

Meet Up Tech

# La Construcción 4.0: metodología BIM

Fecha: 18 de diciembre

Lugar: salón de actos CEEI Castellón

Horario: de 11 a 14 h

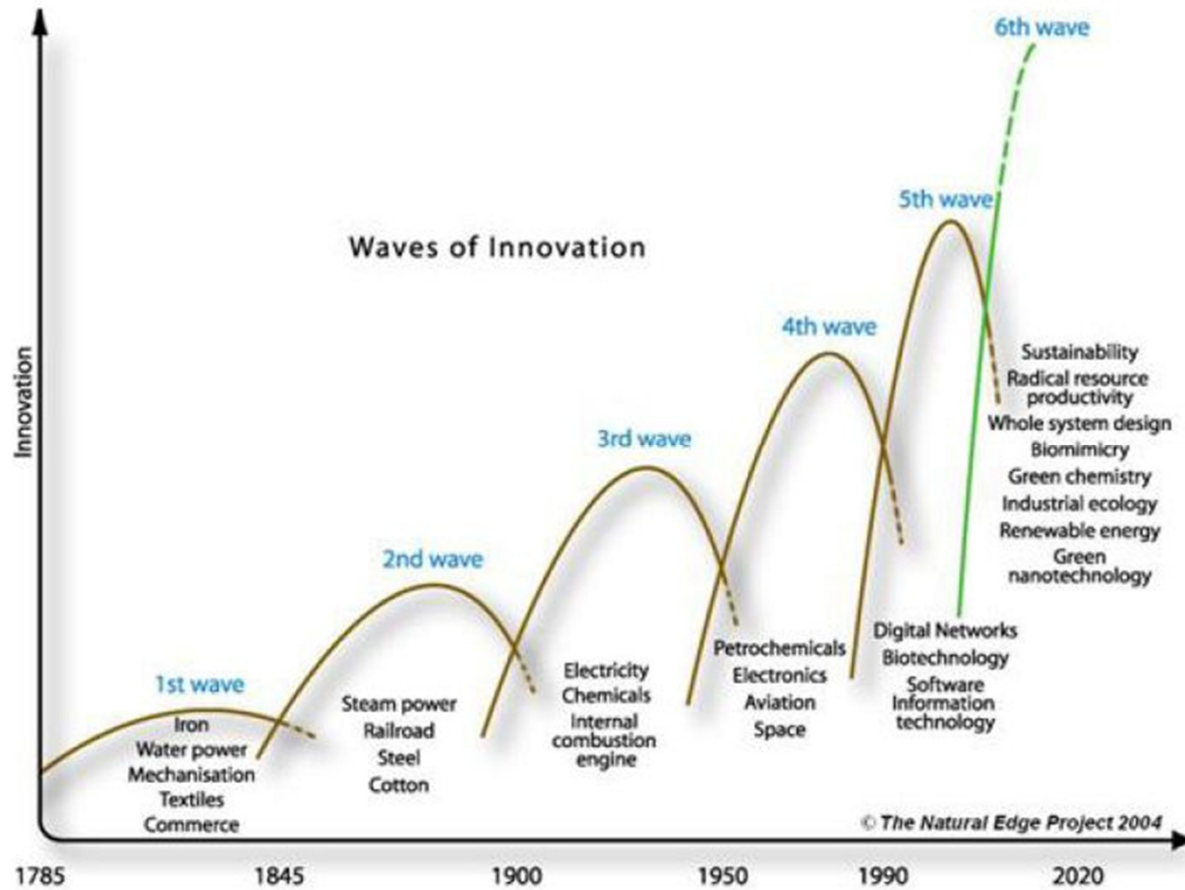


Una manera de hacer Europa

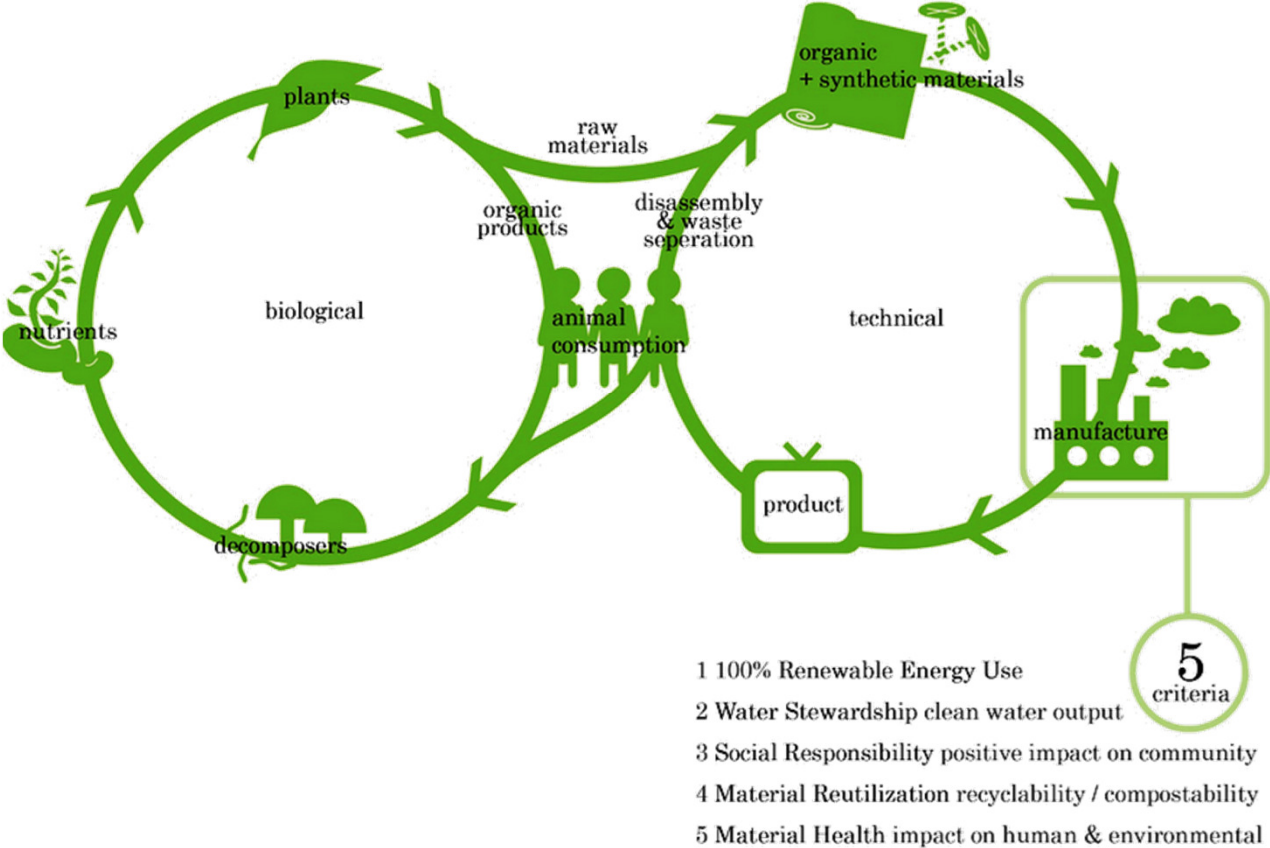
\*Proyecto cofinanciado por los Fondos FEDER dentro del Programa Operativo FEDER de la Comunidad Valenciana 2014-2020\*

Arnaldo Landivar Taborga

# BIM Estado del Arte Olas de Innovación

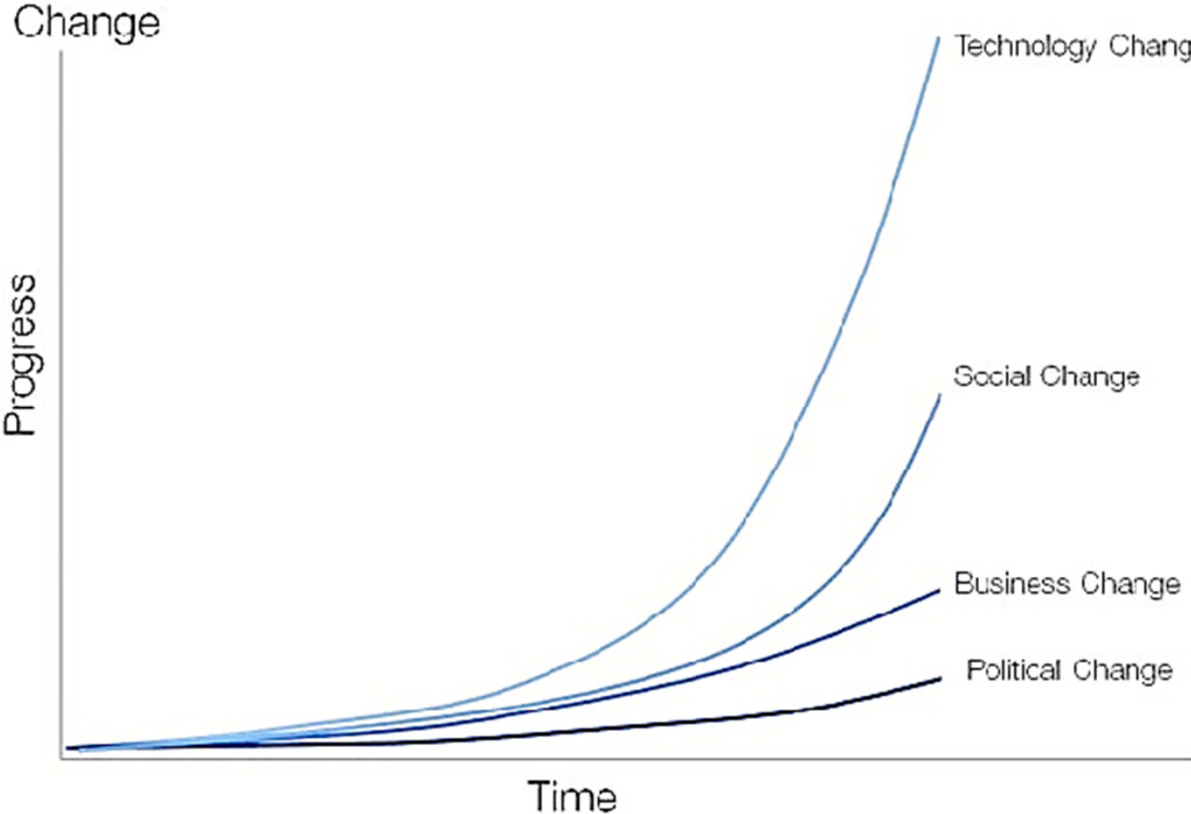


### CradletoCradle



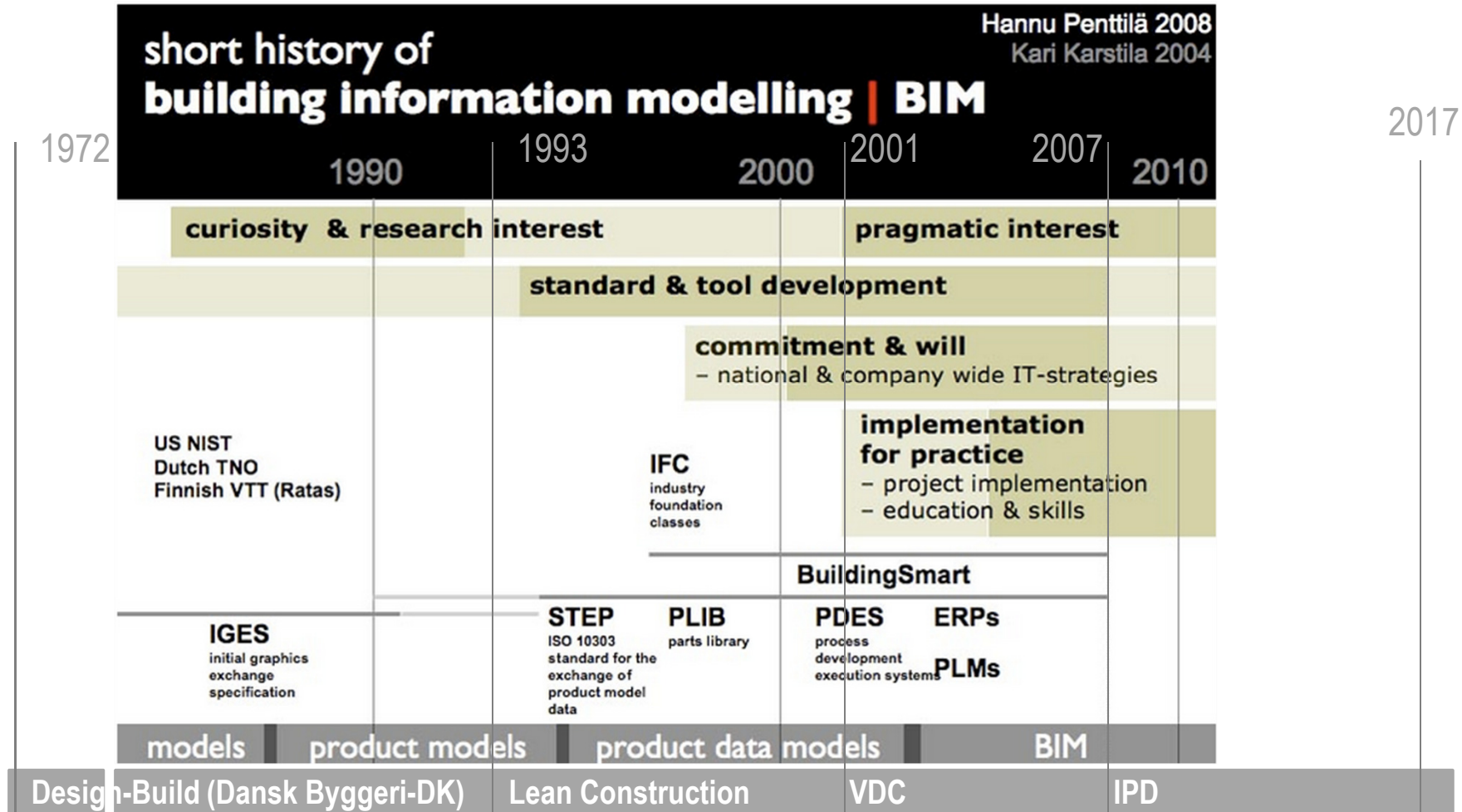
Source: MBDC  
<http://www.mbd.com/>

# BIM Estado del Arte Hacia una sociedad tecnológica



Source: Larry Downes, The Laws of Disruption: Harnessing the New Forces that Govern Life and Business in the Digital Age (2009)

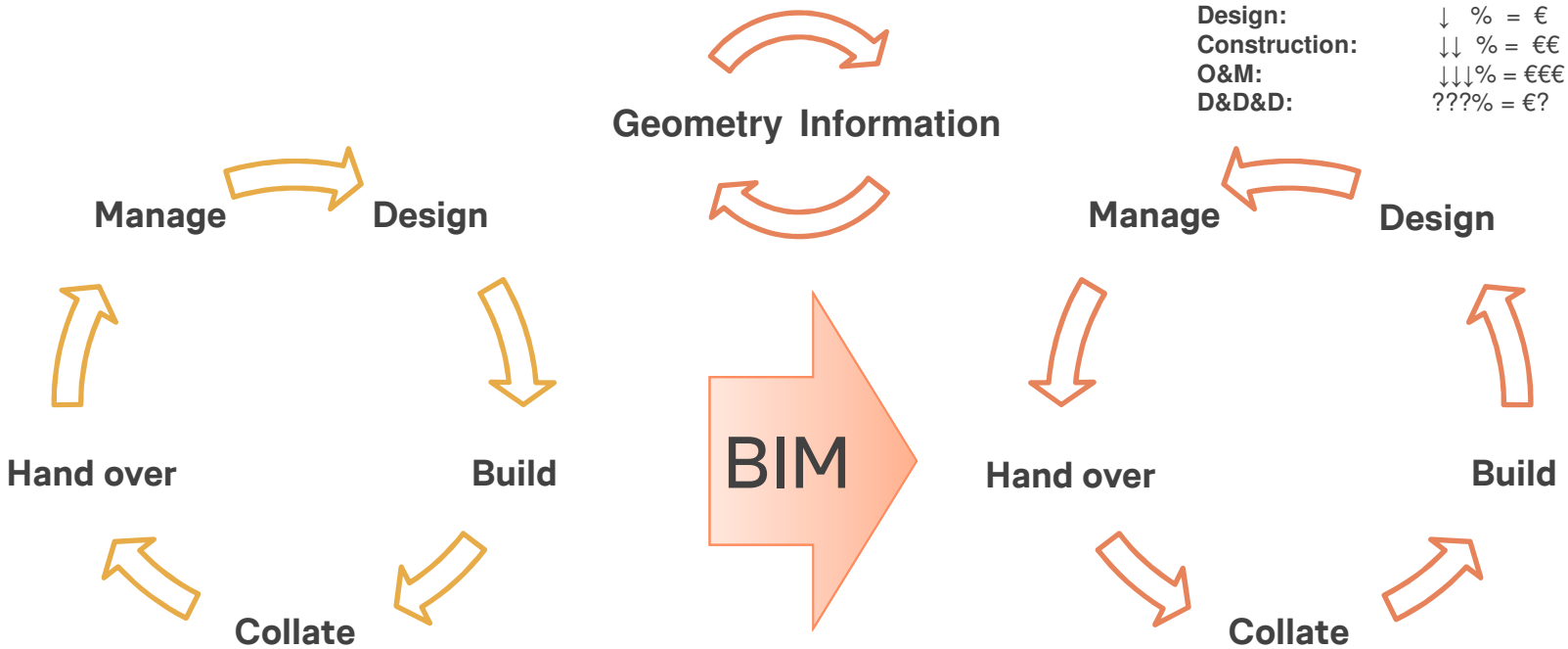
# BIM Estado del Arte Evolución



# BIM Estado del Arte

## Cambios en los ciclos de gestión

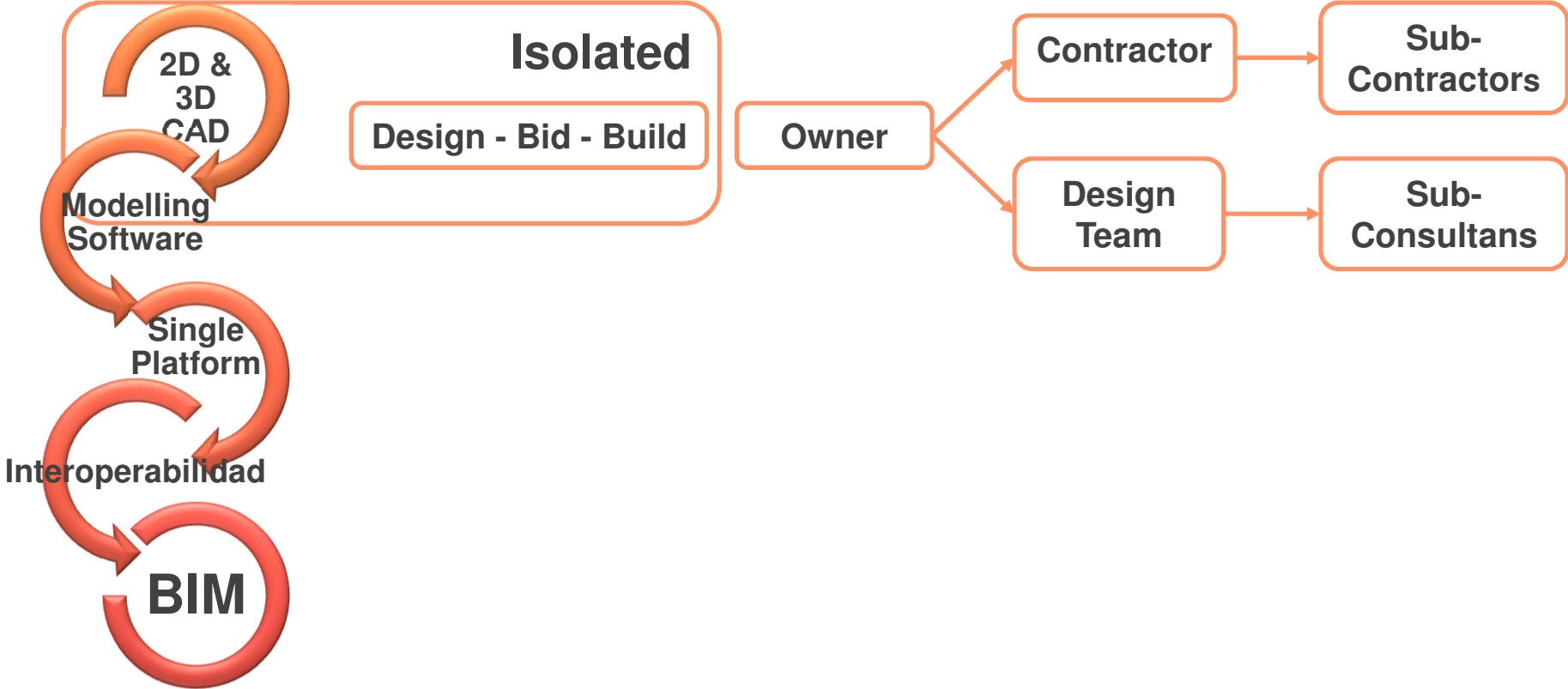
Some Clients already know of and are educated in BIM



Source: The state of BIM in EU Construction within the "4D BIM UK Conference" at Birmingham City University-15/05/2014

