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Département de management et technologie
École des sciences de la gestion
Université du Québec à Montréal

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Supply Chain & Logistics Institute

Hyperconnected Modular and Mobile Manufacturing

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Towards a smart hyperconnected era of efficient and sustainable logistics, supply chains and transportation

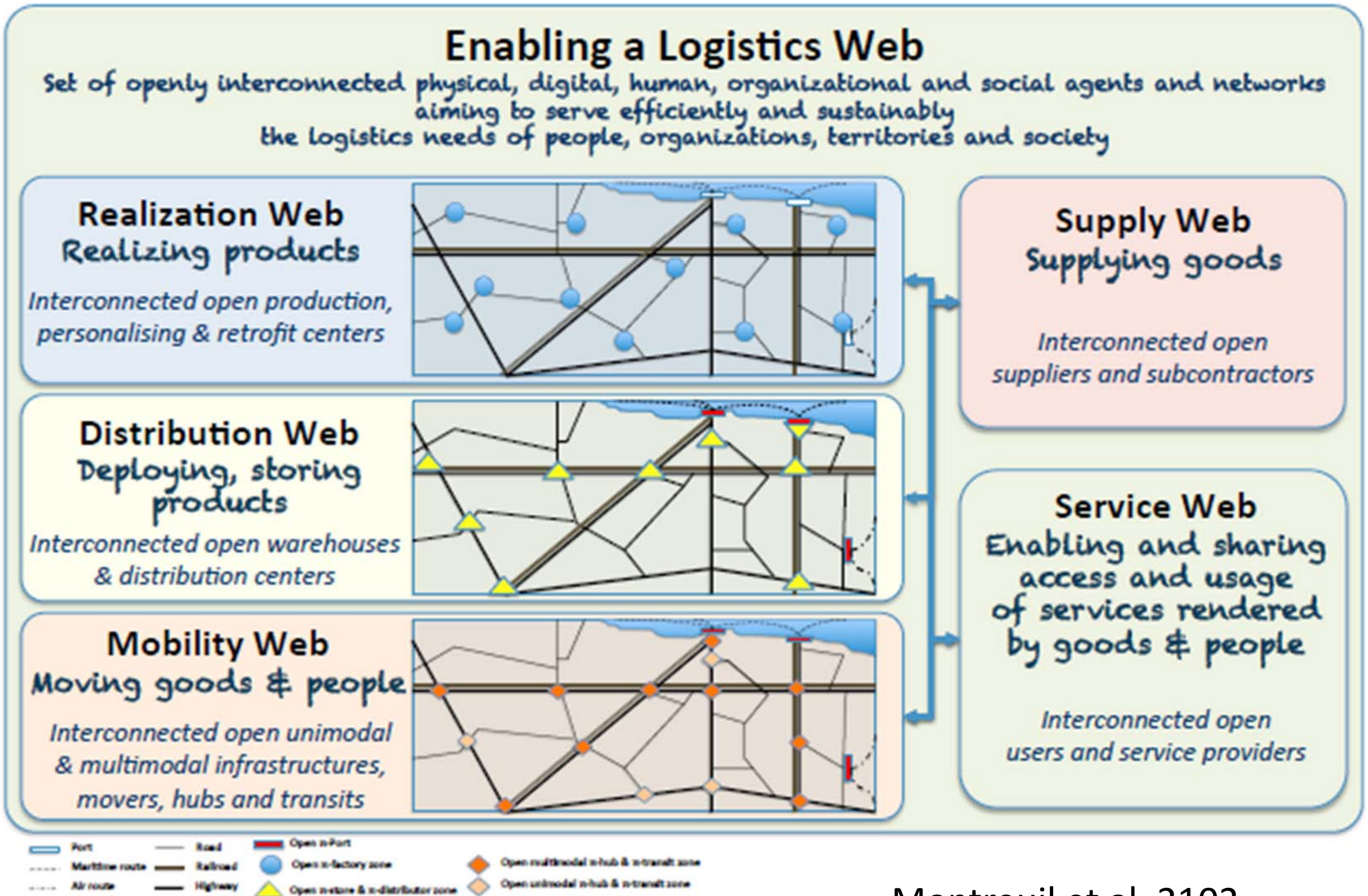
IPIC 2016 - 3rd International Physical Internet Conference

June 29-July 1, 2016 | Atlanta, GA USA

Agenda

- Background
- Modular production within a Logistics Web
- Problem statement
- Presentation of the experts
- Discussion
  - Key questions
  - Issues
  - State of the art
  - Roadblock
  - Challenges
- Roadmap
  - Priorities

Background: Logistics Web



Montreuil et al. 2102

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Background

- Physical Internet
  - Hyperconnected near point-of-use production of goods in a web of open multi-party fabs
  - Hyperconnected dynamic distributed deployment of modular containers in a web of open storage facilities
  - Hyperconnected multi-party multi-modal transportation of modular containers across a web of open hubs
- Modular containerized production
  - Process and technological innovations encapsulating production units in plug-and-play modular containers, enabling production capacity to be moved dynamically from site to site

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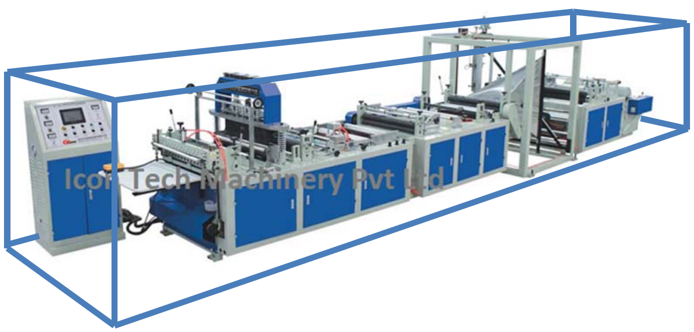
Production Resources and Modules

