SMART FACTORY & AMP; MANAGEMENT 4.0 VISION FOR APPAREL INDUSTRY IN ROMANIA

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ABSTRACT

The vision of smart factory for production organization is still in the early stage of implementation in Romania, especially for non-durable items industry, such as textile & apparel field of activity. The practical experience into the trade draw to the conclusion that the entrepreneurial interest is more concentrated on the services domain less difficult to process control and faster profitability, than production, besides the main concepts of Industry 4.0. One of them is identified as smart factory or reference architectural mode, both are quite new and also not fully clarified for business environment. The advantages offered by digitalisation technologies are not completely comprehended, mainly due to shortage of social interest into the field. The best practice examples of Industry 4.0 into clothing or non-durable industry are not functioning yet in Romania, in order to be followed, only at the level of niche high tech industries which for the moment demand valuable investment in creativity, complex information technology and long time for return of investment. The latest events of pandemic crisis prove once again the importance of solid economic ground which a crucial role is played by an industrial engine autonomy with production stakeholders in the proximity of each country and continent. This study is aiming to research the conditions of functioning the smart factory, as a relevant model of digitalised manufacturing unit and implementation of Apparel 4.0 as particular field of Industry 4.0. One of the main concern of this thesis is the proper understanding, implementation and certain challenges to be faced in regard to reference architectural model concept for apparel business. The model is still pending for a complete standardization of supply chain and operations between enterprises. A potential direction of study is the shifting model of Leavitt's diamond of change to be analyzed, for a potential set-up on apparel industry as a particular case for commodities. The long chain of activities into the trade, involving a consistent content of human manufacturing effort request an assembly study, solving the integration of all the links from design, producing until dispatch on the market, which actually is affected by divergent interest of either retailers interests on low price, fast fashion and quick delivery or the creative work shops looking into elaborated costly products which need to be produced into a smart factory capable of versatility, multiskilled human work force with quality reliable level. A proper comprehension of RAMI (reference architectural model 4.0) could offer a solution to obtain the smart relation between the product, producer and final client integrated virtually through digitalisation technologies benefits.

KEYWORDS: *Digitalisation, Industry.40, Leavitt diamond of changes, RAMI model, Smart factory.*

1. INTRODUCTION

The latest changes which have been occurred world wide through the recent virus pandemic COVID 19 are still ongoing and the mankind is looking for balancing means to cross this crisis, whereas the global economy shall react and adapt by using the existing know-how, applying error

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test methods mainly and improving the obtained results. Romania could have a great chance to revigorate, looking at the traditional industries with solid contribution to national income and export engine as well. The opportunity is coming from the actual era of advantages offered by Industry 4.0 and the steps made ahead by Germany as best practice example with program of “industry renaissance” (Kusters et al., 2017)

Besides automotive and IT, the apparel industry could be adapted to the new wave of Industrial revolution 4.0. A solution assumed by this study is the applicability of smart factory concept which shall be built on proper understanding of reference architectural model 4.0 (RAMI). The definition of this model is involving the system of manufacturing and market as final beneficiary of supply chain link. As long as the smart factory exists, the smart products will be the outcome with final destination for smart clients. The relation shall be improved, because there are missing links related to standardizing the processes among stake holders of related business in chain, which could come to unified term by digitizing of communication, marketing, manufacturing and selling, finally resulting into partnerships and possible clusters.

