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Effective and Quality Technical Support in Business to Business Partnerships with focus on the High-Tech (Semiconductor Industry) Products

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Effective and Quality Technical Support in Business to Business Partnerships with focus on the High-Tech (Semiconductor Industry) Products

by

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Thesis

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Dedication

I would like to dedicate this thesis to my wife Juliet and daughters Patricia, Agnes, and Zoe. In addition, I dedicate this work to all those in Uganda and the United States who made it possible to for me to pursue my studies in the United States.

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I would like to thank my Supervisor Kyle Lewis, Ph.D. and my Co-Supervisor Anthony P. Ambler, Ph.D. for their input. I would also like to thank my Manager at Advanced Micro Devices (AMD), Mr. George Bickley, who encouraged me during my graduate studies.

Abstract

Effective and Quality Technical Support in Business to Business Partnerships with focus on the High-Tech (Semiconductor Industry) Products

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The University of Texas at Austin, 2011

Supervisor: Kyle Lewis
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My choice of this thesis topic is very much in line with my passionate desire to contribute and share my experience in the area of Business to Business (B2B) technical support while continuing to explore the constantly evolving challenges involved when a corporation that makes semiconductor products (Original Semiconductor Manufacturer) has to provide effective and efficient quality technical support to another corporation (Original Equipment Manufacturer) that uses the semiconductor product in designing a final product. For example, how does an Original Semiconductor manufacture (OSM) such as AMD or Intel provide effective technical support to an Original Equipment Manufacturer (OEM) such as HP or Dell? This partnership has to be well managed to

ensure continuous technical support from new product conception through the sustaining phase of the product.

This area of business to business technical support is not well understood because of company Intellectual Property (IP) issues and propriety information involved. This type of activity happens under Non-Disclosure Agreements (NDAs), behind “firewalls” and varies from corporation to corporation.

Most people have had experience with or have heard stories about customer service issues between an individual consumer customer and a corporation selling a product (such as buying a PC/Laptop from Dell or HP). This thesis will not explore this area since it is very familiar and well understood.

First, by drawing on my observations spanning 16 years working in different customer facing areas for AMD and noting the changes that have taken place in the way B2B technical support has evolved, I will constantly point out scenarios that continuously come up in an effort to deliver quality and effective customer technical support.

Second, there is a lot of literature available that explores how the semiconductor industry has changed from companies being component sellers to “solutions providers”. Historically, technical support used to be considered as only necessary after a product had gone into production. However, that model has changed in the current environment of more complex products such as Microprocessors (CPU), System-on-a-Chip (SoC), and Accelerated Processing units (APU). For B2B customer technical support to be effective and high quality, it has to meet and exceed the customers’ expectations throughout the product life-cycle.

Furthermore, the current trend is for Original Equipment Manufacturers to use Original Design Manufacturers (ODM) to build the Hardware platforms and perform all the system integration functions. There are best practices and deliverables that must be accomplished at every stage to make the multiple partnerships between the OSM and OEM and the ODM work flawlessly.

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Glossary of Acronyms

Term:	**Definition**
AMD	Advanced Micro Devices Inc.
APU	Accelerated Processing Unit (CPU + GPU)
BIOS	Basic Input/Output System
CPU	Central Processing Unit
DVT	Design Verification Test
ECO	Engineering Change Order
EVT	Engineering Verification Test
FAE	Field Applications Engineer
GPU	Graphics Processing Unit
NDA	Non-Disclosure Agreement
ODM	Original Design Manufacturer
OEM	Original Equipment Manufacturer
OSM	Original Semiconductor Manufacturer
PCI	Peripheral Component Interconnect
PCIe	Peripheral Component Interconnect Express
PVT	Production Verification Test
SBIOS	System BIOS
SoC	System-on-a-Chip
TPM	Technical Project/Program Manager
TSDB	Technical Support Database
VBIOS	Video BIOS

Chapter 1: Introduction

RESEARCH QUESTION

My choice of this thesis topic is very much in line with my passionate desire to contribute and share my experience in the area of Business to Business (B2B) technical support while continuing to explore the constantly evolving challenges involved when a corporation that makes semiconductor products (Original Semiconductor Manufacturer) has to provide effective and efficient quality technical support to another corporation (Original Equipment Manufacturer) that uses the semiconductor product in designing a final product. My focus will be on the Semiconductor Industry products such as Micro Processors (CPUs), System-on-a-Chip (SoC), Graphic Processing Units (GPUs), Network Products and other High-Tech products in the same category. For example, a Semiconductor Original Manufacturer (OSM) such as AMD or Intel has to provide "hands-on" support to an Original Equipment Manufacturer (OEM) such as Dell or HP in order to collaboratively design a System solution (e.g. Server, Laptop, or Workstation) for their target end-customers who may consist of Banks, Datacenters or Internet Information providers.

WHY IS THIS IMPORTANT?

This area of business to business technical support is not well understood because it mainly happens under Non-Disclosure Agreements (NDAs), behind "firewalls" and is tailored to key customers' requirements. There is also a strong requirement to protect intellectual property (IP) and other proprietary information thus further complicating the technical support landscape. For technical support to a business customer to be effective and high quality, it has to meet and exceed the customer's expectations throughout the product life-cycle. There are best practices and deliverables that must be accomplished at every stage to make the partnership mutually beneficial. This is in contrast to the more familiar customer service relationships between an individual buying a product from a corporation that sells products to the public (such as buying a PC/Laptop from an OEM such as Dell or HP). This thesis will not explore this area since it is more familiar and well understood.

