it, as an operational tool in the sector, which remained a prerogative that is strongly limited to the US market. It was then, with the publication of the British PAS 1192 (parts 2 and 3), in 2013, and with the optional introduction of BIM in European Community public procurement in 2014 (D. 2014/24/EU), that, in Europe and across the world, the slow but continuous spread of the new BIM technology and methodology began throughout the entire sector. In this evolutionary scenario of BIM, Italy has played an important role, albeit little known. The creation of a digital BIM platform for the construction industry was theorized in 2007 (cit.). In 2009 (4 years before the PAS 1192), the first standard was published for the Italian market, the UNI 11337:2017: “*Building and civil*

*engineering works. Codification criteria for construction products and activities and resources. Identification, description and interoperability. (6.2.1—Object-oriented Planning and design).*” In 2009, a consortium of private entities and research bodies, led by the ANCEnergia consortium, won the Industry 2015 Energy Efficiency Call promoted by the MISE (57 points out of 60), with a supply chain project named INNOVance: a digital platform for the construction sector. A co-financed project which started in 2011, for a total duration of 3 years.

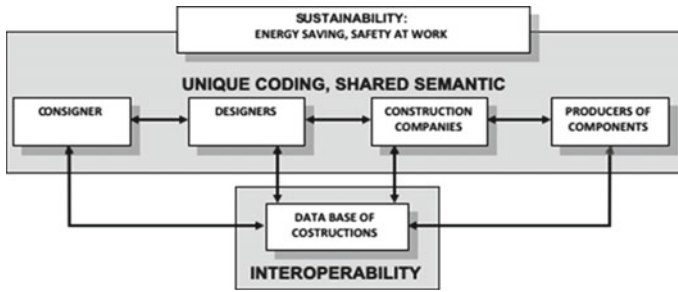
## 2 The Project

The INNOVance project (product/process innovations and integration of the building construction chain for energy efficiency and sustainable development: action on a national level of the reed system with integrated strategic vision and life cycle) aims at the construction of the first “... *free access data base containing the information, all of the information, whether of a technical, scientific, economic legal nature, or more, that is useful for the entire building process. The program concerns the creation of the first national database for the construction industry...*”

A DB for the dissemination of knowledge in construction, indispensable for a truly innovative transition toward new technologies that support energy efficiency, sustainability, etc.

*...The energy problems and, in general, the environmental sustainability of production and the products, require a radical internal reorganization of the construction sector that will enable access to growing sophisticated technologies and high standard production systems. Today's construction system, rightfully defined as “traditional”, does not adapt to the ever more requiring needs of performance in terms of energy and acoustics containment imposed by the recent national and European regulations...*

*...In the data base, for each phase of the construction processes, all the procedures and processes (components and results) of the entire building process (objects, works and resources) will be codified, described and named in a uniform manner; through collection schemes of shared and transparent information for all individuals operating in the sector; in order to optimize for the whole “building system”, also through actions of feed back (from the construction site to the final user), the energy performance of the “building product” and subsequently the entire “building process” in general.*



**Fig. 1** Unique codified

*The system of codification, nomenclature and filing of the products and processes will be object of technical national regulation within the UNI and UNI-CTI (the first on a European level) and will contribute to the overall reorganization, in semantic terms, of the technical information (already occurring on a European level). The interoperability platform and usage of the BIM technology (Building Information Model) will ensure a considerable competitive advantage for Italian companies abroad who will operate on superior consolidated qualitative standards compared to the competition... (see Fig. 1)*

Right from the start, the partnership has focused on interoperability as a basic requirement in such a fragmented and varied supply chain.