This research is preparing to identify the strong points which can make this supply chain reliable and functional by integrating the new young concepts of Reference architectural model of industry (RAMI) 4.0. The SMART factory and the type of shift over are challenging the existing enterprises which need to contain the complete vertical supply chain from creation till selling. Upon reading several existing thesis, the RAMI mode is recognized to contain certain gaps, recognized by experts (Ojanpera et al., 2019) in order to become applicable. Therefore the hereby concepts of RAMI, such as Enterprise Architecture (EA), Enterprises Integration (EI), IoT (Internet of things), CPPS (cyber physical production systems) will be described from the managerial point of view, aiming the applicability into a supply chain for a SMART clothing business, providing SMART products, for SMART clients:

2. CONCEPTS 4.0. APPLICABILITY

2.1 Reference architectural model of industry (RAMI) 4.0:

Represent a tridimensional assembly, whereas the main axis of “X” is given by the product cycle from preparing to production, axis Y is the iteration of elements belonging to internal environment making the product (from product devices to station and enterprise) linked to external environment of clients and suppliers. The 3-rd dimension is the compound of levels consolidating the new type of architecture by introducing the specific elements of Industry 4.0, like business layer processes (from supplier, through manufacturing to clients) which is linked to the level of information (i.e., resulting in documents, product assembly, know-how, data bases construction) both of these 2 layers connected by high tech channels to the level of communication, recently defined by notions of IoT (Internet of things) and CPPS (cyber physical production systems).

Figure1. Reference Architecture model 4.0

Source: adapted from Zezulka (2016, p.151)

2.2. Enterprise Architecture (EA).

Could be recognized as the function to be fulfilled by the management in order to synchronize all the layers (business, information communication) of RAMI 4.0 for up streaming the value of product (axis X-product cycle) and optimize the cost based on the modern tools offered by digitalisation, which allow converting the jobs content in this respect and upgrade the human resources to the level of higher work process design (axis Y hierarchy levels). The simulation of modeling this concept for a clothing manufacturing supply chain is not analyzing yet the involvement of the layers "Functional, Integration, Assets because are not seen as separate layers, working independently, but as a compound function unifying the layers marked in color orange. This layer is covered by managerial decisions, business strategies and unified business directions given by stakeholders. In this particular study the stakeholders are containing all the key players along the supply chain of clothing business, not just for manufacturing unit.

2.3 Enterprise Integration (EI)

Shall be recognized as the unifying virtual link for all the business layers (axis Z), product cycle (axis X), hierarchy levels (axis Y). Meanwhile EI could be translated as the equitation where the SMART factory is acting to produce SMART products for SMART clients (the assumption proposed in this paper work into introduction chapter). By reading the experts Ojanpera et al. (2019), a dilemma is admitted about the complete functioning of last 2 layers of RAMI 4.0 from axis Z. The arguments are realistic, as from a simple employee, he will see a vast pyramid of relationships, special vocabulary and sophisticated equipment's which must be put at work. This is the critical level of specialists who is involved into solving process of compatibility for various IT systems with data loading crossing through suppliers, challenged as well by data security and the delays for final product outcome. Actually what is recognized as major weakness of EI into a RAMI model is the standardization enabling interoperability of different vendors technology which is still under development, besides technology standardization enabling executable business process between networked enterprises is not yet working (Ojanpera et al., 2019).

3. METHOD OF STUDY ON RAMI 4.0.ADAPTED FOR MANUFACTURING AND CLOTHING SUPPLY CHAIN

Taking into account that industrial units are still working with big size of human resources and complex activities mix, this study will assume the change must be done first into manufacturing (recognized into RAMI model as the layer axis Z of business, with the axis Y of hierarchy level of Enterprise) The change shall attain the level of enterprise structure model, a certain culture to be achieved and strategy change to be applied. The judgment will apply through the concept of Leavitt diamond of changes, for production unit and STEEP (social, technology, economic, ecology, political) factors from external environment. These factors are aiming to complete the potential RAMI model connection to the rest of supply chain links, recognized as crossing axis Z-layer of business with axis Y- hierarchy level of connected world.

3.1 Definition and analysis by concept of changes Leavitt diamond

The mentioned concept identify the main elements of changes which are interacting and any difference occurred to one of them determine a change into the whole system of organization. Therefore any change action shall take into account to maintain the balance of the system, otherwise the conflictual relationship will affect the performance of the whole company (Leavitt, 1964). The original shape of the model is presented hereby (Fig.2), followed by the actual status of "malfunction" identified to the actual industrial clothing manufactures, due to the impact of Industry 4.0 (Fig.3). The new industrial revolution is coming with breakthrough shift introducing the digitalization and information technology which is still incomplete adapted to the production

activity flow, either due the reluctant attitude of managers or rejected completely by internal environment. The blockage has the origin into social reactions and human prejudices of jobless and fear of unknown change.

