

5D conference 2012 May 21-22 Process integration: From 3D/BIM to 5D

Konstantinos Kessoudis, chairman 5D-initiative

situation in construction industry

we have to ascertain that in construction industry there is:

 a constant productivity loss in comparison to the non-farm industries in total over the years.



Labor productivity index for U.S. construction industry and all non-farm industries (Source: US Department of Commerce Bureau of Labor Statistics)

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situation in construction industry

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 an information loss through the existing fragmented construction processes - from planning to maintenance.



Information Loss – Conceptual Plot motivating the USACE's process analysis (Developed by Dana K. Smith, Building Smart Alliance, NBIMS)

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situation in construction industry

we have to ascertain that in construction industry there is:

• a constant productivity loss in comparison to the non-farm industries in total over the years.

 an information loss through the existing fragmented construction processes - from planning to maintenance.

 within every fragmented construction process there are disconnected process islands.



The islands off automation [in design] by Matti Hannus, VTT Finland

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"...I personally am skeptical if an improvement in partnership in construction by setting up a "guideline for partnership in construction" will be enough improvement.

In truth we are navigating towards a systemic crisis.

A crisis caused by a serious fault of a holistic approach in the construction process"

Dr. Georg-Michael Vavrovsky, commemorative speech at Austrian society for construction technology, April 2012







challenges on construction

 increasing deadline constrains, demands for higher quality and cost pressure demand a more efficient planning and construction process.

→ change towards more industrialization and lean methods in construction

 life cycle evaluation demands to infrastructure and buildings a multi functional view and design:

- eco-balance, environmental performance evaluation
- multi functional buildings, components require interdisciplinary design and construction
- a sustainable design, maintenance & operation, changing & dismantling concepts
 - change towards a holistic approach of construction processes

➔ increasing need for process integration





process integration: in construction?

The beginning of <u>digital</u> process integration started in construction





- on May 12th 1941 Konrad Zuse presented the "Z3", the world's first functional programcontrolled Turing-complete computer.
- the aim was to achieve a more efficient static calculation.
- then in 1961 Konrad Zuse presented the "Z64" on the Hannover ferry, the world's first Plotter.
- the aim was to achieve a presentation of the geometries calculated and to increase the efficiency of technical drawings.



at first, although the implementation is faster in mechanical industry, the development is comparable

 first finite element calculations are introduced in the 50's. John Argyris / Ray W.Clough / Olgierd C. Zienkiewicz (all structural engineers) set up the foundation for the first <u>digital</u> finite element solutions.

Starting in the 70's finite element calculations are being used as a standard solution on mainframe computers.

- the use of 2D-CAD-systems started in 1965 on mainframe computers.
 Widely used on PC from 1980 in mechanical from 1985 in construction.
- first developments of 2½D-systems (2D with adding height) lead to first 3D-geometries. Limited forms and laborious workflow prevent a wider use.
- In the 80's the PC revolutionizes the availability of software solutions that are able to support processes like: scheduling / estimation / procurement





during the 90's the development of process integration starts to stagnate in the construction industry

whilst the mechanical industry introduces:

 object oriented real 3D geometry in CAD systems: any forms, parametric to attributes, parametric rules between objects









during the 90's the development of process integration starts to stagnate in the construction industry

whilst the mechanical industry introduces:

 virtualization of the planning, the product behavior and the production conditions are first visualized and more and more simulated to make complex interactions and process results more transparent and efficient.











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during the 90's the development of process integration starts to stagnate in the construction industry

whilst the mechanical industry introduces :

 the use of IT-networks not only for data storage but also for process integration: setting up Product Life-cycle Management systems (PLM)

PLM was the base for:

- increasing variety of products
- cutting time of development of product <u>as well as</u> production line up to 50%
- increasing quality
- increasing efficiency by avoiding waste (lean tool)

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process integration: driving factors

demands:

- efficiency
- lean
- holistic views, integrated processes

support:

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- success story in mechanical industry
- available IT-infrastructure: Network – computing capacity
- helpful innovations: BIM

constrains:

- supporting the given fragmental structure in construction business
- taking into account the exceptionally high dependency of all construction processes on geometry
- <u>a change strategy</u> taking into account the possibilities and contextual restraints of construction business





process integration: isn't BIM enough?

Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a facility:

 starting in the late 80's as shared representation for architects and designers.



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process integration: isn't BIM enough?

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- it was augmented to allow the representation of the "whole construction process"



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process integration: isn't BIM enough?

Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a facility:

 starting in the late 80's as shared representation for architects and designers.

 it was augmented to allow the representation of the "whole construction process"

➔ it still remains the "bearer" of geometric information

➔ its to be used in other processes without describing how to be used as input and output



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 \rightarrow we need a coupling of BIM and processes \rightarrow how?







mechanical industry "can tell us what" but they "can't tell us how"









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mechanical industry "can tell us what" but they "can't tell us how"

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 mechanical industry "can tell us what" but they "can't tell us how"

the change is fundamental



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 mechanical industry "can tell us what" but they "can't tell us how"

the change is fundamental

 strategy for implementation applicable within construction conditions (fragmented structure / changing partners / production variety)



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 bring the definition to the start of the development path



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 strategy for implementation within construction conditions (fragmented structure / changing partners / production variety)

 bring the definition to the start of the development path

start incremental development & implementation









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 mechanical industry "can tell us what" but they "can't tell us how"

the change is fundamental

 strategy for implementation within construction conditions (fragmented structure / changing partners / production variety)

 bring the definition to the start of the development path

 start incremental development & implementation

achieve incremental benefits

start with a definition able to fulfill these requirements







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the goal definition: augmentation of BIM towards PLM for construction – **5D**



- Object-based 3D model with userdefined attributes
- What you see is what you build

BIM

Development

 Building Information Model, managing all relevant data in a central database



- Construction sequencing by linking the geometrical model to a scheduling programme
- What you see is how you build it

Virtual construction site

 Dynamic construction process

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"virtual mock up"



- 3D model-based quantity take-off
- What you see is what you calculated ...