*...A BIM3D archive is a virtual model of the building in a digital format, from which to extract the necessary documentation during the planning, executive and management phases.*

*Different process operators can access the data contained in a BIM with different applications, and share and use constantly updated information, without data loss and without the need to continuously check their consistency and, in extreme cases, to reconstruct from nothing the database when the software used is completely incompatible.*

*The concept of software interoperability is fundamental in order to create an operating environment like the one described above...*

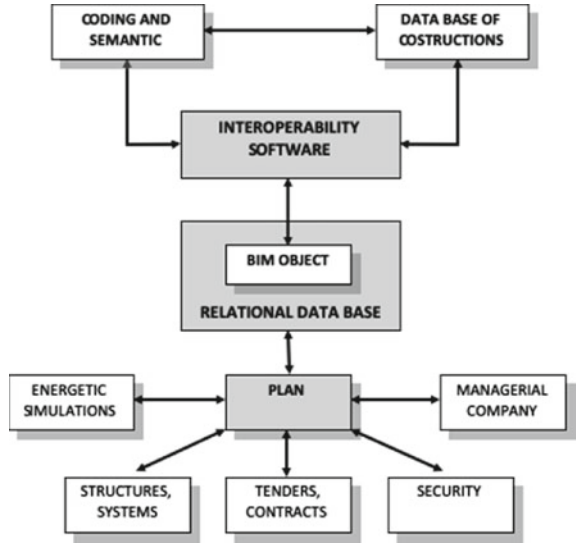
*...The main format for software interoperability in construction is the IFC standard - Industry Foundation Classes - developed by the BuildingSMART Alliance, also known as the IAI - International Alliance for Interoperability [www.iai-international.org](http://www.iai-international.org) -. The IFC standard is based on the ISO STEP 10303 standard, and is itself an ISO/PAS 16739 protocol...<sup>1</sup> (see Fig. 2)*

Since its proposal (2008), the INNOVance project has, therefore, placed itself at the forefront for the period (the PAS 1192 arrived only 5 years later, the BIMToolkit after 7, there were still none of the CDE on the market today, BIM360, BIMx, BIM plus, etc.), focusing on collaboration and open languages as its first goals.

The project started formally in 2011 and ended as established in 2014, with the intervention of more than 300 collaborators belonging to the 14 partners:

<sup>1</sup>The original parts taken from the technical proposal of the project INNOVance (2008) are in italics.

Fig. 2 INNOVance platform structure

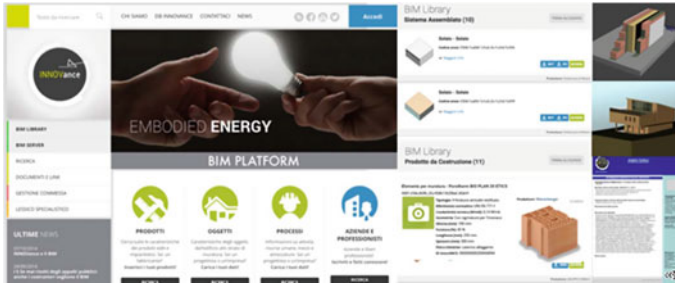


- First proposer: Consorzio ANCEnergia;
- Universities and research institutes: Politecnico di Milano and the Politecnico di Torino, Università Federico II di Napoli, ITC-CNR, ISTEDIL, Istituto Sperimentale per l’Edilizia, S.p.A., Consorzio TRE;
- Software houses: SAP Italia S.p.A., ONE TEAM S.r.l., DERGA S.r.l.
- Component manufacturers: Edilstampa S.r.l.—(ANCE), Aedilmedia S.r.l.—(UCSAAL), Laterservice S.r.l.—(ANDIL), Concreto S.r.l.—(ATECAP), Federlegno Arredo S.r.l.—(Federlegno).

### 3 The Prototype

INNOVance is an open platform on which any other software (design, calculation, management, etc.) can freely operate extracting and redeploying data and, unlike other potential competitors, is at the same time: BIM library, catalog of products and building systems; BIM server (CDE), work environment for collaboration, and information sharing between subjects; BIM platform, an environment for storing and structured data and information management (see Fig. 3).

INNOVance is a collaborative platform that collects in a structured way and relates all kinds of information serving the user and their software which, through open protocols, can operate on it extracting and redeploying raw and/or aggregated data, improving the process thanks to the continuous increase of the contained knowledge, whatever it may be.



