F2008-SC-027

Applying Ubiquitous Technologies to PLM of an Automotive Die Shop

[1]Park, Yang Ho, [1]Lee, Sang Seok, [1]Kim, Jong Hwan, [1]Joung, Youn-kyoung, [2]Noh, Sang Do
[1]Department of Industrial Engineering, Graduate School, Sungkyunkwan University, Korea
[2]Department of Systems Management Engineering, Sungkyunkwan University, Korea

KEYWORDS – Ubiquitous, RFID (Radio Frequency Identification), PLM (Product Lifecycle Management), Die, Tryout

ABSTRACT – The ubiquitous technology could be applied to real-time data exchange among diverse enterprise-wide IT solutions in automotive companies, such as ERP (Enterprise Resource Planning), MES (Manufacturing Execution System), QIS (Quality Information System) and PLM (Product Lifecycle Management). It allows a direct and real time link between the physical product and its related information, and the field data in production shops can be collected and synchronized through wireless devices including RFID (Radio Frequency Identification), Auto-ID sensors and USN (ubiquitous sensor network). This paper shows possibilities of applying Ubiquitous Technologies to manufacturing engineering in PLM of an Automotive Die Shop. By real-time information sharing between production shops and engineering departments, we can improve preciseness and responsiveness of engineering from design to production of automotive dies.

INTRODUCTION

As global competition is getting fiercer, reducing cost, improving quality and shortening time in product development and production are becoming the key factors of competitiveness in the consumer-oriented market. Most automotive companies are trying to introduce a new manufacturing paradigm for agile productions. Design, analysis and build dies in automotive companies are critical paths of new car development and production. Saving time in die manufacturing can bring remarkable impacts to entire product development and production of an automotive company, because the die design and production occupies 30-40% of total car development time. So, collaborative and concurrent engineering is necessary to diverse engineering works in automotive die shops such as design, pattern, casting, tooling, and assembly. [1]

PLM (Product Lifecycle Management) is one of innovative manufacturing paradigms which leverage e-business technologies to allow a company's product content to be developed and integrated with all company business processes through the extended enterprise. This provides the ability to make business decisions with full understanding of the product and product portfolio including process, resource and plant. [2]

Recently, ubiquitous applications using RFID (Radio Frequency Identification), Auto-ID sensors and USN (ubiquitous sensor network) are applied more, and this technology can make PLM application to collect and trace data and information in the real plant through entire product lifecycle.

This paper shows possibilities of applying ubiquitous technologies to manufacturing engineering in PLM of an Automotive Die Shop. We propose a new concept and develop a wireless application for tryout of automotive die using ubiquitous technologies.

BACKGROUND

Ubiquitous Technologies

RFID (Radio Frequency Identification) technology is not recent technology. The present labels are developed with respect to the demands of baggage tag and ticketing applications. This means that the proper range of operation is approximately 1 m. Also, there are long-range labels, working in a semi-passive or semi-active mode. The short and medium range systems work with electromagnetic field reading at 125kHz or 13.56MHz. Long range transponders work at higher frequencies. Most of them contain battery for power in operation. [3] Some of the specific benefits that can therefore be expected in initial applications of Auto ID technology within the manufacturing industry include : simpler inventory management, greater product tracking accuracy, more accurate replenishment, counterfeit protection, identification of product diversions, faster retail checkout systems. [4] And, the electronic product code (EPC) is a numbering scheme that can provide unique identification for physical objects, assemblies and systems. Information is not stored directly within the code, rather the code servers as a reference for networked (or Internet-based) information. In other words, the code is an 'address' – it tells a computer where it should go to find information on the internet. [5] The EPC code system is developed for replacing the UPC barcode system, and based on 64bit, 96bit, 256bit code systems. Figure 1 shows overview of the EPCglobal standard to commercialize RFID technology.

