

Organized DFM for total optimization in semiconductor manufacturing – Takashi Sato

Michio Honma/Hiroyuki Itoh/Nobuyuki Iriki/Sachiko Kobayashi1/Sumio Kuwabara/Norihiko Miyazaki/

Hiroyuki Suzuki/Nobuyuki Yoshioka/Sumika Arima/Kazuya Kadota

ta.sato@toshiba.co.jp – itou@selete.co.jp, iriki.nobuyuki2@renesas.com, sachiko1.kobayashi@toshiba.co.jp,s.kuwabara@necel.com, miyazaki.norihi@jp.fujitsu.com, hiroyuki.suzuki@sanyo.com,yoshioka.nobuyuki@renesas.com, arima@sk.tsukuba.ac.jp, k-kadota@aist.go.jp

Toshiba Corporation / JEITA

8, Shinsugita-cho, Isogo-ku, Yokohama-shi, Kanagawa 235-8522, Japan

Phone: +81 -(0)45 776 5273 Fax: +81-(0)45 776 4102

1. Introduction

We have studied issues concerning design for manufacturability (DFM) technology in the DFM product management (DFM-PM) subcommittee, which is one of the subcommittees of the Japan Electronics and Information Technology Industries Association. DFM involves improving design and taking certain issues into account so that device manufacturing is characterized by high yield, excellent performance and good quality, and therefore stable productivity is possible over a long period. DFM can be categorized according to the purpose: DFP (Performance), DFD (Design), DFF (Fab), DFY (Yield), DFR(Reliability), and DFT(Testability). As the manufacturing process of a semiconductor device is complicated, we proposed organized DFM. This paper reports on recent investigations. It presents the outline of organized DFM and indicates the path toward total optimization in a semiconductor process.

2. DFM and total optimization of the process

Figure 1 shows a generalized structure in a business model of manufacturing industry. A sphere of activity is defined as a domain. Then a framework is decided and a platform made. Unit process technology is located on the platform. A workflow for production connects them. Figure 2 shows the case of the semiconductor process. The DFM platform is specified in the framework for a design and a process, which has layered relation with AEC/APC. The AEC technology is according to a process control model in equipment. The APC technology is according to performance modeling, or integrity, of process module. The quality management technique uses TEG for transistor characteristics. DFM technology is taking manufacturing factors into design.

By e-Manufacturing using IT technology, innovation of engineering work is possible, namely, integration of factory management, process control, equipment control, and quality control. On the workflow, there are gates for quality assurance. As shown in Fig. 3, a product is released to the market after the final assurance test. The quality that a customer needs must

agree with the quality a manufacturer assures. Because of the layered platform structure, the quality of process also controls hierarchically. In-depth stabilization of the inner parts of equipment and module tools is thoroughly performed using EEQA and EEQM (FDC) .

The production line consists of a manufacturing platform and an information platform. Organizational IQ would indicate whether the platform is operated sufficiently. Here, organizational IQ has five axes: external information awareness (EIA), effective decision architecture (EDA), internal knowledge dissemination (IKD), organizational focus (OF), and continuous innovation (CI). Meanwhile, the degree of condensation and the degree of coupling can be made into indexes for the efficiency of software employment of a platform. The degree of condensation can express the numerousness of the function in a module and the informational relation. The higher condensation is better. The degree of coupling can express the connection between modules. The smaller coupling makes the maintenance easier. Moreover, a proper scale is important for it. To obtain good values for these indexes, new sophisticated DFM needs to be managed. Device manufacturers and various suppliers should aim at cooperative development. DFM-PM is preparing to propose guidelines for that purpose.

3. Conclusion

DFM needs to consider the relationships among modules and to optimize systematically and organizationally. In order to make DFM more sophisticated, the conventional approach of handling DFM as a unit technology needs to evolve into a new approach that seeks total optimization by effectively linking various elements and functions in a company or in the industry.

References:

1. T. Sato, et al, "Organized DFM," Photomask Japan 2009 [7379-112], Yokohama Japan, April 2009. Proc. SPIE 7379, 737934(2009).