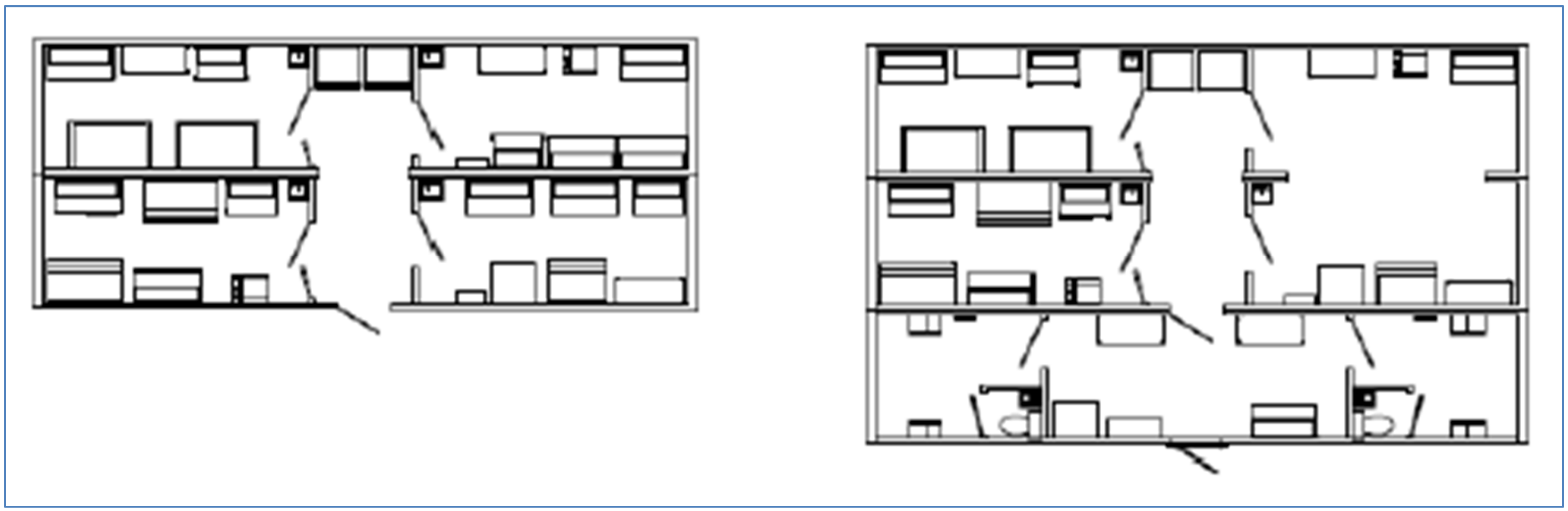


(adapted from Icon Tech Machinery Pvt Ltd)

- Performs some or all operations required for a finished product/service
- Can make different products
- Movable, reconfigurable
- Cost to install/uninstall/use/produce/move
- Requires installations
- Different sizes (requires space and or « plugs »)

Background
Proctor and Gamble (Germfree)

- Modular production
- Small footprint
- Require low investment
- Facility grows from two to three modules



(Germfree, illustrated in Sibomana 2015)

Background
Germfree

- Designing mobile laboratories

PHARMACY	LABORATORY EQUIPMENT	MOBILE LABS	ANALYTICAL LABS	LIFE SCIENCE LABS
				
Equipment for USP 797 Sterile Compounding	Biosafety Cabinets (BSC) & Lab Enclosures	Mobile Bio-Containment & Analytical Laboratories	Modular & Mobile Analytical / Chem Labs	Bio-Containment Labs & Pharmaceutical Facilities
Compounding Isolators	Class III BSC	Truck Labs	Environmental Labs	BSL-3 Labs
Radiopharmacy	Class II BSC	Van Labs	Mining Labs	BSL-2 Labs & TB Labs
Laminar Flow Hoods	Fume Hoods	Trailer Labs	Petroleum Labs	BSL-3-Ag & BSL-4
Biosafety Cabinets	Class I BSC & Enclosures	Mobile Container Labs	Industrial Labs	Pharmaceutical Biologics
Powder Containment	Laminar Flow & PCR	Air-Transportable Labs	Integrated Modular	ABSL-3 Labs
Rental Pharmacies	Gloveboxes	Rental Mobile Labs	Rental Labs	Integrated Modular

Background
Farber

- Designing mobile laboratories

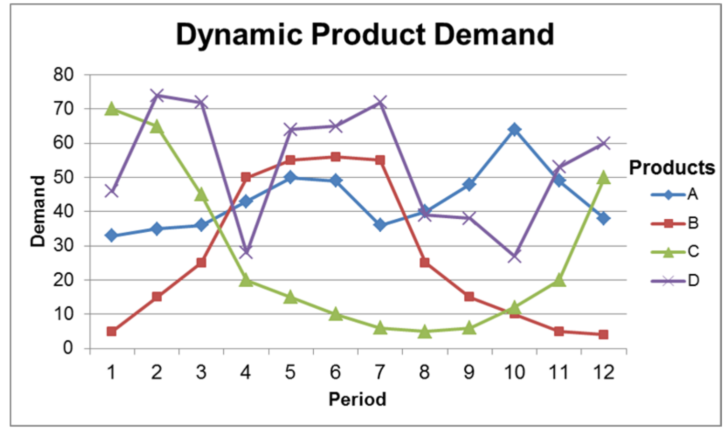
- DEPT OF VETERANS AFFAIRS
- MOBILE COMMAND POSTS
- HAZMAT VEHICLES
- BOMB RESPONSE UNITS
- SWAT VEHICLES
- CRIME SCENE VEHICLES
- DUI/BAT VEHICLES
- FIRE AND RESCUE UNITS
- MOBILE CLASSROOMS
- MEDICAL
- DENTAL
- MAMMOGRAPHY
- BLOODMOBILES
- AUDIOLOGY
- OPHTHALMOLOGY
- VETERINARY
- LABORATORIES
- BOOKMOBILES
- EVENT MARKETING
- OTHER VEHICLES

Background
Bayer and Project F3 Factory

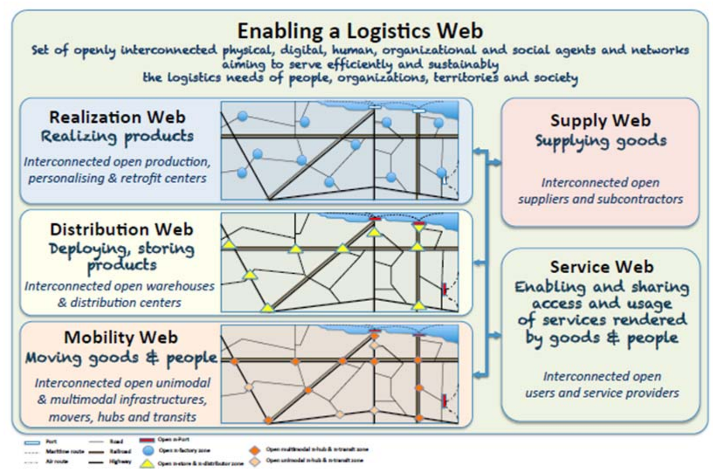
- Bayer Technology Services
- The *F* 3 (Flexible, Fast and Future) Factory project (www.f3factory.com)
- Plug-and-play modular containers
- Low to medium scale production
- Chemical industry
- Continuous production technology using novel, intensified equipment and processes in a standardized, container-based manufacturing environment