# BIM Estado del Arte

## Cambios en Project Delivery Systems (PDS)



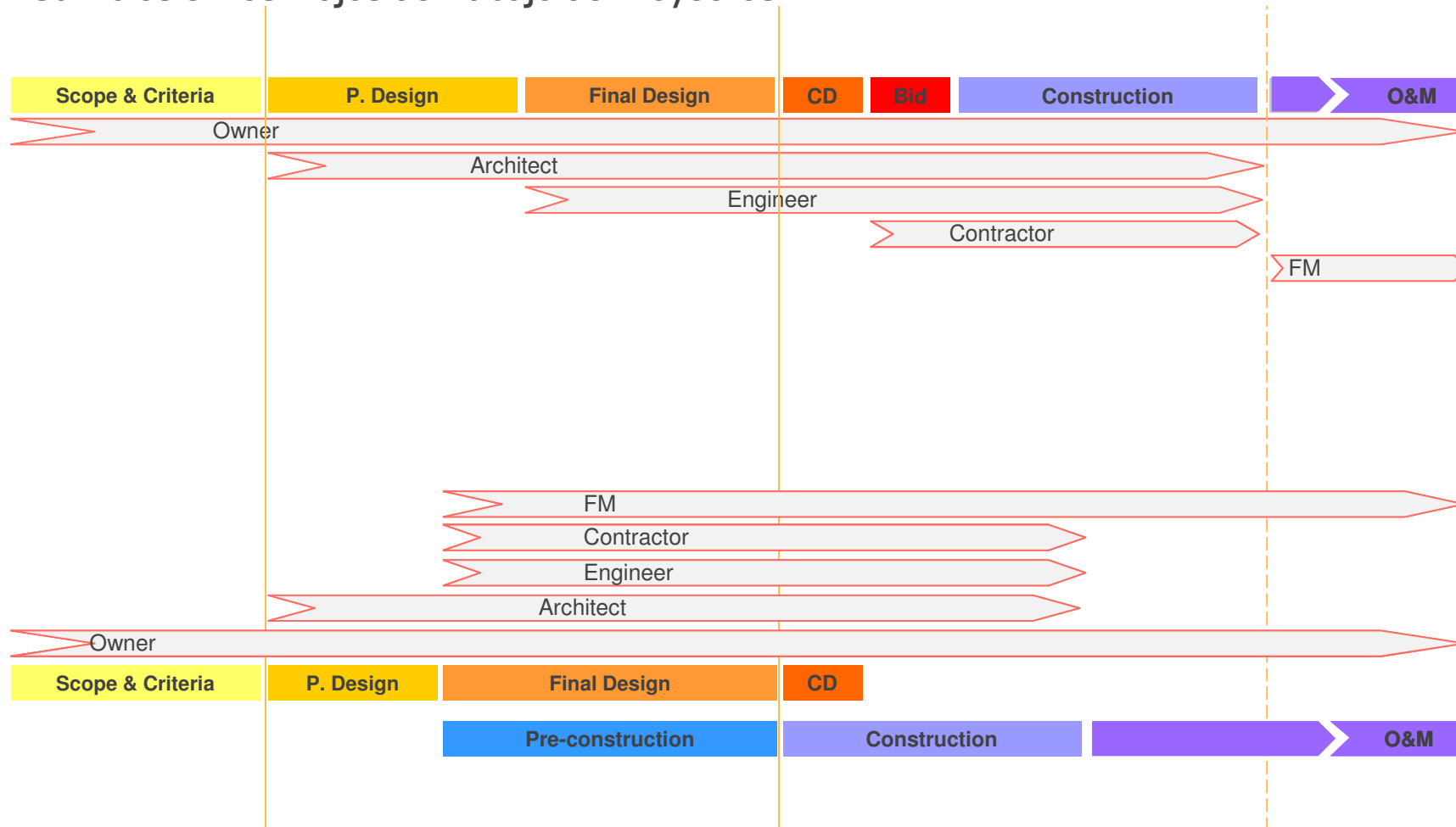
Source: CRC for Construction Innovation-Australia  
[http://www.construction-innovation.info/images/pdfs/Research\\_library/Extension/National\\_BIM\\_guidelines\\_July08\\_presentation.pdf](http://www.construction-innovation.info/images/pdfs/Research_library/Extension/National_BIM_guidelines_July08_presentation.pdf)



# BIM Estado del Arte

## Cambios en los Flujos de trabajo de Proyectos

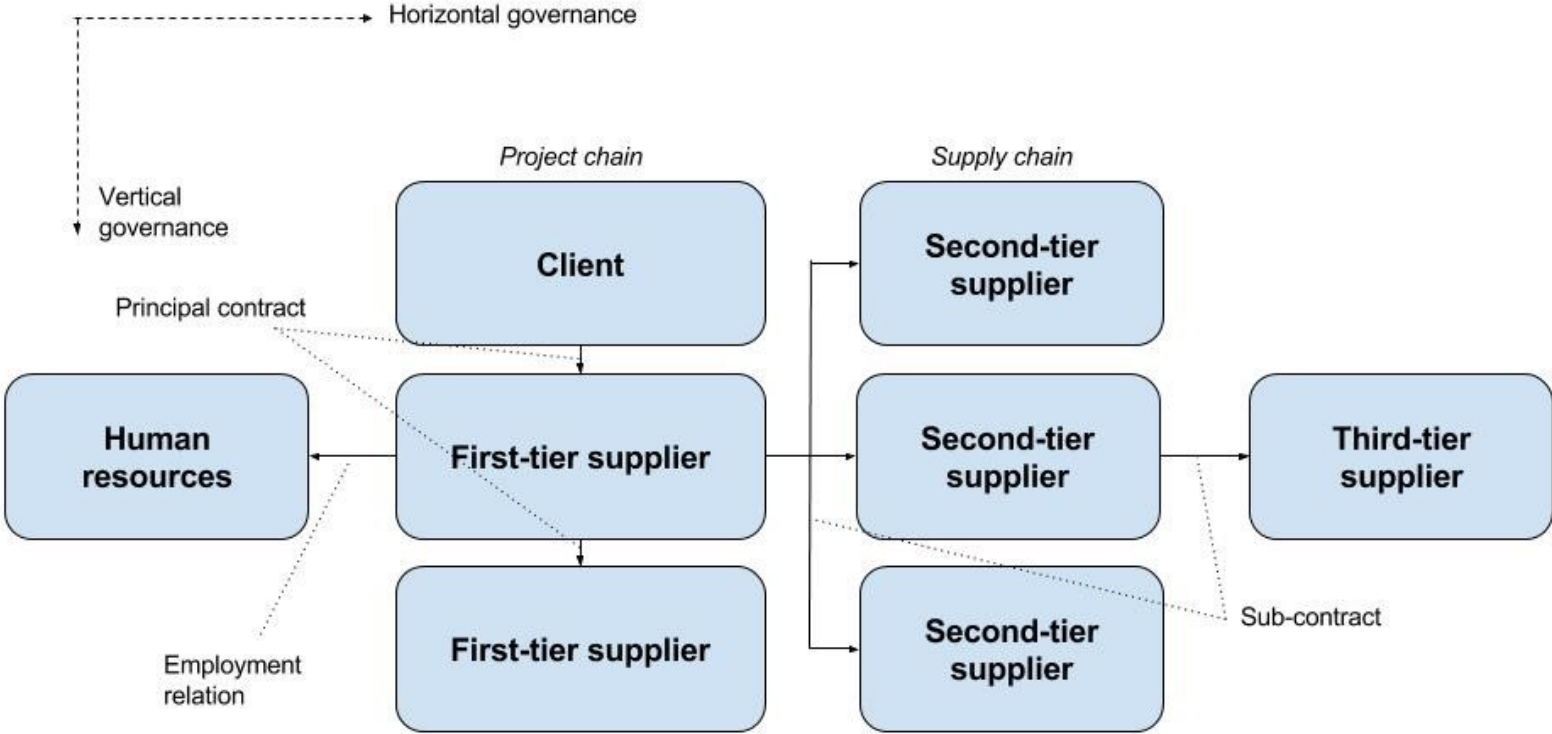
Construcción 4.0-CEEI-Castellón





# BIM Estado del Arte

## Cadenas de valor Proyectos & Suministros

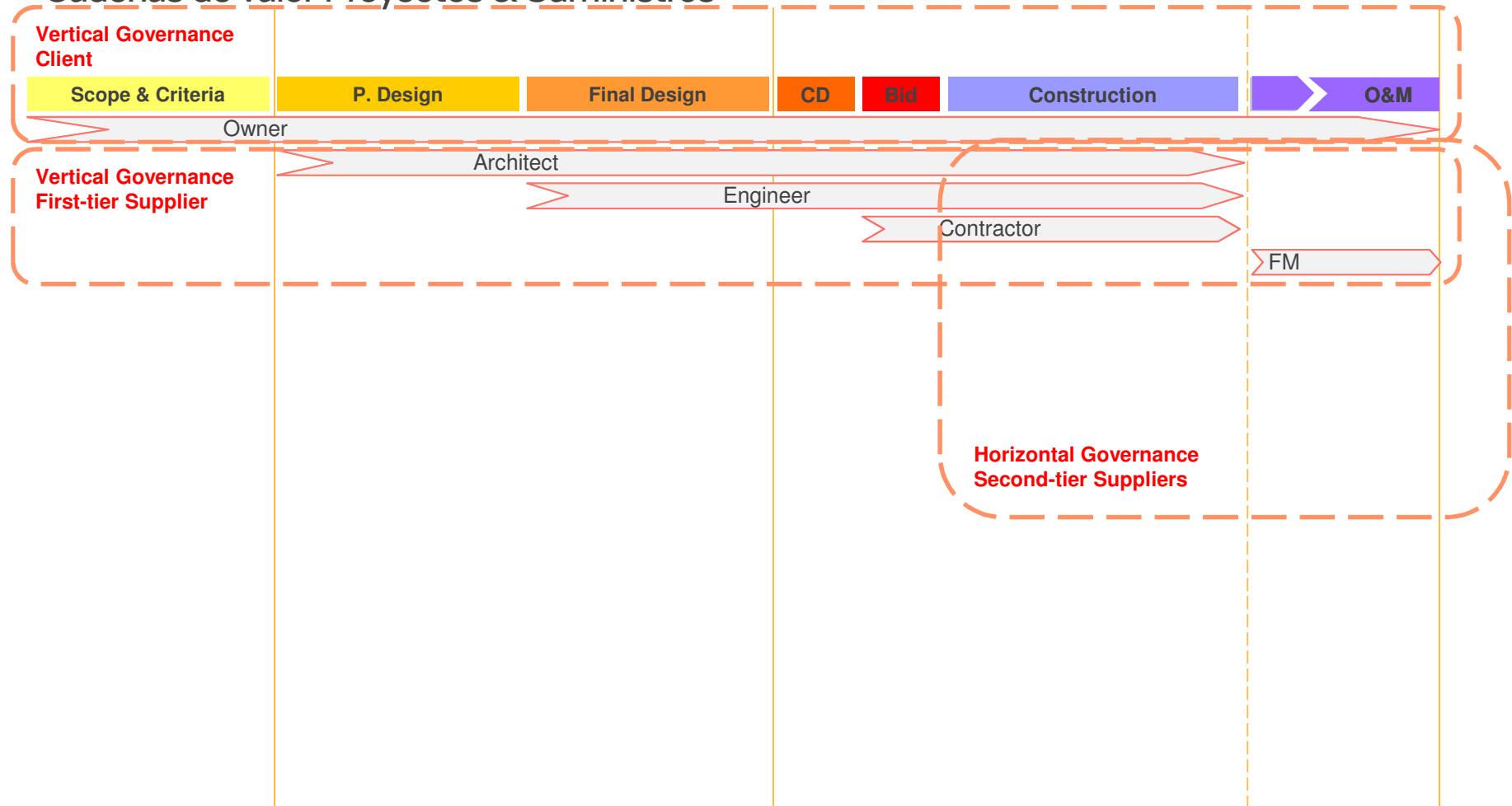


Source: Winch, 2010  
Managing Construction Projects

# BIM Estado del Arte

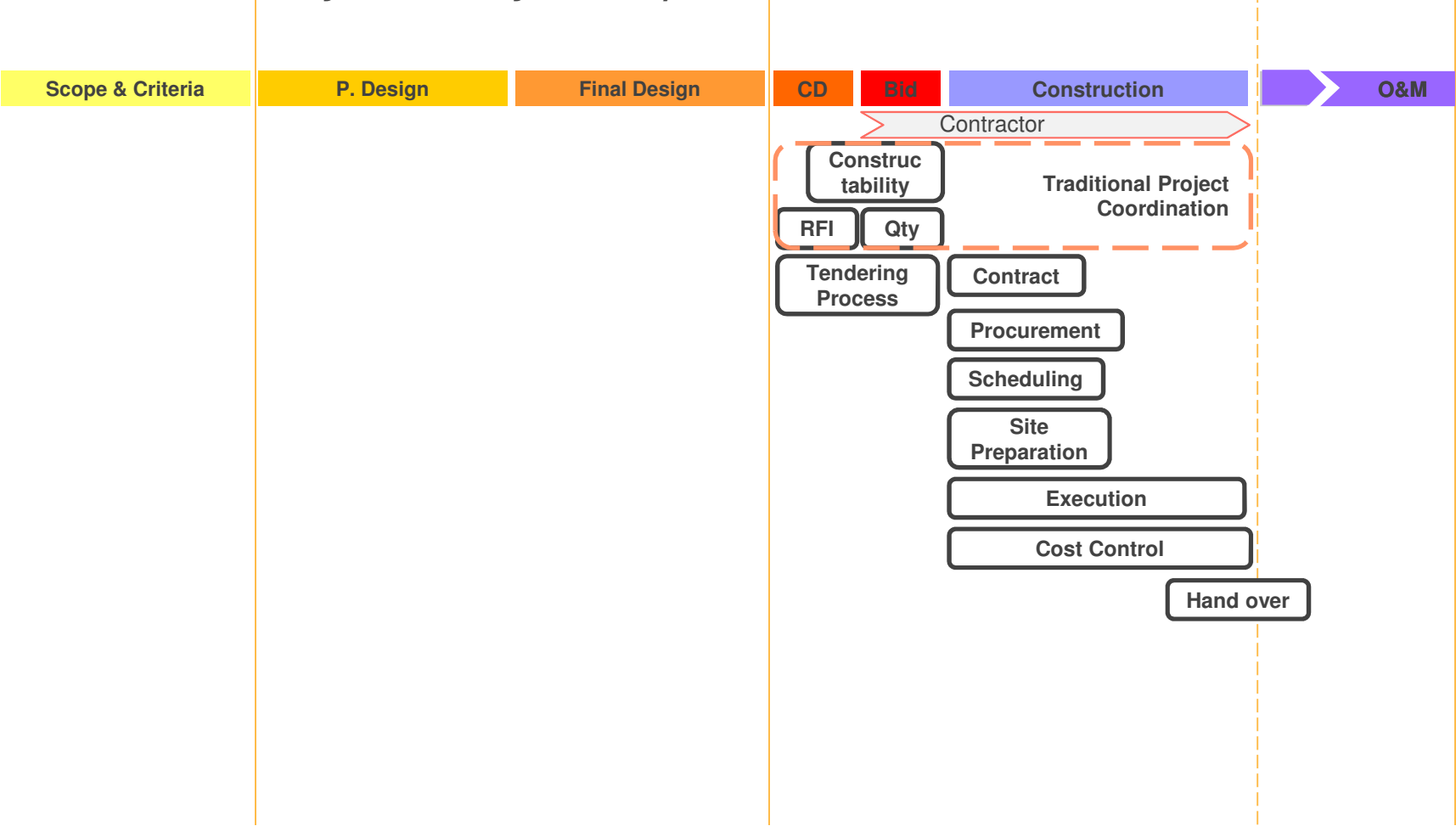
## Cadenas de valor Proyectos & Suministros

Construcción 4.0-CEEI-Castellón



# BIM Estado del Arte

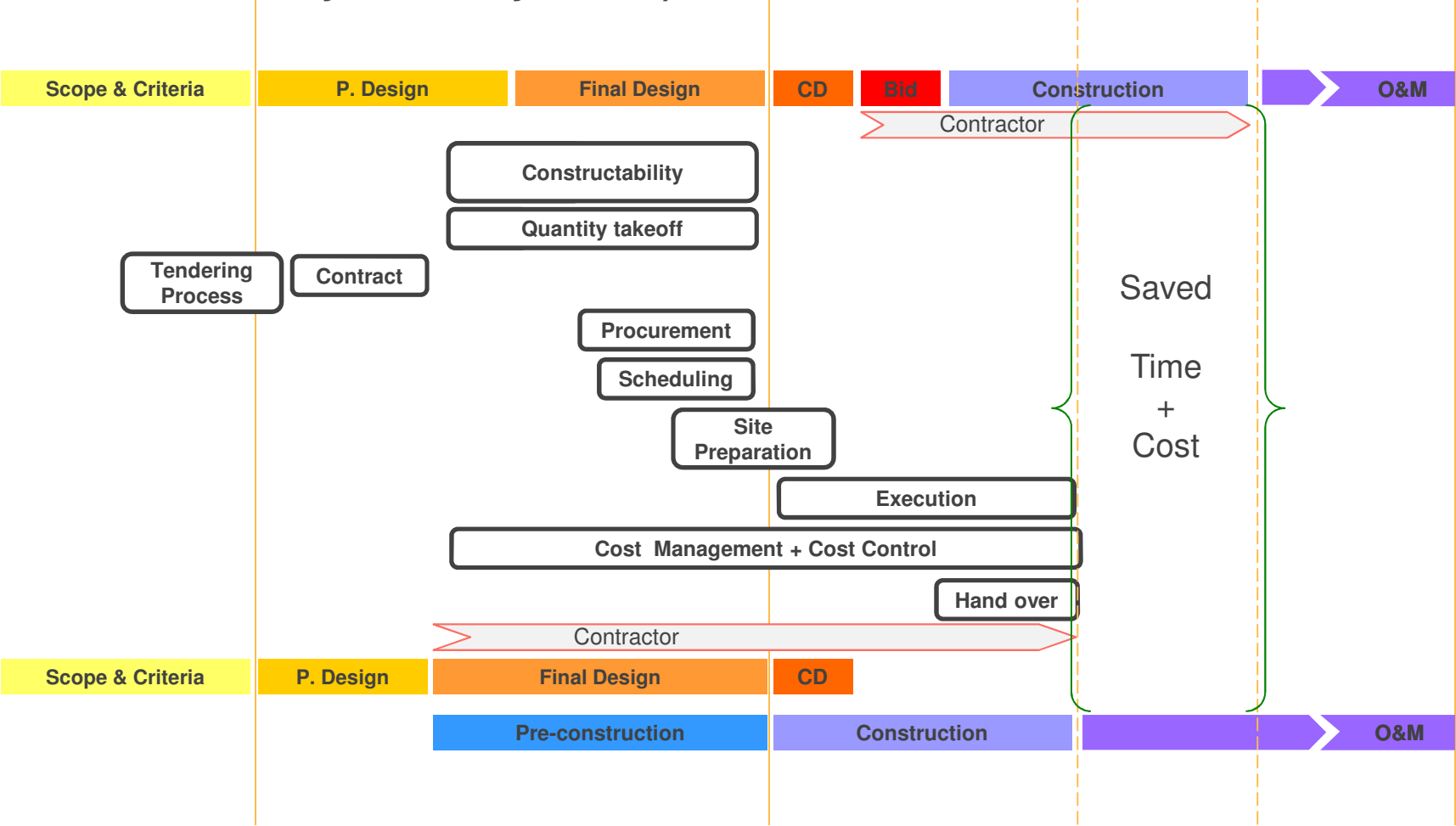
## Cambios en los Flujos de trabajo de Proyectos



Source: Arnaldo Landivar Taborga  
 EDUBIM 2015, "Les journées del'enseignement de la Maquette Numérique et du BIM en France"

# BIM Estado del Arte

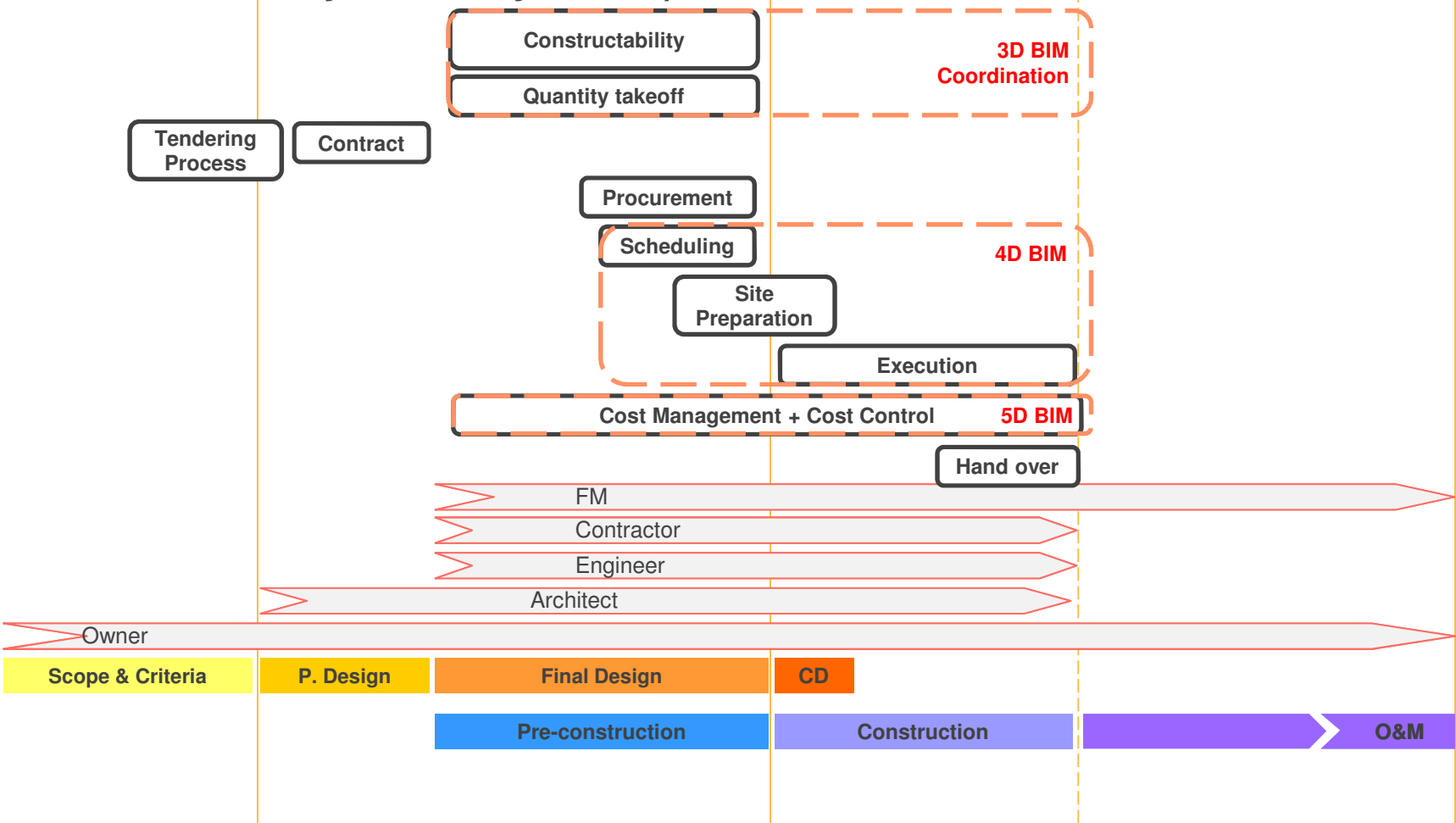
## Cambios en los Flujos de trabajo de Proyectos



Source: Arnaldo Landivar Taborga  
 EDUBIM 2015, "Les journées de l'enseignement de la Maquette Numérique et du BIM en France"