Fig.2 Leavitt's diamond shaped organizational systems model (1965)

Source: adapted from Leavitt (1964, p.323)

Figure 3. Leavitt's diamond in transitional convulsion determined by Industry 4.0 technologies.

Source: adapted from Leavitt (1964, p.323)

By pursuing the impact of Industry 4.0, it is vital to comprehend that this is a complete revolution, not just a technological improvement with local effect. The global society has embraced its benefits as communication gadgets, or working stations (PC) or software platform for data exchanges between various services, but is more than these facilities. The mankind is looking how to manage the phenomenon and for this purpose shall recognize its existence and find the proper tools to stop the conflicts and return to the balance of the system. The reference architectural model RAMI 4.0 prove the concern about the global implication coming with the theoretical construction of enterprise where Internet of Things(IoT)and Cyber-Physical production system(CPPS) dispense their power of shifting all the entities into manufacturing system. The weak point in this case, is the friendly communication for all the "people" layers, most of them having no training, knowledge or expert vocabulary to comprehend the assembly. The complexity of new architectural model RAMI 4.0 of a SMART factory could work if the proper shifting strategies are applied. Further to this analysis, the concepts of Just in Time and Lean Manufacturing must be introduced and applicable practices suitable to the business profile of the industry to see the functionality of RAMI 4.0. A proposed model is presented into the next figure (Fig.4) of interactions of all the elements into Leavitt's diamond having certain Lean Manufacturing and Just in Time strategies as follows:- relationship between task/processes + structure of organization +people is interconnected through Lean Manufacturing;

- relationship between structure of organization+people+technology is interconnected through Lean manufacturing;
- development of future enterprise shall be based on balancing all the 4 components rising strategy of training/rewarding the human resources to be involved, loyalty and responsibility of producing SMART products, under a democratic structure with a continuous creative application of technology Industry 4.0

Figure4. Leavitt's diamond balanced as SMART factory with Lean manufacturing.

Source: adapted from Leavitt (1964, p.323)

Lean Manufacturing principles are ensuring the balance of Leavitt's diamond, creating the premises of managing the smart factory. The management tools are “Just in time “(JIT) decisions to control the process, not the people, who is looking to perform and provide solutions, not waiting for them. A Lean system is built on flatted organization structure where the decisions are taken by even levels of management into different work departments. The entity of “people” is continuously trained and educated to be able performing on various tasks, which is fulfilling another Lean principle by creating the responsibility and commitment for the organization. The manufacturing way of “pull-push” is applied to balance the production flow (as a Lean principle) for effective stocks control and improved productivity. Therefore, by a systemic application of Lean Manufacturing principles, combined with technology facilities offered by Industry 4.0, the entities of Leavitt's diamond belonging to smart factory could be released from the conflicted situation, previously identified.

3.2 Leavitt's diamond changes onto a SMART factory

3.2.1 Changes on organization structure:

The actual pyramid having on top the traditional single decision maker will be turned into a flatten shape because the business become more complex with faster pace of taking multi levels decisions which request ideas and solutions from all categories of personnel. Meanwhile as a consequence of the above changes, the organizational culture will be transformed from “power” type to a “role” type whereas the objectives are committed by the entire community, sharing the tasks, developing co-creation and responsibility for the team. The management “just in time”(JIT) will be applied

with transparency on the shop floor and delegation for supervisory leadership. The change will bring more of the shaping of a RAMI tridimensional model.