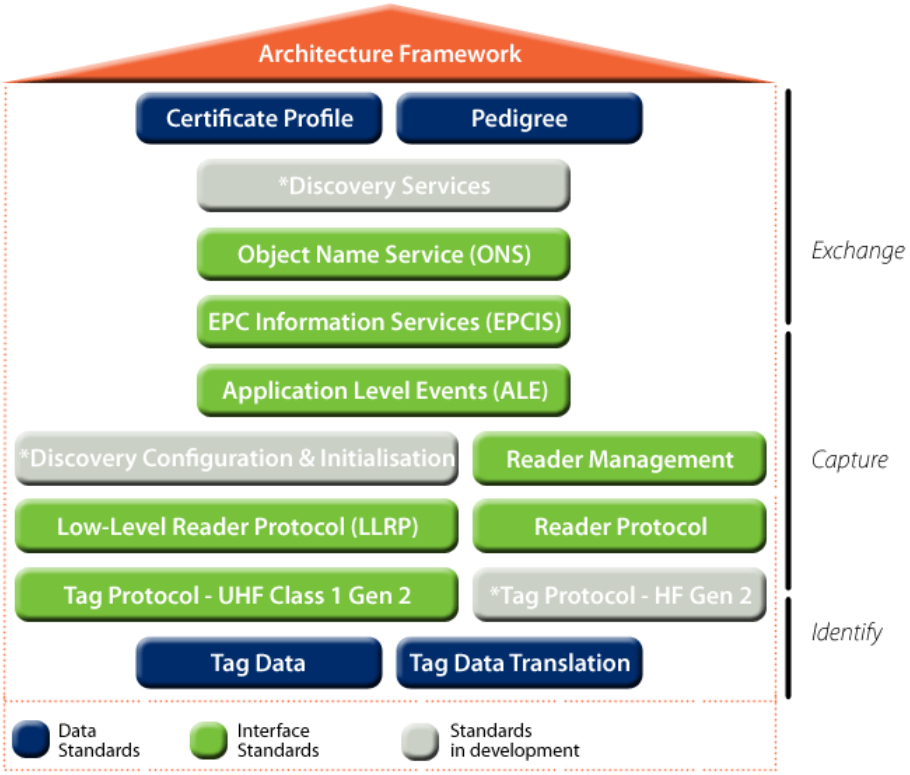

Figure 1 EPCglobal standards overview [6]

PLM (Product Lifecycle Management)

PLM is one of innovative manufacturing paradigms which leverage e-business technologies to allow a company's product content to be developed and integrated with all company business processes through the extended enterprise. All companies need to communicate and manage information with its customers and its suppliers and the resource within the enterprise. In addition, manufacturing engineering companies must also develop, describe, manage and communicate information about their product. This provides the ability to make business decisions with full understanding of the product and process, resource and plant. Although PLM emerged tools such as CAD/CAM and PDM, we need to understand it as the integration of these tools with methods, people and the processes through all stages of a product's life. Especially, the core of PLM is in the integrated management of all product related information and how to exchange this information and knowledge. [7]

Tryout process in Automotive Die Production

Tryout is the last step to evaluate the die as a finished product, and it takes much time than any other activity. It occupies about 40% of entire die production period. In tryout process, design of dies, evaluating process parameters, check quality of produced panels and press conditions should be considered. By taking countermeasures for tryout result, worker can check whether die design is adequate to produce the designed product or not. Unless output product is passed, worker must decide each parameter, such as modifying the conditions of process, modifying the die in the press and other engineering changes.

CONCEPTS AND SYSTEM CONFIGURATIONS

Figure 2 shows the concept of applying ubiquitous technologies to PLM in automotive Die Production. Detailed work flow is described as follows.

