

Situation

The Microsoft Home and Entertainment Division (HED) had to reduce the cost of producing the Xbox 360 GPU, and it had to beat the competition to market.

Consequently, the SiOps group within the HED had to set up a fabless semiconductor manufacturing business and deploy a solution with powerful MRP and supply chain management capabilities, and it had to meet an extremely aggressive schedule.

Solution

Microsoft Dynamics AX delivered, out of the box, virtually all of the MRP and supply chain management capabilities that the SiOps group needed. The SiOps group met its aggressive deployment schedule and is implementing business process improvements.

Benefits

- Quick deployment to meet market requirements
- 10 percent reduction in component inventories
- 126 percent return in development savings on the \$950,000 investment
- Low cost of ownership
- Worldwide capabilities

Products & Technologies

- Microsoft Dynamics AX
- Microsoft BizTalk Server 2004
- BizTalk Accelerator for RosettaNet

Managing Fabless Semiconductor Manufacturing by Using Microsoft Dynamics AX

Technical Case Study

Published: March 2006

By using Microsoft Dynamics™ AX, the Silicon Operations (SiOps) group at the Microsoft Home and Entertainment Division (HED) set up fabless semiconductor manufacturing to reduce the cost of producing the Graphics Processing Unit (GPU) for the Microsoft® Xbox 360™ video game and entertainment system and to help beat the competition to market.

The Microsoft HED had to reduce the cost of producing the next-generation Microsoft Xbox 360, especially the custom-designed GPU. It also had to get the new Xbox 360 to market in time for the 2005 holiday season. To reduce the costs of producing the GPU, the new SiOps group within HED constructed a virtual silicon chip manufacturing business, where it designed the chip but outsourced the chip's manufacturing.

To manage this virtual silicon chip manufacturing business, the SiOps group implemented an enterprise resource planning (ERP) solution based on Microsoft Dynamics™ AX (formerly Microsoft Axapta). The group was able to quickly deploy Microsoft Dynamics AX, and then use it to model the entire business, manage production processes across multiple vendors, and help identify where process improvements could lead to cost savings.

The Microsoft Dynamics AX solution that the SiOps group implemented can aid other organizations that need a solution to manage their own outsourced manufacturing processes. This case study is intended for chief information officers, IT directors, solution architects, and technical decision makers who need a cost-effective and easy-to-deploy ERP system.

Background

For previous versions of the Microsoft Xbox® video game system, the HED purchased finished GPU integrated circuits from a vendor that both designed and manufactured the chips (a *turnkey* vendor). To reduce the cost of the custom-designed GPU for the next-generation Xbox 360, the HED decided that it had to own and control the design and manufacturing processes.

Manufacturers of semiconductors can both design the chips and manufacture them in their own manufacturing plants, or they can design the chips and then outsource the manufacturing to another company or companies (generically called *contract manufacturers* or CMs). A chip manufacturing plant that has no research or design facilities is called a *fabrication plant*. A *fabless* manufacturer focuses on the research, design, and development

of semiconductors, but outsources the production of the chips to fabrication plants and other CMs. Hardware manufacturers are finding it increasingly cost-effective to set up fabless semiconductor manufacturing organizations.

There are two models of fabless semiconductor manufacturing. In the application-specific integrated circuit (ASIC) model, the vendor handles the physical design of the integrated circuit, and it handles all of the manufacturing steps. In the customer-owned tooling (COT) model, the fabless manufacturer designs the integrated circuits to the physical design level and then manages the CMs through each of the manufacturing steps: fabrication, packaging, assembly and test, and delivery to the unit assembler.

In fabless semiconductor manufacturing under the COT model, cost savings result from the discovery and implementation of efficiencies in the chip design, production, and delivery processes. Over the life of a chip's design, these savings can be substantial. The HED realized that manufacturing under the COT model would enable Microsoft to accrue those cost savings. In the previous turnkey manufacturing model, in which Microsoft purchased finished GPUs, those cost savings accrued to the turnkey vendor.

Situation

For fabless semiconductor manufacturing under the COT model to be effective and produce the desired cost savings, the SiOps group would have to perform scrupulous material requirements planning (MRP) and tightly control every aspect of the supply chain: managing the CMs (including work-in-progress [WIP] tracking and yield management), balancing production with demand, and maintaining optimum inventory levels. To reach those levels of MRP and supply chain management, the SiOps group had to identify and deploy an ERP solution that offered powerful MRP and supply chain management capabilities.