# BIM Estado del Arte

## Cambios en los Flujos de trabajo de Proyectos

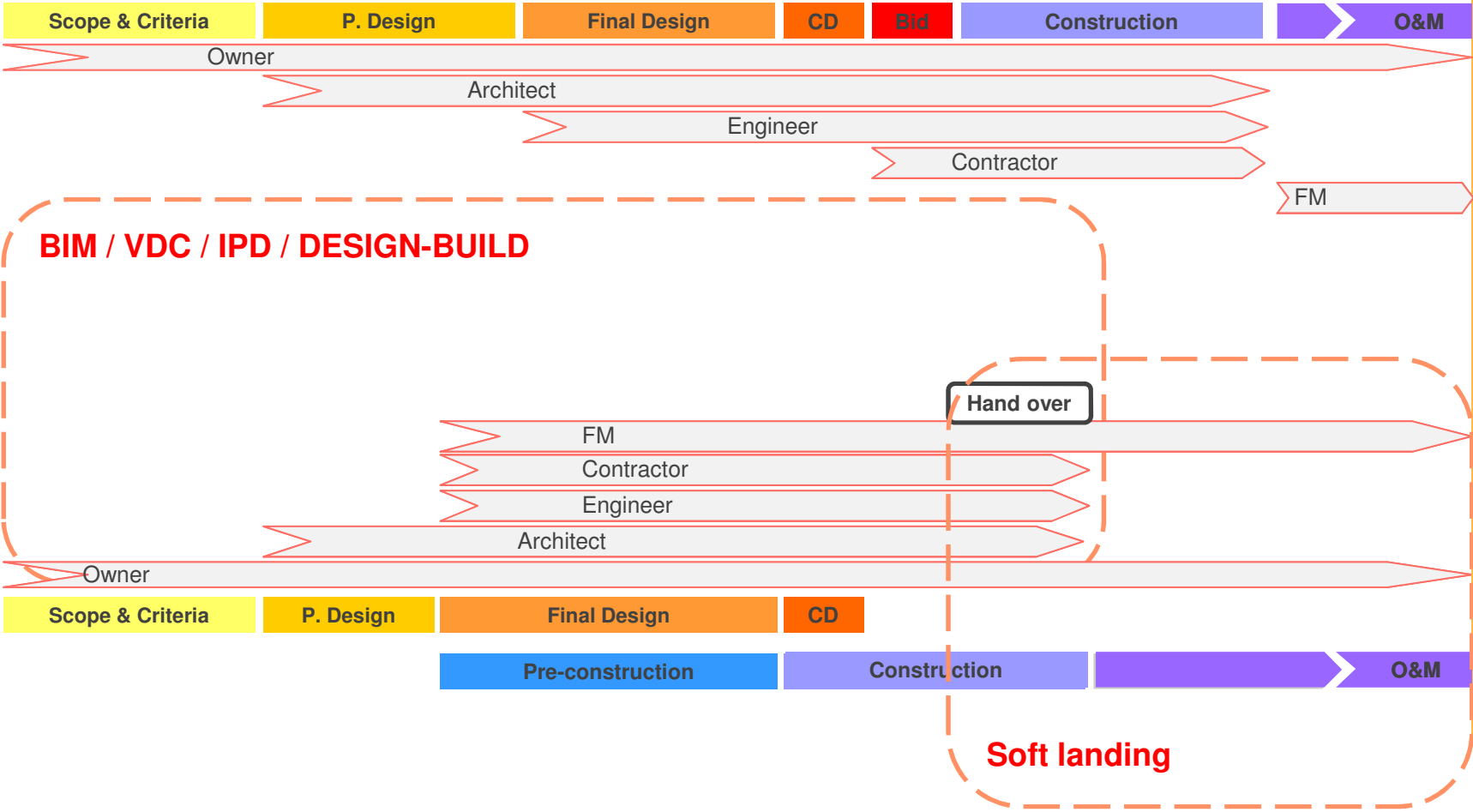


Source: Arnaldo Landivar Taborga  
 EDUBIM 2015, "Les journées de l'enseignement de la Maquette Numérique et du BIM en France"

# BIM Estado del Arte

## Cambios en los Flujos de trabajo de Proyectos

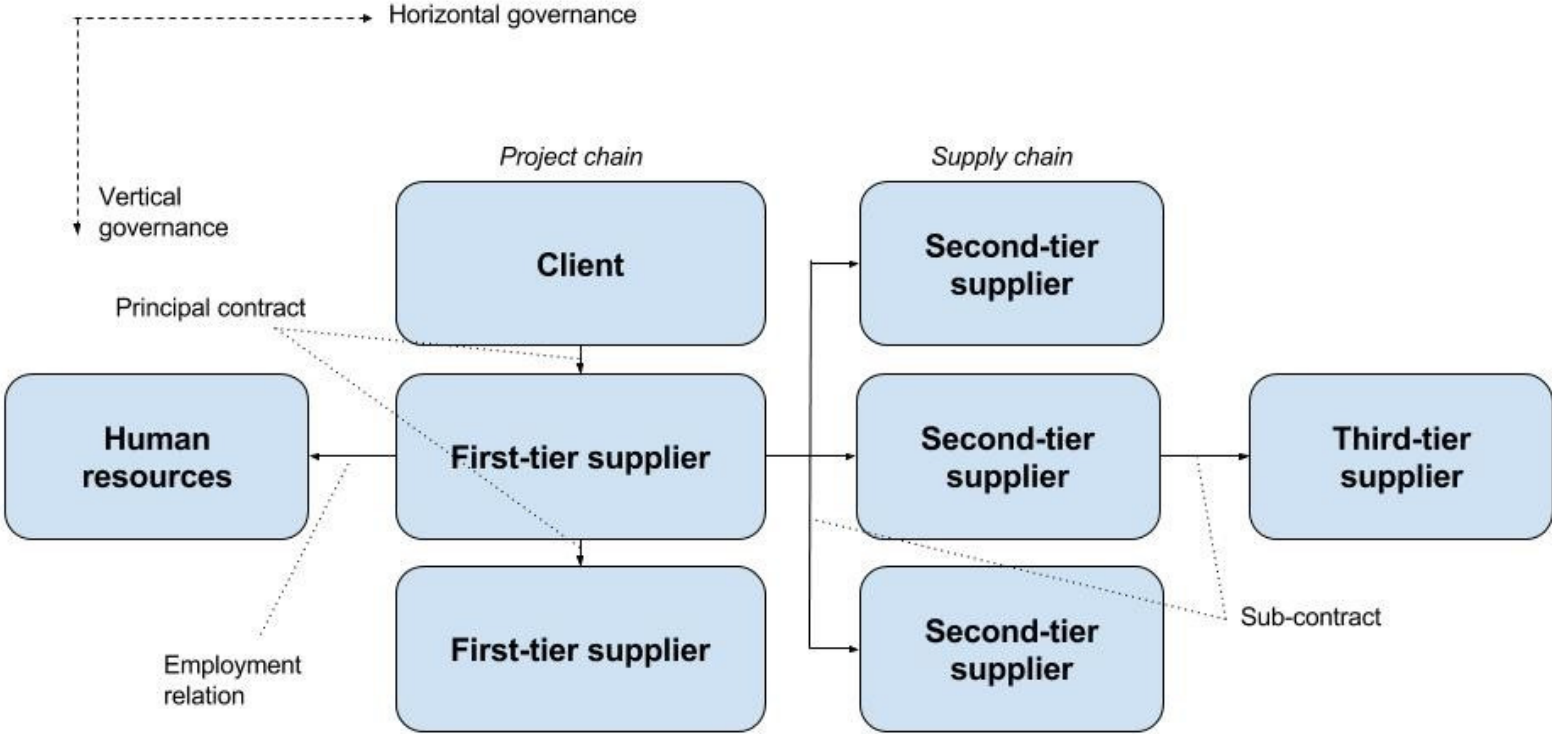
### Shifting Project Delivery Systems (PDS)



Source: Mr. A.Lopez-Director of validation services-Solibri Iberia

# BIM Estado del Arte

## Cadenas de valor Proyectos & Suministros



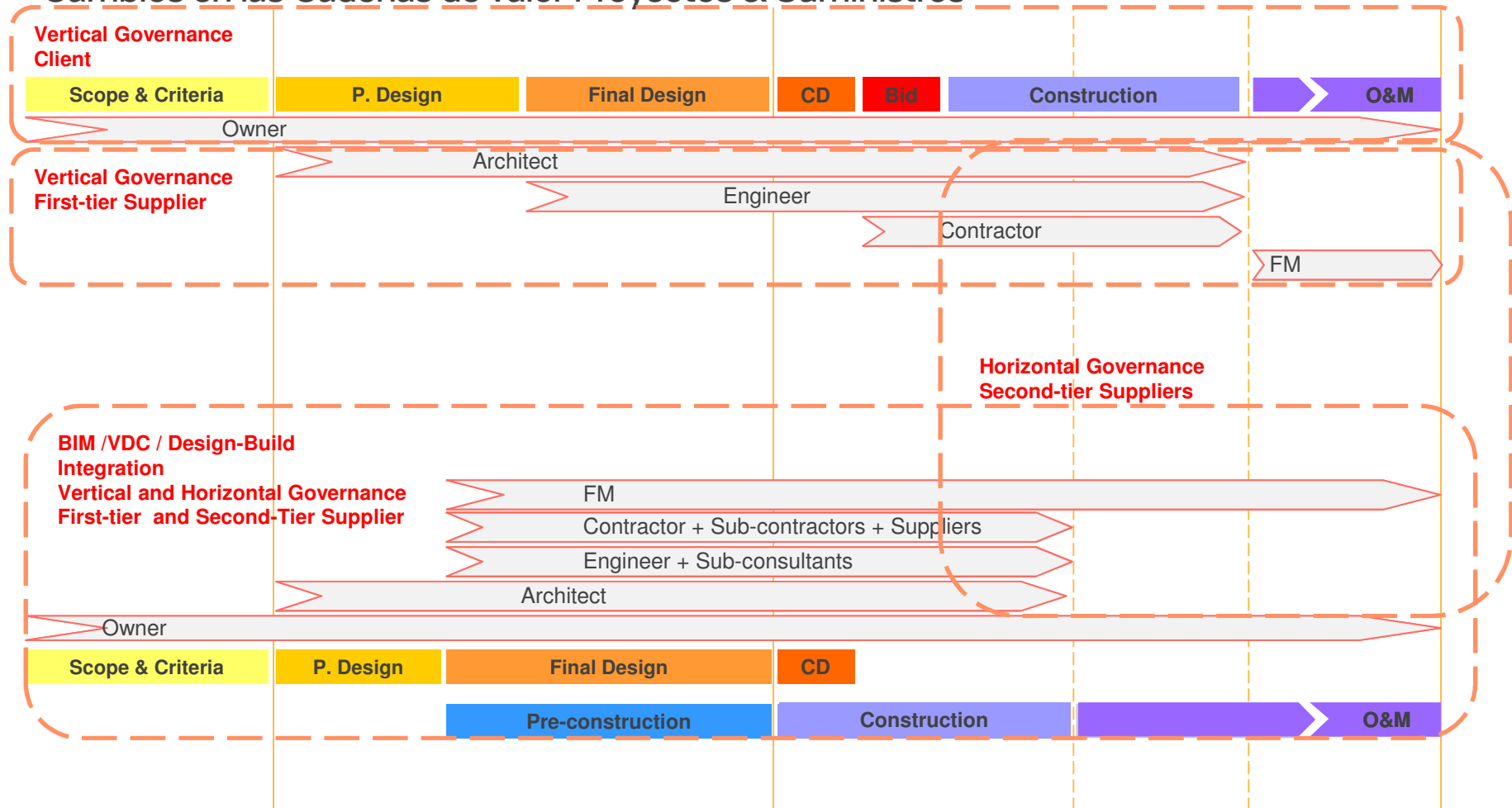
Source: Winch, 2010  
Managing Construction Projects



# BIM Estado del Arte

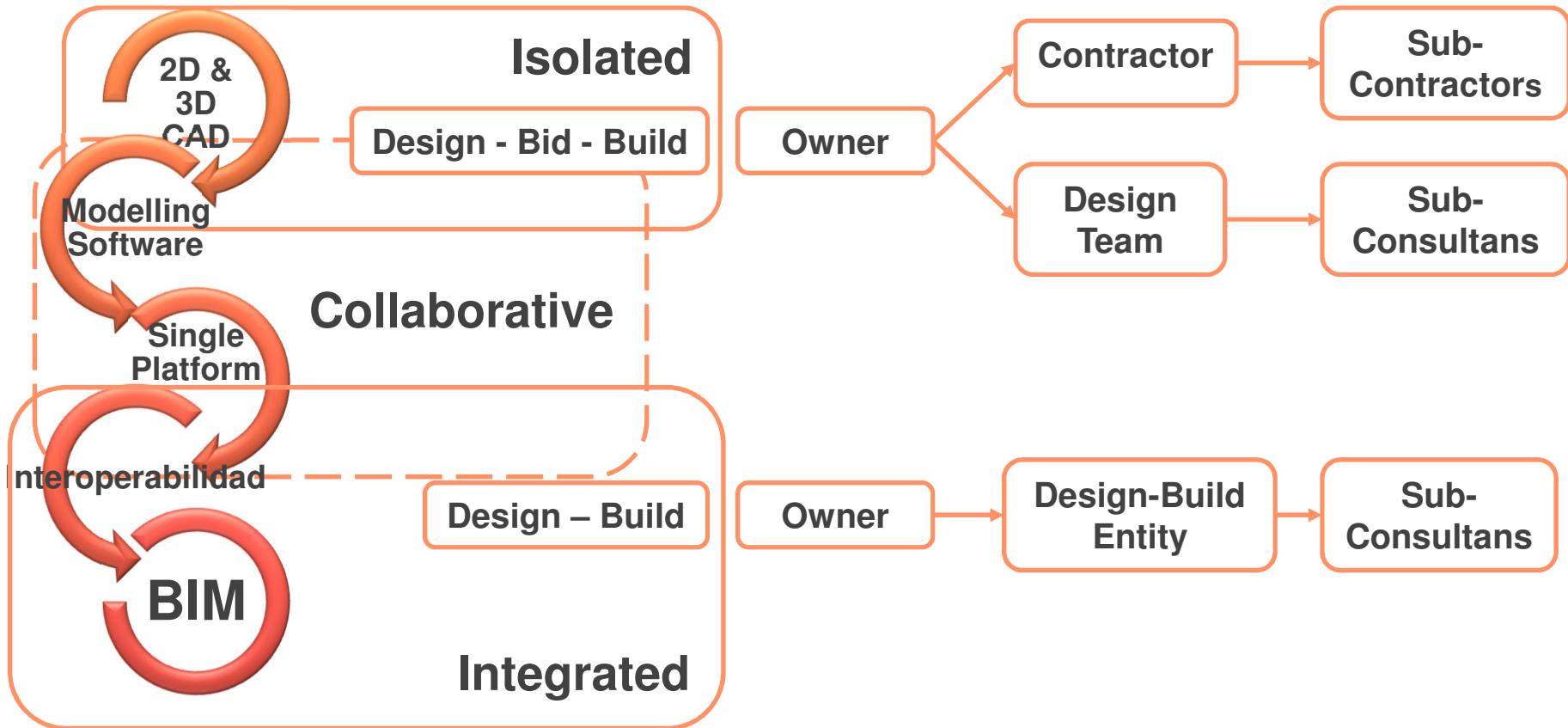
## Cambios en las Cadenas de valor Proyectos & Suministros

Construcción 4.0-CEEI-Castellón

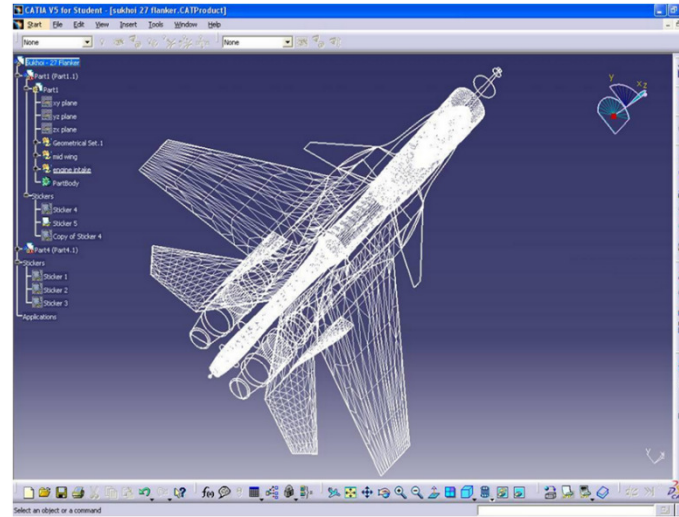
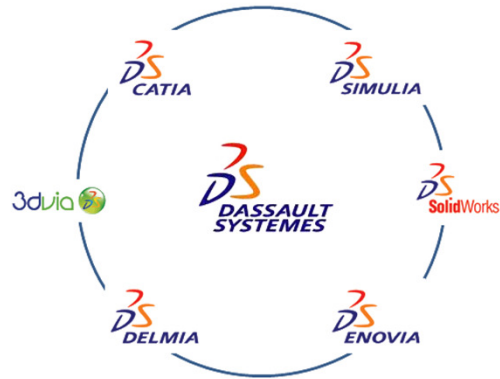


# BIM Estado del Arte

## Cambios en Project Delivery Systems (PDS)

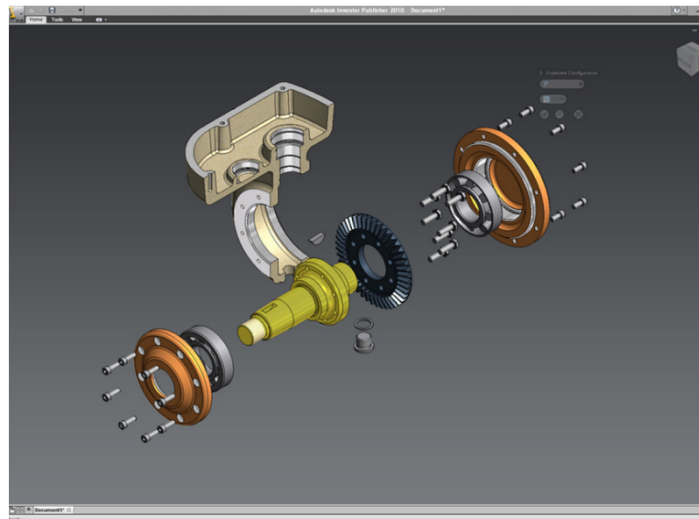


# BIM Estado del Arte Model-Based Industries



Source: Dassault Systems  
<http://www.3ds.com/>

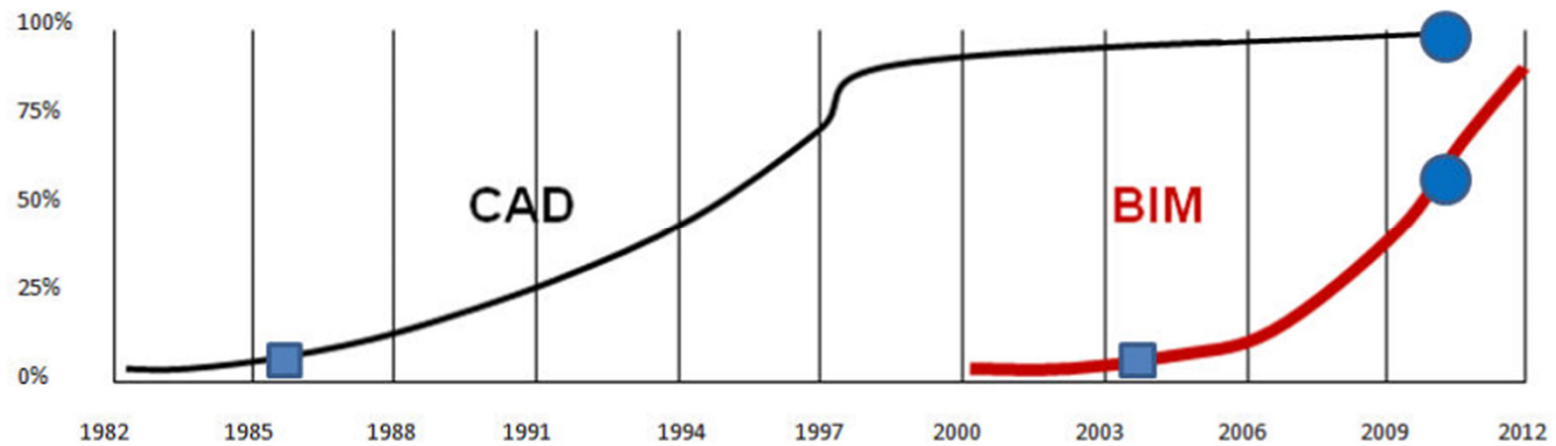
Source: Autodesk  
<http://www.autodesk.com/products/inventor/overview>



# BIM Estado del Arte

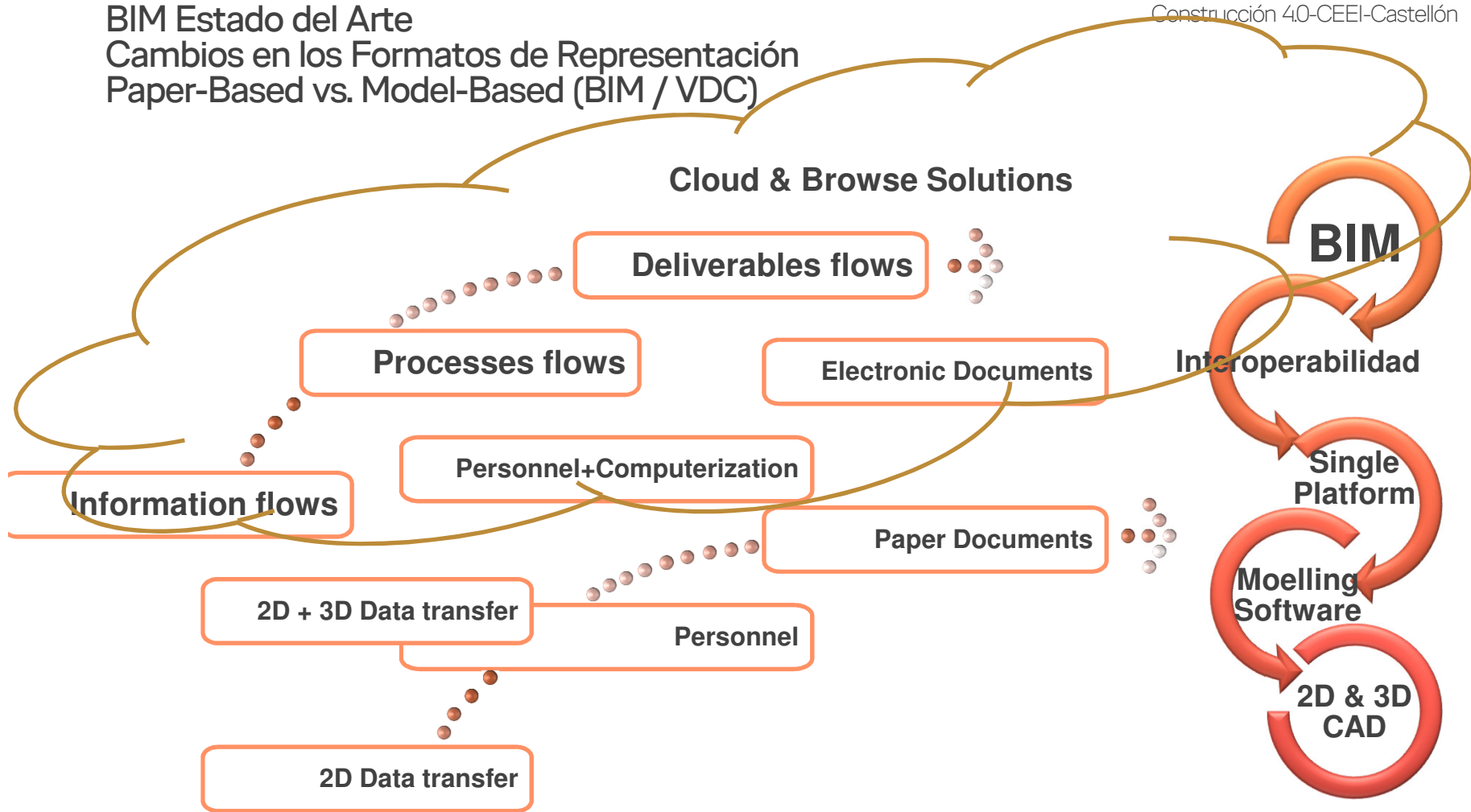
## Cambios en los Formatos de Representación Paper-Based vs. Model-Based (BIM / VDC)

Construcción 4.0-CEEI-Castellón



BIM Estado del Arte  
Cambios en los Formatos de Representación  
Paper-Based vs. Model-Based (BIM / VDC)

Construcción 4.0-CEEI-Castellón



## Algunas soluciones disponibles

- Autodesk (Calculations and Collaboration)
- Graphisoft (Collaboration)
- Aconex (Document Management and Collaboration)
- 4Project (Document Management and Collaboration)
- RIB (Document Management and Collaboration)
- BIM Object (Content Management and Collaboration)

.....

