Challenges Ahead For Smart Textiles

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Abstract— *According to the literature survey it is forecasted that the next industrial revolution is based on smart system which is complex and multi disciplinary digital technologies. The inherent heterogeneity and the close integration of different components pose new challenges. This article investigates such challenges in textile industrial process by discussing the prevalent concepts.*

Keywords— Textiles, Smart System, cellulosic.

I. INTRODUCTION

The capability landscape of process industries in India has changed several times over the past few decades and continues to be a highly dynamic space. It is essential for process industries to ensure their decision making will yield a long term competitive advantage.

This calls for new approach of improvements in efficiency and decision making through emerging Technologies.A set of emerging technologies such as Big data Analytics, Internet of Things, etc. open up new possibility for the process industries.

The wide reach of the Internet along with rapid advances in miniaturization, speed, power, and mobility have led to the pervasive use of networking and information technologies (IT) across the industries. Increasingly, these technologies are combined with machines, devices, structures to create smart systems that offer functions not previously possible

II. LITERATURE REVIEW

Modern manufacturing facilities are data rich environments that support the transmission, sharing and analysis of information across pervasive networks to produce manufacturing intelligence. (Banaszak Z. and Zaremba M. 2003).

Manufacturing companies are exposed to significant pressures of competition. Worldwide, existing production networks and unpredictable consumer behavior lead to increasingly dynamic production conditions. As aresult, enterprises are forced to be more changeable.(Zaeh, M.F., Moeller, N. and Vogl, W. 2005)

The exponential growth in manufacturing information will be the result ofincrease in the number of devices that record measurement from physical environments and processes as well as an increase in the frequency atwhich these devices record information.(Dolgui A., Morel G. and Pereira C.E. 2006)

Transformation technology can differentiate and the approach to Smart, Safe, Sustainable Manufacturing will help to replace disparate silos of technology with an integrated, information-enabled plant and supply network.(Keith D. Nosbusch2009)

In the market of future only quick and nimble will survive and the requirements for this is innovation in information technology . In the new environment transition and interactions are getting stronger due to innovation . To some extent work pieces can navigate through the processes on their own. These processes generate a large amount of data that is yet to be used to any real extent.(Council on competitiveness, June 2011)

IT-enabled *Smart* system can better respond to strategic imperatives and can revitalize the industrial sector by facilitating global competitiveness, providing radically improving performance, and facilitating manufacturing innovation (Kristianto, Y., Ajmal, M., Addo Tenkorang, R. and Hussain, M. 2011)

When analyzing different manufacturing industries capabilities according to (Booz& co 2011) It was indicated that the automotive and machineries industries lead the way , while the process and basic industries are lagging.

Protection and safety systems have become increasingly complex in high reliability manufacturing facilities, (Ajimotokan, H.A. 2011) and this review considers a quantitative approach to managing protective system

Manufacturing industries strive to out-innovate and outperform the international competition has always been one of NIST's top priorities. Innovation and manufacturing work hand in hand. An innovation ecosystem has many interrelated elements—entrepreneurs, skilled workers, tax policies, to name a few. But without manufacturing, the economic magic of innovation and its benefits to the nation are not nearly as great (Gaithersburg,2012.),

III. SMART SYSTEM

Smart System is a new generation of system architecture that provide real time awareness based on input from machines, people and processes and more that integrate people, processes and knowledge to enable collective awareness and better decision making.

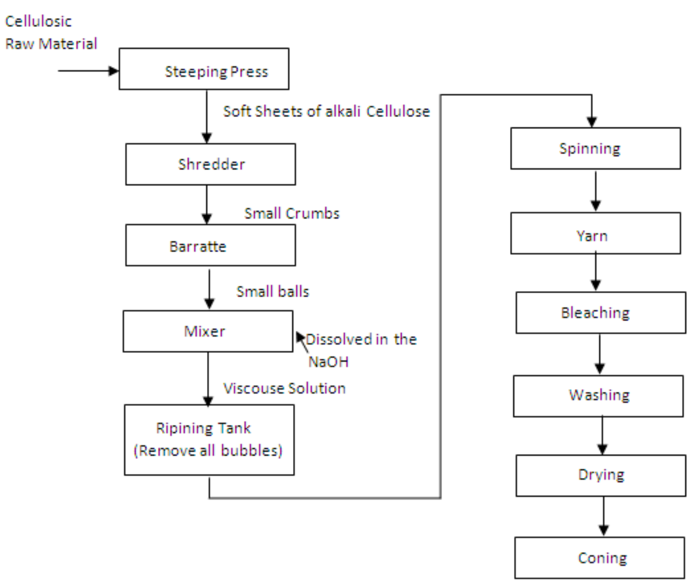
The term smart in Process Industries means that the industries that create and use data and information throughout the product life cycle with a goal of creating flexible manufacturing processes that respond rapidly to changes in demand. It is conceptualized as a system that goes beyond the shop floor and emerge as a revolutionary new capabilities.

