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INSPIRE

Towards growth for business by flexible processing in customer-driven value chain

EC GA 723748

Deliverable D1.3
Major supply chain issues
V 1.0

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D 1.3 - Major supply chain issues

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Introduction

This report contains the findings from a study on innovative business models that PNO, TNO, ITIA and ZLC have conducted on behalf of the European Commission for WP1 of the GA Nr.723748 - INSPIRE under H2020-IND-CE-2016-17/H2020-SPIRE-2016.

The first stage of the project resulted in an overview of how new business models are being driven by innovation of technology and business processes (D1.2). As a result of the preliminary evaluation of 4 different archetypes, a shortlist of topics to investigate in WP 3 and WP 4 has to be set. According the DoW D1.3, this shortlist covers factors that impact the supply chain. We list the key parameters which ensure or hinder the deployment of optimize flows in the value chain. It helps us to understand some of the major parameters/issues that are critical to the success of the mentioned business models.

The objective of the shortlist is to identify major supply chain issues (bottlenecks) and to understand the major drivers and requirements for more **flexible and demand-driven sustainable manufacturing and processing**.

The shortlist assesses topics to be investigated in WP 3. It allows us, in combination with the technology assessment of WP 2, to derive in WP 4 how these drivers and requirements result in more flexible, demand-driven and sustainable operations for the process industries and what kind of **business models** it would necessitate.

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Shortlist

- Prioritization of challenges (conflicting objectives, government regulations, inefficiencies, lack of technology, new model being more expensive, lack of willingness to change/adapt, etc.)/opportunities by analysing which challenges/opportunities arise most often (possibly some common patterns will emerge)
- Potential of the business models/technologies in addressing them and reaching the "ideal" situation (SC configuration and business model) by analysing which of these challenges/opportunities are addressed by which business models
- Linking the business models to the "objectives" defined in the INSPIRE proposal : the potential of the business models to achieve the "targets" specified
- Discussion of the possibility of the desk research and the case/interview findings to be generalized to make use of the insights generated for Europe in general
- Selection of a few business models and cases, which have the most potential. Perform a general analysis as follows and use one of the examples (cases with an interview) to do some "estimates"
- Based on the results of the interviews and desk research, a deeper analysis must be performed to investigate the impact of the business models on "delocalization". In doing so, some macro level data must be obtained to see the level of "offshoring" activities for certain sectors and products. For example, if a firm changes from a "centralized" model to a "decentralized" model, but continues to perform all activities in Europe, the impact on delocalization would be minimal. Therefore, further research as to which activities in the supply chains are outsourced (outside Europe) will shed more light on the potential of the business models to reverse this effect, and help us concentrate on products/sectors that have a more significant impact in this regard.
- Cost of production per unit (raw materials used in a unit of product plus the manufacturing cost) with different business models
- Product characteristics to see which business models suit better given the type of the product. The price of the product (luxury versus standard, specialty/fine chemicals versus commodities), cost of production, waste produced during production, number of stock keeping units (variety offered to the customers), number of suppliers/customers involved, market size for the product, existence of alternatives from competition, "parts commonality" among different products etc.)

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- Risks involved with the business models and offering novel ways to mitigate those. One example is the guarantees to make sure that the PSS model would benefit both the provider and the consumer in the long run to reduce the risk of losing money for each party. An example would be the risk of forward integration, that the provider having too much control could try to vertically integrate. Also, the fact that the customer becomes more dependent on the provider with the PSS model might pose another risk for the customer.
- To be used in WP 4: different values of critical parameters should be considered (e.g., how would the "cost of virgin raw materials" and the "cost of conversion of recycled waste" change in the next 5-10 years so that the proposed business model is still profitable and sustainable?). A collection of important parameters and the "ranges" for the values that they could take will be crucial for the robustness test in WP 4 of the proposed solutions in WP3.

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Impact on the supply chain

Following is a summary of the findings with respect of the impact of business models on the supply chain. The items will be further investigated in WP3.

New players/roles in the value chain:

- The supply chain configuration before and after the implementation of the business model to clearly identify the activities that are different to perform a marginal analysis on the key performance measures and objectives
- Some players will disappear from the supply chain as a result of the implementation of the business models. For example, the "ammonia production case" (see the "*decentralized or modular production discussion*) may replace "ammonia suppliers" by the "new equipment located on the farm itself".
- Similarly, with 3D printing some parts/subassembly manufacturers may disappear because of additive manufacturing making these parts unnecessary
- "Prosumers" emerging as a new player in the supply chains (e.g., *3D printing* allowing consumers print products as well as the ammonia and peroxide producers with *decentralized production*)
- New players would emerge responsible for "waste collection" and "conversion of waste into usable raw materials" (e.g. see re-use and sustainability business model)
- New roles for the governments to incentivize more sustainable practices (such as high landfill and incineration taxes)
- New players in order to ensure sustainable coordination and collaboration among supply chain partners (especially for SMEs) is essential for most business models:
    - New players will emerge when some business models are implemented. For example, the multi-sided platform that allows small producers and customers have access to supply and consumer markets emerged as a new entity in the supply chain (see the case study "*multi-sided platform*").
    - New players that would ensure safe and secure data/information flow between different actors in the supply chain (e.g., PSS model and the Chemical Leasing Case where the information regarding the use of chemical and the surface cleaned needs to be communicated perfectly to the customer and supplier periodically) and also

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players that would manage the relationships among SC actors (e.g., see the re-use business model discussion for the "Kalundborg Symbiosis Institute").