**Fig. 3** INNOVance web portal

INNOVance manages data and information on:

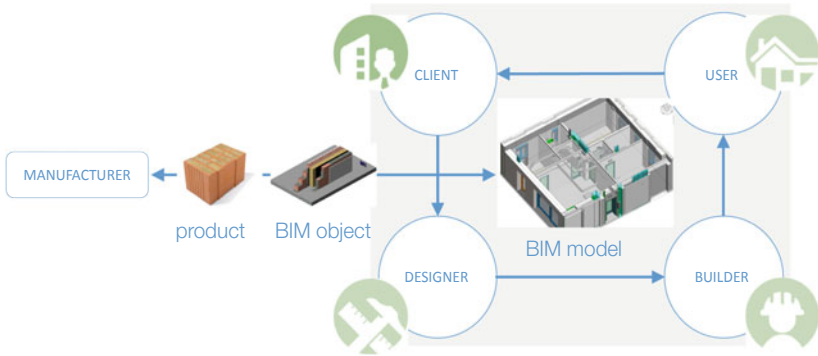
- Products (from sand, mortar or brick, to radiators like the boiler, the glass, and the window);
- Subsystems (from the layer of plaster to that of masonry or insulation, water tightness, etc.);
- Systems (closing wall or partition packages, partition or roof slab packages, etc.);
- Works (houses, industrial complexes, green areas, infrastructures, etc.);
- Spaces (from residential or tertiary volumes to hot/cold/fire zones, rooms, premises, etc.)
- Work (laying, construction, installation, maintenance, etc.);
- Human resources (professionals, workers, specialists, etc.);
- Vehicles and equipment (cranes, excavators, concrete mixers, grinders, drills, etc.).

In INNOVance, it is possible to find the digital object “BIM” but also the video of the installation, the dimensional tolerances, the type of control activity or the preparation work of the necessary support, the nature and type of a typical team, the kind of license required by the operator for that machine such as which safety devices must be worn, the type of packaging and the quantity of waste it generates and the disposal operations to be carried out, the installation times such as scheduled maintenance periods, the location of the production plant, incompatible products, the regulatory dimensions of a room according to the standards of reference, the costs of a product as a process up to the accounting of a work, its volume, the floor area, the charges of urbanization, the load and outreach of a crane, the power of an excavator and the type of accessories that can be installed: bucket, compacting machine, caliper, etc., and all their characteristics (see Fig. 4).

Compared to common libraries of objects, the core of INNOVance is not the component products but the resulting product of the supply chain: the work (building or infrastructure). The work is defined in the platform through the model to which the following chapters of general attributes are connected:

Work result (building or infrastructure):

1. Name + INNOVance code
2. CPV identification code



**Fig. 4** INNOVance information flow

3. Intended use
4. Functional and spatial division of the work
5. Project parameters
6. Environmental well-being
7. Plant system
8. Energy efficiency
9. Fire extinguishing system
10. Distribution systems
11. As Built

And nine related specialist files:

- A. Descriptive dossiers:
  1. Registry Dossier
  2. Territorial dossier framework
- B. Operational Dossiers:
  1. Procedural Dossier
  2. Economic framework Dossier
  3. Timeline dossiers
  4. Construction site Dossier
- C. Specialized dossiers:
  1. Geological and geotechnical dossier
  2. Structural dossier
  3. Maintenance Dossier

In INNOVance, it is possible to search and download a current industrial production object and insert it into the model with all its attributes. In the same way you can also virtually build a wall (system) by first defining the layers, selecting

materials directly from the portal using the products datasheets and then sending all the information to the BIM authoring software (for the direct test project carried out with Revit) for it to create (itself) the geometrical BIM object or system. Or one can model a wall in the BIM authoring software and send it to INNOVance for it to build (itself) the necessary information sheets to fill out the attributes. Attributes that will remain inextricably linked to the BIM objects but will not weigh down the graphic file (except for those that directly serve the authoring software management) (see Fig. 5).