3.2.2 Changes on task/organization processes:

The manufacturing principles of Lean must be applied by a mix of pull/push of product stock with a technology management of grouped operations or cellular layout, with digital technology such as CAD/CAM and robotics for equipment. Beside manufacturing optimization solutions as previously mentioned, the other main input activities as product design, development, floor set-up, or planning shall be converted into compatible data for manufacturing in order to reduce wastage of time of loading the system information. The output results need to follow similar compatibility to JIT principle, in order to reduce the product cycle time, as waiting lines for warehousing or delivery to client. Here are certain limits imposed by the particularity of the industry as fashion trend, seasonal changes, client demands which could determine certain delays either for date entry from customer or/and waiting lines at the end of production output. Actually, with all the versatility of IT solutions, any optimization project for manufacturing lines, the development of customized equipment could last around 3 months which risk becoming useless if the product is declared unfashionable with no market demand for next season. These challenges shall be treated with the rest of stakeholders in the supply chain to become SMART suppliers and SMART clients.

3.2.3 Changes on people /human resources involved in the system:

The difference between "blue collars" and "white collar" is becoming more thinner in matter of importance and managerial competence. The micro-management will be more extended which derive from the flatten model of managerial structure. As long as the tasks and making process need multi-skills operators, they become multifunctional in various fields with competence on decisions making as well. The internal policies of the enterprise shall project training programs for distinctive competences and long-range orientation. A SMART factory will be designed with 3 layers of management acting within a flatten democratic structure as top, middle and micro management, capable to keep the system running, without being blocked by the absence of any member. On the other hand, the culture of loyalty and stable employment must be developed, with respect for the working results of individuals. The existing prejudices which are created around the phenomenon of "digitalize or dye", is increasing the fear of losing jobs in favor of artificial intelligence. They have to be eliminated before affecting the spirit of the whole team. In this respect, the clothing industry must struggle with another limit, determined by the working content which more than 60 % is hand driven. So far the range of available automatization is not covering the whole range of operational; therefore a combined competences package must be developed for a suitable team with know-how specialists enabled for middle and micro-management decisions.

3.2.4 Changes on technology systems involved in the system:

This component is subjected to be changed from outside, by the progress records wave of Industry 4.0 and simultaneously by the other components inside the enterprise. Most important direction to be followed by SMART factory management is the internal one. The processes nature request always a customization of intelligent technology in order to function and produce value added products. A software platform which facilitates the work in one department but necessitate multi-entry data, manual filling from other working places is not worthwhile for global efficiency of a company. Many organizations become reluctant to the opportunities offered by Industry 4.0 as they were introduced upon software platforms in different fragments, from different vendors which at the end create the labyrinth of software tools difficult to become compatible. Furthermore an extra cost is added due to exhausting manual data entry and clerk work to be used instead of creativity labor. As it was mentioned in the previous chapters, still there is a lack of technology standardization worldwide, therefore the modernization of technology inside the organization must be seen globally

from the product development, to master production schedule streaming with manufacturing records in real time as follow-up, linked to quality feedback on shop floor and automatic collective of information for the support activities of accounting, maintenance, sales, financial and others. On the other hand, a particular factor should be noticed, for certain customers who are designing their own styles, about the lack of technical knowledge which could link the practical applicability to the design. There are still many design concepts which are done in the traditional way as handicraft sketch in pencil, with manual hand notes, requiring convertible software for digitalization and introducing into system. Upon resuming the previous analysis, a certain conflict could be noticed between the paradigm of versatility requests of the smart factory and the standardization technology. On one hand the digital integration provided by IoT (Internet of Things), big data applications, Cloud system offer real time management of data for production, employee's performance, quality assurance and also remote control on sales, stocks and financial controlling along the whole chain of supply and operations. On the other hand, cyber entities and industrial robots perform the manufacturing process such as drawing shapes and cutting, certain assembly operations (i.e. Sewing, printing, embroidery) or final output for finishing, packing, warehouse distribution. In their case the manufacturing feature is standardization, because the practical “making „process is not virtual, but is conducted by a mix of human-machine action. This one becomes effective following a certain routine. Whether a new product type shall be developed with a different set-up cycle, in most of the cases a new machine configuration is needed, meaning a new IT engineering and testing work cycle. For the apparel industry, this new set-up time could be overlapped along a seasonal production cycle, which for managerial decision could be considered non profitable.