Background
Bayer and Project F3 Factory

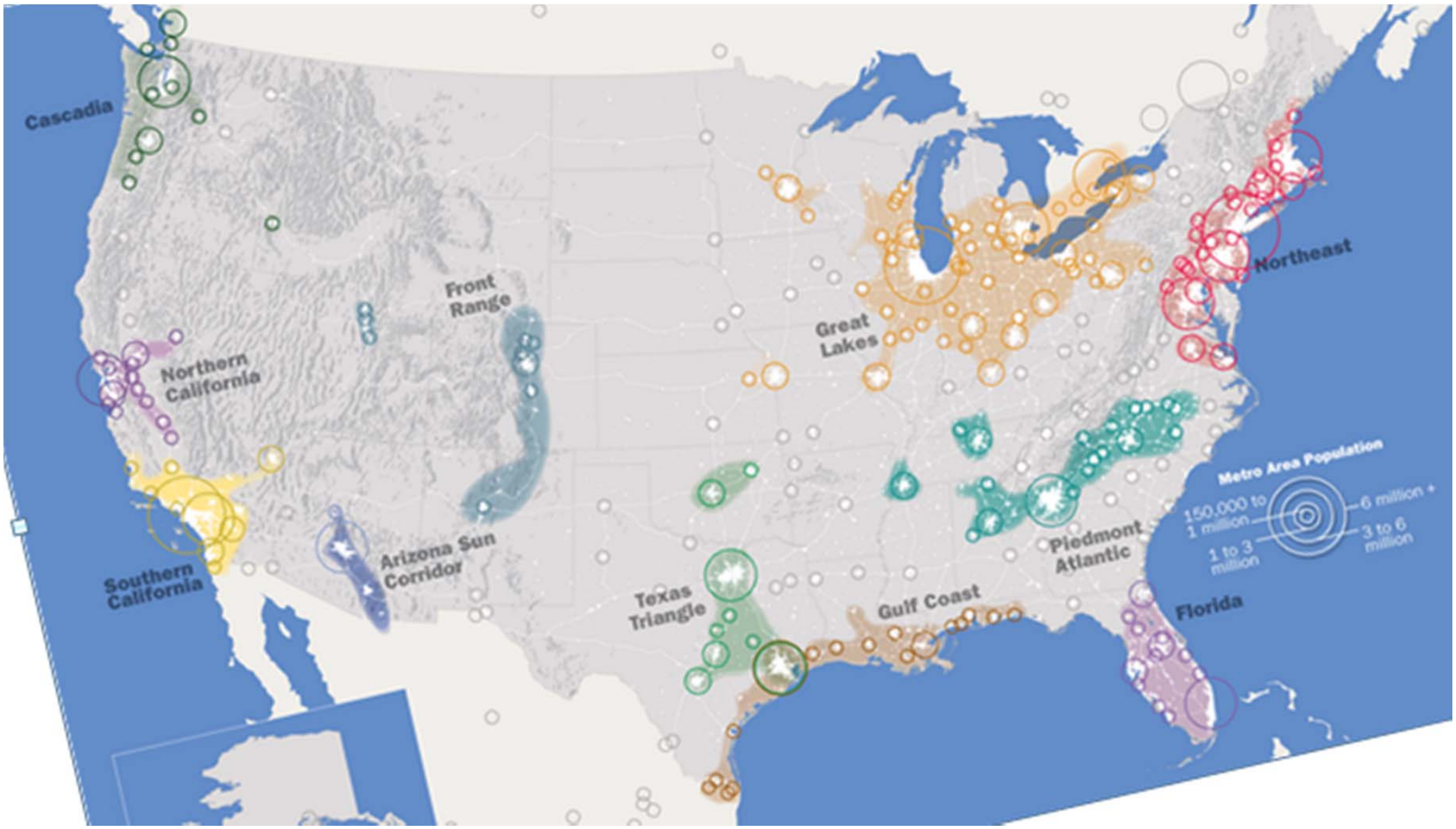
Problem Statement



- How:
  - Design the realization web
  - To serve the distribution web
  - Use the mobility web
- Such to maximizes the profit from
  - Revenue: Selling the products to markets
  - Costs: Deployment of modules and resources
  - Costs: Supply, production and distribution of the products
- Production mode: assembly process under
  - Make-to-order
  - Make-to-stock