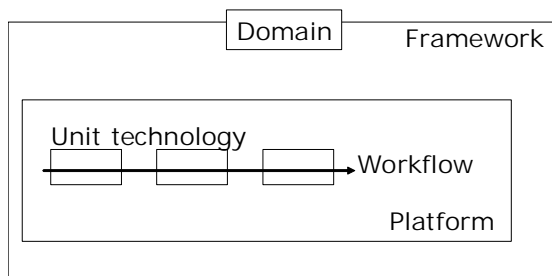


Figure 1. Organizational feature

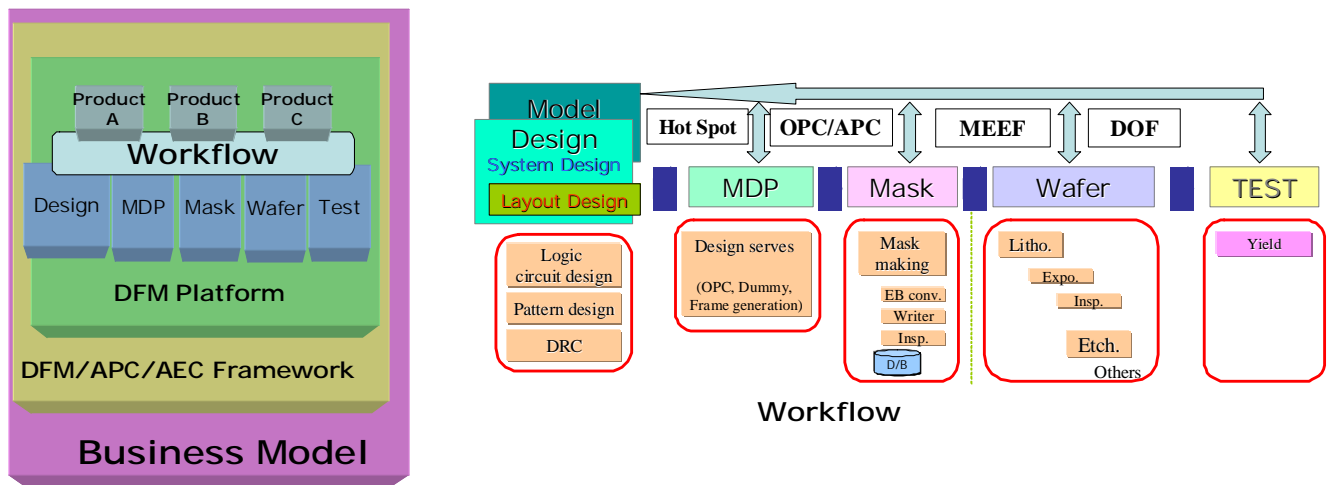


Figure 2. Business model of semiconductor and process and detailed workflow of DFM

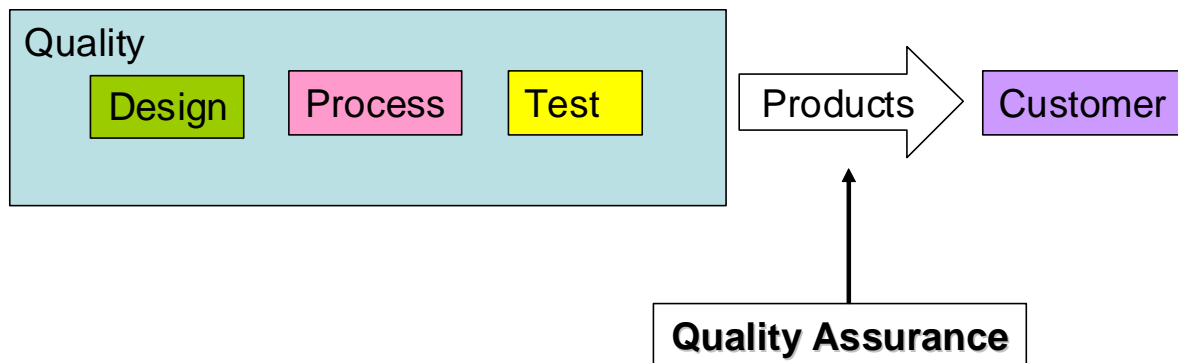


Figure 3. Quality assurance of semiconductor products