## Content management solution



## BIMObject® Hercules

BIMObject® Hercules is a cloud solution for large companies to develop, organise, structure, standardise and manage their own BIM objects and to publish and syndicate these in a controlled way to project groups anywhere in the world.

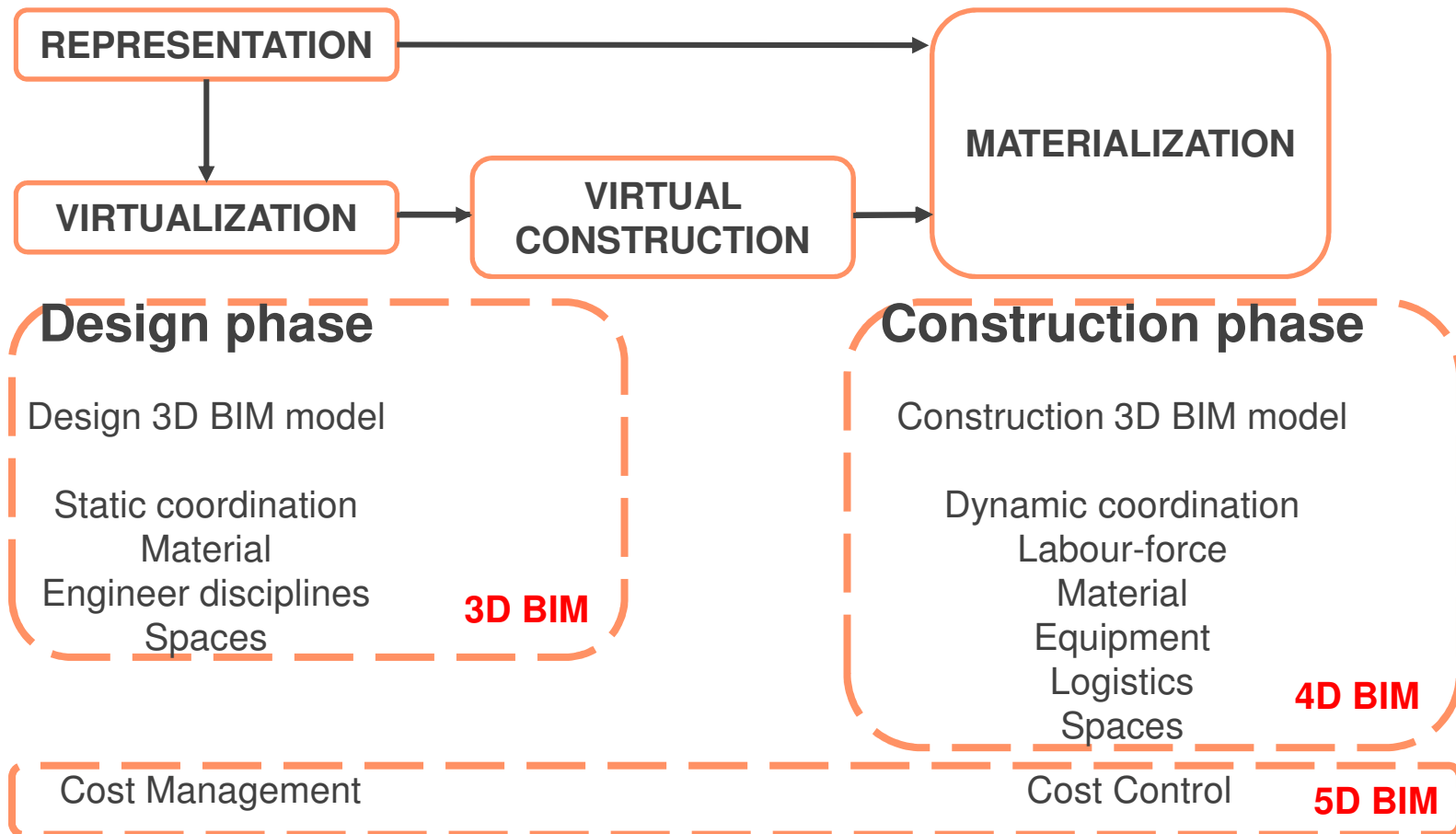


# BIM para Gestión de Construcción Herramientas BIM 2014

Construcción 4.0-CEEI-Castellón



BIM para Gestión de Construcción  
 Paper-Based vs. Model-Based (BIM / VDC)  
 Del 2D hacia el 5D (BIM / VDC)



# BIM para Gestión de Construcción

## Paper-Based vs. Model-Based (BIM / VDC)

### Del 2D hacia el 5D (BIM / VDC)

Construcción 4.0-CEEI-Castellón

Level of Development	LOD 000	LOD 050	LOD 100	LOD 200	LOD 300	LOD 350	LOD 400	LOD 450	LOD 500	LOD 550	LOD 600
Model Class	M000		M100	M200	M300		M400		M500		M600
<b>Model Requirements</b>	No Model		Building / Spatial /Room Massing	Buildings elements with approximate dimensions (SD)	Building elements with design dimensions (DD)		Construction Model (CD)		Fabrication /Virtual Mock-up		As built
Estimating Class	C000		C100	C200	C300		C400		C500		C600
<b>Estimating Requirements</b>			Average cost per m2	Average cost per element	Cost per unique element, activity level		Cost per unique element, resource level		Cost per unique element, resource level		Actual cost
Scheduling Class	S000		S100	S200	S300		S400		S500		S600
<b>Scheduling Requirements</b>			Milestone Schedule	Average production rate per element	Production rate per unique element/ Phase schedule based on resource hours estimates		Production rate for resource hours/ Phase schedule based on subcontract or production commitments		Production rate for resource hours/ Weekly workplans		Actual progressed schedule

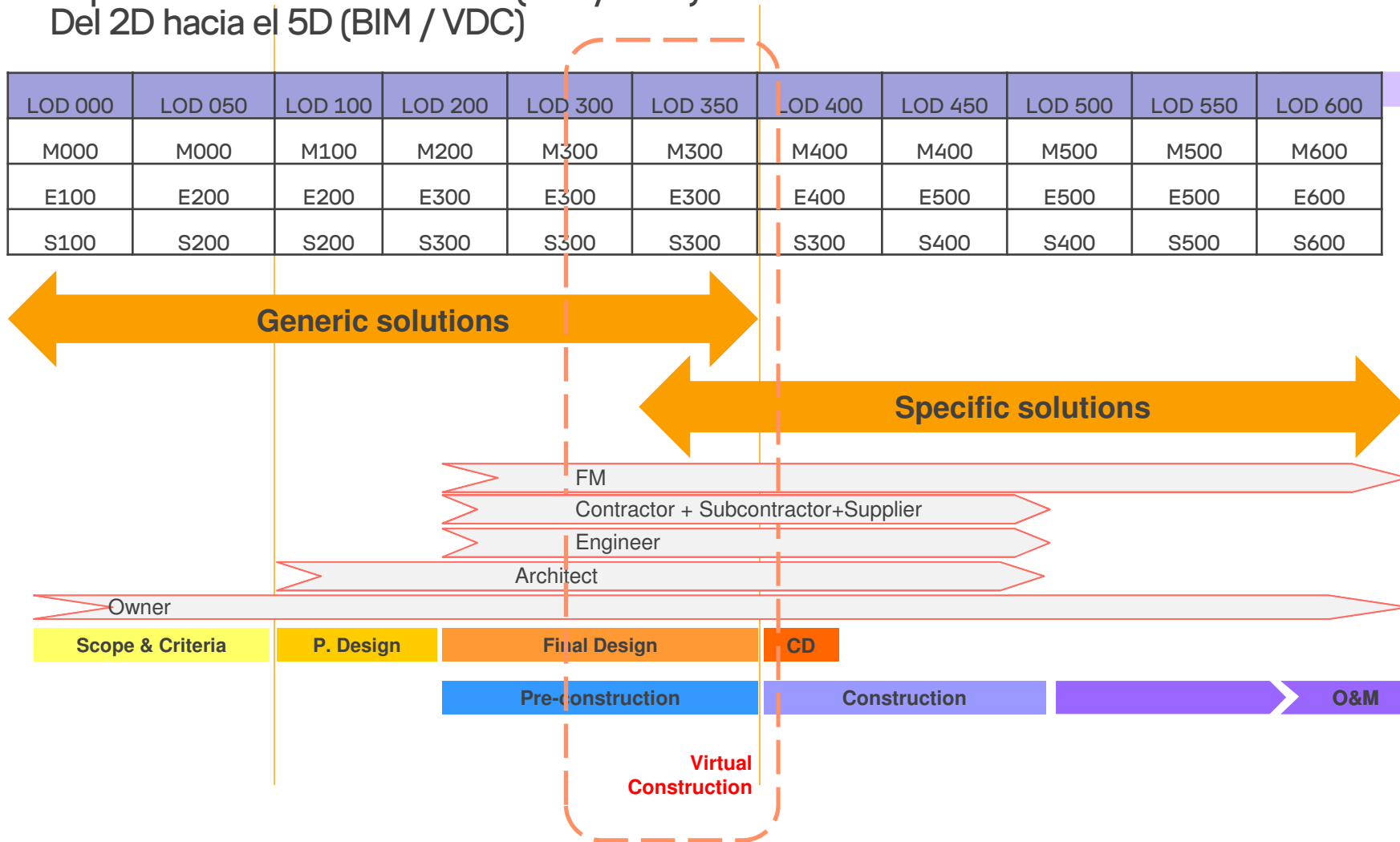
Source: VICO OFFICE

<http://www.vicosoftware.com/bim-execution-plan-vs-mps/tabid/299139/Default.aspx>

# BIM para Gestión de Construcción

## Paper-Based vs. Model-Based (BIM / VDC)

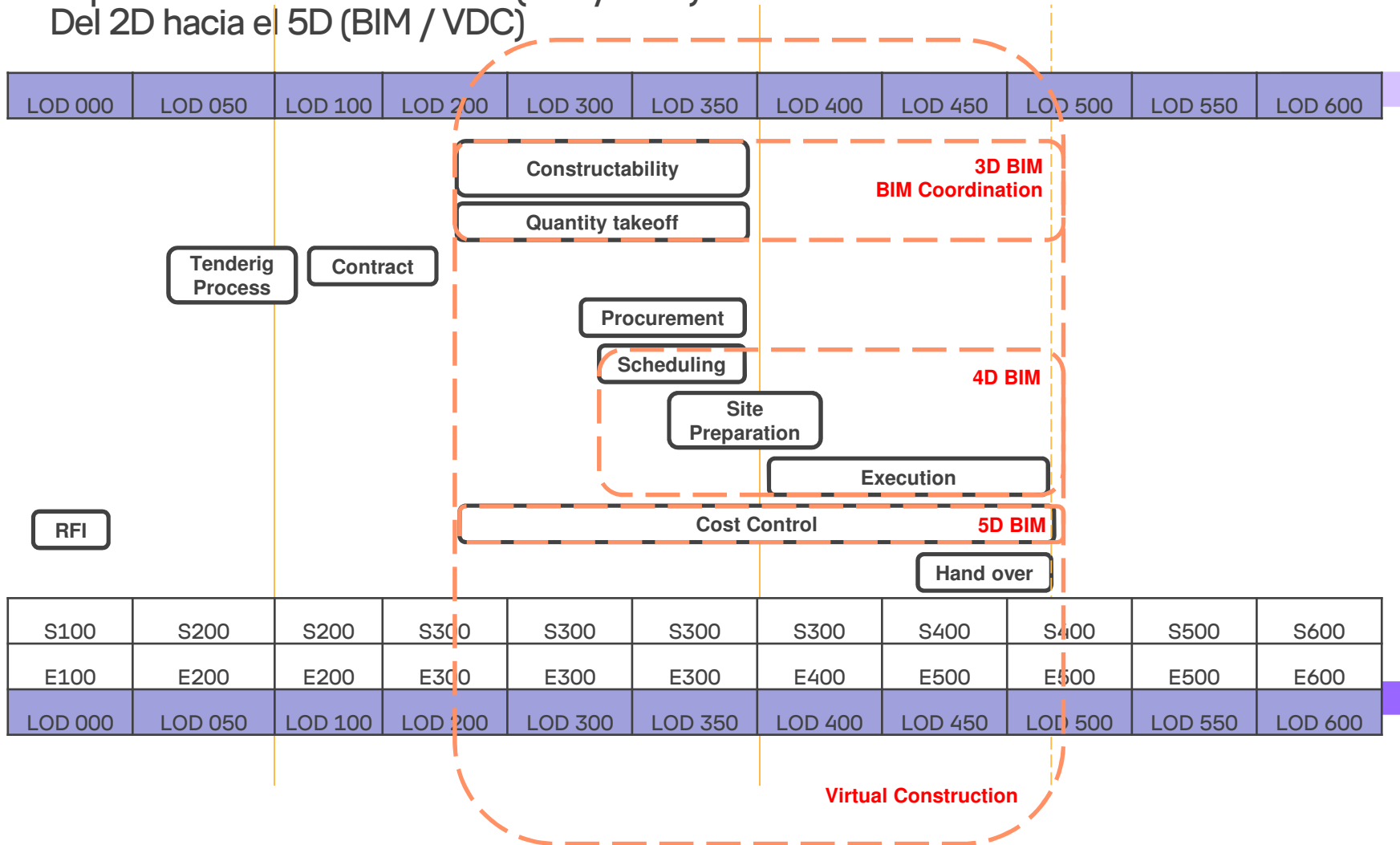
### Del 2D hacia el 5D (BIM / VDC)



# BIM para Gestión de Construcción

## Paper-Based vs. Model-Based (BIM / VDC)

### Del 2D hacia el 5D (BIM / VDC)

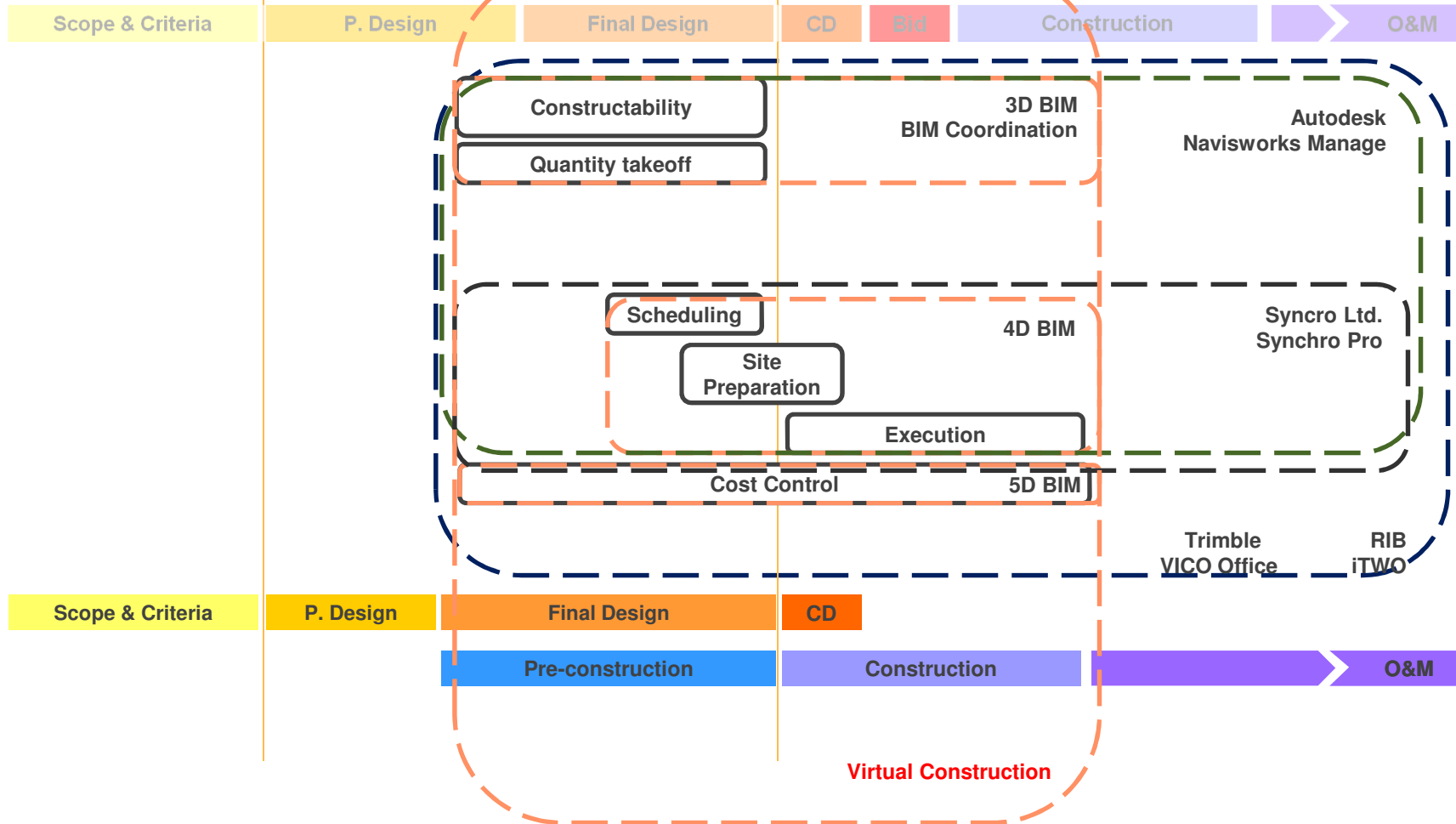


# BIM para Gestión de Construcción

## Del 2D hacia el 5D (BIM / VDC)

### Herramientas BIM para Virtual Construction (VC)

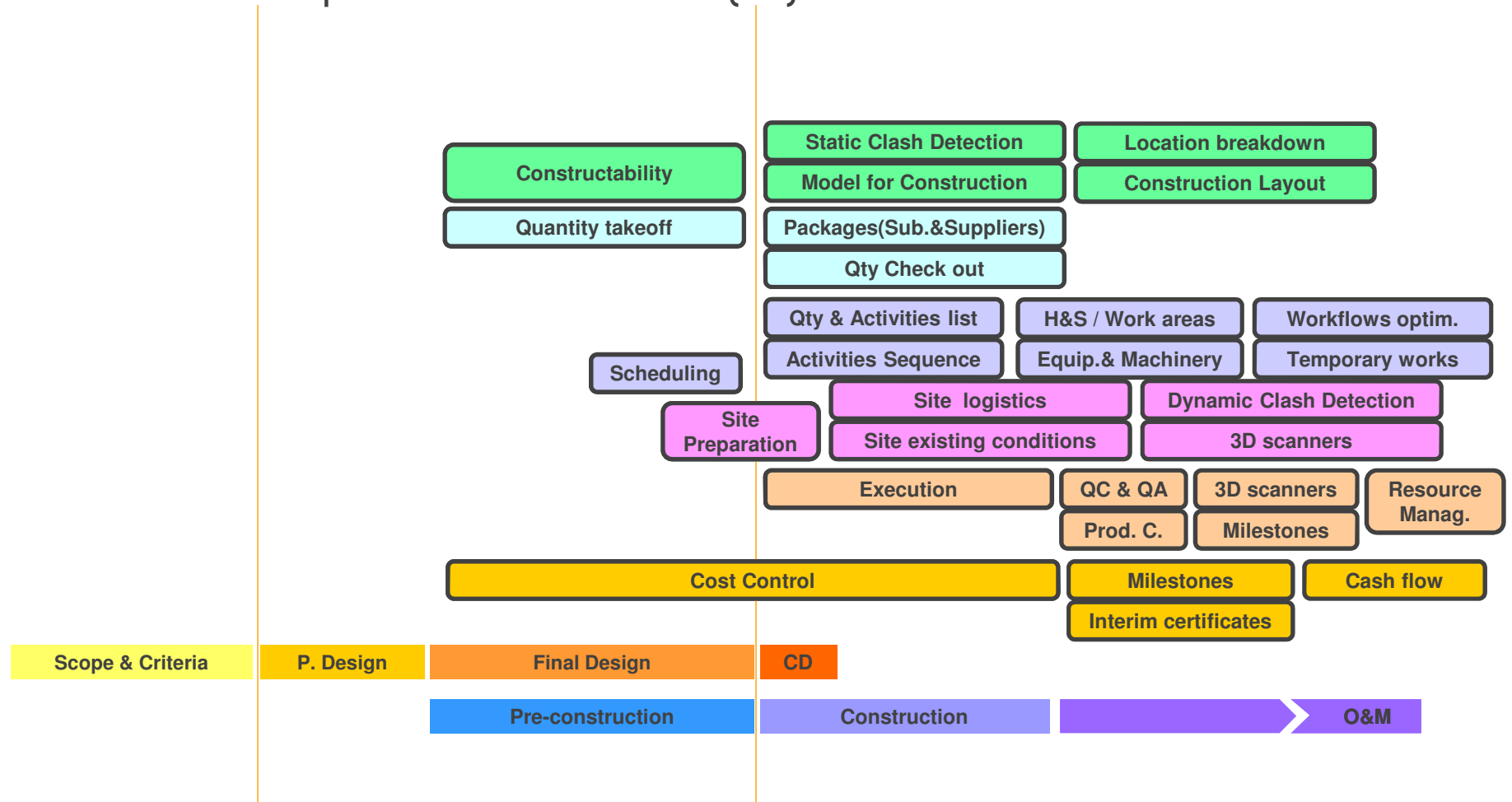
Construcción 4.0-CEEI-Castellón



# BIM para Gestión de Construcción

## Herramientas BIM para Virtual Construction (VC)

Construcción 4.0-CEEI-Castellón



LEGEND:

