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VISIONS

TEFEN'S NEWSLETTER FOR THE SEMICONDUCTOR INDUSTRY

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Editor's Corner

A New Operations Model for the Semiconductor Industry

The operations model for the semiconductor industry has become more complicated as a result of the economic downturn. When the next upturn occurs, which seems to be getting closer and closer, we will be facing a new operations model that will be characterized by multiple alternatives throughout the supply chain.

The foundry sector is growing fast, adding more pure foundry capacity. At the same time, we are seeing more non-foundry companies start to sell their extra capacity to other companies and developing their own mini-foundry businesses. All of these developments will create more manufacturing options for semiconductor companies.

At the same time, this situation will also increase the competition within the industry. The operational challenges will tend to come from two directions. The first will be from managing and controlling the supply chain more efficiently. The second challenge will be to develop the ability to efficiently run a Fab with multiple products, processes and clients. These Fabs will also need to be able to compete with the other fabrication alternatives listed above.

The survivor will be the company that can successfully adapt to this new operations model and redesign their operation to support it. In this newsletter we will present a few of the tools and methodologies that will help to improve the performance in this new market.

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Elements of a Successful Foundry Start-up

Teamwork Creates Semiconductor Intl's 2002 Fab of the Year

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During the start-up of its Fab 1 foundry, SilTerra, working in partnership with LSI Logic and Tefen Ltd. performed full fab construction, equipment installation and qualification in record time. The production line produced its first yielding wafer in 89 days from the first tool move-in and the first revenue yielding wafer was produced two weeks ahead of schedule.

SilTerra was founded in December 1997 as one of the first foundries established in Malaysia. The foundry, which produces 0.25 µm CMOS devices on 200 mm wafers, was built in close coordination with LSI Logic Corporation (Milpitas, CA). Tefen was introduced in the early stages of the project and contributed to this success story in a number of ways that are outlined below.

Production Resource Planning

In order to achieve a monthly production capacity of at least 30,000 wafers (200 mm), SilTerra compiled a preliminary list of required equipment. This list used tool-specific information available in LSI's Industrial Engineering (IE) database and assumed certain technology, product mix and equipment throughput. The team used Tefen's Visions™ capacity planning software. Visions takes equipment and process metrics such as throughput (units/hr), tool availability, test wafer usage, and process flows and calculates the required tool count, identifies bottlenecks and allows the user to perform "what-if" analysis for multiple time periods. The number of operators and technicians needed for fab ramp-up was determined by using output from Visions together along with Tefen's staffing benchmark data.

Micro Project Scheduling

Using the Macro schedule, the next step was to developed a detailed micro-level schedule. The main building block used was a tool template that incorporated all of the activities required for receiving, installing and qualifying each production tool and its support systems. SilTerra's management set a target period of 40 days for move-in, installation, and qualification of each major piece of equipment. After completing the first round of tool templates, tool dependencies were identified and incorporated into the schedule. For example, many process tools could not be qualified without some key metrology equipment, and it was important to capture these dependencies.

Based on the critical path of the micro schedule, we developed a detailed move-in plan. The goal was to move-in

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seven tools during a 24 hour time period. Some contingency plans were developed with alternative move-in paths, equipment and resources. Different manufacturing areas and equipment were prioritized to allow cleanroom builders to allocate their resources more efficiently. Tefen was in charge of this complex schedule.

Move-in and Installation

To minimize the impact of delayed flights, bad weather, transportation equipment breakdown and other unforeseen events, several air conditioned warehouses were rented close to the fab. Details of the move-in plan, such as move-in path, moving equipment, de-crating, wipe down and cleaning were clearly defined and several specifications were developed. We moved in several small tools before the official start to help streamline the process and identify potential problems and "show stoppers."

After months of careful planning and preparation, SilTerra began their move-in activities in September 2000. The operation proved extremely successful. Workers exceeded their initial goal of moving in seven tools per day. In one month, more than two hundred pieces of equipment and their support components, together with hundreds of pumps, panels and other items were moved into their final locations in the fab and sub-fab.

Utilities Availability and Support

One of the major challenges was to ensure that the basic utilities needed to operate the equipment (such as electricity, exhaust, and drain) were ready on time. Several construction delays caused the schedule for these utilities to fall behind the tool installation schedule.

To minimize the impact of these delays on the overall plan, all efforts turned to providing high priority FOAK (First Of A Kind) tools with the basic utilities. To speed the recovery process, several cross-functional teams were formed, each consisting of construction, hook-up, facility and production engineering representatives. The main responsibility of these teams was to ensure that utilities were available on time, in the right amount and within the specifications set. These measures minimized project delays caused by base build activities.

Tool Installation

Installing equipment in a cleanroom environment is a challenging task. Many cleanliness requirements need to be met before installation teams can begin assembling the tool and connecting it to the different types of utilities within the fab.

