

Intelligent Manufacturing Systems

Global Research and Business Innovation Program



Outcomes of a
World Café on Industry 4.0 – subtopic simulation
during the World Manufacturing Forum in
Monterrey / Mexico on November 9th, 2017



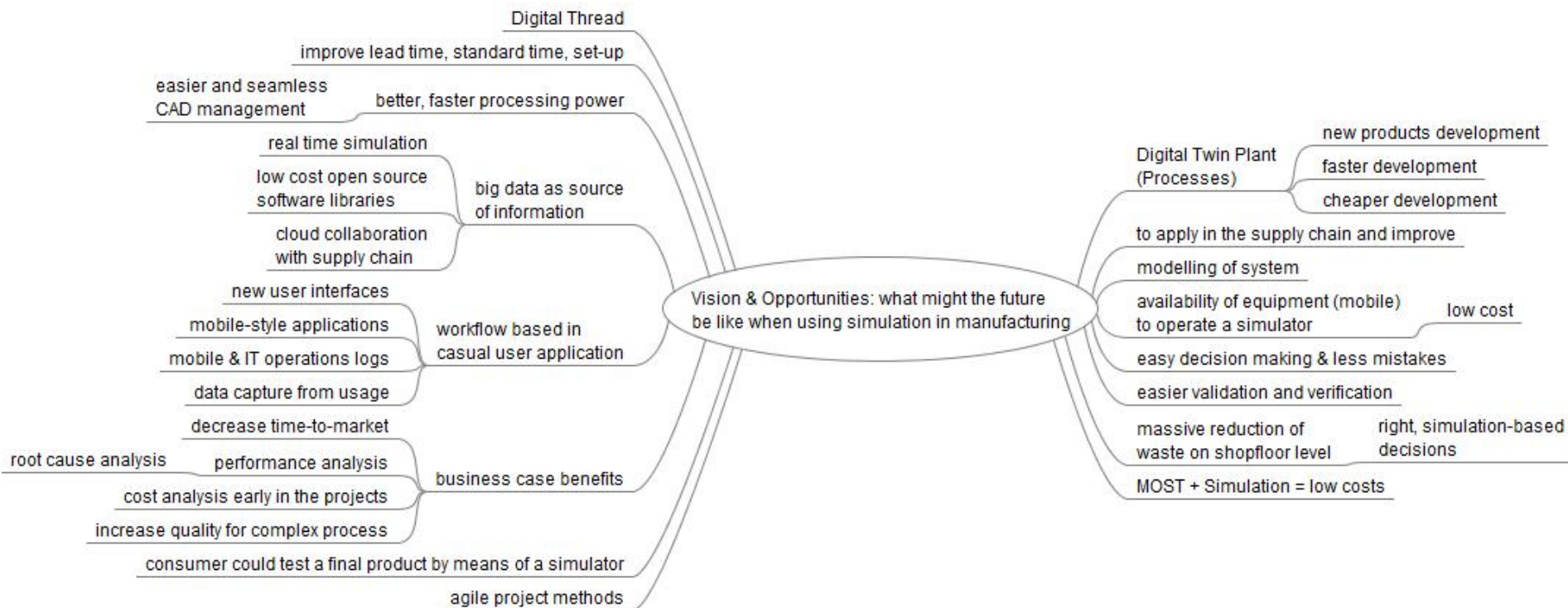


World Café on Industry 4.0 – subtopic simulation

- World Manufacturing Forum in Monterrey / Mexico
- November 9th, 2017
- subtopic: simulation
- answers from 10 manufacturing experts from all over the world
- core questions:
 - vision and opportunities:
„What might the future be like when using simulation in manufacturing?“
 - drivers:
„What are drivers that foster the use of simulation?“
 - obstacles and barriers:
„What are obstacles and barriers are preventing us from using simulation in manufacturing?“
- result 1: mind maps on 3 questions above
- result 2: answers assigned to 7 fields of influencing factors