Coloured **Process/Subprocess** can be performed by the BIM tool

Non coloured **Process/Subprocess** cannot be performed by the BIM tool

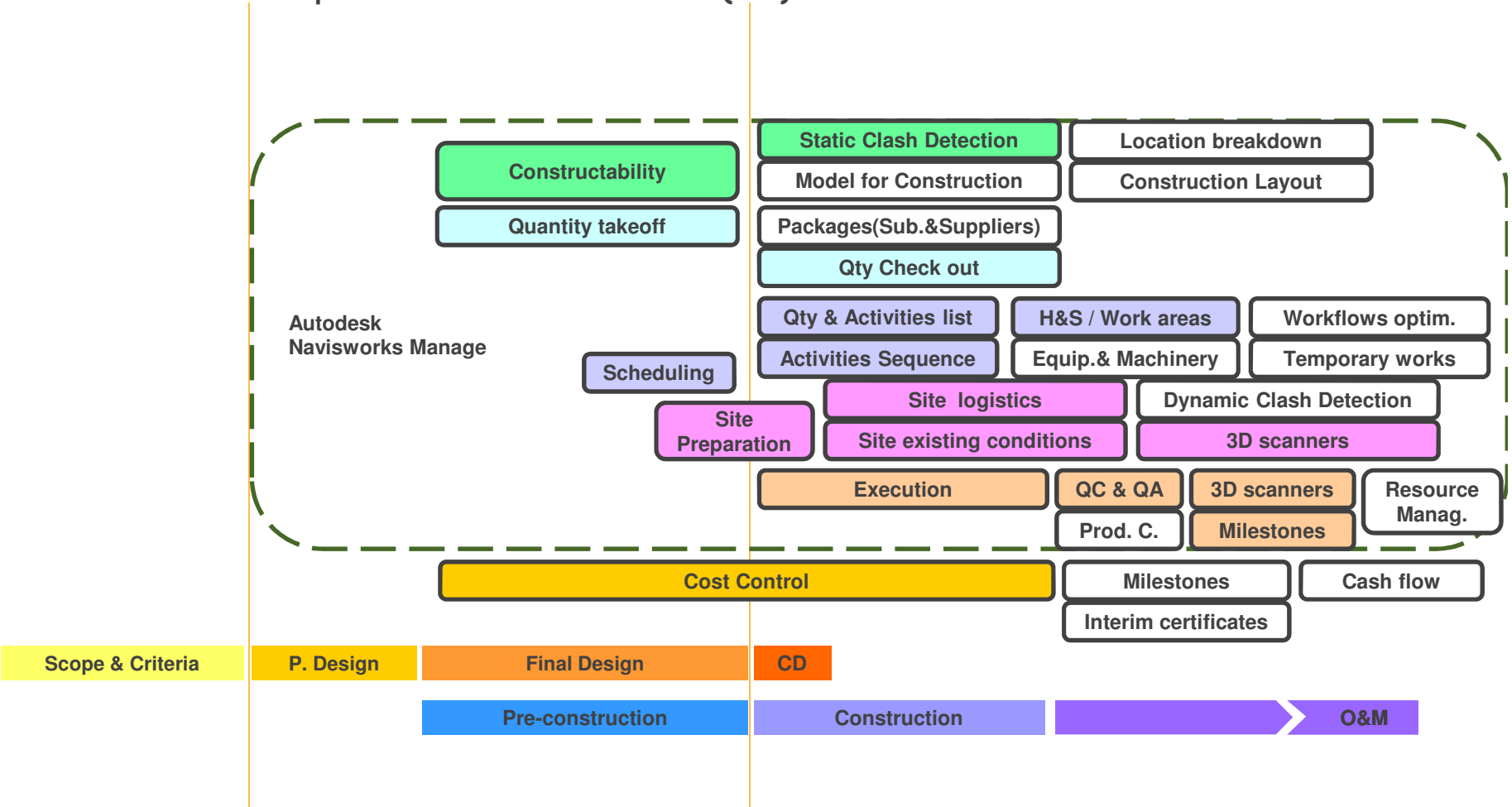
Source: Arnaldo Landivar Taborga

EDUBIM 2015, "Les journées del'enseignement de la Maquette Numérique et du BIM en France"



# BIM para Gestión de Construcción

## Herramientas BIM para Virtual Construction (VC)

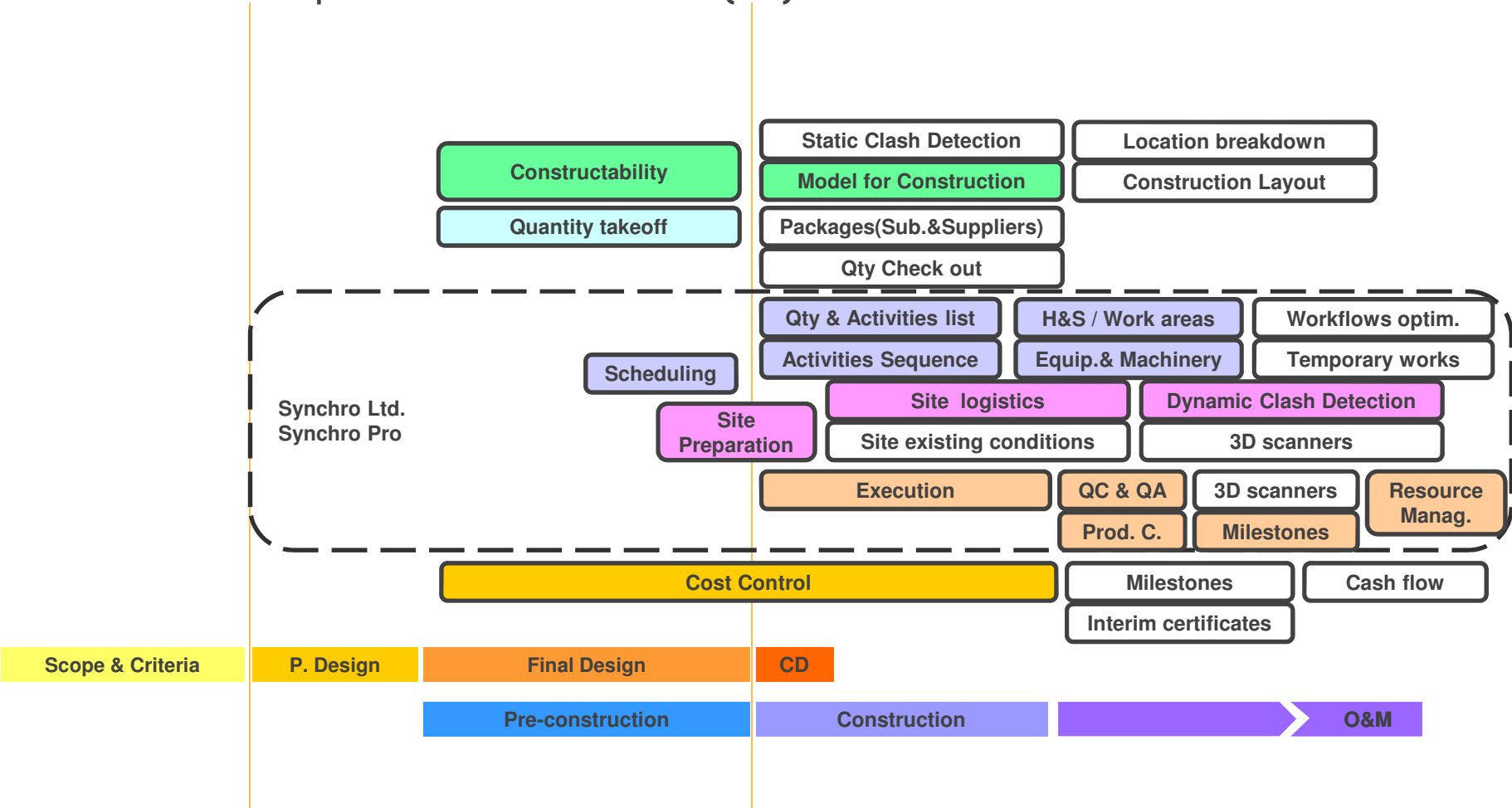


LEGEND:  
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Source: Arnaldo Landivar Taborga  
 EDUBIM 2015, "Les journées del'enseignement de la Maquette Numérique et du BIM en France"

# BIM para Gestión de Construcción

## Herramientas BIM para Virtual Construction (VC)



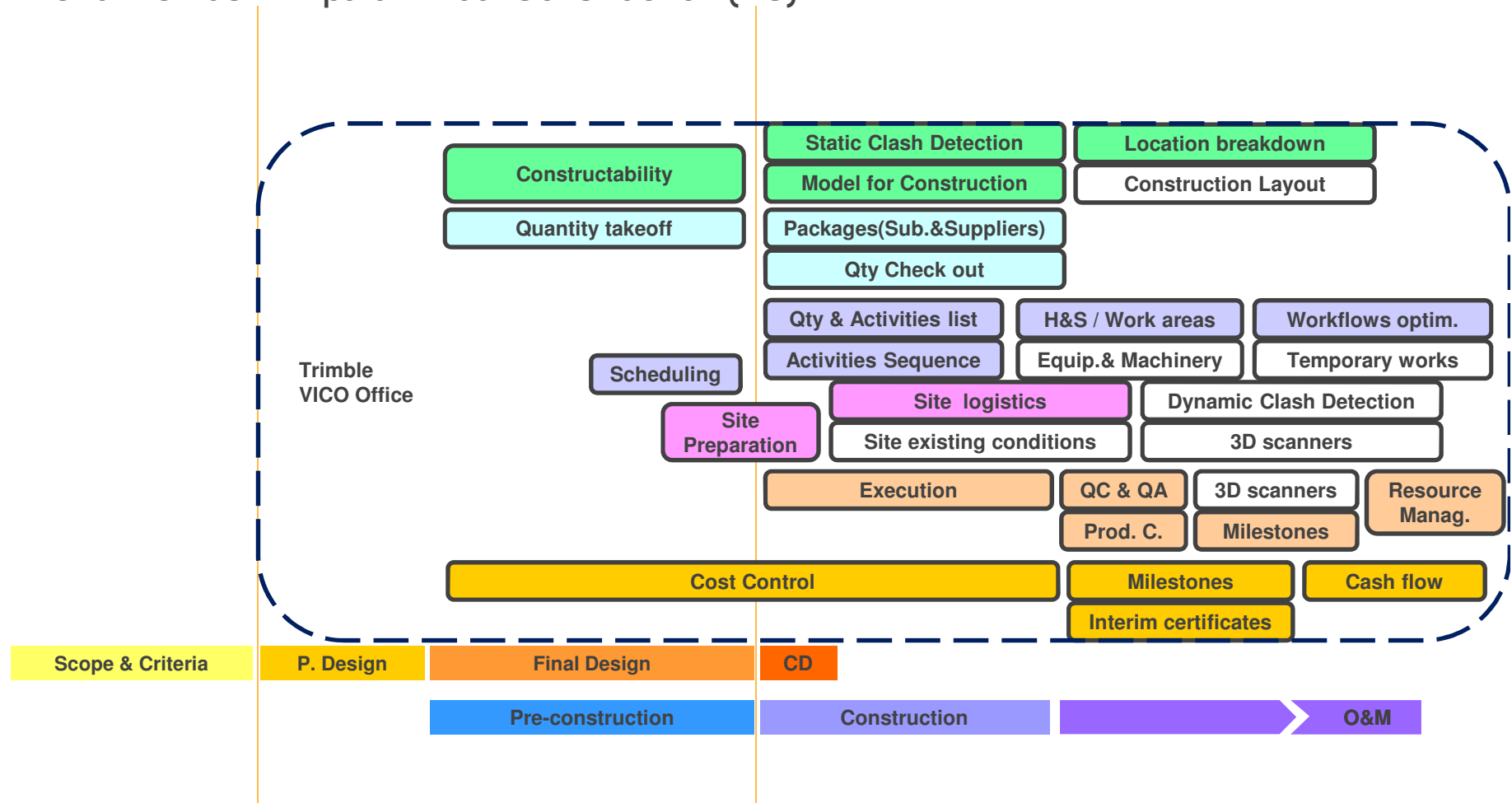
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# BIM para Gestión de Construcción

## Herramientas BIM para Virtual Construction (VC)

Construcción 4.0-CEEI-Castellón



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Source: Arnaldo Landivar Taborga

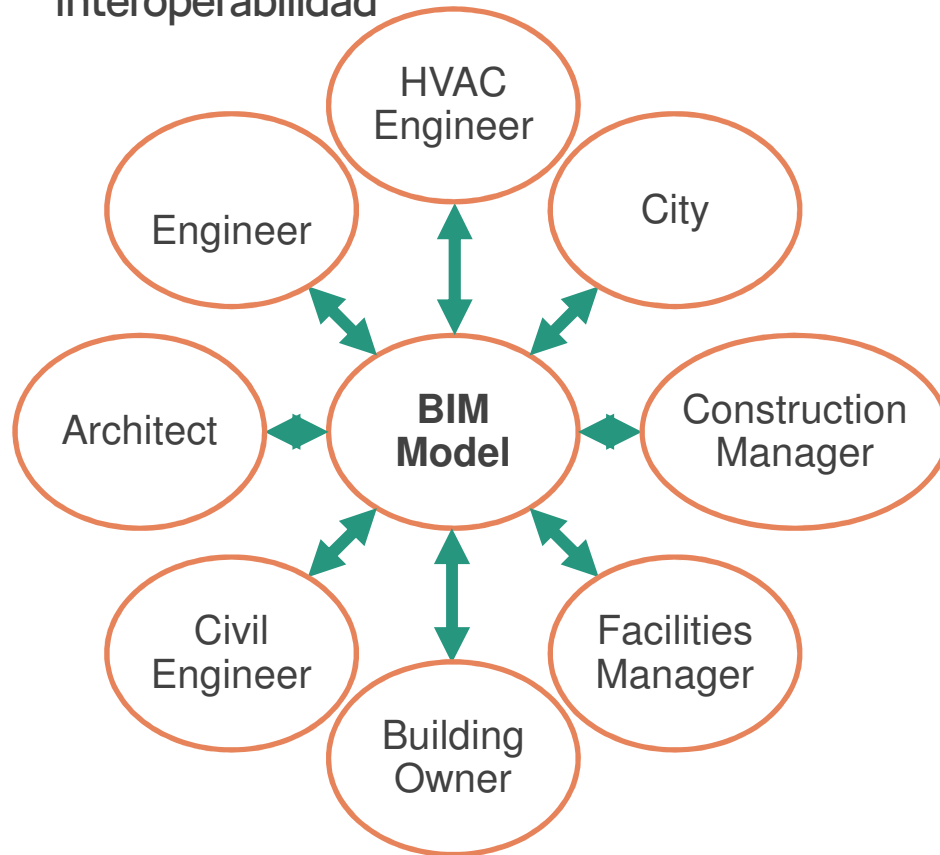
EDUBIM 2015, "Les journées del'enseignement de la Maquette Numérique et du BIM en France"

# BIM para Gestión de Construcción

## Herramientas BIM para Virtual Construction (VC)

### Interoperabilidad

Construcción 4.0-CEEI-Castellón

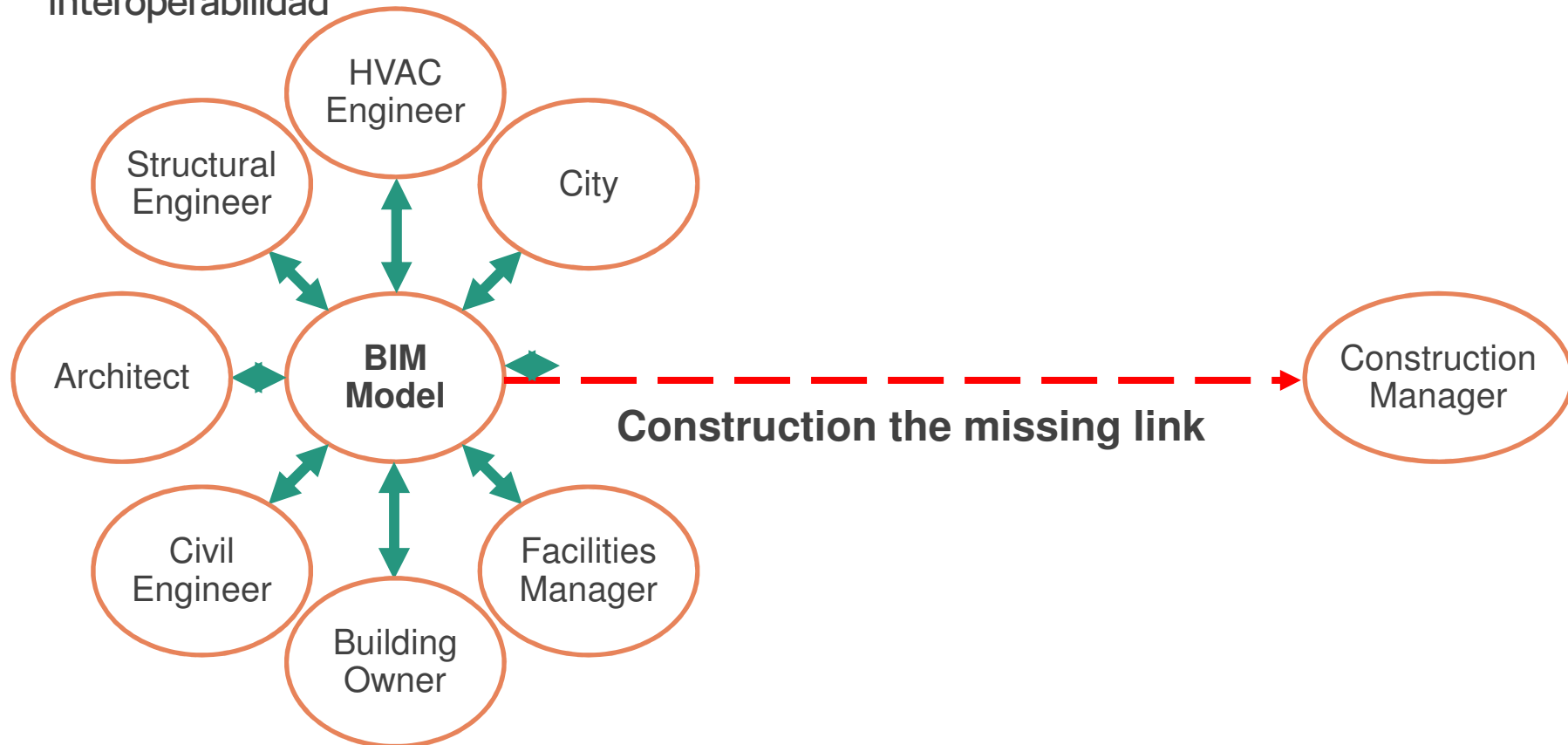


La capacidad de administrar y comunicar datos electrónicos de productos y proyectos entre empresas colaboradoras y dentro de los sistemas de diseño, construcción, mantenimiento y procesos de negocios de las empresas individuales

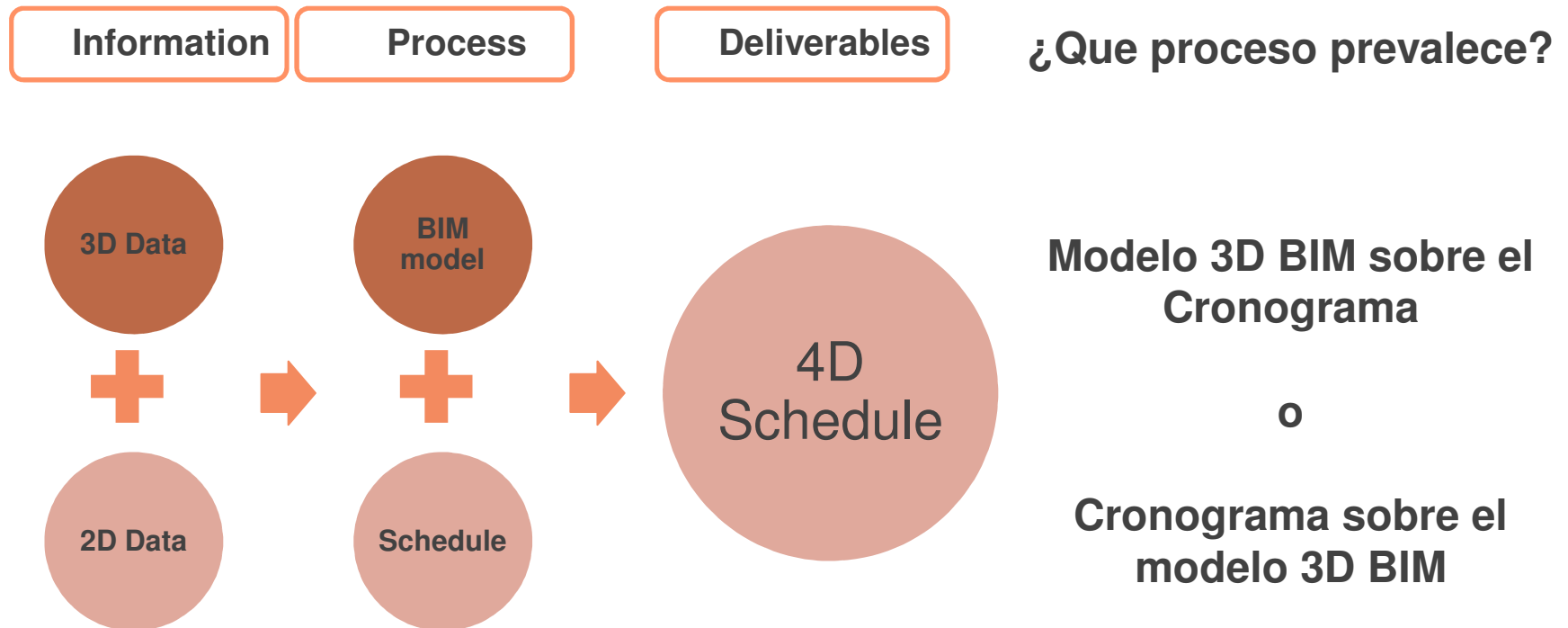
## Capabilities

CONCEPT		Navisworks Manage		VICO Office		Synchro Pro	
		Yes	No	Yes	No	Yes	No
Import Capabilities	BIM model and files format	X		X		X	
	Schedule tools and files formats	X			X	X	
	IFC	X		X		X	
Export Capabilities	BIM model and files format	X		X		X	
	IFC		X		X	X	
	Movie format	X			X	X	
	PDF* / PDF 3D**		X	X*		X**	
	Reduce file size	X		?	?	?	?
Bi-directional data exchange ***Only with P6		X		X		X***	