The Emerging Megaregions



http://www.america2050.org/images/2050_Map_Megaregions2008_150.png

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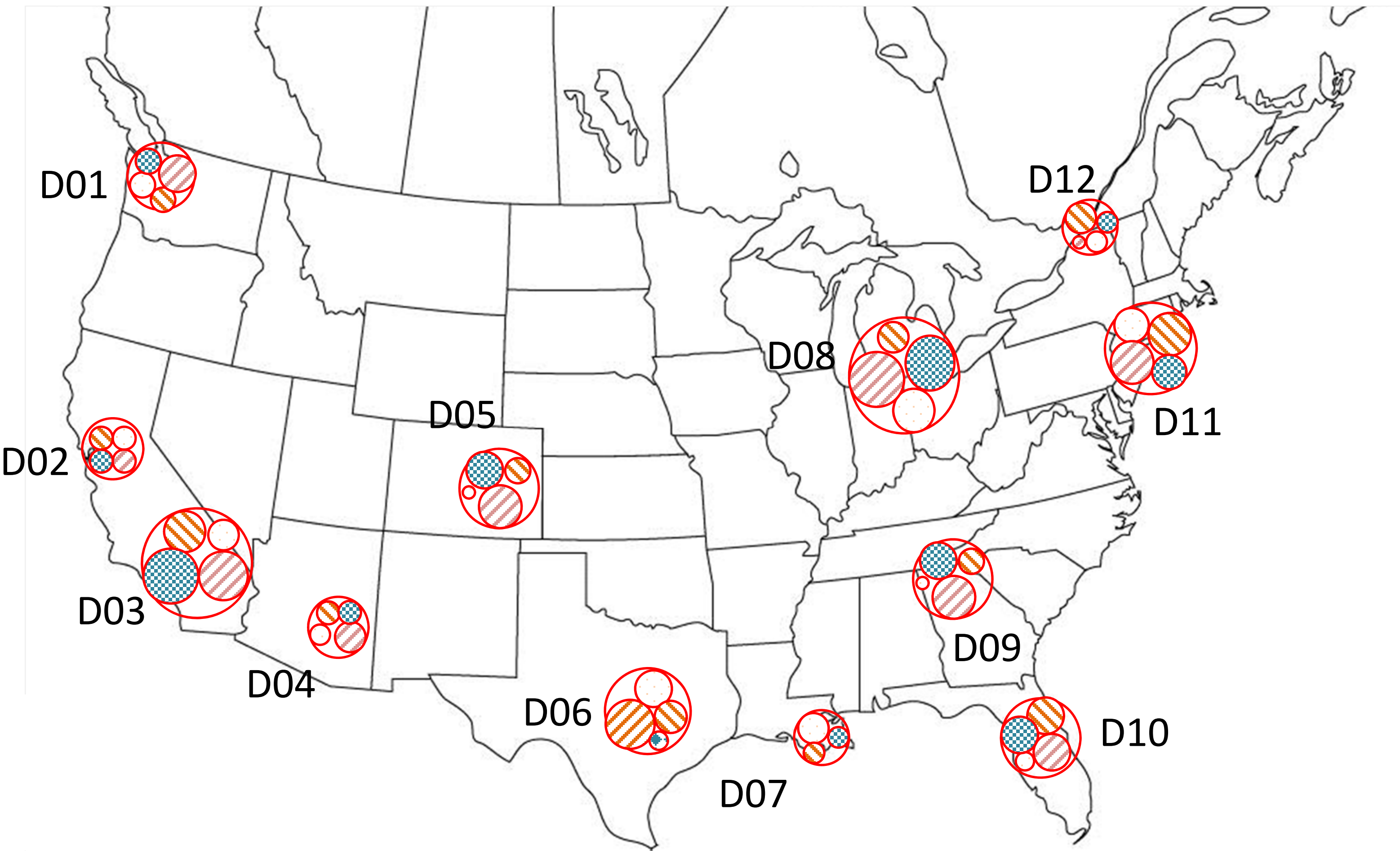
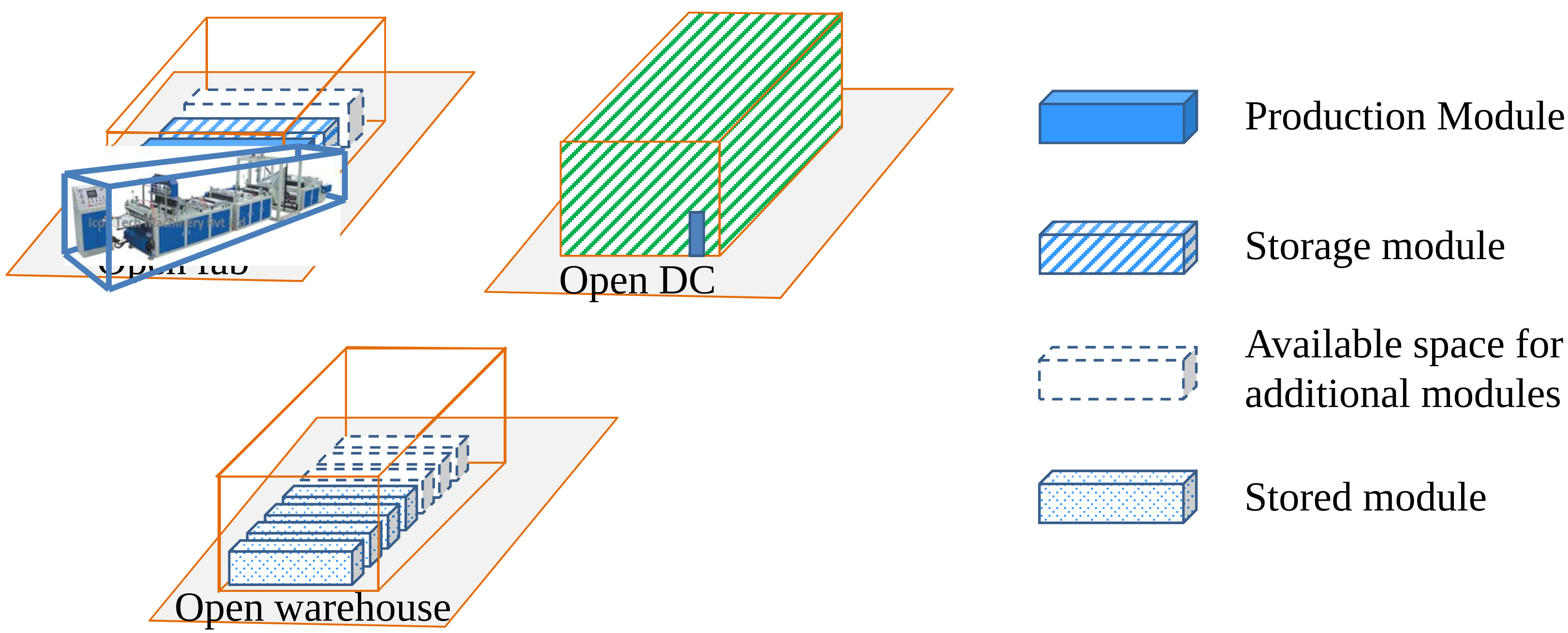
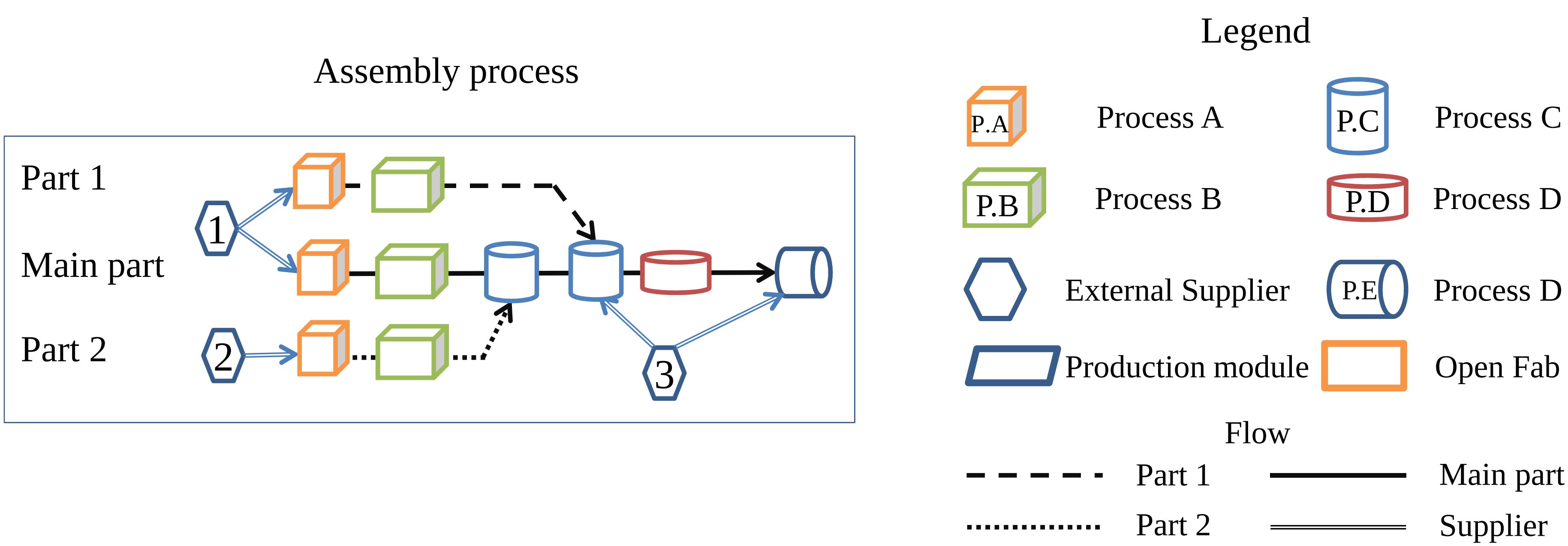
Products Demand