SilTerra developed a detailed schedule for the "pre-facilitation" of major equipment, making sure that all facilities were ready at the point of connection (POC). One of the main advantages of such a schedule was that it allowed the installation and hook-up crew to accurately estimate their workload and balance it against available resources. This plan allowed maximum utilization of scarce resources and was later linked to the overall project micro schedule for daily update and activity tracking.

Line Qualification

Each manufacturing module (Photo, Etch, CMP, etc.) was internally qualified before line qualification began. This ensured that equipment in one module would perform well with the other tools in that module. The Integration group was in charge of this operation and managed to qualify the production line and produce the first yielding wafer in 89 days, a world record in the semiconductor business. The first revenue wafer was produced two weeks ahead of schedule and SilTerra is well on its way to ramping up to 30,000 wafers per month by 2002.

Key Success Factors

The key factors that contributed to the success of this project were SilTerra's strong management commitment, the support from LSI Logic and teamwork.

SilTerra's management was committed to building a world class manufacturing facility in the shortest time frame in the most effective way possible. Management determined a set of milestones and incentive plans to reward people who contributed the most to the project.

SilTerra promoted a "schedule oriented" culture and all activities were measured against the micro schedule targets. Managers, engineers and contractors were required to know the schedule and major milestones. All contractors drove their efforts toward on-time completion of tasks and main contractors were required to present their progress reports during the daily operations meeting.

As the technology partner, LSI provided training to SilTerra engineers and managers. When fab construction began in Kulim, Malaysia, LSI provided its expertise and helped SilTerra with different construction problems. A team of experienced LSI's engineers and managers stationed in Kulim assisted SilTerra with rapidly installing and qualifying the equipment.

The broad scope of this project made teamwork a necessity. Various teams of experts were created to handle multiple tasks. For example, move-in and installation of tools in each manufacturing module was handled by a team consisting of equipment engineers, module IE's, module managers, hook-up contractors and facility engineers.

Conclusions

The factors described above outline a very aggressive, but realistic, fab building project. They have proven that in order to succeed in a project of this magnitude, teamwork and management commitment are critical. The success of this project is also proof of the value and contributions that the Industrial Engineering discipline brings to a project.

We believe that exceptional projects can not succeed by following conventional methods. In pursuit of success, companies and individuals must develop new techniques and methodologies. They have to plan for all possible situations and accept nothing but success. ■

Tomorrow's Technology, Today's Demand

How to Integrate R&D Wafers into Production Fabrication

By Haim Albalak, Tefen Ltd.

Research and development is the only way to move your business forward, but it isn't easy to manage. Anyone who has tried to integrate R&D wafers into a production fabrication facility knows how tricky it can be.

Departments may argue. Resources may not be available when they're needed. Work-in-process could flood the production line. If you experienced any of these scenarios — or numerous other potential problems — you are not alone.

Your goal is to introduce new processes and products as quickly as possible, while you continue to serve existing customers well. But how?

Tefen consultants have observed many approaches, and they've come up with solutions and recommendations that can help you integrate R&D into production with a minimal of frustrations and complications.

Sharing Management of the Fab

Many companies attempt to integrate R&D with production by having the two departments share management of the fab. This approach works poorly for a variety of reasons. Both staff efficiency and equipment utilization tend to be low because of frequent changeovers and the extra cleaning and tests required. Managers must wait a long time for test results, and scheduling can be extremely difficult.

Such problems make sharing management of the fab a costly strategy. This arrangement also reduces the incentive for the R&D department to carefully plan and monitor its budget for the project. Plus, expensive R&D resources are used to run production — a waste of unique resources.

Another drawback of sharing management responsibility is that the production and R&D departments use two different indicators of performance. Production is measured by fab performance, while research and development looks for the development results. Success becomes difficult to measure as priorities conflict.

Shared management can also cause conflict among staff. Communication issues come up frequently as workers adjust to a temporary shift in roles and responsibilities. Managers may argue over whose priorities come first, and executives may not hold them accountable for running the fab efficiently and effectively.

Because time-to-market is so important in the changing semiconductor industry, fast cycle time is key to successful research and development. The shared management approach's poor cycle time performance can affect the time it takes to get new products and services to the customer. For all these reasons, this approach is not recommended.

R&D in Charge

When the R&D department runs the fab, objectives are clear and conflicts do not normally arise between R&D and production staff members. Managers and workers are accountable for their work, and everyone involved in the project knows who is responsible for the fab. Another advantage of this approach is that the R&D department has some incentive for controlling its budget. However, having the R&D managers run the fab tends to be too expensive and inefficient.

When the R&D Department is responsible for the Fab, equipment and staff utilization tend to be low. The research and development department ends up using its resources for production purposes, costing the company unnecessary dollars. This strategy is both costly and slow, but it does have some advantages.