BIM para Gestión de Construcción  
Herramientas BIM para Virtual Construction (VC)  
Interoperabilidad



## ¿Qué significa programación 4D ?



## 4D Simulation vs. 4D Scheduling vs. 4D Visualiztion

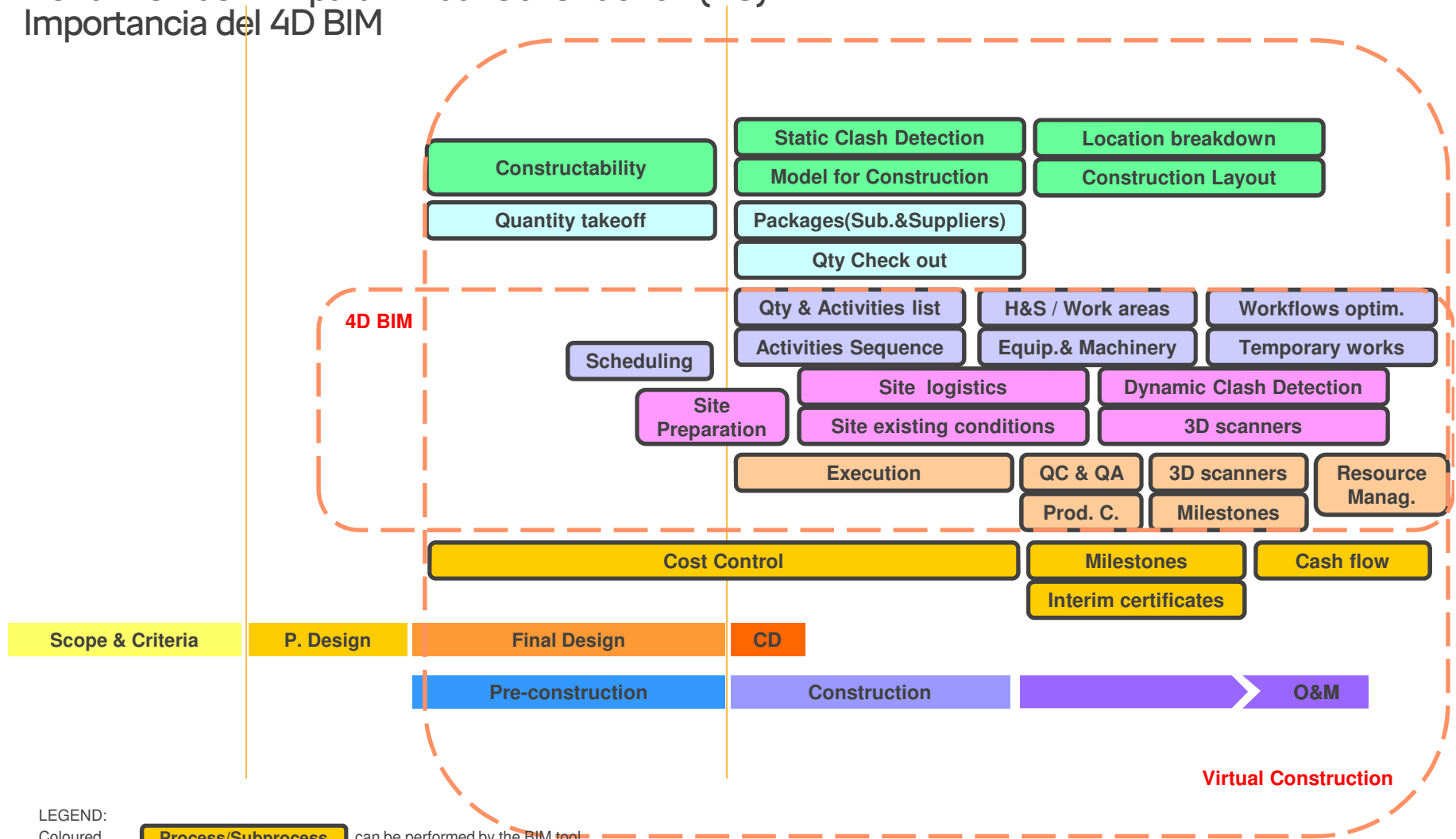
- 4D SIMULATION: Proporciona diferentes escenarios de secuencias de construcción animadas
- 4D SCHEDULING: Habilidad de realizar un cronograma y una secuencia de construcción animada asociada con un modelo 3D BIM
- 4D VISUALIZATION: Habilidad de realizar una secuencia de construcción animada del modelo 3D BIM



# BIM para Gestión de Construcción

## Herramientas BIM para Virtual Construction (VC)

### Importancia del 4D BIM



LEGEND:

Coloured **Process/Subprocess** can be performed by the BIM tool

Non coloured **Process/Subprocess** cannot be performed by the BIM tool

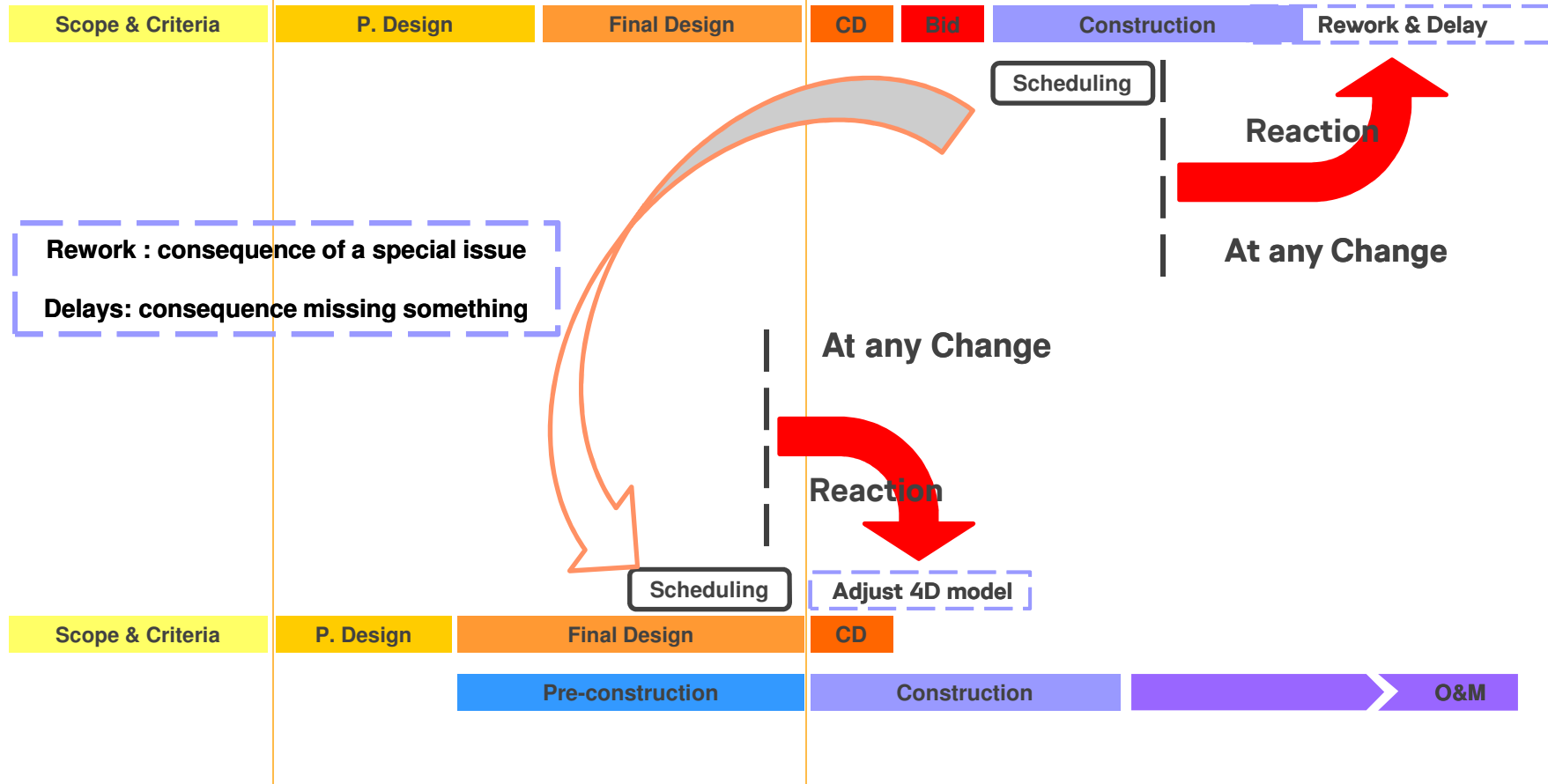
Source: Arnaldo Landivar Taborga

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# BIM para Gestión de Construcción

## Herramientas BIM para Virtual Construction (VC)

### Importancia del 4D BIM



## Capacidades Funcionales

CONCEPT	Navisworks Manage		VICO Office		Synchro Pro	
	Yes	No	Yes	No	Yes	No
4D Visualization	X		X		X	
4D Dynamic visualization	X			X	X	
4D Scheduling		X	X		X	
4D Dynamic scheduling		X		X	X	
3D Static Model coordination	X		X			X
3D Dynamic clash detection	Xcond.			X	X	
3D Equipment and Machinery Database	X			X	X	
3D Model edit tool		X		X	X	

## Tipos de Despilfarro en Construcción

Material Loss (**Perdida de material**):

1. (M1) Material waste | **Despilfarro de material**
2. (M2) Non-optimal use of material (Unnecessary amount used in the product)  
| **Nefasto uso de materiales (Cantidad innecesaria empleada en un producto)**
3. (M3) Non-optimal use of machinery, energy or labour (Unnecessary amount used in the production process) | **Nefasto uso de maquinaria, energía o M.O. (Cantidad innecesaria empleada en el proceso de producción)**

## Tipos de Despilfarro en Construcción

Time Loss | (Perdida de tiempo):

In the workflow | (En los flujos de trabajo)

1. (T1) Unnecessary movement (of people) | Movimientos innecesarios (M.O.)
2. (T2) Unnecessary work | (Trabajo innecesario)
3. (T3) Inefficient work | (Trabajo ineficiente)
4. (T4) Waiting | (Esperas)

## Tipos de Despilfarro en Construcción

Time Loss | (Perdida de tiempo):

In the product flow | (En los flujos de producción)

5. (T5) Space not being worked in | (Espacios no trabajados)
6. (T6) Materials not being processed | (Materiales no procesados)
7. (T7) Unnecessary transportation (of material) | Transporte innecesario (de material)

## Tipos de Despilfarro en Construcción Associated Builders and Contractors, Inc. USA

- Rework | **Rehacer tareas** (M1, T3)
- Request for Information | **Solicitud de Información**
- Change orders | **Cambio de ordenes**
- Inadequate Resources | **Recursos inadecuados** (M3)
- Inefficient workflow | **Flujo de trabajo ineficiente** (T3)
- Work around | **Vaguear** (T3)
- **Multiple handling of material | Manejo múltiple de materiales (T7)**

## Tipos de Despilfarro en Construcción Associated Builders and Contractors, Inc. USA

- Excess material | **Exceso de material** (M1)
- Waiting on supplies | **Esperando suministros** (T4)
- Waiting on another trade | **Esperando a un industrial** (T4)
- Safety losses | **Pérdida de seguridad**
- Improper sequencing of work | **Secuencia de trabajo inadecuada** (T3)



## Tipos de Despilfarro en Construcción

CONCEPT	3D CAPABILITIES			4D CAPABILITIES		
	Navisworks Manage	VICO Office	Synchro Pro	Navisworks Manage	VICO Office	Synchro Pro
Detect (D) Mitigate Impact (M)						
Request for Information	D M	D M	D M			
Change orders	D M	D M	D M			
Safety losses	D M	D M	D M			
Excess material (M1)		D M				
Rework (M1, T3)				D	D	D
Inadequate Resources (M3)					D M	D M
Inefficient workflow (T3)					D M	
Work around (T3)				D	D	D
Improper sequencing of work (T3)				D	D M	D M
Waiting on supplies (T4)				D	D M	D
Waiting on another trade (T4)				D	D M	D

# Construcción 4.0



## ¿Qué es Construcción 4.0 ?

Automation and data exchange in manufacturing technologies |

Automatización e intercambio de datos en tecnologías de fabricación

Cyber-physical systems | Sistemas ciberfísicos

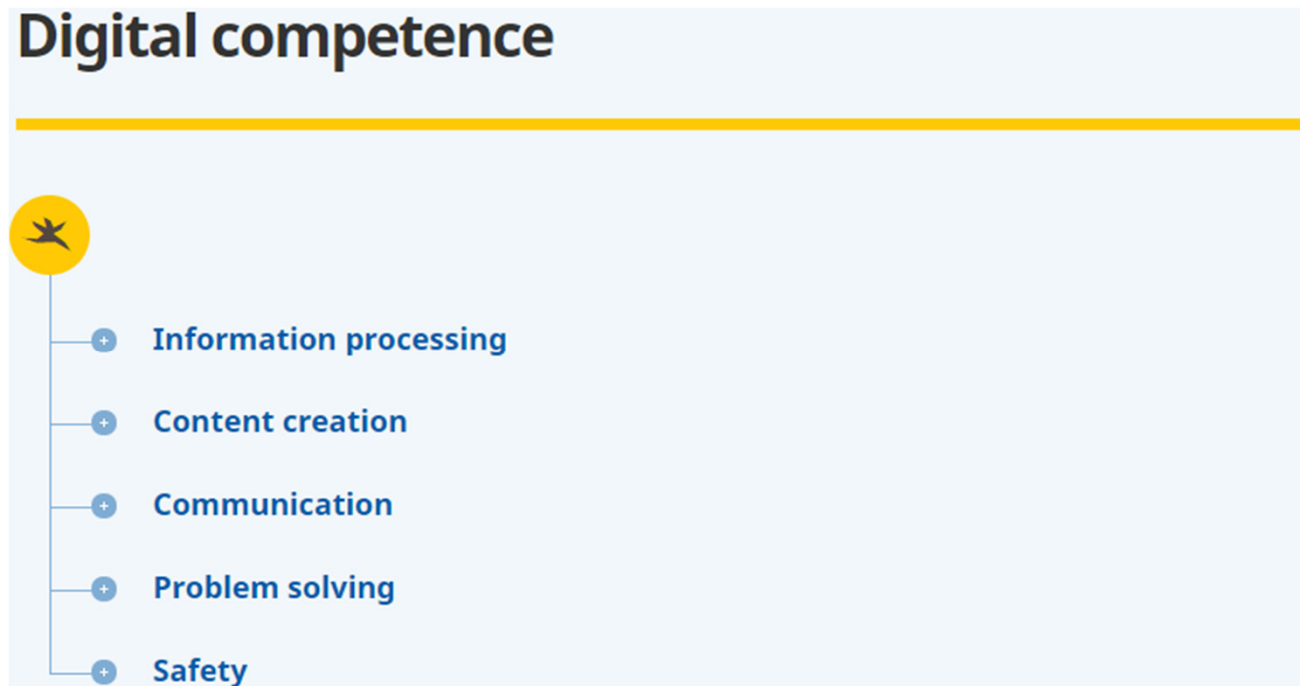
The Internet of things | El Internet de las cosas

Cloud computing | Computación en la nube

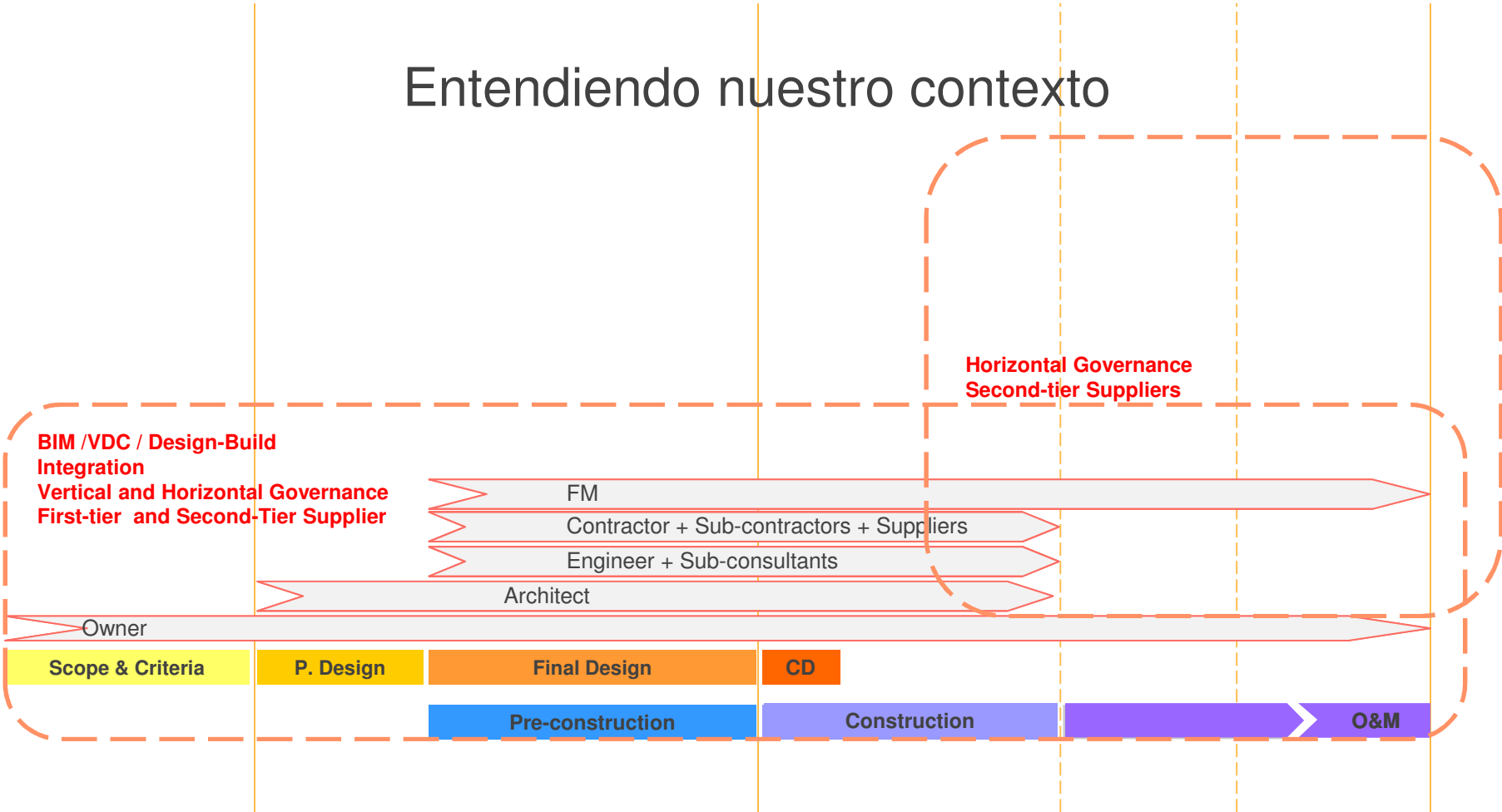
Cognitive computing | Computación cognitiva