4. MODELING RESULTS RELATED TO RAMI MODEL 4.0 IN CONNECTION TO SOCIAL-TECHNOLOGY-ECONOMIC-ECOLOGY-POLITICAL (STEEP) FACTORS

Extending the judgement from the SMART factory through RAMI model 4.0 toward the rest of components of assumed relation” SMART clothing business, providing SMART products, for SMART clients”, the relevancy of the combination show the disrupting development of each component horizontally wise, but very rarely together integrating the complete vertical chain. Many reasons could explain this heterogeneous structure, starting from the globalization of apparel business spreaded worldwide with separate countries designing & developing the products, others used as manufacturers and then the international retail chains selling the production elsewhere. This relation prove the versatility of the business adapted to 2 of the principles of Industry 4.0 as decentralization and modularity, but their functionality is costly because of information waste information and time delay, due the lack of standardization of data transfer. As long as RAMI model 4.0 is applicable to manufacturing units, the same model shall include the complete supply chain stakeholders either as suppliers or clients, despite the missing standardization technology. As so far, this paper work mentioned the concepts 4.0 going around Industry 4.0, a better comprehension related to clothing industry powered by the influence of STEEP (social, technology, economic, ecology, political) factors could be thoroughgoing study by a short review of industrial waves from 1.0 to 4.0. The steps as presented in figure 5, starting in United Kingdom, end of Eighteenth Century, where the energy of steam boosted textile industry as a major engine of the European and North America industrialization. Next stage is found in the early Twentieth Century identifying the apparel industry as relevant player of the 2nd industrial revolution, wide spreader the mass production model for mass market demand. Modern globalization phenomenon began after the Second World War offered by a crowded market eager to consume, creating the conditions for large plants producing biz size volume of items. While some countries such Italy, Germany or France were able to feed and grow their textile & apparel industrial system through brand-oriented strategies, others such as UK or USA countries, gradually released their manufacturing, sometimes

with high social cost (Bertola & Colombi, 2014). In this period Romania had taken an interesting opportunity to become an important player in both textile and apparel industry, absorbing the available innovations and new technologies at that time, growing an export segment with important contribution to the national income. The development of international trade agreements with growing economies, such as Romania and Asian ones accelerated the process of extensive delocalization. Finally, the electronically controlled production systems identified with the 3-rd industrial revolution facilitate the next level of globalization by CAD/CAM platforms allowing data exchange by customized software. This factor determines emancipation of the market which after the saturation wave of mass production, demand more customized products, but at the same low cost. Beside the competition coming from China and other Asian growing economies, the fashion/apparel industry was dramatically transformed (Djelic & Aimano, 1999). Romanian apparel industry succeeded to gain partially from previous losses in competition with Asian ones, having the benefit of European Union membership and particular initiatives of foreign investors in Romania.

Figure 5. The four waves of industrial revolution.
 Source from DFKI(2011)

As a consequence of massive delocalization followed also by Western European countries, many original regions were impoverished, disconnected from their traditional industry and the short term advantage of low cost outsourced textile/clothing units. The statement made in 2011, by Germany through the chancellor Angela Merkel of the new vision by “industrial renaissance” in Europe is integrating the global unified orientation, of gathering the complete supply chain in the same proximity. This proximity is not necessary in matter of distance, could be translated in virtual terms, highlighting the need of inter-operability standardization for all the components, including the fashion/apparel business.

The proposed relation of SMART factory making SMART products for SMART clients was inspired by the proposed model of Teunissen and Bertola (2018), which could be suitable in connection with RAMI 4.0 model, previously analyzed. The researches and trail-error method reveal the opportunities 4.0 of digitalization Industry 4.0 to make the model more efficient and meanwhile to emphasize certain obstacles which need to be overcome with solutions provided from Internet of Things (IoT) technology/Cyber Physical production System (CPPS).