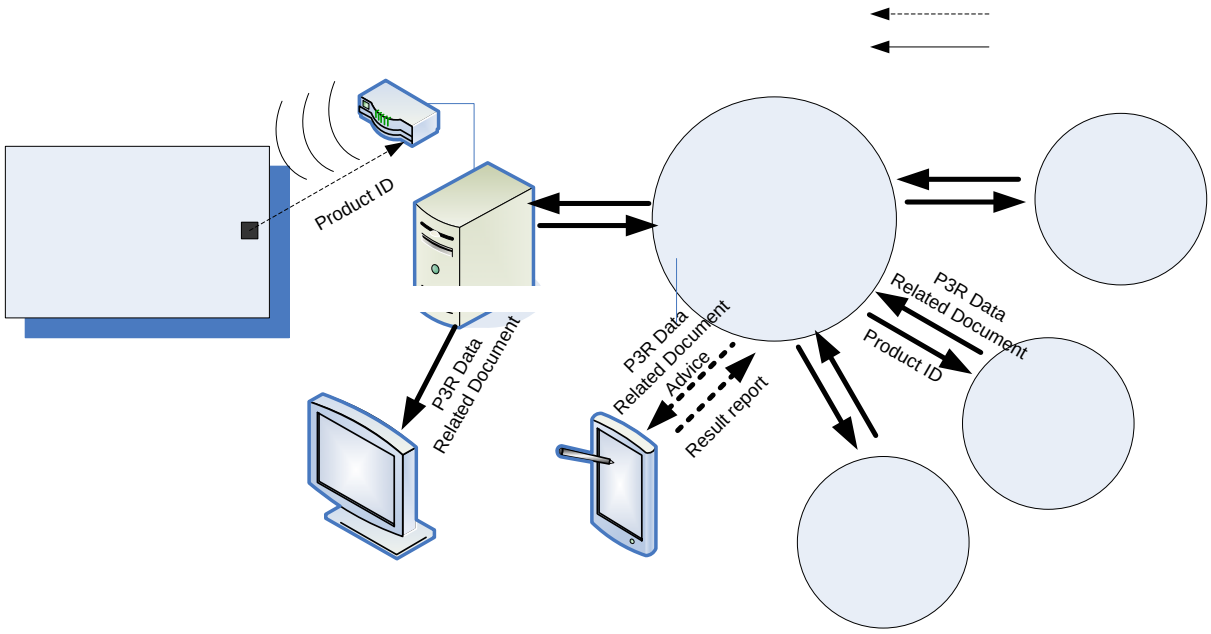

Figure 2. Applying ubiquitous technologies to PLM in Die Productions

When a product on which RFID tag embedded enters into tryout work-cell, a RFID reader reads the product information directly from embedded tag or from PLM system with the search keyword form tag. Product information, product ID sends to RFID middleware server,

middleware communicates with u-PLM hub server. The u-PLM hub server requests related data, model and information to PLM system with product's ID, and this collects diverse engineering information from enterprise-wide business applications, such as ERP (Enterprise Resource Planning), MES (Manufacturing Execution System), QIS (Quality Information System), PLM (Product Lifecycle Management) and so on. 3D model and related technical documents of the product are downloaded to the u-PLM hub server, and it shares them with other user or application. So, during tryout process, a worker always finds the entered product's information and data on display devices. After tryout, the worker can input the result using input devices in wireless. Also, every field data related to product and its production updates into enterprise-wide business solution using u-PLM. All participants including worker, designer and engineer can see and share real-time and synchronized data at the same time, and all information can be monitored and tracked anywhere and anytime.

The u-PLM hub is a kind of middleware for data exchanges between diverse enterprise-wide business solutions. In order to achieve ubiquitous applied PLM in distributed environment and many different systems, it is necessary to define a neutral data schema.