## ¿Que es Construcción 4.0 ?

Es la transformación digital más allá de BIM

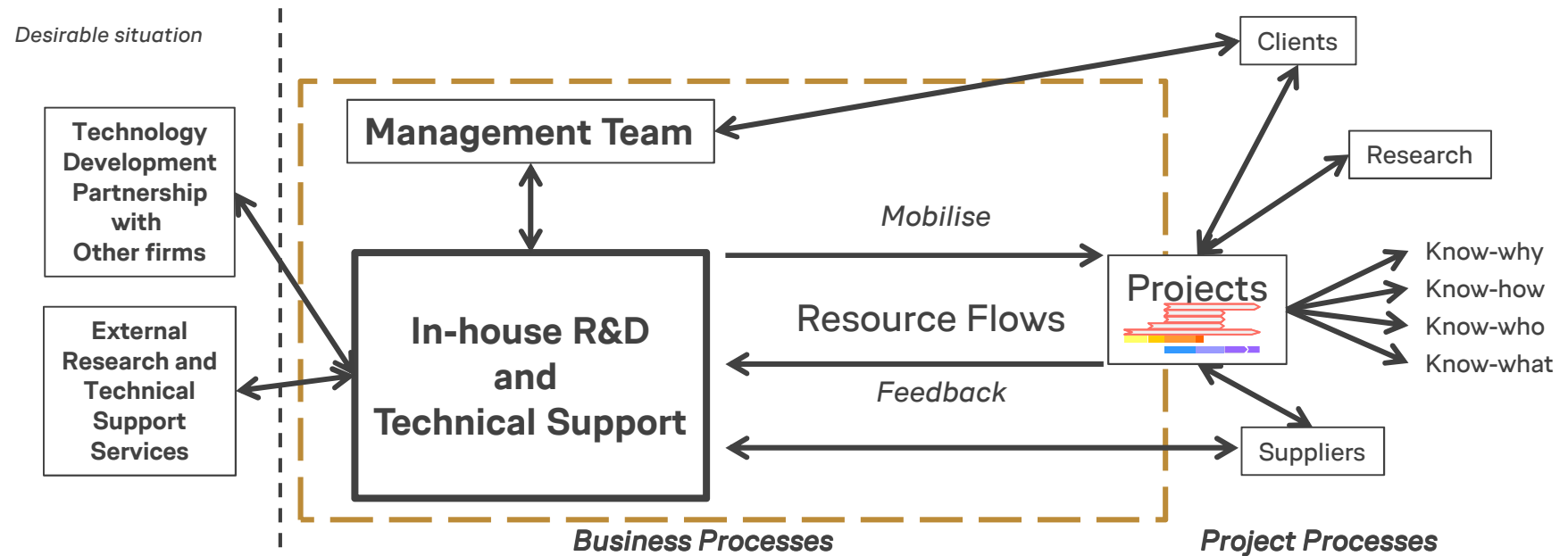


# Entendiendo nuestro contexto



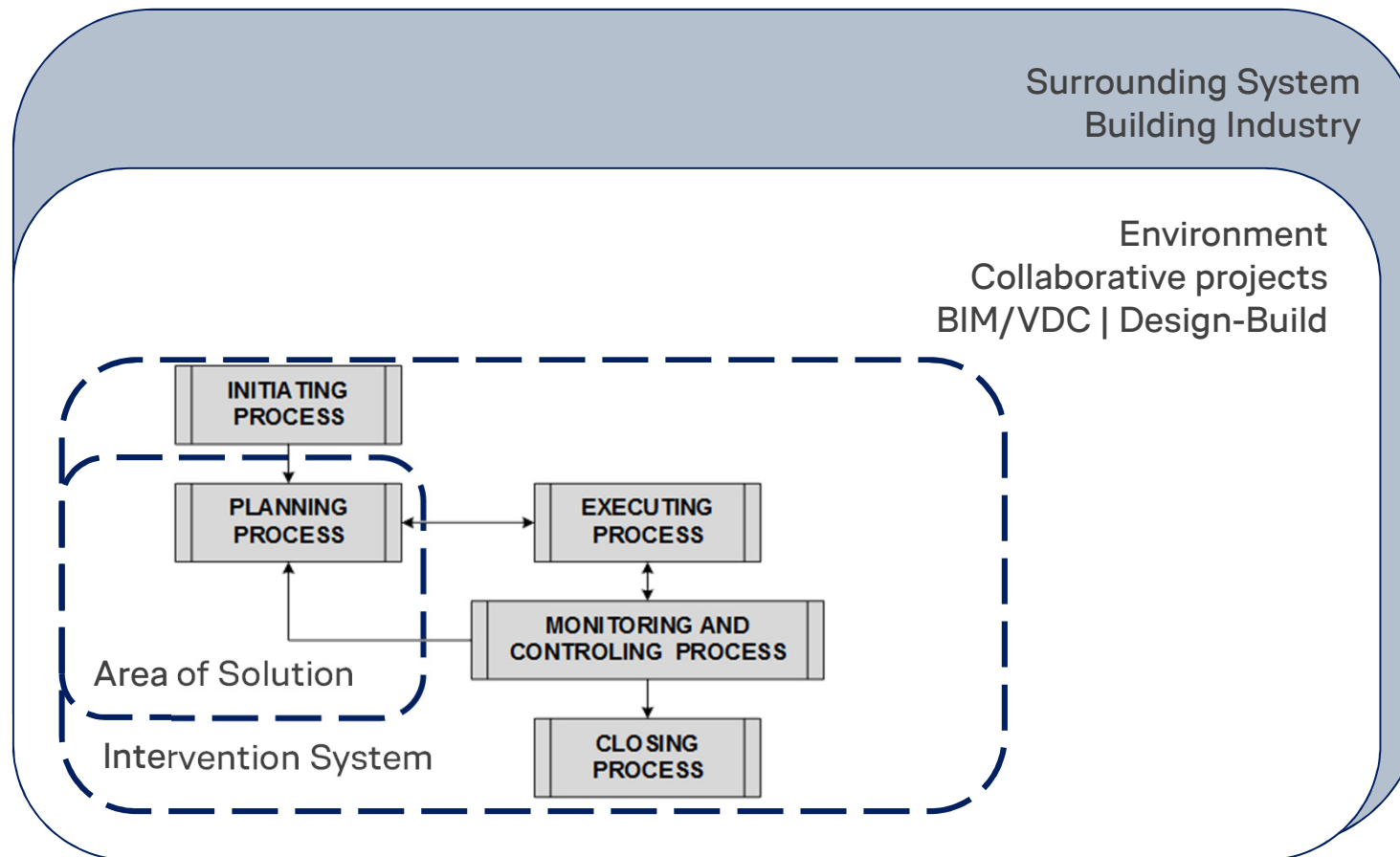
Source: Arnaldo Landivar Taborga | adapted from Winch, 2010  
Managing Construction Projects

## Entendiendo nuestro contexto



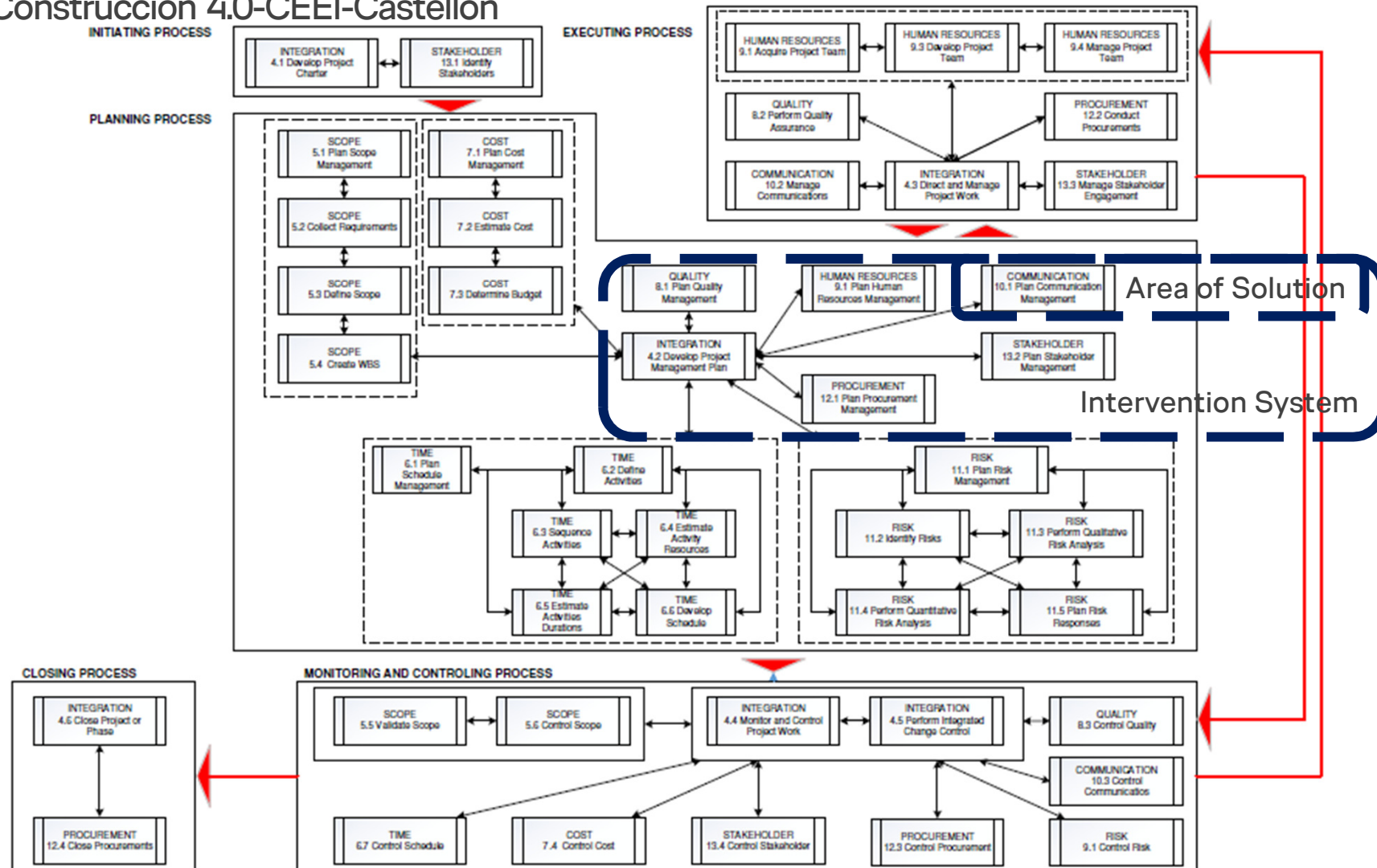
Captura de Valor  
Captura de Conocimiento

## Demarcando nuestra área de actuación



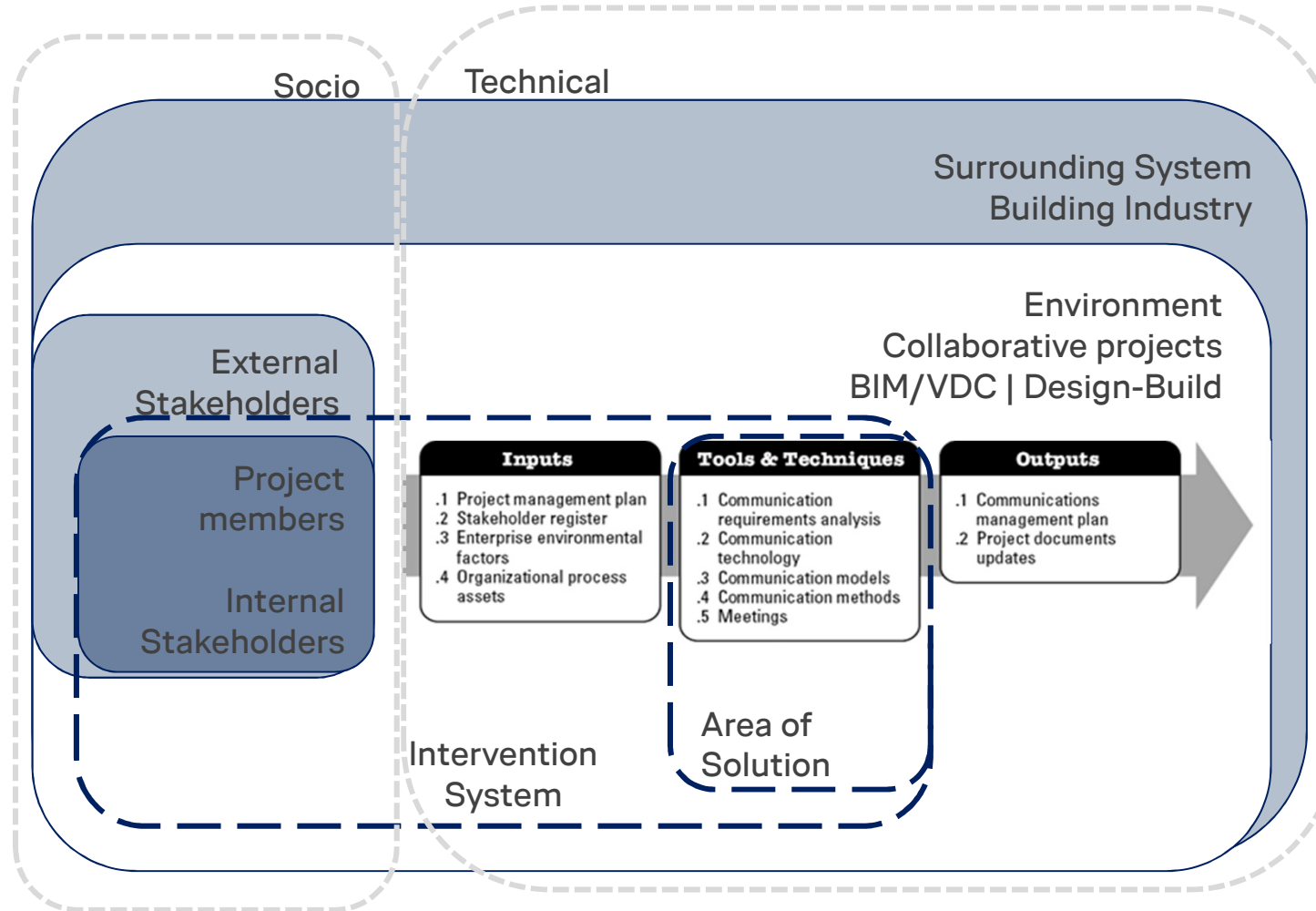
# Implementación Digital + BIM Construcción 4.0-CEEI-Castellón