Figure 6. Integration RAMI 4.0 SMART supply chain.
 Source adapted from Zezulka(2016,p150)

The figurative presentation shown above (Fig.6) identifies the possibility of integration of Smart supply chain with the entire 3 SMART components(product, factory and client) within the tridimensional architectural model RAMI4.0 through its component “World connection”(found on Y axis of hierarchy). The previous chapter analyzed the parameters which need to be changed inside a SMART factory as a starting element to be upgraded and integrated within the RAMI 4.0 model of supply chain through Enterprise Architecture. The next sections are analyzing the other 2 entities of SMART product and SMART client, assuming their most encountered working principles of actual apparel business of decentralization and modularity. These 2 principles refer to the actual business globalization, where the SMART client is the author of SMART product design, but the implementation in production is done by different entities (modularity principle) as the manufacturing unit and supplier of materials which could be totally separate organizations (decentralization principle)

5. INTEGRATION OF RAMI4.0 WITH SMART PRODUCT

The described connecting link within the RAMI model is done by upstreaming the product value from design stage, beyond the permanent task of manufactory efficiency which has no value if the input info from initial stage are not projected based on fulfilling both market driven perspective and production compatibility units. Within this goal, design can become an empowered creative engine interacting in real time with the whole value chain and driving innovations processes gathered in partnership relation with final customer, manufacturing and supplying stakeholders. The infrastructure support come from the same components of RAMI model layers of information and communication, exemplified by Product Lifecycle Management(PLM),Cyber-produce system (CPS), Internet of thing(IoT) and Internet of people(IoP) They are embedding big-data analytics of information exchanged simultaneously with SMART factory and SMART clients. This could allow the seasonal the shift from seasonal creative cycles, generating large and complex product portfolio to continuous design cycles generating small set of products, more focused and consistent cultural and client trend (Teunissen & Bertola, 2018). This is the path enabling the RAMI4.0 model to provide its functionality of last hierarchy level “world connectivity. It means by real time capability of data coming both from supplying networks and customers, could be visualized in real time. Furthermore, always new opportunities are opening up through the active interaction between users and brands. In fact, the trends to customization is enhanced by the social media communication

attitude of contemporary users, expanding the design perimeters including participative processes (Al-Deen et al., 2012; Bollier & Racine, 2005). This enlighten an additional principle of 4.0 model the service orientation logic, which also tends to transform the product design and service design changing DNA of the design practice and products features (Bianchini & Maffei 2014; Stickdorn et al., 2018). With this perspective the horizontal elements of product development and hierarchy levels of manufacturing, the RAMI model 4.0 is represented by products becoming smart, embedding technologies which offer new services and performance to users but at the same time are connected to the world and are trackable for their entire life cycle (Teunissen & Bertola, 2018).

6. INTEGRATION OF RAMI4.0 WITH SMART CLIENTS

The 3-rd element of SMART relation is representing by the client which is the essence of business function, as long the market need is fulfilled and create another demand. The RAMI model integration 4.0 is done through the layers of communication and information which shall end and re-start the cycle of apparel supply chain. In fact the paradigm of smart client need a dramatic change recognized by specialists into the trade quoted previously. The management of software for PLM (product life cycle) is partially functioning on the horizontal integration, in matter of collecting data from retail chains and following products until end-life. Important brands as Fendi, Max Mara, and Michael Kors are already integrating RFID in their products with tracking purpose mainly to fight against counterfeited items or create interactions with customers in their retail space. But the lack of standardization technology emphasized as a weakness for the moment is proven by these examples, because the partial integrating of devices which could offer information from the market miss the fully integration with manufacturing and product technical development. The product design is missing as well in many cases the connection with industrial making process, caused by various reasons either related to a shortage of comprehension or shortage of knowledge of industrial complexity of work. Therefore the implementation of "smart network" paradigm shall need a crucial change also on retail/sales approach still weighted down by expansive and inefficient processes, such as sampling and pre-production. These phases could be consistently simplified by virtual reality, which is able nowadays to generate digital catalogues, or even augmented reality, that can today engage into impressive virtual fashion show (Teunissen & Bertola, 2018). These solutions represent significant cost diminishing in time work load and cost wise with clear benefits in productivity of manufactures (released from the long running production interruption) and sustainability (reduction of materials and other facilities waste). The described integrated system connecting smart factories with smart clients has a potential that goes beyond the mentioned benefits, when seen from design and customer driven perspective. In fact, design could go back towards the core of fashion industry, connecting factories, networks and products, as it was originally design-brand business created, fully recognizable into RAMI 4.0 model.