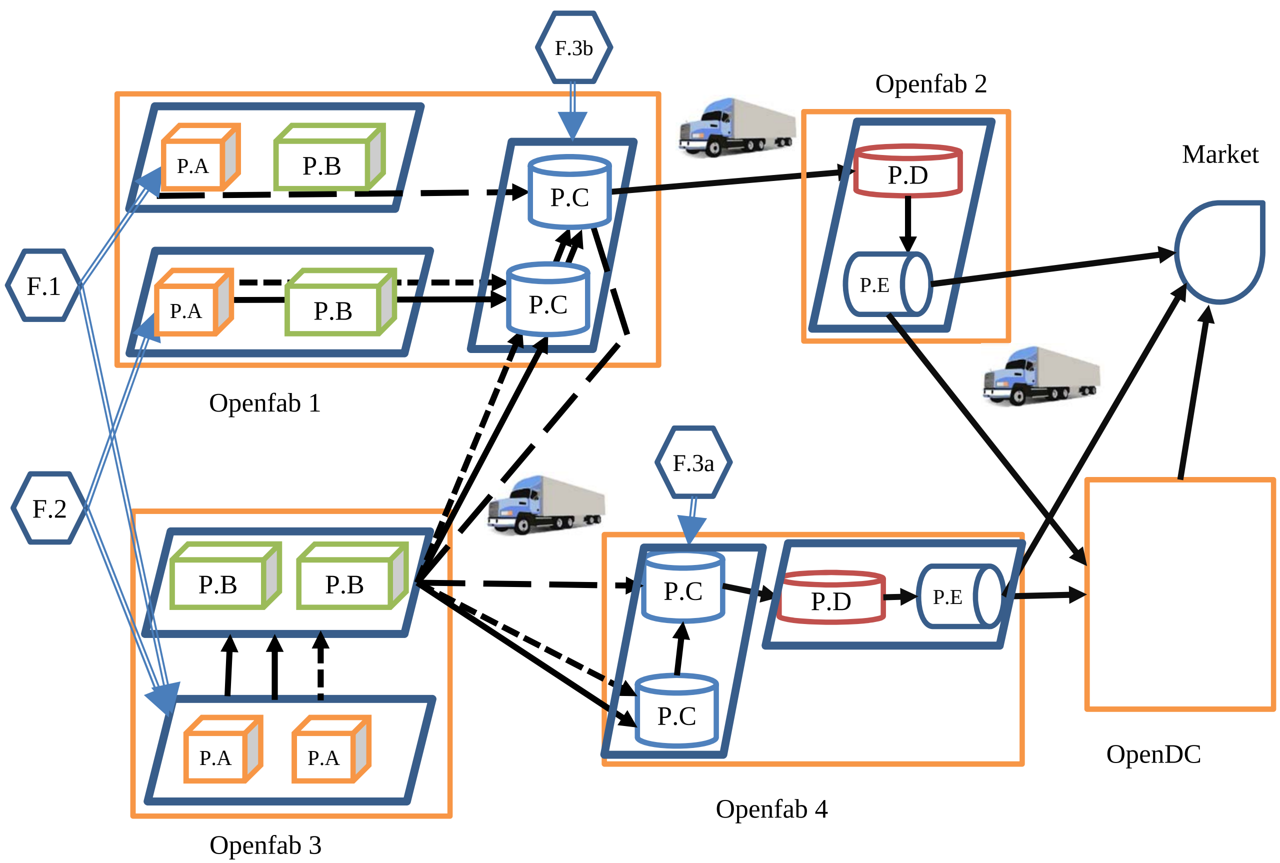
Open Sites, Fabs, DC, Warehouse



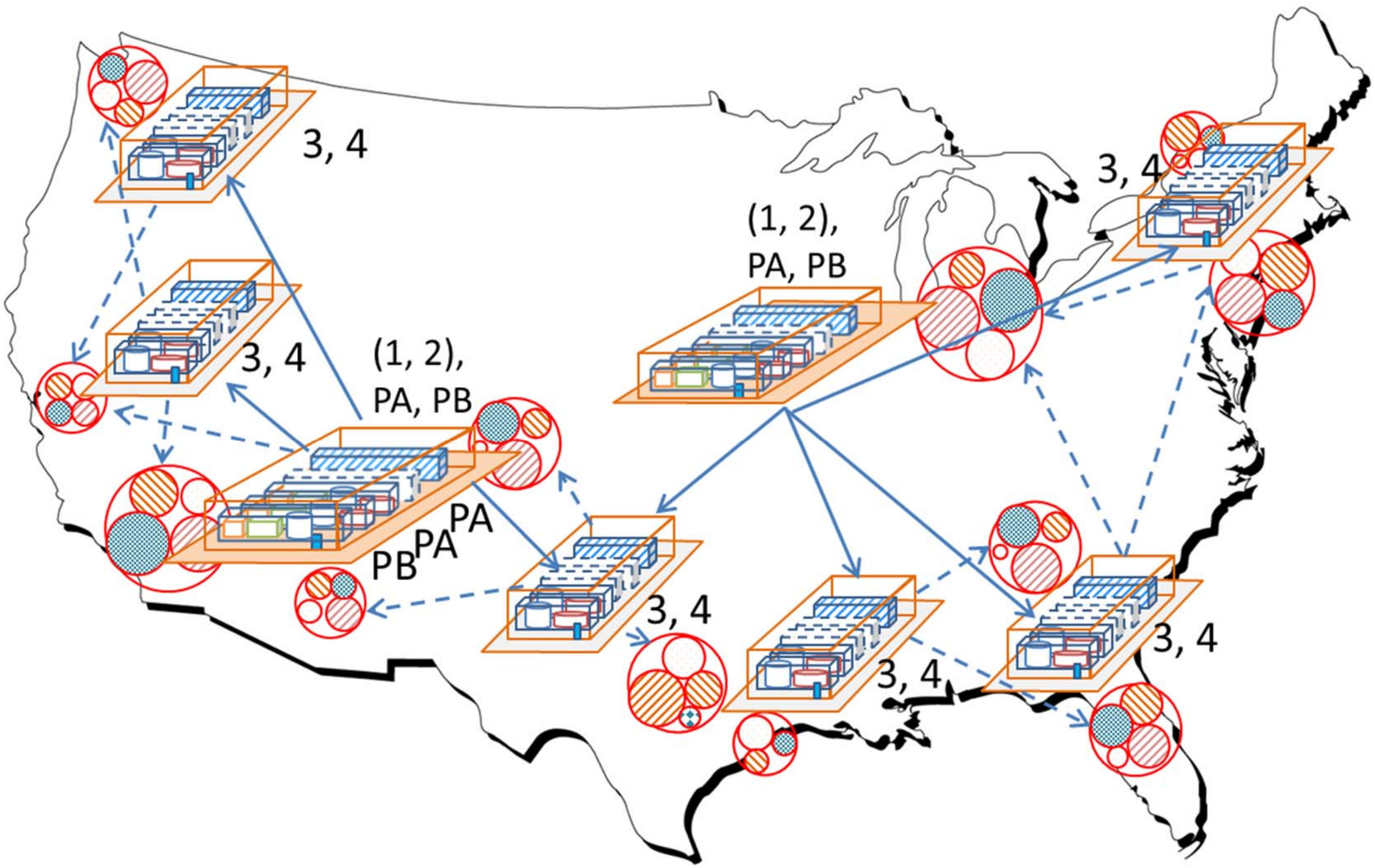
Example of an assembly process and the links with the suppliers