In INNOVance, every component object (product, system or subsystem) is identified by its geometric information (managed by the BIM authoring software and viewable from the portal) such as

1. Identification information of the manufacturer
2. Product identification information
  - 2.1. Denomination (UNI 11337: TS1)
  - 2.2. Identification code (UNI 11337: TS1)
  - 2.3. Trading name
  - 2.4. CPV code
  - 2.5. Other internal codes assigned by the manufacturer
  - 2.6. Intended use (obtained from the harmonized technical specification)
  - 2.7. Harmonized technical specification (hEN-EAD): name, classification, definition, code, number and standard year
  - 2.8. Description from specifications
  - 2.9. Description from the price list
  - 2.10. Synonyms
  - 2.11. Keywords
3. Technical information
  - 3.1. Morphological-descriptive characteristics
    - 3.1.1. Geometry and shape
    - 3.1.2. Visual and constructive aspect
    - 3.1.3. Dimensions
    - 3.1.4. Physical-chemical: qualitative, quantitative
    - 3.1.5. Main components of the product
  - 3.2. Declared performance characteristics
    - 3.2.1. Essential features
    - 3.2.2. Voluntary characteristics



**Fig. 5** Revit new command directly work on INNOVance platform



- 3.3. Information on sustainability
- 3.4. Safety information
4. Information on packaging, handling, storage at the factory and transport
5. Business information
6. Additional technical information
7. Attachments
8. Information on data reliability
  - 8.1. Date of realization of the technical sheet
  - 8.2. Compiler ID
  - 8.3. Date of revision of the technical sheet
  - 8.4. Auditor ID (see Fig. 6).

The attributes of the work results and of the products or systems are interrelated to each other through the execution information that allows the control and use of the BIM models not only in design or planning but also on the construction site:

Processing attribute chapters:

- General information
- Analysis of the resources necessary for processing
- Accounting for resources
- Operational constraints
- Operating procedures and controls in progress (preliminary, in progress, final)
- Environmental management of the site
- Safety management and risk analysis
- General provisions
- Additional information
- Summary and annexes
- Accounting for resources.



Fig. 6 INNOVance products sheet

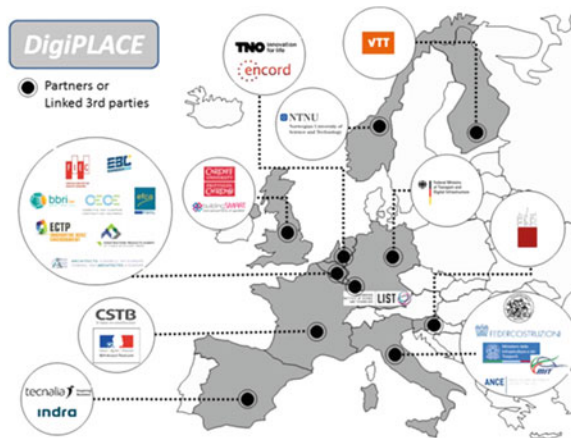
Means and equipment attribute chapters:

- Use and labor
- Emissions
- General security measures
- Instructions to reduce (or eliminate) risks
- Accessories
- Documentation present on site during the time of use of the machine
- Additional information
- Photographs, videos, drawings, graphic details.

## 4 Conclusion

The INNOVance project represented the testing field for BIM in Italy, anticipating many of the common intended or consolidated topics today (first real CDE in the world) as in others that are still beginning to appear on the international scene like the European digital platform for the construction sector 2019–2023 (call DT-ICT-13-2019, DigiPLACE Project, Politecnico di Milano). INNOVance is also at the heart of the new UNI 11337: 2017 regulatory body and its works have, therefore, contributed to the writing of the ISO 19650: 2018 standard. The same can be said for the European regulatory work on the CEN still in existence. The debate that has arisen at every level around INNOVance has favored the introduction of BIM in public procurement in Italy DM 50/2016 and DM and its diffusion among the private sector. It is interesting to note that the future developments of BIM have been partly anticipated in INNOVance and still find meaning today by providing valid inspiration (see Figs. 7–9).