7. CONCLUSIONS AND PERSPECTIVE.

The specific advantages of digitalization and high tech technology 4.0 are present in all the business entities, partially succeeding to integrate a big groups of activities within the supply chain of apparel trade, but as many other domains, not yet completing the whole cercle. Still remain the challenge of connection a systemic process by achieving 2 principles of Industry 4.0, such as modularity and decentralization. By applying them, the RAMI 4.0 could function as enterprise architecture for smart product with smart factory and smart client. Modularity is targeting the creation/design/development which could work around a smart manufacturing, being client & service oriented with a parallel objective of efficient way of production. Decentralization allow the possibility of spreading the business modules worldwide, but keeping the main specific

elements of product and the cultural assets behind the brand name. The configuration of RAMI model with triple smart entities of product, factory and client enable the adaptation both to small and large scale manufacturing cycles, complying demand variations, quickly adapting to production issues and market change, thanks to virtualization and real-time data feedback. Best practice example could be offered as case of Clerici Tessuto, whereby the old legacy of local industrial community have been revived into modern called "glocal" chains (Guelpa & Micelle, 2007; Buciuni & Finotto, 2016).

In matter of future vision, this profile of apparel & fashion business offered an interesting paradox. The forward thinking is mandatory; in order to create the new trends of wearable items, on the other hand is hardly innovative, claiming traditions, rules and a specific conservative think tank group. Reading a part of McKinsey report, there is a high expectation that in 7-10 years 3D design, virtual prototyping, RFID, automated manufacturing and flexible planning will highly impact the fashion system. It is recognized in many experts groups that no major changes have been made in fashion system yet. Still the old traditional rule of runway where the future trends are presented and focus the attention of magazine which their photos are overruled by live stream and virtual readers. Despite the high security and protection measures taken by the high fashion designers, still fast fashion brands such as H&M or Zara are able to put in few months the catwalk in their stores, much faster than the original models.

Several best practices example will be shortly presented hereafter, aiming to be followed, improved and used as an inspiration for Romanian apparel industry, which need to attain the premium brands, if their representative would like to succeed in the future economic environment. So far only a few small disruptive brands on global fashion industry started to revolutionize the fashion system a bit further. "Maven Women" and "Away to Mars" opened up their creative process to the digital world. In "Away to Mars" aspiring talents from the globe come together as in community to co-create designs via the Internet by gathering idea from social media and the other row models or influencers. The brand provides an online space where designers put up images of the collection they are working on and users can contribute to, advice on and get involved in the design process. Next, each piece is promoted through crowdsourcing technical experts provide the necessary knowledge to create prototypes, oversees the production and finally hosts the sales. This system became a reality during the months of pandemic Covid 19 crisis, as a request of surviving in the name of this business. As a result of STEEP factors influence and environment change, a new form of creation could be developed, likely to be blended in the user experience and innovative technologies/business models associated to 4.0. The fact that wearable garments are able to enhance or to monitor the performance of our own body, and is able to affect human perception and to initiate new ways of interacting with the world might also contribute to this shift. Especially the work of Pauline van Dongen is interesting in this area. She is actively exploring these new dimensions with her wearable garments such as Solar Shirt (2013) and especially Phototrope (2015) where light in clothing reacts when a group of joggers train together. Here the garment actively shapes human perception and action (Smelik, 2017). Nakazato from Japan, is the second designer using wearable technology who has managed to become officially part of the Haute Couture Fashion Week in 2017. By using digital fabrication, he made a system that allowed various materials used for clothing like cotton, wool, and nylon to be combined freely. This system allows building all silhouettes, just like creating a garment from a dress pattern but with more flexibility. No two human bodies are shaped exactly the same. With 3D unit textile parts, he is able to adjust size and shape of a garment to be a precise fit to the wearer's figure, unlike the standard method of making clothes from a sewing pattern (Teunissen & Bertola, 2018). The first step was done, but need to be followed consistently by more key players in this business. But high costs for large operations reengineering and even most importantly, the dramatic needed process of management reorganization are preventing traditional established companies from systemically approaching their transition into the forth industrial revolution. Several breaks were involved due to the seasonal

