Factory subclasses relevant to Industry 4.0 challenges

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Abstract. The practical probation results of the different future factories options innovative business strategies created today sufficient conditions to form the industrial companies second echelon (subclasses). Some future factories subclasses families are proposed and based on the business company models differentiation. There are varieties of services, sharing, system and study factories as the smart factory subclasses. There are varieties of open, pilot, creative and framework factories as the digital factory subclasses. There are varieties of cluster, client, route and recycling factories as the virtual factory subclasses. There is a similar scheme for all subclasses types of families. All factories subclasses are additionally grouped in the speciality of their business strategies. In essence, the satisfaction of customized consumer requirements or manufacturer market trading offers provision, which is equally actual for Industry 4.0.

1. Introduction

The Industry 4.0 strategies functional potential formed institution conditions to develop this business directly related to the cyber-technologies application in the production environment [1, 2]. Strategy application practical scenarios define its result to create a new competitive business space, which opens the future factories new business capabilities [3, 4].

Expert and analytical society as the new companies business strategies the first echelon sees the future factories where three factory classes are defined [5, 6]:

- the digital factory supporting mental (cognitive) designer activity to provide intellectual the reverse engineering projects cases control;
- a smart factory which basic directions include the product several times reproduction using auto identified industrial equipment;
- a virtual factory which operational environment includes the target application problem field in the product servicing after the sale.

The first results from the future factories reference group utilizing experience revealed many factors, which prevents the cyber-technology scaled translation in the industry several directions, which must be transformed [7]. Those factors include [8, 9]:

- the cyber-technologies qualification low level with specialist contingent which justifies the new knowledge motivated population part demand;
- the most part cyber-technologies location out of the norm field (the digital economy law, cyber-production certified basis, cyber-trading tax payment and other);
• the absence of available complex solutions cyber-technologies in the market to provide the advanced industrial equipment for the cyber-productions being created and those which are abroad and others.

The optimistic evaluations show that to overcome the existing industry stereotypes and to make a significant potential profit in some economic sectors having realized the Industry 4.0 strategies must be expected not sooner than the year 2030 [10, 11]. The strategy ideologies relate its long term success with the future factories maturity level as the company preparation level for the knowledge economy [12].

The company business processes cyber-technologies integration degree is a part of the future factories maturity level and the cognitive service interfaces penetration depth into company business models [13, 14]. The theoretical approaches to increase the future factories maturity level in the business companies first echelon is of low efficiency in practice. That is why it is necessary to define the second echelon companies (subclasses), which form the production chains of the additional cost product directly and which are more suitable innovations [15, 16].

2. The industry future factories subclasses

The advanced industry economic relationships subjects are the future factories, which provide the State national technologies dominance in the global markets and may increase the product being manufactured export potential. The future factories appearance is because of the significant moral degradation of the Industry 3.0 production companies fund, which gets stronger because companies delay technologically in industrial environment material and technological base updating.

![Diagram of Industry 4.0 factories base classes and subclasses](image_url)

**Figure 1.** The future industrial factories subclasses families differentiated in business models types being realized.
Industry 4.0 vanguard is the future factories, which inter-replenish resources to provide developing countries economic growth. The future factories business processes are based on science, industry and education technologies integration, which realize the economy de-industrialization multi-polar principle.

The industrial segment national regulation priority task is to develop the future factories subclasses families with differentiating property of the company business model. The future industrial factories subclasses families are given in Figure 1.

Industry 4.0 makes actual the platform economy where the additional cost products chains could be independently formed with two reciprocal company business strategies:

- by the product consumer requirements who directly influence their personal preferences the digital being produced product properties (smart);
- by the product manufacturer offers who manufacture and release to the market the products corresponding to the population mass demand.

In Figure 1, all future factories subclasses are differentiated according to the company business model speciality to satisfy the customized demand and companies who form their product offer in the market.