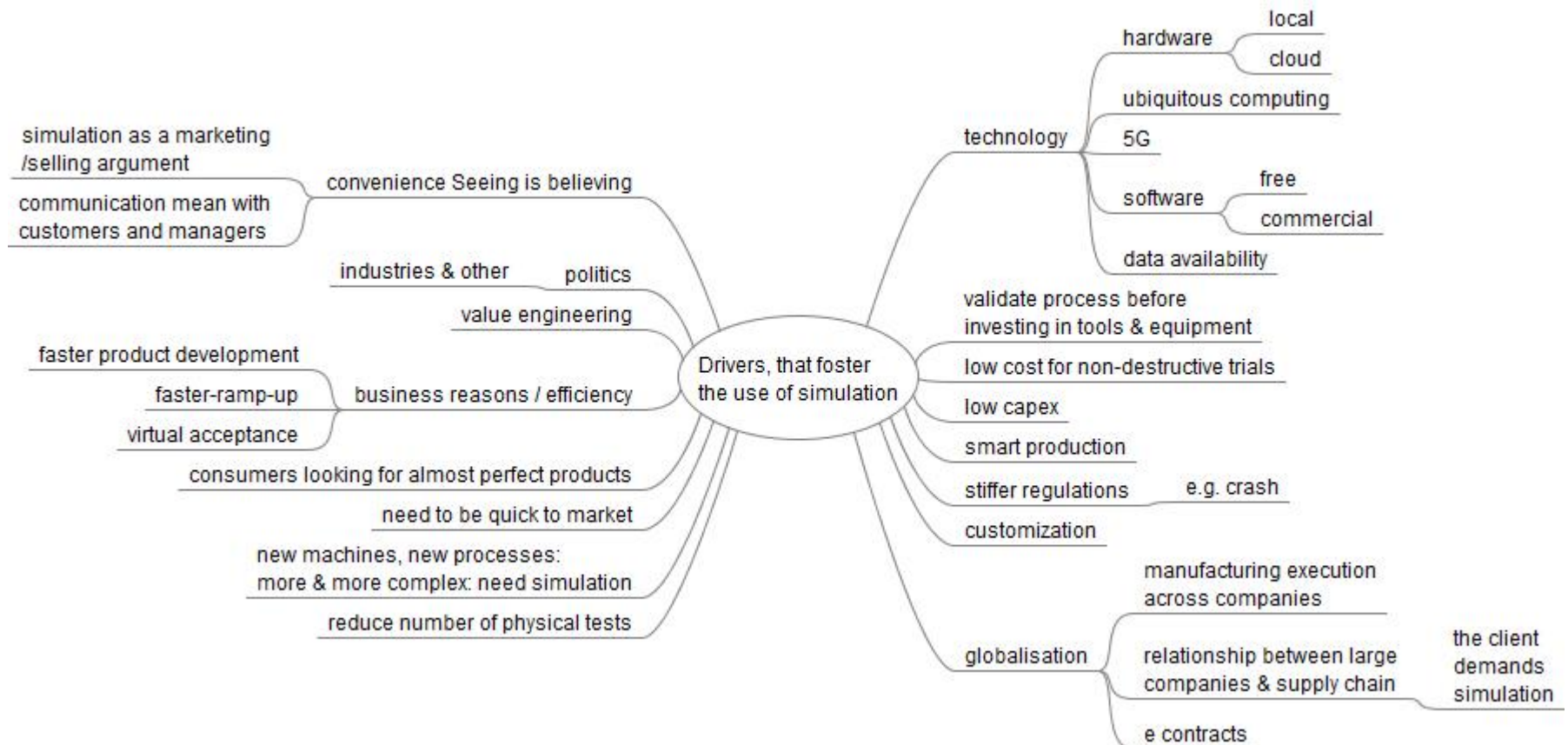
World Café on Industry 4.0 – subtopic simulation

- vision and opportunities: „What might the future be like when using simulation in manufacturing?“



World Café on Industry 4.0 – subtopic simulation

- drivers: „What are drivers that foster the use of simulation?“



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- obstacles and barriers: „*What are obstacles and barriers are preventing us from using simulation in manufacturing?*“



Simulation: market and business models as

Vision & Opportunities

- decrease time-to-market
- business case benefits due to
 - performance analysis: root cause analysis
 - cost analysis early in the projects
 - increased quality for complex processes
- cost analysis early in the projects
- consumer could test a final product by means of a simulator
- cheaper development due to digital twin plant
- massive reduction of waste on shopfloor level (through right, decision-based decisions)
- MOST + simulation = low costs