The smart system in process industries will be able to determine and identify their field of activities configuration options and production conditions and communicate independently and wirelessly with other units.

Smart System in Textile Process

In this system, machine can communicate to each other and the operators, they can inform about their status and upcoming problems such as maintenance and the factory will reconfigure itself inorder to fulfil the customer requirements. This will lead to an autonomic textile process chain as given below.

Smart System in Textile (Synthetic Fibers) Process



Unit Operations and Unit Processes

The cellulosic raw material (usually sheets made from wood pulp) is charged to a steeping press containing vertical perforated steel plates; and is steeped in a caustic soda solution (approximately 18 per cent) for 2 to 4 hr. at 56 to 62°F. (Pr.).

The excess liquor is· drained off and recovered. The soft sheets of alkali cellulose are reduced to small crumbs in a shredder (Op.). This requires. 2 to 3 hr., and the temperature is maintained at 65 to 68°F.

The crumbs of alkali cellulose are aged for 48 to 72 hr. at 75°F. in steel cans. Some oxidation and degradation occur, although the actual chemical change is unknown (Pr.).

After sufficient aging, the crumbs are charged into the barratte (a hexagonal, horizontal iron drum mixer with a hollow axis). Carbon disulfide in the ratio of 1 kg. of disulfide per 10 kg. of crumbs is added. The drum is rotated for about3 hr., during which the crumbs gradually turn yellow and finally a deep orange and coagulate into small balls (Pr.).

The cellulose xanthate balls are dropped into a jacketed mixer (dissolver) containing dilute sodium hydroxide. The xanthate particles dissolve in the caustic and the final product, viscose solution, contains 61 per cent cellulose and 8 per cent sodium hydroxide (Pr.). If desired, delustering agents such as titanium dioxide or organic pigments are added to the viscose solution in the mixer.

Several batches of viscose solution are blended and ripened for 4 to 5 days under rigidly controlled conditions at 66°F. and until the cellulose approaches nearly to the coagulating point. The percentage of combined sulfur decreases as some xanthic acid splits off and part of the cellulose is regenerated (Pr.).

During this ripening period the solution is filtered several times to get rid of solid material likely to clog the spinnerets and finally placed under vacuum to remove all bubbles which would break the continuity of the filament (Op.).

The solution is fed to the spinning machine. Two types are in general use: the bucket and the bobbin. The 'solution is extruded under pressure (gear pumps are used) through the spinneret into the spinning bath (Op.).

The spinnerets are small caps of noble metal, containing minute holes through which the solution is extruded, Just ahead of the spinneret are the candle filters to remove, in a final filtration, any foreign matter that might clog the holes.

The spinning solution contains 8 to 10 per cent sulfuric acid to neutralize the caustic, 13.5 to 21.5 per cent sodium sulfate, about 1 per cent zinc sulfate to promote crenellation of the fiber, and 4 to 10 per cent glucose to prevent crystallization of the salts in the filaments. The solution from the spinnerets is coagulated in the bath as a filament of regenerated cellulose (Pr.).

If the bucket machine is used, the spinneret head dips horizontally into the spinning solution, several of the filaments are gathered into a thread and fed down to a small centrifugal bucket spinning at 7,500 r.p.m. (Op.). The bucket imparts one twist to the filaments per revolution and removes a greater portion of the occluded bath liquor through perforations in the periphery.

If the bobbin machine is used, the spinnerets dip vertically upward into the spinning bath, and the filaments are wound on a revolving bobbin, (Op.). No twist is imparted to the thread. Yarn from either type is washed to remove the spinning, liquor (Op.).

The bobbin yarn is dried (Op.), twisted, and skeined (Op.). The bucket cakes are skeined without drying (Op.). Both types of yarn are desulfurized by treating with a 1 per cent sodium sulfide solution (Pr.).

Both types are washed (Op.), bleached in hydrochlorite solution (Pr.), washed again, dried, and coned (Op.).

IV. TECHNICAL CHALLENGES

The smart system will contain heterogeneous distributed components and systems of large number that must work together effectively to deliver expected performance.

According to report 90 %machines in factories throughout the world are not connected, and about 70 % machines are more than 15 years old . Reference: 2014 machine report for CISCO and PWC internet of things in manufacturing (2015)

For smart system to operate dependably, safely, securely, efficiently and in real time all components must be able to interact and communicate. These interaction require a high level of system integration and interoperability

Achieving the interoperability of various components constructed in different engineering domains and integration of complex , heterogeneous large – scale system presents a major technical challenge of smart system for process industries.