**Fig. 7** Partner of European digital BIM construction platform



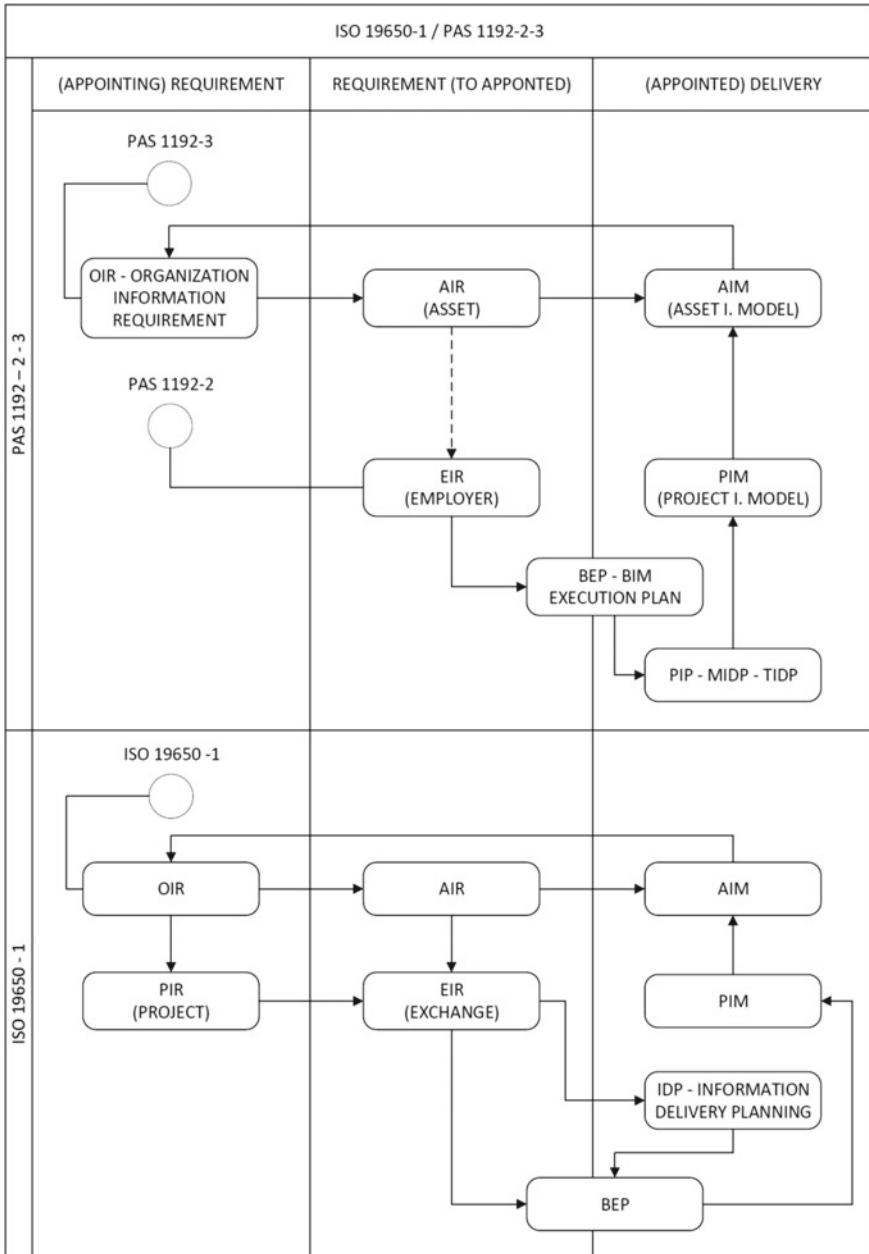


Fig. 8 ISO 19650-1/PAS 1192-2-3

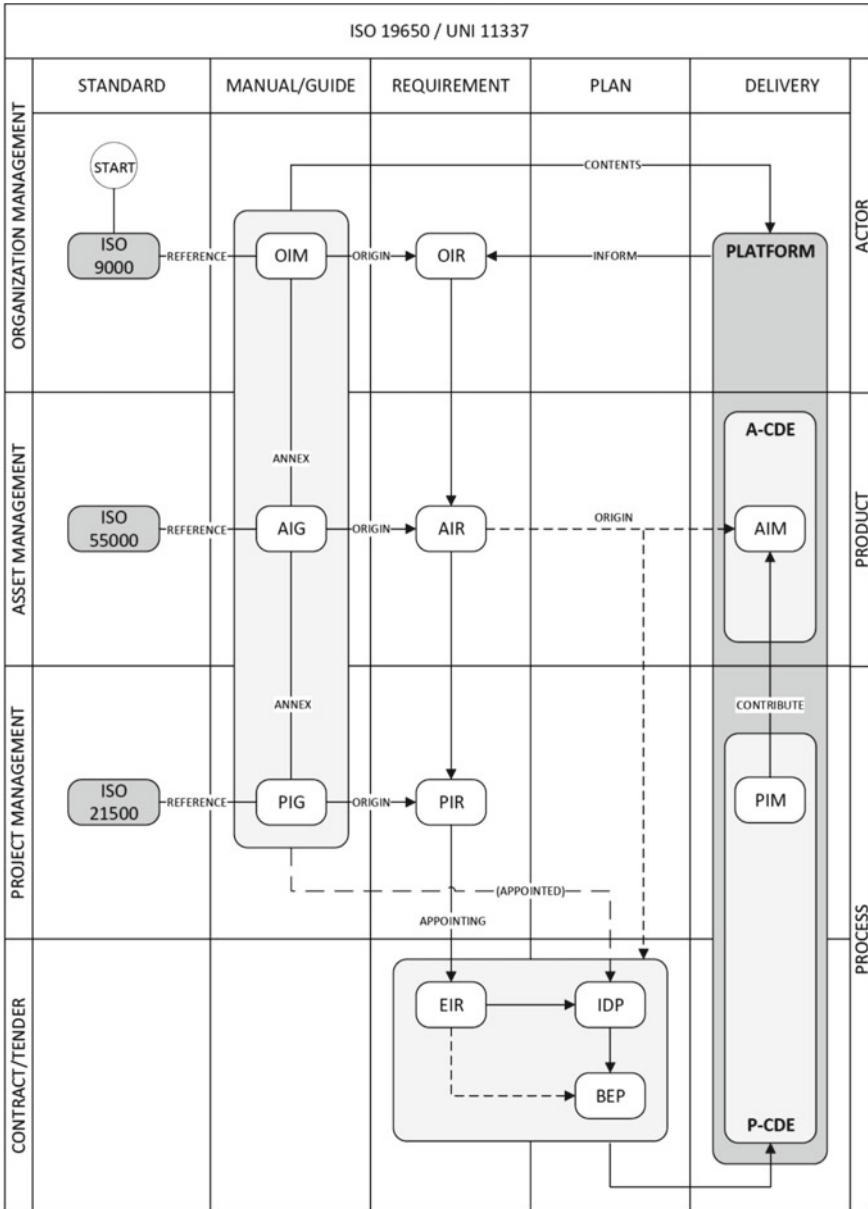


Fig. 9 ISO 19650/UNI11337

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- UNI 11337:2017-5—Building and civil engineering works—Digital management of the informative processes—Part 5: Informative flows in the digital processes
- UNI 11337:2017-6—Building and civil engineering works—Digital management of the informative processes -Part 6: Guidance to redaction the informative specific information. Ente Italiano di Normazione
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- PAS 1192-3:2013—Specification for Information Management for the operational phase of construction projects using Building Information Modelling
- ISO 16739:2013—Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries
- ISO19650-1:2018—Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM)—Information management using building information modelling
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