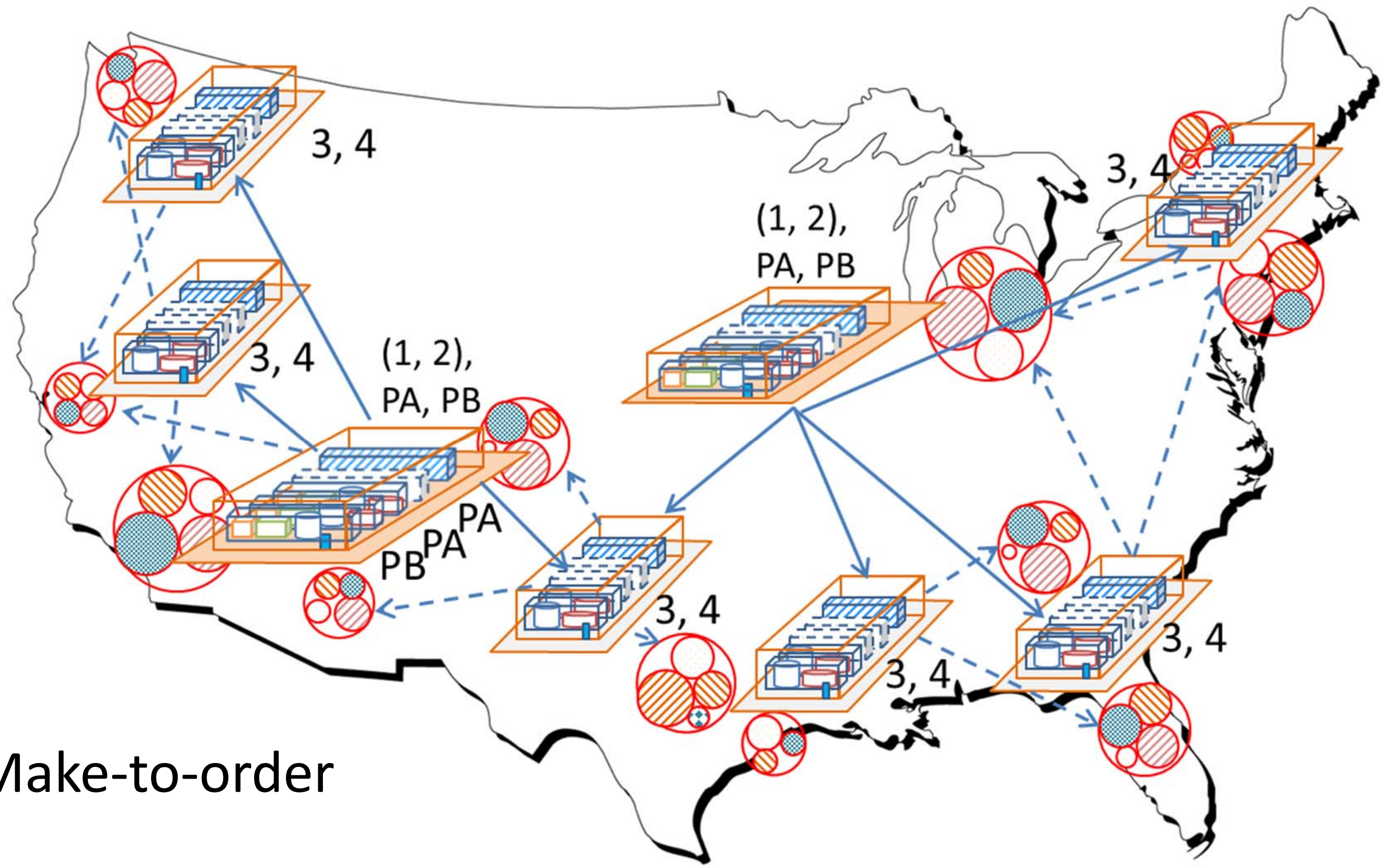
Examples of open fabs, production modules, their resources through the production and assembly process