changes which are decided by elite groups, blocking decision of other stakeholders on medium and long terms in order to develop investments plans for virtualization or automatic manufacturing. A successful example of a omni channel with direct connection between producers and customers is Velasca group, a leather shoes brand founded in 2012. The innovative process involve scouting, connecting and sell archetypical shoes from small high fashion workshops which combine contemporary design with handicraft, ending through e-commerce for smart customers. The entrepreneurs with future vision continue to invest their revenue for artificial intelligence. Finally, this brief analysis of supply chain of apparel business is looking for an integration of the main components product, producer and client under enterprise architecture 4. and also to emphasize the voices of the specialists group concerned about apparel industry. Upon scouting the existing best practices, a set of benefits and also challenges resulting from Industry 4.0 are recognized by other experts into the field. A recent study from 2019, belonging to Gokalp et al. (2018), identify that the agility, reduced operational costs and increased customer satisfaction could be obtained by digitalization facilities, but challenges will occur such as: initial investment cost (claiming financial resources from the entrepreneurs), technical challenges (shortage of experience and IT education), privacy of data (still an issue for confidentiality and data protection), lack of global standard (lack of interfaces and software compatibility to allow data transfer between supplier-producer-customer) and social difficulties (the number of required low-skilled labor force will shift towards more high-skilled complex jobs which require a more intense focus on emerging technologies, to reduce the unemployment). Therefore the set of social, technical, economic, ecology and political factors (STEOP) shall be explored to find appropriate actions for local apparel/fashion industry in Romania in order to see the opportunities allowed by Industry 4.0 but also the threats coming from internal and international environment. The local efforts made by several investors need to be reinforced by an economical frame where the policy makers shall play an important role. Still the Romanian clothing industry has solid premises in matter of know-how, experience in product development and manufacturing and furthermore could be supported through the economic advantage coming from EU membership. This is one of the most achievable opportunities from STEOP (eco-political factor), knowing the actual trend of “industrial renaissance” stated by European leaders for the next decade. In matter of socio-technical factors, certain local strengths features could be identified at the level of existing a background of specialized education and academic institution which has a long tradition but need a serious modernizing to reach the level of comprehension Industry 4.0. Countries such as France and Italy developed a strong education and networking on design and fashion, but Romania could complete them with technical & practical know-how, by further development of industrial prototypes (smart product) and industrial production (smart factory). The above best practice examples were searched and briefly presented, in order to prove the actual awareness about this field on international business community and future perspective. The practitioners which are deeply immersed into technical and creative matters are able to create bridges and by interconnection with the economic system, could use the advantages of this new industrial revolution 4.0. My personal experience of 30 years into the trade with successful projects developed with various manufacturers and customers could be taken as primary data of research and justified this paper work.

The apparel industry shall start to be identified as Apparel 4.0, part of the vast Industry 4.0 and future work will follow in order to perform cost-benefit analysis, pilot studies and a guide line for producers and practitioners in terms of applicability of proposed innovative approaches.

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