Data- & process mgmt

- company-wide logistics
- connecting all business processes to the 3D model and the work flow







IT-platform	processes		
new IT-solutions	process definition in construction		
 platform definition for the whole industry sector augmenting existing solutions towards 5D functionality and rising interoperability scalable 	 including all actors, stakeholders full inclusion of construction industry, 90% - 95% of erecting costs are directly related to construction industry including project development / operating a facility 		

company specific implementation

- linking tools and company specific processes
- linking company specific processes to other companies
- strategy for implementation

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implementation knowledge

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IT-platform

processes



quality controlguidelinesknowledge on processes linkagestructuretraining concepttemplatesknowledge on hard- and software

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company implementation knowledge

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company implementation knowledge

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5D*i* – accepting the challenge









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5Di – our objectives

- to define and demand
 - 5D software solutions with software partners
 - support of 5D development by research institutes
 - 5D implementation with construction industry , stakeholders, institutions



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- organizational structure
 - open collaboration platform of construction companies
 - active pro-actively driving the discussion by workshops, definition software and implementation strategies

http://www.5D-initiative.eu

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5D*i* – definition of 5D on highest level – tier 0

- Starting from a high level:
 - main components of IT–Platform
 - highest processes to be connected through IT–Platform





Position paper of the European Construction Industry for developing model-based IT tools for planning, realising and operating buildings, facilities and infrastructure

Introduction

The construction sector is the largest industrial sector with a portion of approx. 10% of the entire European GDP. Changes brought around by ,virtual planning, production and operation" will



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5Di – definition of the 5D IT-platform





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5Di – definition of the processes to be integrated



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5Di – scalability of proposed solution

- demanding a "step by step" implementation.
 - order of necessity
 - collaboration between steps
 - allocation to the "over all" map
- Every 5D step has to improve existing processes

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- enabling company specific solution to support internal processes
- enabling application in a project by linking to construction partners





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5D*i* – explaining the demands in detail

setting up use cases to define the first focus points of 5D in detail

Ballast Nedam Building Process Integration – Systems Engineering and BIM / Client **Requirements Processing**

Manage Change – Change Δ Managed



Model-based Estimation – QTO Processes STRABAG



Reprogress Collection, Monitoring and Control







5Di – use case 1.0 – definition tier 1

 2010 / 2011 several workshops with research institutes and software companies on base of use case status 1.0 (issued as 1.1)

- allocation of use case to IT-platform and process map
- identify existing tools to be plugged into "5D" and necessary new tools



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5D*i* – use case 2.0 – definition tier 2

Feb. – Oct. 2011 Use Case 2.0 was issued

- detailing use-case 1.0
 - setting up the Workflows
 - the roles of the stakeholders
 - the activities involved in the use-cases

Iist of the requirements sent to SW-Vendors and industry leaders

Progress collection, Manitoring and Control	SX 30-BM Development Process - Garante Distance	EQUIREMENTS FROM THE SOFTWARE IN	IDUSTRY TO ANSWER US	5-CASE	
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and the second s		All Discylence integrated in one BM pietform The further elaboration and processing			
Repairing the second second		Wingroting Bild with WIIS and OBS			
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5D*i* – partnering to achieve goals

- April 2011 closer partnering started with five software vendors: Autodesk / Bentley / CCT / RIB / Tekla
- Partnerships are the basis for:
 - intensive discussions and workshops based on use case 2.0
 - further defining / testing and implementing 5D solutions use case 3.0 is in preparation phase
- Partnerships are set up for software industry and will be built out for research institutes and others like supply industry / stake holders

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PRESS RELEASE

The 5D Initiative enters into a process of more intensive cooperation with Autodesk, Bentley, CCT, RIB and Tekla in order to develop new BIM software solutions that fit needs of European contractors.

Based on the strategic discussions over the past 2 years, the 5D Initiative moves forward by taking pragmatic steps together with Autodesk Inc (Autodesk), Bentley Systems Incorporated (Bentley), Computers and Communication Technology International (CCT), RIB Software AG (RIB) and Tekla Corporation (Tekla), in order to reflect the practical needs of higher process integration in the whole life-cycle in construction.

Stuttgart, Germany. April 21, 2011 - The 5D Initiative, founded and working as an independent think





5D*i* – ongoing work

- intensifying the collaboration with software partners
 - integrated use case 3.0 linked to actual product data for testing and validation
 - intensive workshops with software developers on base of issued use cases
 - implementing software solutions
- Discussions with research institutes to achieve defined partnership for
 - long term research collaboration
 - future needed education and formation
- amplification of 5Di
 - new construction companies as active members
 - expanding partnership







conclusion

 a process integration to achieve a product focused improvement in construction industry promises a higher efficiency – as the example in mechanical industry is demonstrating.

 technical preconditions, like network and computing capacity, are in a achievable range for construction stakeholders.

 BIM solutions as geometric input for all construction processes are available and can be implemented as starting step of a process integration.

In mechanical, PLM was driven by making a mass product more efficient whilst designer – manufacturer – distributer being one company. It led to a system where sub-contractors were incrementally integrated, such as variation of the mass product was raised without losing mass production benefits.

 to achieve same effect on construction we can orient at mechanical but turning the implementation path around – build up variety (=building) on base of process integration through involved companies.

 a successful definition for such a strategy, 5D, can only be done by the process "owner" – the construction stakeholders.