Hyperconnected modular and mobile manufacturing

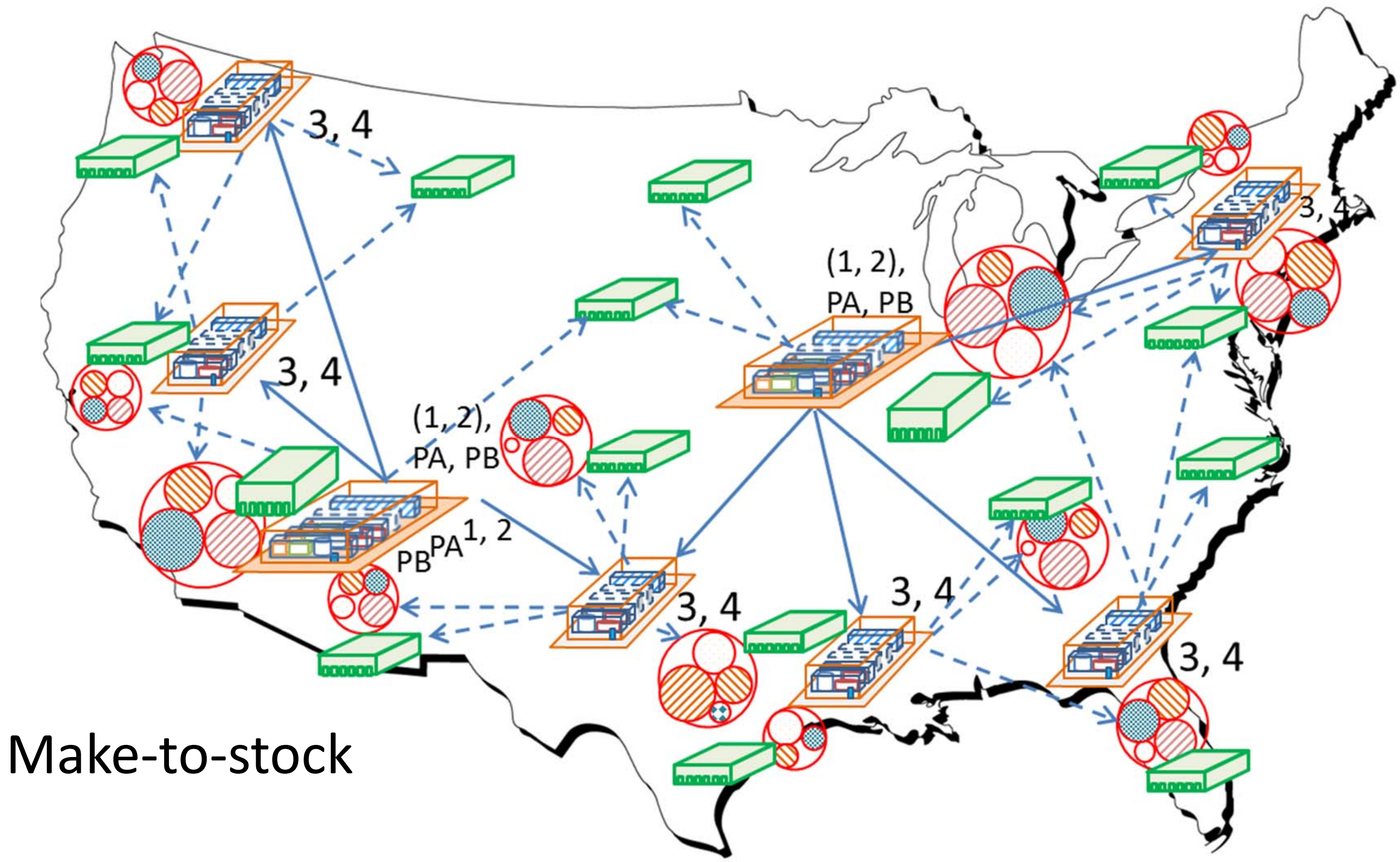


Hyperconnected modular and mobile manufacturing



Make-to-order

Hyperconnected modular and mobile manufacturing



Conclusion

- Hyperconnected modular and mobile production
  - Multiple sites
  - Modules deployment (purchase, relocation)
  - Module types (capacity, capability, etc.)
- Formalized, described and modeled hyperconnected modular production and storage decisions

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Supply Chain Optimization of Agroindustrial Residuals for Biofuel Production