The SiOps group needed an MRP solution that would provide forward supply projection (the ability to determine order dates from required delivery dates) and reverse bill of material (BOM) management (the ability to break down the GPU delivery requirements into production schedules). The SiOps group also had to perform what-if analysis for various MRP parameters, such as pay points, prices, yields, and lead times.

To perform accurate supply chain management, the SiOps group would need to take into account the capacities of each supplier and manage capacity commitments across multiple suppliers. The solution would need to interoperate with different supplier capabilities and standards, modeling different business processes and employing different communications formats, such as RosettaNet, XML, electronic data interchange (EDI), Microsoft Excel®, and flat files.

To gain visibility into the supply chain and identify where to increase efficiency, the SiOps group had to track WIP at several stages of completion. Tracking WIP would require near real-time data from multiple vendors' systems. The SiOps group had to trace each GPU by lot, genealogy by lot, and shipment by lot. Also, the SiOps solution would need to handle some suppliers who do not work under the COT model.

The SiOps group needed a solution that could be integrated with existing systems at Microsoft and at the CMs. On the Microsoft side, the corporate ERP system, SAP R/3, had to handle the execution of purchase orders and the financial tracking. On the CMs' side, the SiOps solution had to communicate in near real time with multiple vendors' MRP and shop-

floor systems. This communication would supply the needed visibility into the manufacturing processes.

It was imperative that the SiOps group met the schedule required to launch the next-generation Xbox 360 by its target date. The group had to set up the whole fabless semiconductor manufacturing operation, and have it running smoothly, under an extremely aggressive schedule. The group could not afford to spend a lot of time on custom programming. It needed a solution that delivered most of the needed functionality out of the box. And it could not afford the time to train people on a difficult-to-learn user interface.

In addition, the SiOps group would be dealing with CMs located throughout the world. The group needed a solution that would provide multiple-site and multiple-language capabilities.

Because the SiOps group was created to reduce the costs of the Xbox 360 GPU, the group had to keep its internal costs low. It needed a solution that entailed a low cost of deployment. The solution had to handle changes in the business model and be able to scale upward without expensive upgrades.

Solution

The Microsoft Xbox 360 SiOps group searched for the best solution to meet its needs. The group looked at extending the existing corporate ERP System, SAP R/3. However, the group found that extending SAP R/3 to meet its MRP and supply chain management needs would require too much customization, and so take more time than the group could afford. The SiOps group then studied all of the other MRP/supply chain management solutions that were available. After a comprehensive study, the group chose Microsoft Dynamics AX for its solution.

Microsoft Dynamics AX delivered, out of the box, virtually all of the MRP and supply chain management capabilities that the SiOps group needed. The MRP and supply chain managers could model their business processes, and the business processes of the CMs, within the user interface. The SiOps deployment team would not have to do any time-consuming customization programming to get the solution that it needed.

Microsoft Dynamics AX proved to be extremely powerful with a deep set of time-saving features. For example, it has a unique feature in which newly created customized fields are assigned to a category and then appear throughout the interface on the appropriate user screens.

To handle future growth, Microsoft Dynamics AX delivers a three-tier, object-oriented, layered architecture that makes scaling the model easy as the business grows. Microsoft Dynamics AX can economically support fewer than 50 users or more than 500 users as needed, and it can scale faster and more affordably than competitors.

Microsoft Dynamics AX is a complete, holistic solution, not pieced together from third-party add-in products. Every module in Microsoft Dynamics AX therefore has a more consistent appearance and tighter integration.

The Microsoft Dynamics AX user interface (shown in Figure 1) has a familiar, straightforward interface designed to look like Microsoft Windows® Explorer. This interface makes training faster and easier, and it delivers ongoing ease of use. Users can focus on the work they need to do, instead of focusing on how to make the product accomplish the required tasks.

"We were looking for an end-to-end planning and execution solution for managing the supply chain of our Silicon Operations business that we could configure and deploy quickly. Microsoft Dynamics AX provided us with that capability."