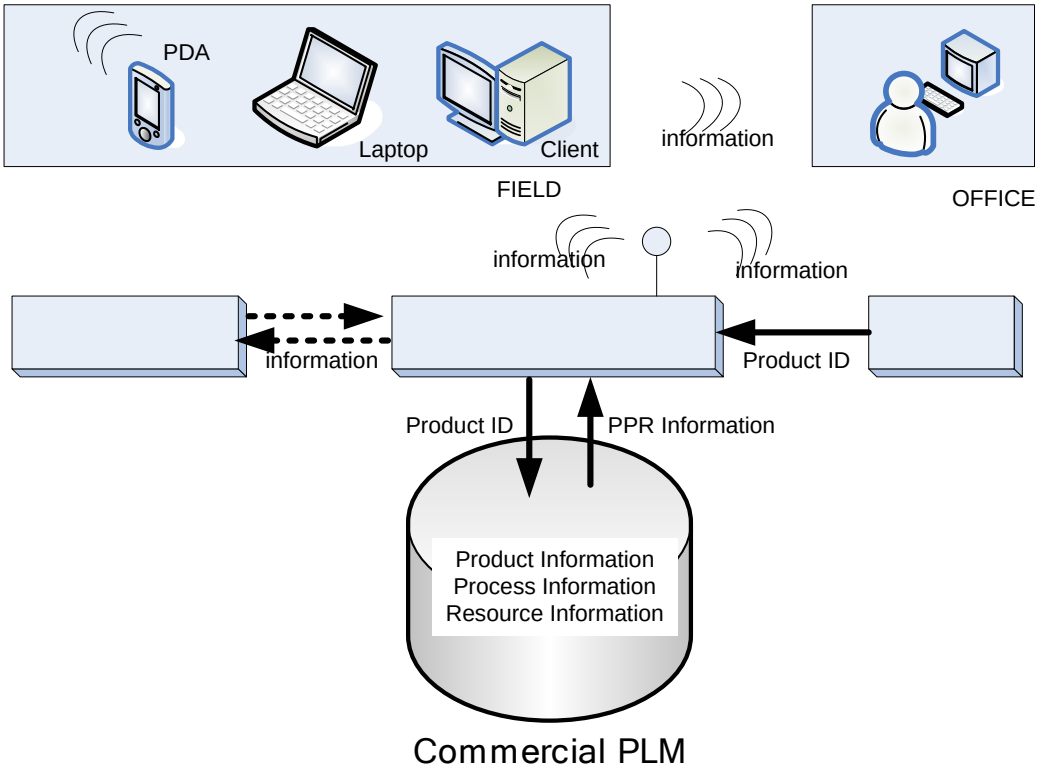

Figure 3. Real time information sharing in PLM with ubiquitous technologies

Manual systems of data collection and capturing are time consuming, prone to errors, and tedious. It is a daunting task to trace and track work in process product in a large manufacturing plant. By applying ubiquitous technologies, real-time monitoring of equipments and automatic gathering of information are possible, and computational and communication capabilities of plant become more an more.

Manual identification sheets are frequently damaged, lost or misplaced, but shop-floor operators are always busy with operations that are supposed to add values to products. So, worker are hardly motivated to type in the data about their operations because such data entry

operations are non-value adding activities. As a result, the information does not accurately and promptly reflect the situations and changes of the situations due to disturbances. Without up-to-date information, it is impossible to make accurate shop floor decisions, no matter how advanced planning, systems and manufacturing equipment are.

CONCLUSION

In this paper, we propose a new concept and develop a wireless application for tryout of automotive die using ubiquitous technologies. The ubiquitous technology can realize real time data exchanges among enterprise-wide IT solutions, and it allows direct links between physical product and its related data and information. Furthermore, field data from production lines can be collected and synchronized by wireless devices and their information networks. Compared with the concept of traditional PLM system, ubiquitous supported PLM can focus on the real time collaboration and concurrent engineering with more emphasis on tracking and managing of information of whole product lifecycle, and possible feedback of information in entire product lifecycle. By real-time information sharing between production shops and engineering departments, we can improve preciseness and responsiveness of engineering from design to production of automotive dies.

Acknowledgments

This work was supported by the Korea Science and Engineering Foundation (KOSEF) grant funded by the Korea government (MOST) (2006-0068-000).

REFERENCES

(1) G. Y. Kim, S. D. Noh, “PPR Information Management for Manufacturing of automotive Press Dies”, Transactions of the Society of CAD/CAM Engineers Vol. 12, No. 6, pp. 452-460, Dec, 2007.
(2) UGS PLM Solutions, “P3R and PLM”, UGS User Conference, 2003
(3) D. Kiritsis, A. Bufardi, “Research issues on product lifecycle management and information tracking using smart embedded systems”, Advanced Engineering Informatics 17, pp.189-202, 2003.
(4) D. McFarlane, S. Sarma, “Auto ID systems and intelligent manufacturing control”, Engineering Applications of Artificial Intelligence 16, pp.365-376, 2003.
(5) H. B. Jun, D. Kiritsis, “Research issues on closed-loop PLM”, Computers in Industry 58, pp. 866-868, 2007.
(6) UGS PLM Solutions, “P3R and PLM”, UGS User Conference, 2003
(7) Steve Shoaf “Innovation that moves markets”, IBM PLM solutions, Dec.,2000
(8) G. Q. Huang, Y. F. Zhang, “RFID-based wireless manufacturing for walking-walker assembly islands with fixed-position layouts”, Robotics and Computer-Integrated Manufacturing 23, pp. 469-477, 2007.