3rd Physical Internet Conference 2016

June 29 – July 1, Atlanta, GA, USA

Dr. Yasel Costa Salas
Prof. Dr. Horst Treiblmaier

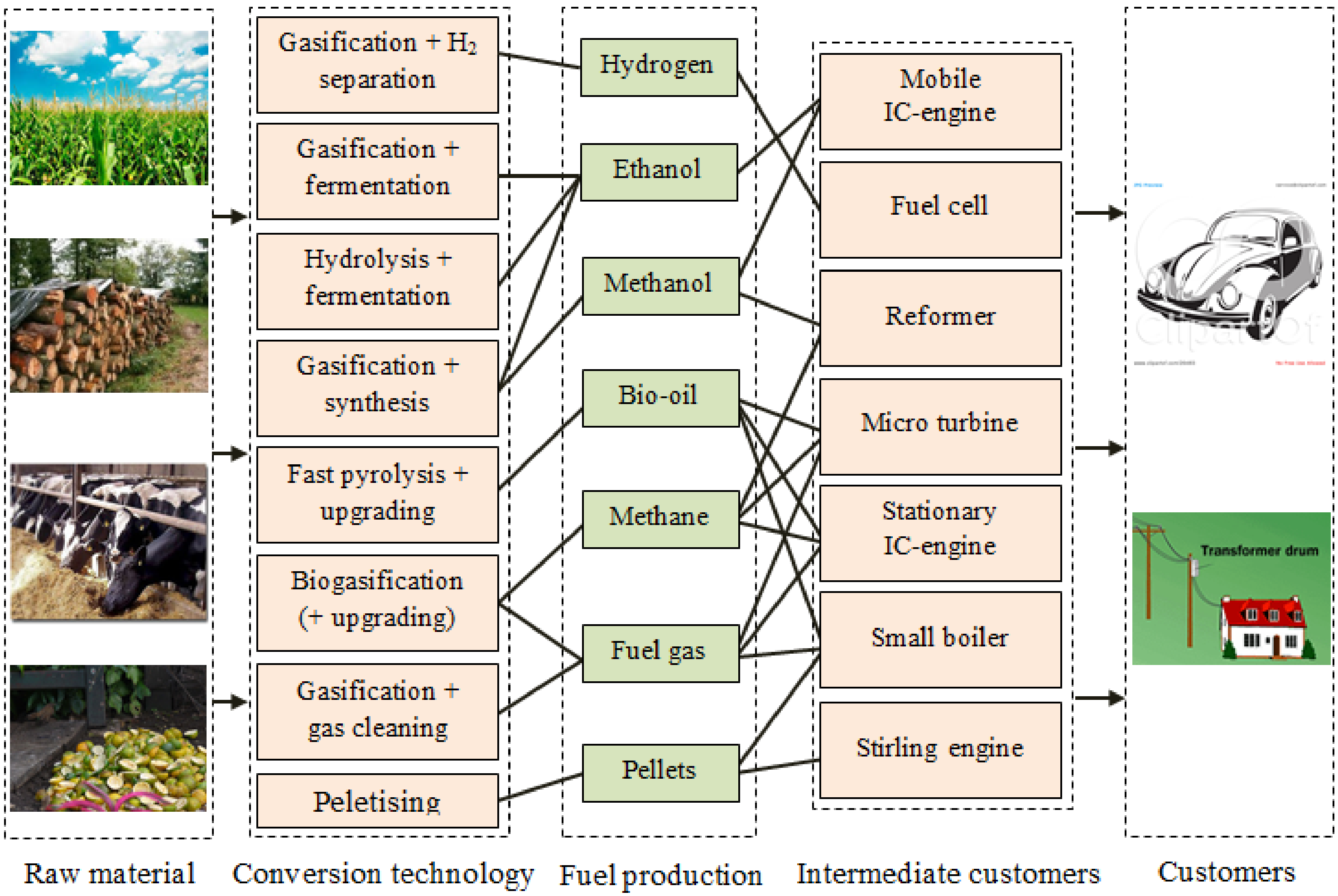
Biofuel Production

- Maize is the most widely grown crop in the Americas. (USA produces almost half of the world´s harvest, 42.5%, corresponding to over 220 million tons) (US-Department of Energy, 2011).
- Brazil is the world's 9th-largest producer of rice, generating around 2.9 million tons of rice husks annually (Gomes et al., 2013).
- Cassava (yucca) residues in Brazil exceed 60 million tons. Wheat residues production in Brazil is around 1.4 million tons (see in Ferreira-Leitão et al., 2010).
- Bagasse availability in Brazil exceeded 160 million tons during the period 2012/2013 (Hofsetz & Silva, 2012).
- In Colombia, the sugarcane feedstock availability is about 93 tons per hectare (but in the main producing regions it is about 120–140 tons / hectare) (Moncada et al., 2013).
- High availability of coffee cut stem in Colombia, the most productive country in coffee harvest, 32 tons per hectare-year (Triana et al., 2011).
- Sugarcane residuals in Cuba are estimated to be over 60 tons per hectare (Alonso Pippo et al., 2007).

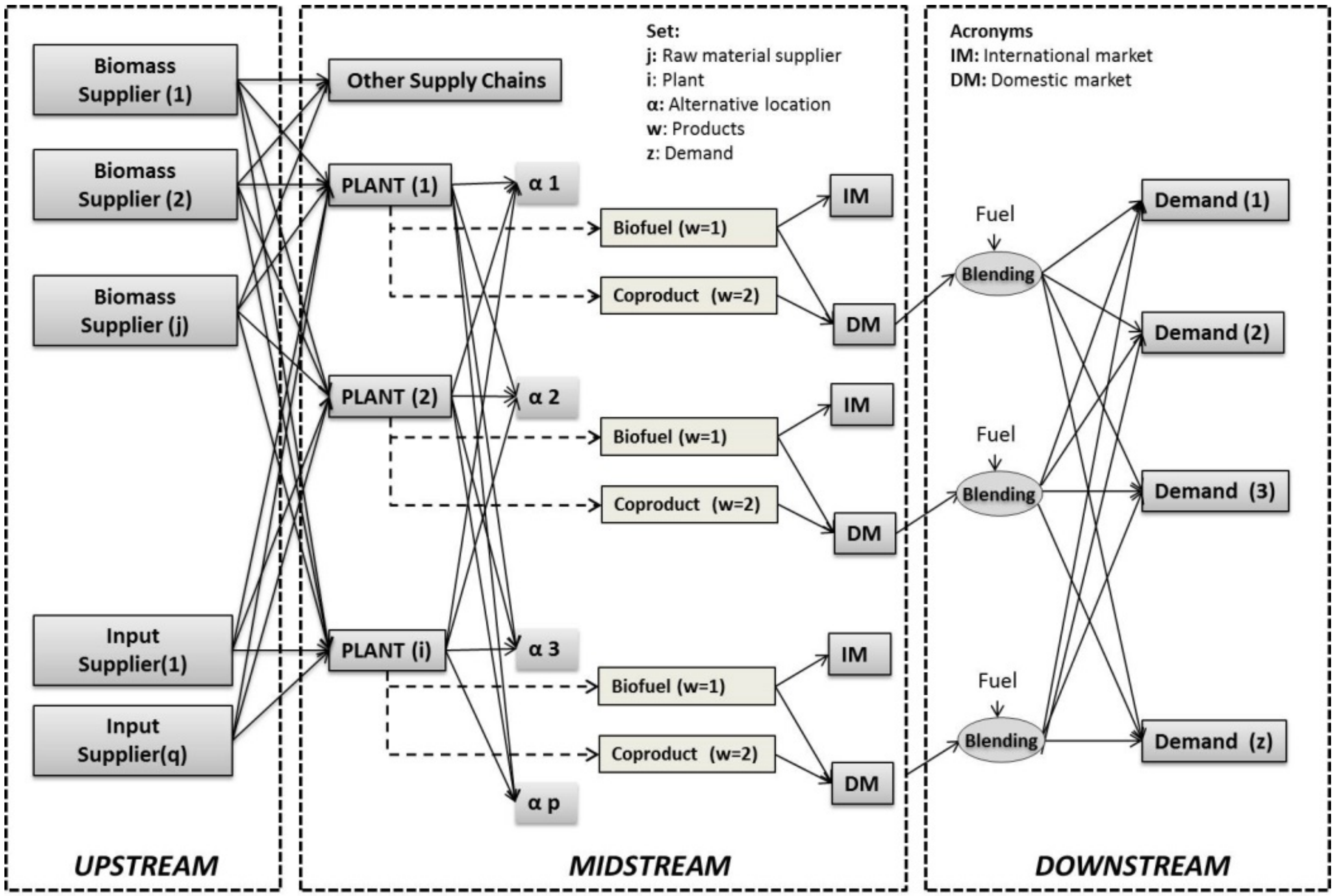
Biofuel Production

- Agroindustrial Supply Chain Network Design (ASCND) implies various optimization problems:
  - number of crop residues suppliers
  - intermediate pre-processing facilities or warehouses,
  - number and location of places where processing facilities can be allocated

Agroindustrial Supply Chain Components



Proposed Supply Chain



Source: Duarte et al. (2016)

Performance Indicators

	Benefit		Cost	
ECONOMICAL	❑ Biofuel sales ❑ Byproduct sales ❑ SC Resilience	−	❑ Residue acquisition ❑ Plant construction ❑ Plant operation ❑ Transport ❑ Unfulfilled demand ❑ Financial risk	Max
	Benefit		**Impact**	
ENVIRONMENTAL	❑ Emission credits ❑ Waste utilization	−	❑ Residue generation ❑ Biomass pretreatment ❑ Biomass transportation ❑ Biofuel production	Max
	Benefit		**Impact**	
SOCIAL	❑ Source of employment ❑ Government targets	−	❑ Capture of agricultural land ❑ Vulnerability of rural communities	Max

Project Goals

- Identify existing agroindustrial supply chains in order to determine their relevance for the research project.
- Conduct data collection and parameter analysis for the identified agroindustrial supply chains.
- Design optimization models for the agroindustrial supply chains.
- Develop, improve and apply optimization algorithms, in particular metaheuristics and hybrid strategies for biofuel SCND.
- Develop robust strategies (sensitivity analysis) based on inferential statistical techniques.

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