Osama Khan
Senior Program Manager
Microsoft Corporation

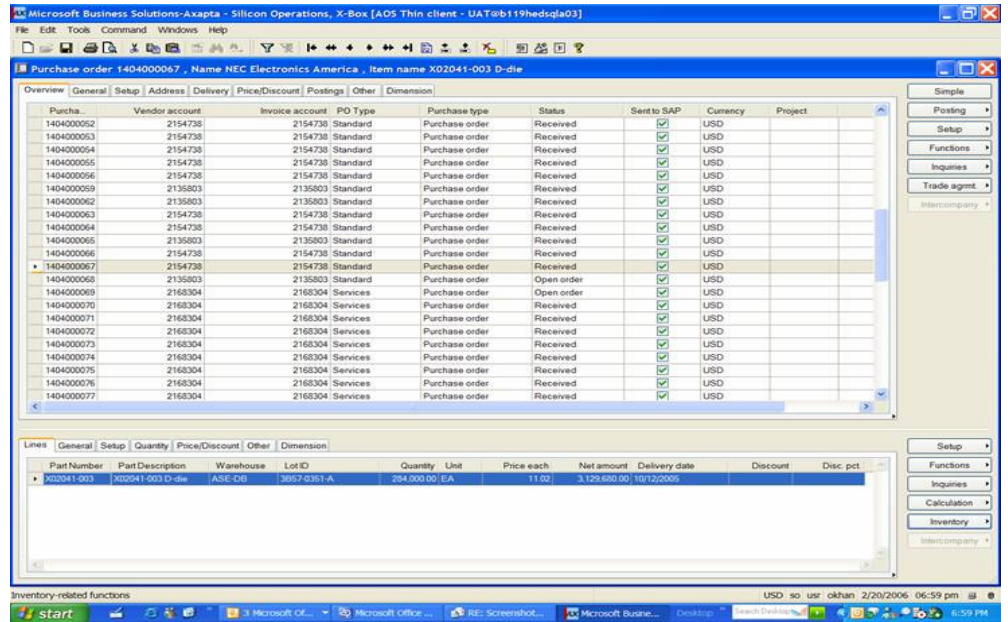


Figure 1. Microsoft Dynamics AX user interface

Finally, the SiOps group found that Microsoft Dynamics AX takes advantage of the Microsoft integrated approach to building products and solutions that are intrinsically designed to work together and interact seamlessly with other data and applications across the IT environment. This approach helps to minimize both deployment costs and support costs.

Integrating the Data Exchange Framework

To integrate the Microsoft Dynamics AX solution with the corporate SAP R/3 system and with the contract manufacturers' systems, the SiOps group implemented a hub-and-spoke, publish-and-subscribe business integration and intelligence framework (shown in Figure 2) based on Microsoft BizTalk® Server 2004 and BizTalk Accelerator for RosettaNet. This framework uses a standardized data exchange interface based on RosettaNet, an industry standard based on XML. RosettaNet is designed to enable companies to integrate applications and processes with their supply chain partners.