Drivers

- virtual acceptance
- need to be quick to market
- relationship between large companies & supply chain: the client demands simulation
- low cost for non-destructive trials
- low capex
- simulation as a marketing/selling argument

Obstacles & Barriers

- large amount of different simulators



Simulation: processes and working methods as

Vision & Opportunities

- digital thread
- improve lead time, standard time, set-up
- decrease time-to-market
- cloud collaboration with supply chain
- increased quality for complex processes
- agile project methods
- digital twin plant (processes) for
 - new products development
 - faster development
 - cheaper development
- to apply in the supply chain and improve it
- easy decision making and less mistakes
- easier validation and verification

Drivers

- faster product development (requires simulation)
- faster ramp-up (requires simulation)
- value engineering
- reduce number of physical tests
- validate processes before investing in tools & equipment
- smart production
- communication mean with customers and managers

Obstacles & Barriers

- large amount of different simulators

Simulation: technologies as

Vision & Opportunities

- easier and seamless CAD management through better/faster processing power
- real-time simulation
- low-cost open source software libraries
- new user interfaces
- mobile-style applications
- workflow based in casual user application
- modeling of system
- availability of equipment (mobile) to operate a simulator (at low cost)

Drivers

- new machines, new processes: more & more complex: need simulation
- hardware local & cloud
- ubiquitous computing
- 5G
- software free & commercial
- data availability

Obstacles & Barriers

- usually complex mathematics behind simulation (-> make it simple?); sometimes not existing -> need for new models
- non-mature technology (digital models)
- lack of interoperability
- sensors not developed for some operations
- not considering ergonomics



Simulation: data availability as

Vision & Opportunities

- big data as source of information
- mobile & IT operations logs
- data capture from usage

Drivers

- 5G
- ubiquitous computing

Obstacles & Barriers

- digital patrol / security of data
- data ownership
- costs and performance is confidential
- sensors not developed for some operations

Simulation: qualifications as

Vision & Opportunities

- easy decision making and less mistakes
- easier validation and verification

Drivers

- -

Obstacles & Barriers

- skills of simulation people: usually have no knowledge of manufacturing processes
- skills of designers [not sufficient]
- usually complex mathematics behind (-> make it simple?); sometimes not existing -> need for new models
- customers don't know how to operate simulation
- large amount of different simulators
- lack of students to support



Simulation: society as

Vision & Opportunity

- consumer could test a final product by means of a simulator
- massive reduction of waste on shop floor level (through right, decision-based decisions)

Driver

- consumers looking for almost perfect products
- customization
- globalization
- manufacturing execution across companies
- relationship between large companies & supply chain: the client demands simulation
- e-contracts
- convenience „seeing is believing“:
 - simulation as a marketing/selling argument
 - communication mean with customers and managers

Obstacle & Barrier

- lack of students to support



Simulation: laws and politics as

Vision & Opportunities

- -

Drivers

- politics will foster the use of simulation for industries and other sectors
- stiffer regulations, e.g. crash

Obstacles & Barriers

- missing standards
- regulations:
 - acceptance only with physical prototype
 - acceptance of training only with physical product



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Project ideas gathered for simulation in manufacturing

Project cluster 1:

1. to simulate the effect of a kiln upon sintering different ceramics compositions
2. to simulate the behavior of different advanced ceramic composites under high temperature and erosion conditions

Project cluster 2:

3. training cook book: process, methods and tools to implement simulations in a factory (including change management) & lessons learned
4. from physical real-time data to real-time simulation:
 - problem identification
 - experimental progress
 - parametric modeling
 - automatic set-up
 - automatic comparison
 - problem solving

Project cluster 3:

5. ontology-based simulation modeling (e.g. machining center + robot + AGV) -> then...
6. simulation standardization
 - shared validation data
 - shared best practices
7. manufacturing processes simulation toolbox, covering most used conventional processes

Project cluster 4:

8. open source solution for
 - factory layout
 - overall simulation
 - integration with models
 - digital twin integration
 - VR
9. design of ergonomic motor to work evaluation
10. standardization & best practices of user interfaces
11. interactive, real-time simulations with VR and AR
12. collaborative, remote working environment for simulation
13. the augmented operator, supported by simulation