Construcción 4.0-CEEI-Castellón

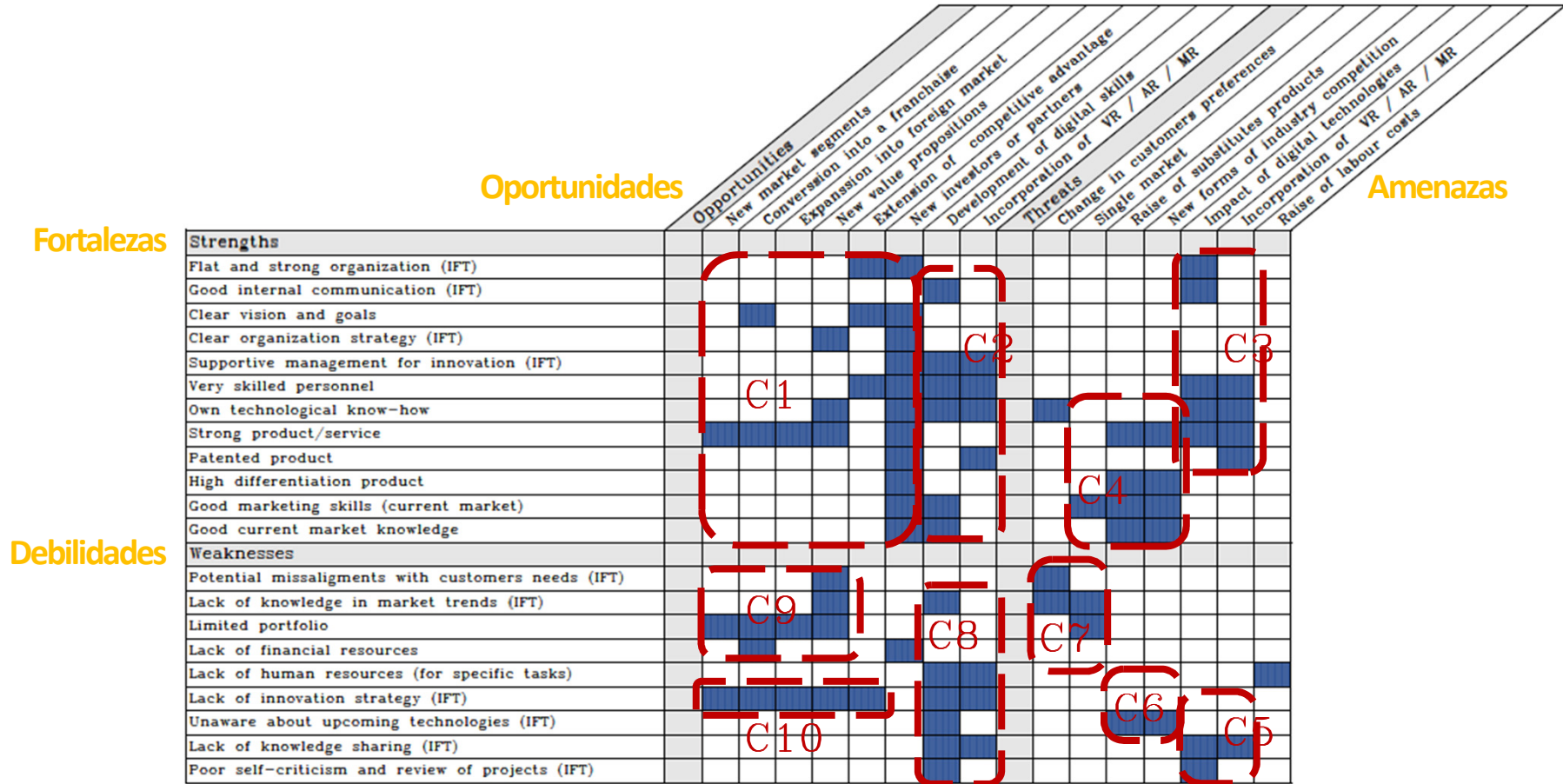




## Demarcando nuestra área de actuación

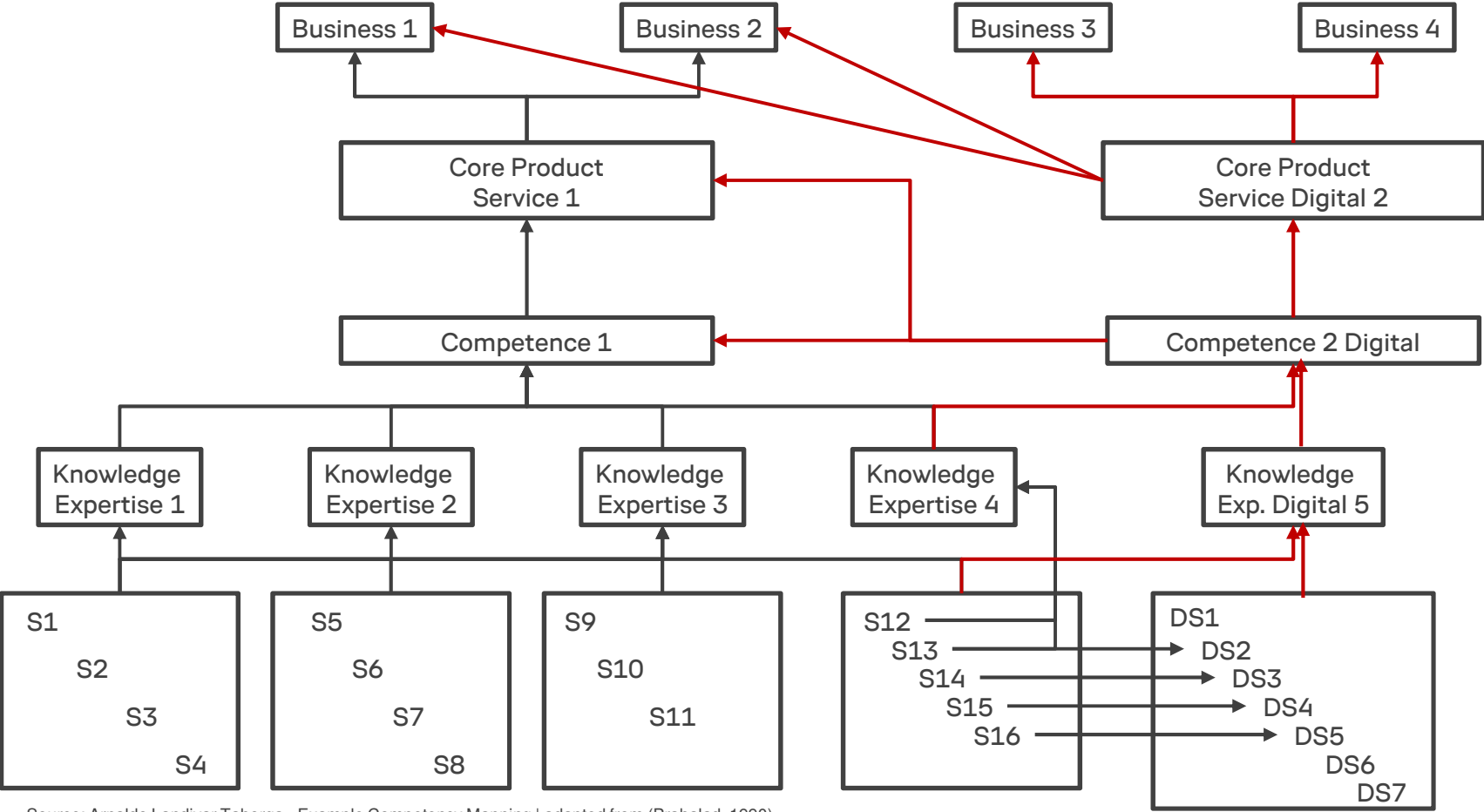


# Análisis SWOT | (DAFO)

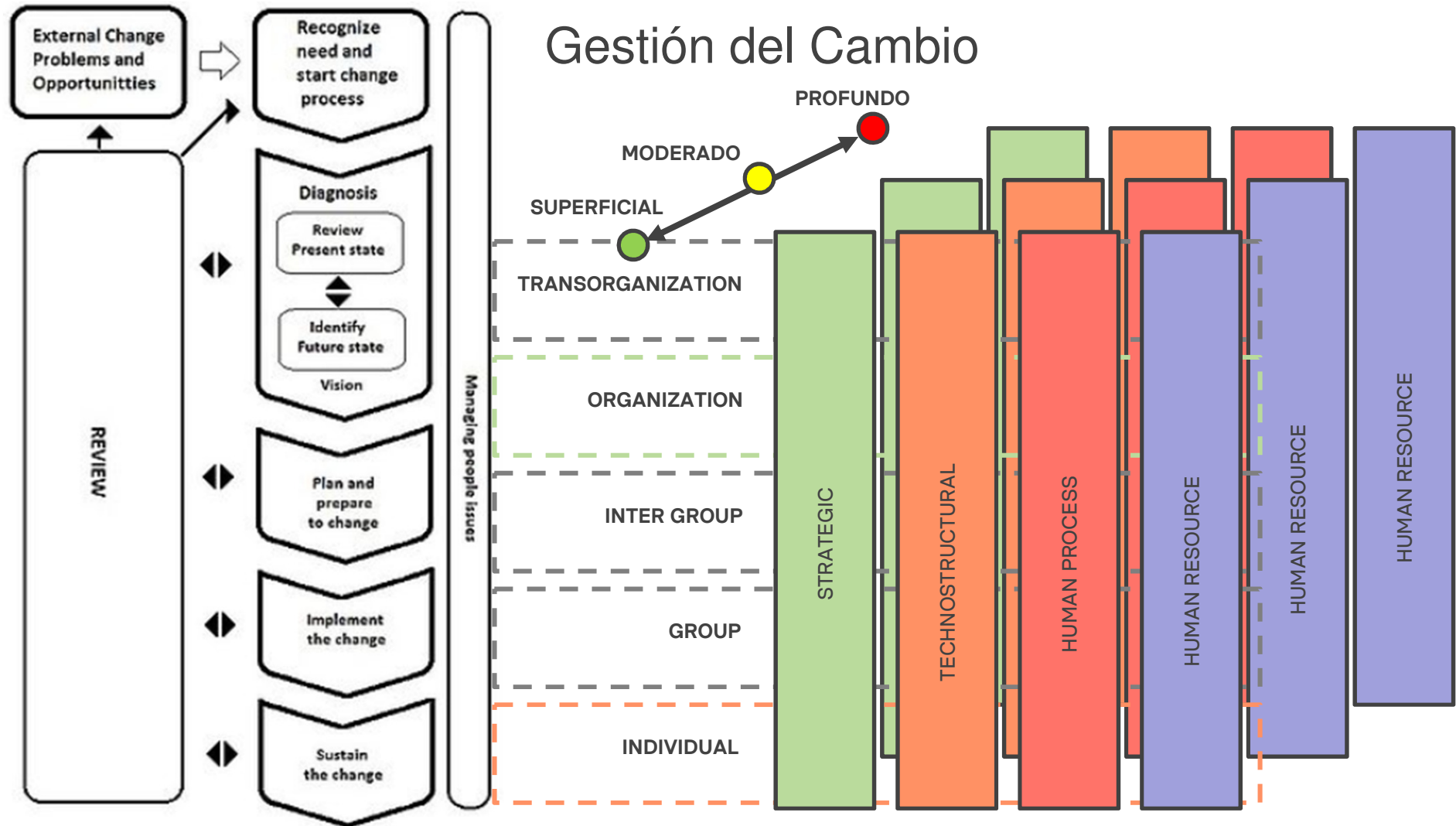


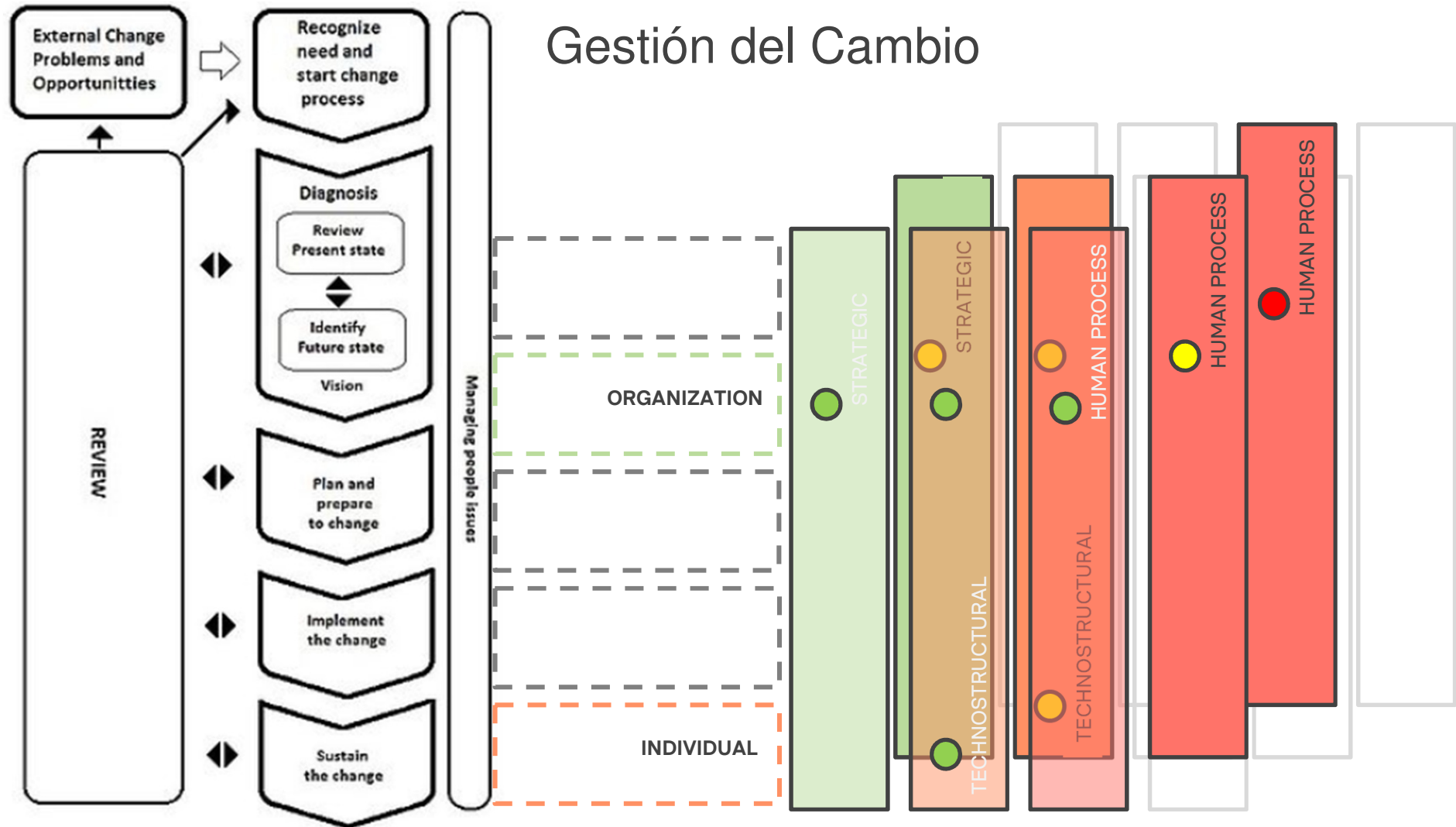
Source: Arnaldo Landivar Taborga - Example SWOT Analysis with action areas | adapted from (Zust, 2006)  
 No More Muddling Through: Mastering Complex Projects in Engineering and Management

# Árbol de competencias



Source: Arnaldo Landivar Taborga - Example Competency Mapping | adapted from (Prahalad, 1990)  
The Core Competence of the Corporation



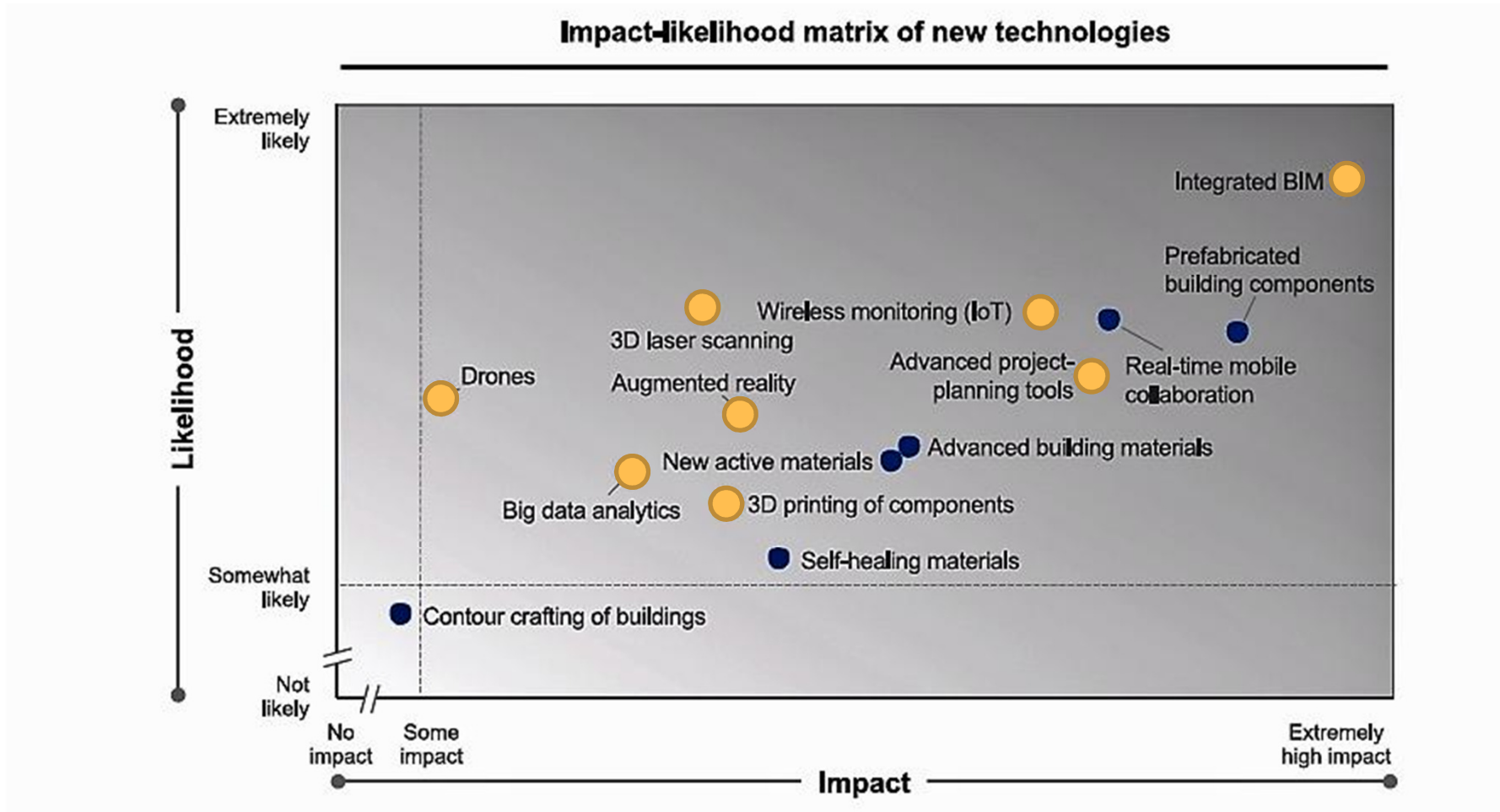


# Gestión de Construcción 4.0-CEEI-Castellón Más allá de las Herramientas BIM

Construcción 4.0-CEEI-Castellón







- Integrated BIM** | Autodesk 360 / Trimble solutions / RIB iTwo
- IoT** | Autodesk-Fusion Connect/ Trimble-IoT & Remote Monitoring / RIB AG-SAA
- 3D laser scanning** | Autodesk-Recap (Point cloud reader) / Trimble-TX6 and TX83D
- Augmented Reality** | Autodesk-Forge / Trimble and Synchro-(Microsoft HoloLens) / Trimble- (Daqri helmet)
- Big data analytics** | Autodesk-(Tableau) / Trimble-Manhattan Analytics / Synchro-Microsoft Power BI / RIB AG-(Wipro Ltd.)
- Drones** | Autodesk-(3DR) / Trimble-UX5 Drone
- 3D printing components** | Autodesk-Fusion 360 (creation of 3D models) / Trimble-(Materialise)

Source: World Economic Forum and

# Gestión de Construcción 4.0-CEEI-Castellón

## Productividad en la Construcción

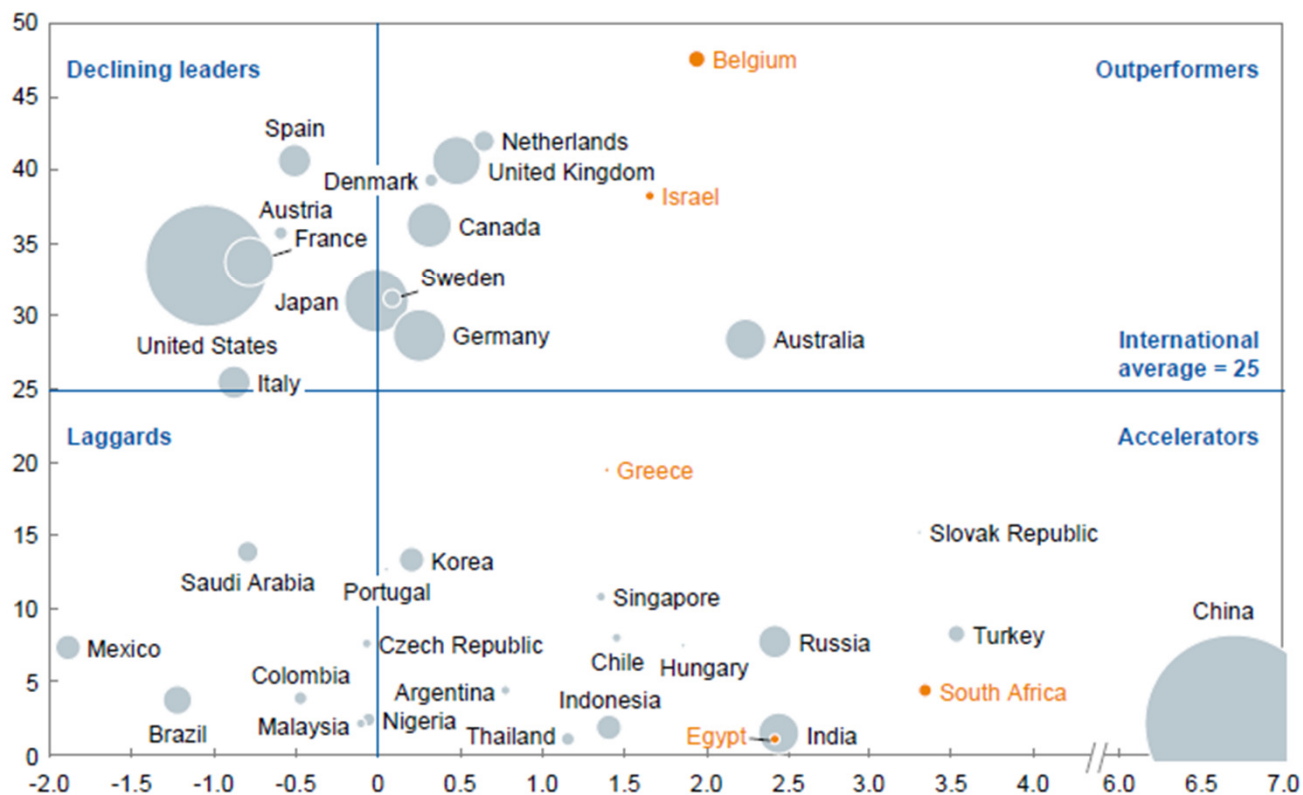
A small number of countries have achieved healthy productivity levels and growth rates

- Sector productivity growth lags behind total economy
- Sector productivity growth exceeds total economy

Size indicates total country construction investment, 2015 \$ billion

Construction labor productivity, 2015<sup>1</sup>

2005 \$ per hour worked by persons employed, not adjusted for purchasing power parity<sup>2</sup>

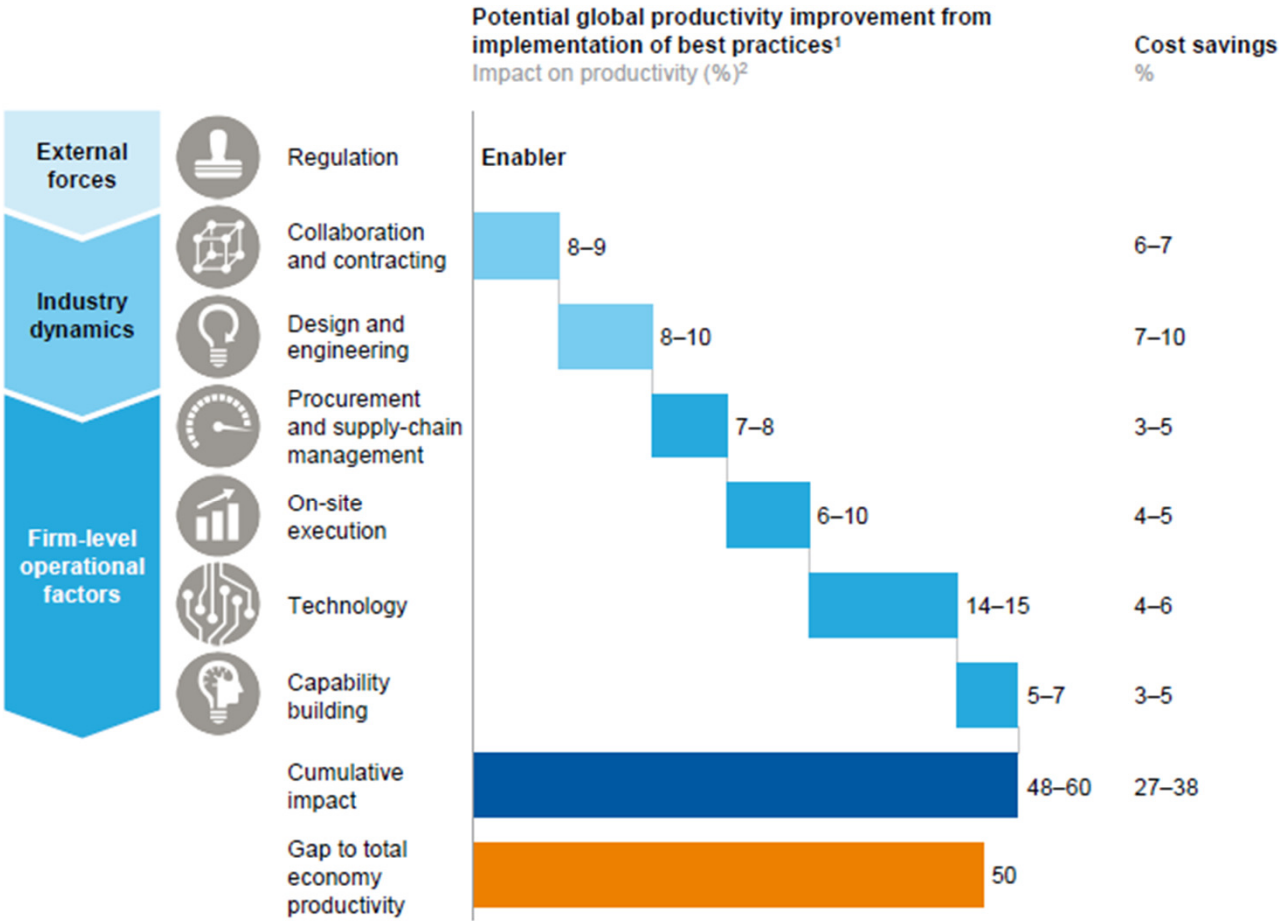


Source: McKinsey, 2017  
Reinventing Construction : a Route to Higher Productivity



# Gestión de Construcción 4.0-CEEI-Castellón

## Productividad en la Construcción



1 The impact numbers have been scaled down from a best case project number to reflect current levels of adoption and applicability across projects, based on respondents to the MGI Construction Productivity Survey who responded "agree" or "strongly agree" to the questions around implementation of the solutions.  
 2 Range reflects expected difference in impact between emerging and developed markets.

# Gestión de Construcción 4.0-CEEI-Castellón

## Productividad en la Construcción

Construcción 4.0-CEEI-Castellón

### Design



**Digital design:** Assist with document control and integration as design progresses from sketches to construction documents

### Preconstruction



**Estimating:**  
Automate and improve the accuracy of bid estimates



**Construction relationship management:**  
Provide dashboard for business-development pipeline



**Market intelligence:**  
Gather and analyze information gathering from past projects and competitor performance



**Marketplace:**  
Create a platform for stakeholders to prequalify, evaluate, and select partners

### Construction

### Operations and management



**Work-order management**



**Remote monitoring of building systems**



**Predictive analytics for system management**



**Mid to small project management**

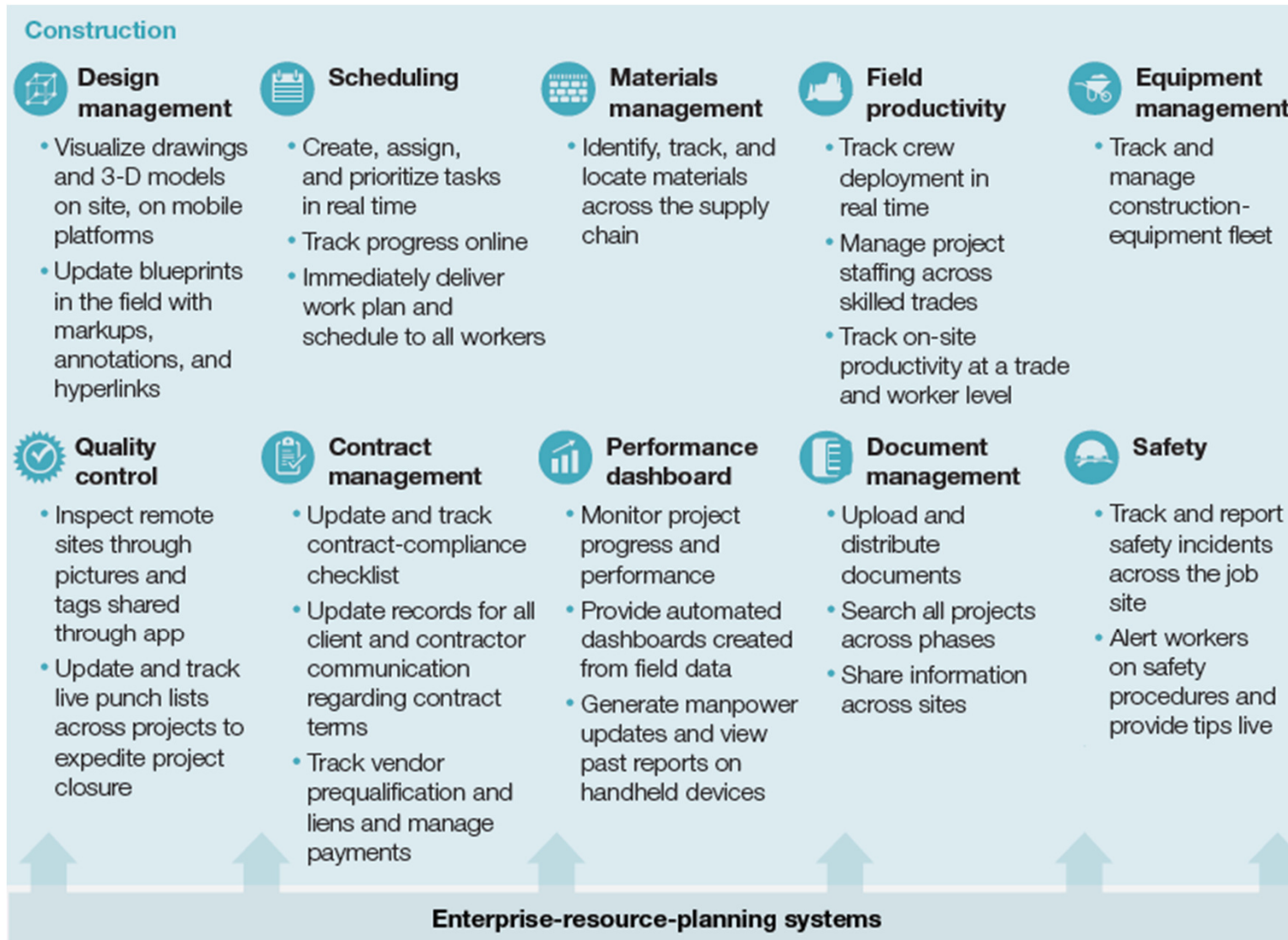


**Asset management with an ongoing record of facility performance and maintenance backlog**

# Gestión de Construcción 4.0-CEEI-Castellón

## Productividad en la Construcción

Construcción 4.0-CEEI-Castellón





Muchas

Gracias

Arnaldo Landivar Taborga