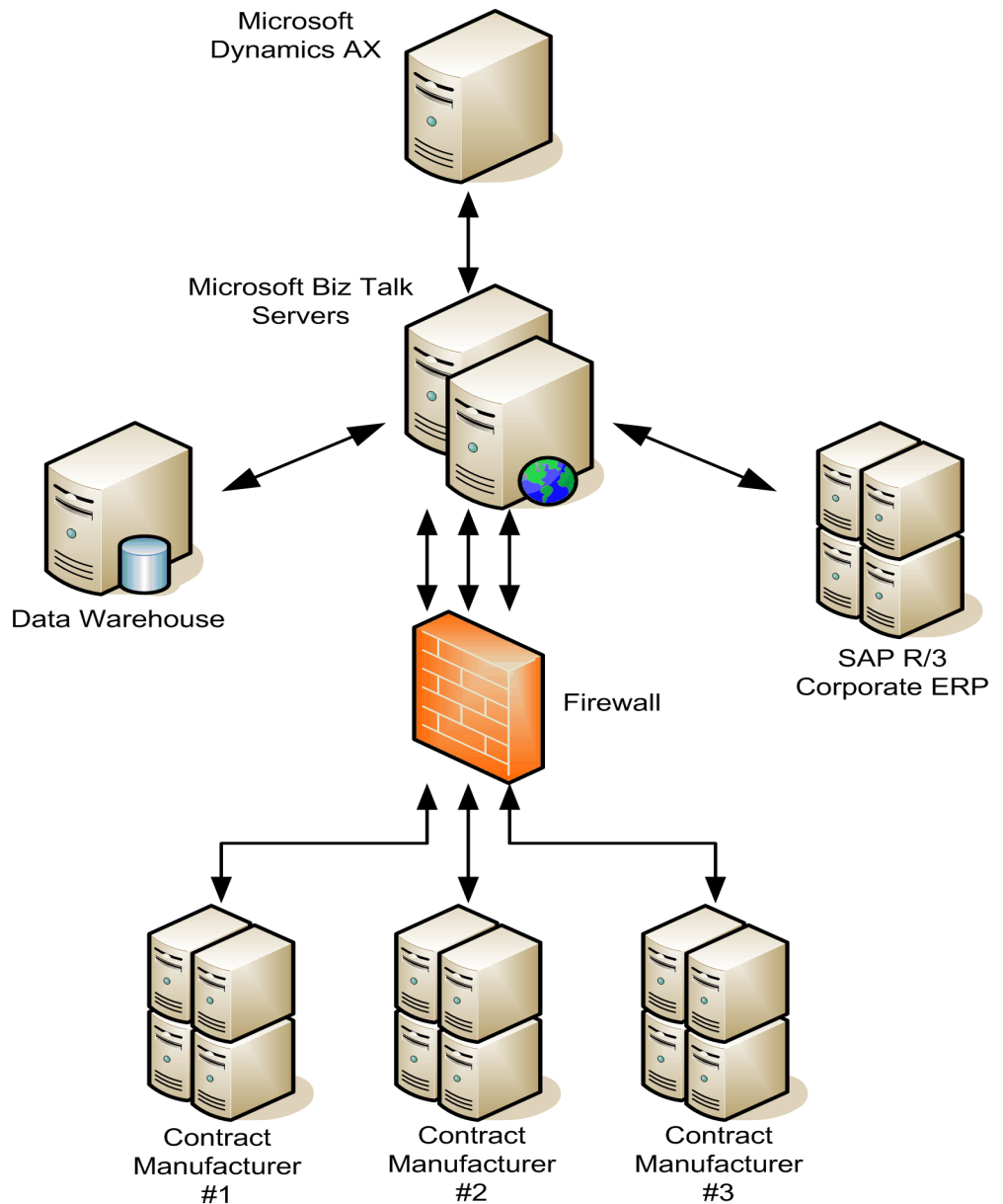


Figure 2. SiOps solution hub-and-spoke architecture

Configuring the Solution

After installing Microsoft Dynamics AX and implementing the hub-and-spoke business integration and intelligence framework, the SiOps group proceeded to configure Microsoft Dynamics AX, modeling its business processes and the business processes of the CMs. To configure the system, the SiOps group performed the following tasks:

- Set up BOMs, trade agreements, stockkeeping units (SKUs), and service items
- Connected production orders to purchase orders
- Modeled the routing for each manufacturing process, identifying the following key production points at which the group required process information:
 - When each item is started
 - When assembly is completed
 - When front-end testing is complete
 - When back-end testing is complete
 - When the item enters the finished goods inventory
- Attached BOMs to the routing
- Set up work centers, which model the capacity constraints at key points in the supply chain

The SiOps deployment team worked closely with the CMs to ensure that the business model and data structures reflected the CMs' business processes and systems.

Managing Business Processes

Now that the SiOps Microsoft Dynamics AX solution is fully implemented, it manages the business processes of the fabless semiconductor manufacturing operation, giving the SiOps group excellent visibility into the processes. The solution performs the following high-level process functions:

1. Receives a demand purchase order from the Xbox 360 console manufacturers.

This purchase order is loaded from the SAP R/3 system into the SiOps solution as a sales order. This sales order communicates the demand for GPUs to the SiOps planners—when and how many GPUs each console manufacturer needs.
2. Generates purchase orders for the die fabricators.
3. Sends the purchase orders for the die fabricators to the SAP R/3 system, from which they are forwarded to the CMs.
4. Receives WIP data from the die fabricators and non-COT model vendors.

This WIP data enables SiOps to track the status of the die fabrication process.
5. Receives advance shipping notices (ASNs) from the die fabricators.

The ASNs update the ship dates in the SiOps Microsoft Dynamics AX solution.
6. Receives purchase order receipts from assembly and test CMs, and updates the inventory records.