A Better Solution

The recommend third approach is: letting production run the fab while serving the R&D department as a preferred client with special needs. In this instance, the Fab should use state of the art tools to manage productivity. Tools such as WIP scheduling, BN management, accurate models, clear work procedures and developing meaningful performance indicators are all extremely important. This strategy offers a number of advantages.

First, performance tends to be high, as the fab is run by manufacturing experts who are trained to make production flow as smoothly and efficiently as possible. The resulting short cycle time improves time-to-market for new products. Objectives and responsibilities are clear, making it easier for both departments to measure performance and reducing conflict and miscommunication among staff.

When the production department serves the R&D department as a client, companies are better able to control costs. Expensive R&D resources are used only for research and development purposes, and are not under utilized on everyday production. The research and development team must carefully plan its project — including the budget — in order to get optimal service from the production department. Because resources are used efficiently, the cost per wafer tends to be relatively low. This structure allows you to deliver new products to your customers as soon as possible, so your business continues to grow and prosper. ■

VISIONS™
Wafer Cost Model

It is vitally important to know your production costs and develop the business practices to remain competitive in the marketplace and increase profitability. In addition, knowing individual wafer costs and the factors that influence these costs improves your ability to control and reduce allocated budgets for all items. You can leverage the market to your benefit by pricing your product in line with your actual cost of production. Visions™, Tefen's capacity analysis tool, includes a Wafer Costing tool that uses solid analysis methodologies to help you understand your cost objectives and to reduce the overall costs affecting your bottom line.

Employing an ABC (Activity Based Costing) methodology, Visions™ uses a variety of inputs to determine your cost per wafer for each product type you sell. All of the information is kept in an analytical tool that is easy to maintain and use.

There are many benefits from Visions™ ABC cost modeling that can improve your bottom line:

- Accurate cost structure and better pricing strategy
- Cost reduction and what-if analysis capabilities

The ABC cost modeling tool uses all costs related to the manufacturing of your product and breaks it down into cost drivers such as:

- Production floor space
- Production volume
- Equipment usage
- Direct labor hours
- Material
- Depreciation
- Additional cost drivers can be defined by the users

Tefen and ActionBase Corporation:

Delivering Project and Process Execution Management Solutions for the Semiconductor Industry

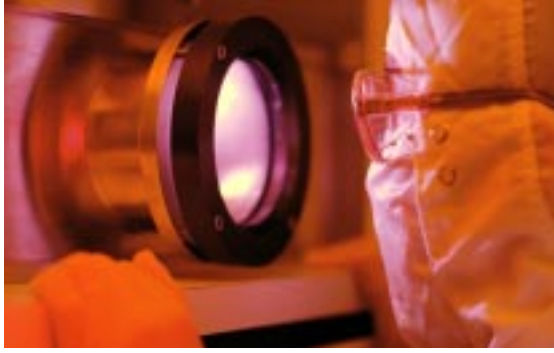
Tefen and Action Base announced a strategic alliance to deliver custom solutions for companies to efficiently manage the execution of their projects, processes, meetings and tasks, including those items that span across organizational boundaries.

Examples of implementations of ActionBase within the Semiconductor Industry:

- The Automation Department of a semiconductor manufacturer, deployed ActionBase to coordinate the audit process before full plant operation. The team responsible for plant setup routed thousands of issues and action items through the ActionBase system. Team members gained clear visibility into problems and were able to resolve the issues quickly. The company realized more than 20% timesaving in the setup cycle, a reduction worth several million dollars.
- The IT Department of a semiconductor manufacturing company is using ActionBase as the platform for managing short term initiatives. The team has used ActionBase to manage software installations, department moves, headcount changes, and to record and track group meetings. This department attests that employees save between 3 to 4 hours every week by using ActionBase.
- The Program Management Group at a fast growing optics and semiconductors testing and manufacturing firm is using ActionBase to manage a highly complex four-step "new product introduction" process. The program management department coordinates the actions of marketing, research and development, engineering, testing, and manufacturing departments throughout a life-cycle of a new product. Custom forms and templates model the complex business process and provide structure and visibility to all team members. Team members have experienced savings between 5 to 10 hours a week and are continually identifying new applications for ActionBase. ■

Optimal Fab Operation Design

There's More to Operation Design than Meets the Eye



By Danny Segev and Haim Albalak, Tefen Ltd.

In the manufacturing and business worlds, the term "operation" encompasses all the resources and activities needed to achieve a company's objectives. Setting up an operation correctly requires specific elements, elements that become the cornerstone of a well-designed operation. The only way to transform a company into an world-class organization is to design and define all of these elements with a sharp focus on the company mission and its objectives.

Many companies focus primarily on the physical elements of the fab operation, such as layout, tools, material and staff. The importance of good design for those elements is obvious-a new facility requires a good layout. A tool list is based on accurate capacity models and adequate staffing.