3. Smart factories subclasses

In Industry 4.0 coordinates all smart factory subclasses are represented the following types of commercial companies:

- service factory which business model is based on the client centring idea. The service factory is exclusively oriented to satisfy the personalized demands of some individual consumers through the web-system of marketplaces under the mass-production condition;
- sharing factory which business model is based on a recently formed business solution of the cyber-production resources temporal renting to manufacture a bunch of products. The sharing factory provides technological renting services for small businesses related to innovations;
- system factory which business model is based on the typical approach of the product mass production for different industry branches. A system factory provides standard ways to manufacture an item with their digital twins prepared in the digital factories;
- study factory which is based on a combination of industrial and study technologies to provide an inter-subject specialist technical study for a cyber-production. A study factory forms the competences exchange environment and realizes the cross-disciplinary of study projects as a competences technical centre.

Each smart factory subclass uses in its business processes only worked out (probed in practice) production technologies and takes the narrow speciality market niche. Smart factory subclasses combined potential let reduce several times many different Industry 3.0 profile companies without any damage for nomenclature and quality of the item being produced.

4. Digital factory subclasses

The Industry 4.0 technical entrepreneurship defines the following digital factory subclasses:

- open factory which business model is oriented for a common way of digital factory virtual design using outside experts and the consumer. An open factory formalizes the intuitive consumer sketches and to provide the workforce for the product digital twins design with given specifications based on the open projection technologies;
- pilot factory which business model is oriented to search for non-standard designing solutions like to research and to implement some passing through technologies to unite the physical items and all business processes of its subsequent manufacturing and exploitation. A pilot factory provides certification and standardizing of the newest (preventive in advance) technologies as a part of an experimental competences centre;
- creative factory which business model is done by standard project management-oriented for
target showcase mass consumption products projection. A creative factory provides an entire off-line cycle to design electronic documentation which result is the item virtual copy;

- framework factory which business model is oriented to project objects of «all as a service» concept. A framework factory provides online and offline designing service applications, which are used by stakeholders (customers, consumers, designer and other) in their activity.

Each digital factory subclass uses in its business processes some standardized technological communication channels to provide an address approach in partner interaction. The digital factories subclasses economic activity growth resources are 3D drawings of export technologies (import) in the automatic projection systems. For unite the all-digital factories subclasses, advantages may permit soon to realize actual digital projects to support item virtual copies bijective display and the item physical samples.

5. **Virtual factories subclasses**

The Industry 4.0 corporative culture defines the following virtual factory subclasses:

- cluster factory which business model uses several commercial companies efforts consolidation technologies of joint design, management, item production and marketing. A cluster factory provides base market necessities in new items;
- route factory which business model is specialized in adaptive logistics and commercial companies components provision automatizing. A route factory provides the control of item provision chains based on material and financial transactions;
- client factory which business model is realized with the item target application. A client factory defines the industrial items public consumption ecosystem manufactured with production objects application;
- recycling factory which business model is oriented for scavenging technologies and industrial goods ecological application technologies in the item life cycle. A recycling factory provides the item maintenance technological processes and its final industrial recycling based on circulating economy principles.

All virtual factory subclasses the most common property is a business process homogeneous structure to define some companies interaction. Each virtual factory subclass supports a unique corporative joint business model, which provides corresponding industry branch technological independence from foreign meddling in the global market.

6. **Conclusion**

The current economic model oriented for resources analytical strategies designing and research today has the specialists increase interest. Such strategies advanced idea accepted by specialists as a base for industrial economy new models, which includes the future factories creation best global practices arrangement.

The future factories subclasses of target establishment creation are defined as industrial growth priority measures to solve the following corporative tasks:

- cyber-technologies system integration into company business processes;
- to implement client services into company business model;
- to implement innovative education methods into cyber-production niche specialists preparation of business processes and others.

Because of low functioning maturity level, today in the future factories prototypes market the industry development corporative tasks solution. Several categories of factory probation (subclasses) would be a wise thing to do to realize narrow speciality business processes. The industry economic model reforming program success special influence could provide system support of new business structures from the government based on the second echelon future factories provision with tax reductions and legal preferences.
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