These purchase order receipts report the arrival dates of the dies and the die bank lot numbers.
7. Generates production orders/purchase orders for assembly and test services.

BOMs and routings in Microsoft Dynamics AX provide the assembly and test details.

8. Sends the assembly and test purchase orders to SAP R/3, from which they are sent to the assembly and test CMs.
9. Receives WIP transactions, against the assembly and test service purchase orders, from the assembly and test CMs.

These WIP transactions are generated for each lot at the following assembly and test milestones:

- When the assembly process starts.
- When the assembly process is complete.
- When front-end testing is complete.
- When the back-end testing is complete.
- When the assembly and test work is complete and the finished GPUs are moved to the finished goods inventory.

The finished goods inventory data includes lot and bin numbers.

10. Receives (along with SAP R/3) ASNs from the assembly and test CMs.

The ASNs are sent on the shipment of GPUs. These transactions are made against the demand purchase orders.

11. Decrements the lots shipped from the inventory and sales orders.

Sales orders are closed when all ordered quantities are shipped.

Benefits

The SiOps Microsoft Dynamics AX solution provided the following benefits during deployment and after the solution was implemented:

- **Quick deployment.** The SiOps group was able to deploy its Microsoft Dynamics AX solution within its aggressive schedule and help meet market requirements.
- **Business process cost savings.** In operation, the Microsoft Dynamics AX solution delivers the information and analysis tools that the SiOps group needs to make fabless semiconductor manufacturing under the COT model work. The near real-time data available from Microsoft Dynamics AX provides effective visibility into the cost structure of the design and manufacturing processes. This visibility enables the SiOps group to discover where it can improve the efficiency of those processes.

After six months of the solution's operation, the SiOps group has achieved excellent quantifiable benefits. It has achieved a 10 percent reduction in component inventories and a 126 percent return in development savings on the investment of \$950,000 U.S. As the SiOps group continues to discover efficiencies, it expects to reduce the cost of the GPU by 20 percent to 70 percent.

- **Low cost of ownership.** By selecting Microsoft Dynamics AX, the SiOps group realized significant cost benefits over competing systems. The first of these benefits was purchase cost, because competing solutions were twice to four times the price. The next benefit was the lower cost of deployment due the speed with which the deployment could be completed. In addition, using Microsoft Dynamics AX minimized training costs. The interface, with a design similar to Windows Explorer, was familiar, easy to learn, and easy to use.

"Microsoft Dynamics AX enabled us to ship XBOX 360 to the market on time and on budget"

Rajiv Kapoor
Product Manager
Microsoft Corporation

- **Scalability.** Along with the low cost of the initial deployment, and the cost savings accruing from the solution's operation to this point, the long-term cost of ownership for Microsoft Dynamics AX will be minimal. The built-in customization tools make it easy to adjust the business model to changes in business condition. And the three-tier, object-oriented, layered architecture makes it easy to scale the model as the business grows. Throughout its life cycle, Microsoft Dynamics AX gives the HED a higher return on investment than other solutions can offer.
- **Adaptability.** Both the MRP and supply chain management capabilities that the SiOps group needed are built in to Microsoft Dynamics AX, along with built-in customization tools. The SiOps deployment team easily adapted Microsoft Dynamics AX to its group's way of doing business, not the other way around.
- **Worldwide capability.** Microsoft Dynamics AX facilitates the SiOps group's interaction with vendors worldwide by providing multiple-site and multiple-language capabilities.

Conclusion

The Microsoft Xbox 360 SiOps group selected Microsoft Dynamics AX as its core ERP solution. This solution was the lowest-cost alternative to purchase. It was quick and easy to deploy and minimized the costs of deployment. In operation, it provides complete, accurate, and flexible automated material requirements planning, and near real-time supply chain management.

Microsoft Dynamics AX enabled quick cost savings from improved inventory management. It will provide additional cost savings as its supply chain visibility reveals additional efficiencies to be realized. As business conditions change, its adaptability will provide additional cost savings. Finally, as the business grows, the SiOps Microsoft Dynamics AX solution will grow without major upgrade costs.

The SiOps group has realized, and will continue to realize, cost savings in the design and manufacturing processes for the Xbox 360 GPU. And the next-generation Xbox was available for the 2005 holiday season.

For More Information

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