In the context of smart system for Process industries , the interoperable systems need to ensure that timely outputs, outcome agreements, resilience, data transfers, and technical security protocols are addressed seamlessly within and between components.

This includes aggregating and sharing data within systems as well as across systems and components. Recent research identified Big Data Analytics as one of the key priorities to manage complex processes.

Dealing with uncertainty.

The smart system need to be able to evolve and operate reliably in new environments. Uncertainty in the knowledge or outcome of a process will require new ways to quantify uncertainty. Current method of uncertainty is limited by reliability and accuracy of physical components , the network connections, etc.Ongoing research alsosurrounds the expectations for quantifying uncertainty,that is, attaining perfect resultsgiven the uncertainty of the physical components and approximations in design.

V. MEASURING AND VERIFYING SYSTEM PERFORMANCE

The evaluation challenge is with large scale process industries having massive inter connected physical components, the network connections, etc.

When the system is completed and implemented, changes might arise in the industry, product, or test environment that must be incorporated into the test system.

The major challenge is in measuring and verifying system performance, which is concerned with the creation of methodology and data sets to support validation of smart system If the design phase is more reliable, testing can become more easy and require less time.

VI. CONCLUSION

Smart systems are supposed to play an important role in the design of future Industrial systems. As the smart system evolve they will shift the reliance on human decision making into new, more strategic aspects and will increasingly rely on operational zing human knowledge through computational intelligence. Meanwhile, its technical issues attract more and more attention not only in academe research but also in an advance field of industry.

REFERENCES

[1] Banaszak Z. and Zaremba M. (Eds.) (2003). Special issue on internet based distributed intelligent manufacturing systems. Journal of Intelligent Manufacturing. **14/1**, 5–144.

[2] Zaeh, M.F., Moeller, N. and Vogl, W. (2005). Symposium of changeableand virtual production. In M. Zaeh et al. (eds.), InternationalConference on Changeable, Agile, Reconfigurable and Virtual Production, München, Utz, 3-10.

[3] Dolgui A., Morel G. and Pereira C.E. (2006) Information control problemsin manufacturing. 12th IFACINCOM'04 Symposium. St Etienne, France,June 17–19.

[4] Keith D. Nosbusch, Smart, Safe, Sustainable Manufacturing*: A* New U.S.(Milwaukee, WI: RockwellAutomation, July 2009),http://www.

Industrial Strategy for Competitiveness rock well automation.com/news/get/KDNSmartSafeandSustainableManufacturning.pdf.

[5] U.S. Manufacturing Competitiveness Initiative., Ignite *2.0:* Voices of American University Presidentsand (National Lab Directors on Manufacturing Competitiveness Washington, DC: Council on competitiveness, June 2011),http://www.compete.org/images/uploads/File/PDF%20Files/Ignite_2.0_.pdf.

[6] Kristianto, Y., Ajmal, M., Addo Tenkorang, R. and Hussain, M. (2011), "Astudy of technology adoption in manufacturing firms", Journal of Manufacturing Technology Management, Vol. 23 No. 2, 2012, Booz & co (2011), " Measuring industry digitization leaders andLaggarans in the digital economy"

[7] P. Smith, D. Hutchison, J. P. Sterbenz, M. Scholler, A. Fessi, M. Karaliopoulos and B. Plattner,"Network resilience: a systematic approach [J]", Communications Magazine, IEEE, vol. 49, no. 7,(2011),

[8] Ajimotokan, H.A. (2011), "Towards a rigorous equation-oriented techniquefor sustainable manufacturing safety programme", Journal of Manufacturing Technology Management, Vol. 23 No 1, pp. 76 – 86

[9] G.,. Tassey, R&D and Long-Term Competitiveness: Manufacturing's Central Role in a Knowledge-Based Economy(Gaithersburg, MD: National Institute of Standards and Technology,2012.), http://www.nist.gov/el/msid/infotest/upload/SIMCAprogram2012.pdf.

[10] Schneider, D.; Holtermann, T.; Neumann, F.; Hehl, A.; Aach, T.; Gries, T.: 2012 7th IEEE Conference on Industrial Electronics and Applications (ICIEA 2012). Proceedings Pages: 14949 Published: 2012 DOI: 10.1109/ICIEA.2012.6360960

[11] Z. Zhou, N. Chawla, Y. Jin, and G.Williams, "Big data opportunitiesand challenges: Discussions from data analytics perspectives [discussion forum]," Computational Intelligence Magazine, IEEE,vol. 9, no. 4, pp. 62–74, 2014.

[12] Zeng, T. Li, D. Liu, J. Zhang, and H. Chen, "A fuzzy rough setapproach for incremental feature selection on hybrid informationsystems," Fuzzy Sets and Systems, vol. 258, pp. 39–60, 2015.