- New players that are able to collect data/information and optimize resource usage and share the benefits to ensure engagement from all parties involved (maintain win-win solutions over time). Particularly important for the re-use and the PSS/Servitisation business models.

Changes in supply:

- Less dependence on the global supply of critical raw materials (e.g., business case: *re-use and sustainability* as well as the *3D printing with mass customization* as a result of more efficient use of raw materials and less waste)
- Type of raw materials or energy sources needed (due to increased feedstock flexibility, see the *re-use and sustainability* case). One example is the most desired replacement of fossil fuel by feedstock from plastic waste.
- Reduced risk of global price fluctuations because of many small local producers (e.g., business case: ammonia production with decentralized/modular production)
- More local sourcing in case of *decentralized modular production*

Changes in demand:

- Willingness to Pay (WTP) becomes higher with mass customization: as customers are more involved in the design process, they would be willing to pay more for a particular product, and also buy more of the same brand. This leads to increased demand in general.
- Reduced development and design time to respond to changing needs of the consumers (prototypes and pilots with 3D printing), leading to consumers having more options to select from over time
- Consumers would be able to "design" the product they want through "digitalization"

Changes in transportation/inventory/delivery:

- With the "decentralized or modular production" and the "3D printing business models", the smaller plants would be closer to the customers, and therefore more responsive providing a

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faster delivery. However, the effect on the total transportation costs is not very clear. Being closer to the customer might mean that you are father away from your suppliers. Detailed analysis need to be carried out to see what the impact would be on "inbound" (transportation of raw materials to the production plant) and "outbound" (transportation of finished goods from the plants to consumers). It has been shown in the supply chain literature that one cannot predict if the total transportation cost will be higher when one moves from decentralized to centralized setting.

  - It is important to note that the other business models (re-use and PSS) might also impact transportation costs. If the waste streams generated can be used instead of virgin raw materials, the firm can save on transportation costs eliminating the delivery of pure raw materials from the suppliers. Similarly, the PSS model might save the added transportation costs of returns from consumers and increased product lifecycle, due to the improvement of the "proper use of the product over its lifetime".

- Reduced batch size (intensified processing with *catalytic reactors using 3D printing*) that ultimately leads to more "responsive" supply chains and lower inventory levels in general
- Business models have an impact on lead time. The "*decentralized production*" may reduce the time to respond to customer demand (given there is sufficient inventory), while "*customization"* may make the lead times longer as the production is initiated with the specific customer order.
- Reduced transportation activities (with *3D printing*, instead of physical goods it would be the electronic files that would be transferred assuming subassemblies and raw materials are locally available). Similarly, with the *re-use* model less waste will be transferred to landfills reducing transportation requirements.

Changes in cost of production:

- A detailed analysis must be performed to see if a particular business model will lead to higher unit costs or not. For example, as far as the "decentralized or modular production" scheme is concerned, the unit cost of production might be higher due to the loss of "economies of scale". However, on the other hand, there might be reductions in the unit cost of production as the local production might be cheaper if sourcing is done locally and cheaper. Similar analysis must be carried out for the other business models reported in this model. 3D printing might reduce the unit cost of production as there would be less waste with additive manufacturing, but suffer from the same loss of economies of scale due to distributed manufacturing. Re-use

and sustainable models will reduce the cost of production as long as the cost of collecting waste and conversion is not prohibitively high.

- Lower cost of customized production (e.g. 3D printing makes it easier to switch between products)
- Reduced risk of investments as it is less costly to build smaller plants (decentralized or modular production and 3D printing)

Changes in the offering:

- Unlocked design options with rapid manufacturing: More complex designs offered to consumers with *mass customization*
- Better "services" offered including the use of product, maintenance, repair, replacement, efficient use of energy, safer work environments (e.g., see *Chemical Leasing case*) with the *PSS/Servitisation* business model. Customers are in general happier with the service under the PSS models. The PSS model for instance is known to "lock-in" the customer as the customer is content with the full service in general and the switching cost to an alternative provider is higher. This could definitely pose a risk for the customer though, in case the service is not as satisfactory.
- Changes in financial flows will materialize, especially with the PSS business models, as the customer will pay for the "service" to a single provider, instead of paying for the "product" to the supplier and for the "service" to other actors (maintenance, repair, etc.) in the supply chain.
- Increased product life cycles through better use of the product by the supplier/provider.