There are, however, other elements that are key to the operation but tend to be overlooked in the initial design phase. This situation is very common in the semiconductor industry, which is driven by technology and expensive facilities with exponentially priced equipment.

Often, the neglected areas end up being the "soft" elements of the operation. Areas such as business processes, work methods, and job definitions. These elements are essential for both new and existing organizations. Their development, though, tends to be based on constraints, company history, power balance, and some limited structural design.

Key Elements of Fab Operations Design

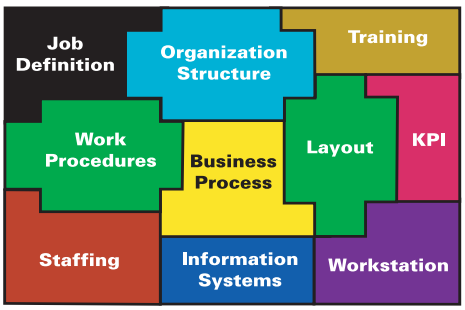


Fig. 1 Elements of a successful operations design

What elements make up a well-planned operation for a fab? Often times it can seem hard to define. Clear job responsibilities, business processes, work procedures, key performance indicators (KPIs), information systems, staffing, and training are all-important.

There are many stages to the successful design of an operation. The first step is to define the company objectives. Clearly defined objectives will help build a road map to productivity and success. First, identify the specific departments within the organization and the areas of responsibility for all functions of the operation. Those areas will include manufacturing, maintenance, engineering, planning & control, and facilities, among others.

The next step is to define the responsibilities of each job. Focus on essential jobs within the organization and develop a job description for each. Consider the job's areas of responsibility and what qualifications are needed for the position. Determine what authority the person doing the job should have and develop a basic structure for reports and meetings.

Define what type and how many staff is needed for each function and for each phase of the ramp plan. Then develop a recruiting and training plan based upon those requirements. Designing key performance indicators (KPI) that support the main goals of the organization help manage and track productivity. Managers can develop such indicators by defining what to measure, how to measure it, and what action is required of each different process. Then create management reports to assess the results.

Next define business processes within the organization. Start by asking these questions for each process:

- What needs to happen?
- When does it need to take place?
- Where should it take place?
- How should it happen?
- What information is required?
- How should we monitor and control the process?
- How can this operation improve the overall performance?

Business processes cover many areas, including material management, production planning, production control, manufacturing, maintenance, facilities, sales and distribution, engineering, quality management, information systems, and disaster recovery procedures. In addition, we should consider how products would be transferred from development to manufacturing.

Together with business processes, creating clear work procedures is a good way to boost efficiency. Create a set of procedures for the entire organization based on the best known methods in the industry. Examples for work procedures are: a closing check list, a procedure for manual operation when automated systems fail, a tenant improvement request, and shift change procedures. Procedures for wafer start scheduling, yield lost investigations, inventory cycle count, lot transportation and staging and tool preparation are just a few of the procedures that should also be designed.

No operation design will function well without the right type of information system in place. What systems does your company need? Possibilities include MES, ERP, supply chain management, maintenance management, exception management, yield management, and document control systems. Do the research necessary to make sure the operation has the information system support it needs.

When we consider the "soft" side of operation design, the result is a business that functions smoothly and efficiently. Taking business processes, job definitions, and related elements into account means a more successful fab operation from the bottom up. ■

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Tefen Designs Kulicke & Soffa's New Facility in China

Kulicke & Soffa, the world's largest supplier of semiconductor assembly equipment, is expanding its operations in Asia and shifting a portion of its manufacturing of capillaries, saw blades and selected test products to a facility outside of Shanghai. This move supports a corporate decision to establish a supply chain in China for the Company's equipment products.

Tefen has had a long relationship with Kulicke & Soffa, supporting its facilities in the US and in Israel with projects that include productivity improvement, capacity planning and functional layout design.

The design of the new facility started with a master plan, identifying the requirements of each department and product line and their location within the facility. The next step will be a detailed layout design. As part of its standard layout methodology, Tefen analyzes the material flow, capacity, affinities and other requirements to create a design that will support productive operations.

Tefen and Kulicke & Soffa have teams in different K&S sites across the globe, working to incorporate the requirements of future residents of the China facility. The facility is planned to become fully operational in 2003.

Tefen Offers Deals for Semicon Attendees

Semicon West is quickly approaching and we would love to save you some money. Tefen is excited to be exhibiting at the San Francisco Wafer Processing Expo in Booth #5019, July 22 - 24. If you have not already registered to attend – we would love get you into the Expo Hall free! Send us an email at visions@tefen.com or call 800-9TEFEN9 and request your discount coupon good for free registration (a $50 value). We look forward to meeting you in July!

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