OVERVIEW

After exploring existing literature on the subject of customer-centric technical support, I will also draw on first hand experiences gained interacting with many customers over many years. My experience dealing with different types of High-Tech customers in my various roles ranging from Systems Development Engineer, people manager as well as a Technical Project Manager has exposed me to typical customer technical support issues that are likely to come up in any organization dealing with corporate customers.

It was amazing to observe how different divisions of the same company I worked for handled customer technical support. Although the different divisions and departments were part of the same corporation, all had different technical support processes to support business customers. As an example, the Network Products division's process was different from the Embedded Systems division's process which was also different from the Microprocessor division's support process. Furthermore, the Customer Technical Support Databases used to support customers were not the same across the company and each division tended to adapt its own unique system. Not only were the Customer Relationship management processes different but also the engagement with customers happened at different stages in the life-cycle of the product being supported.

The quality of the product being supported also plays a big role in providing effective and quality technical support to the business customer. When I managed a group made up of Systems Validation Engineers as well as Applications Support Engineers, it was obvious that the more bugs missed during the Validation phase of the product, the harder it became for the Applications engineers to support the customers. The Systems validation strategies need to be planned along with the product specification and well before the product is shipped to customers. All the design and marketing collateral and other dependent deliverables need to be coordinated ahead of time and from the view point of the customers' needs.

The thesis will articulate the technical activities that have to be performed at each stage of the product life-cycle to ensure a systematic approach that is repeatable and can be used as a template by managers or technical support personnel engaged in this area to provide a consistent customer technical support model. After providing a brief history of corporate technical support, I will start with the discussion of how the shift from Product–centric to Customer-centric mode of operation taking place in the semi-conductor industry has affected the practice of customer technical support. I will then discuss the various stages of the product life-cycle. The inclusion of Technical Support and System Validation strategies as part of the planning process will be emphasized. The deliverables at each stage will be discussed. A “Technical Support Case Study” and the need for fresh, innovative management and organizational changes necessary to retain loyal customers will be provided. Finally, the thesis will conclude with a set of recommendations and a conclusion about effective and quality technical support.

Chapter 2: A Brief History of Business to Business Customer Support

LITERATURE OVERVIEW

According to Harvey Thompson (Thompson, H., 2000),

> Incorporating the word customer into the vision mission statements of business organizations has been a fairly recent phenomenon especially when viewed in the context of 100-plus years since the industrial revolution. The customer has not traditionally appeared in a company's stated reason for being; normally the shareholders occupied that lofty space (e.g. "To provide our shareholders with industry leading value and returns").

Thompson goes on to say (page 6) that:

> Until the 1990s the world of business was typically characterized by overdemand, and customers were often literally relegated to stand in line while eagerly purchasing all the products and services that could be manufactured and delivered. No more. In today's environment, the world can be characterized by overcapacity and customers have become kings and queens. They have taken on the new importance as the focal point for business, as seen on the banner of corporate stockholders reports and vision statements (e.g. "Our vision is to be the premier provider of [insert product or service] to our customers").

Nowadays, customers are in the driver's seat and have a lot of input in what goes into the semiconductor products (CPU/SoC/Chipset, etc.) during the design phase. Business customers will for example expect and demand similar features from two different OSMs such as AMD and Intel. With almost identical features and similar pricing, the only differentiator left is the quality of customer technical support and the consulting services a company provides throughout the product life-cycle. In this environment, the more customer-centric OSMs will end up with a greater share of satisfied customers; this translates into bigger profits.

Complexity of products required a new approach to customer Technical Support

In the early 1990s the prevailing customer support model at many Semiconductor companies in Silicon Valley was the Customer Support 'Hotline" consisting of phones staffed by many support engineers whose sole responsibility was to provide answers to customers' technical questions. By mostly digging up answers from thick Databooks and some internal Product Specifications unavailable to customers, these support engineers added a lot of value in supporting customers who came across technical problems during their design phase. However, as semiconductor products got packed with more features, it became more difficult for customer support personnel and as a result, that model was mostly abandoned. The Field Application Engineer (FAE) specialists started doing most of the debug of the failures at the customer site with help from the internal Systems Development Engineers. The FAEs tended to be more experienced than the in-house Applications Support team members. However, following Moore's law which states that "The number of transistors on a chip will double about every two years", semiconductor devices have become so complex that no one specialist can handle all the necessary support. The FAE became more dependent on the "factory" resources in order to be more effective in resolving customers' technical issues. As Microprocessor technology moved from 32-bit based systems to 64-bit systems and as more features were packed into SoCs, the added complexity called for a more hands-on support from the makers of the newer, more complex semiconductor devices.

Customer-Centric vs. Product-Centric Corporations

In the last fifteen years, Semiconductor Companies have been shifting from a product-centric model to a customer-centric model to meet increasing customer demands. Customers are now demanding complete solutions instead of stand-alone products. Corporations in the semiconductor industry have also realized that in order to survive the cutthroat competition, they need to adapt and be more customer-centric. This requires more elaborate technical support. Selling solutions instead of stand-alone semiconductor-products also means there is a longer term relationships between the OSM and OEM partners. This also translates into repeat business and corresponding profitability.

In his book, "Designing the Customer-Centric Organizations" Jay Galbraith states that,

> Wall Street will be evaluating companies based on the total value of their customer relationships. (Galbraith, J., 2005)

This is in line with semiconductor company trends to form partnership so as to create solutions instead of stand-alone products. The following table can help one identify if a semiconductor firm is a product centric or a customer centric corporation.

Table 1: A Product-Centric vs. Customer-Centric Company (Galbraith, J., 2005)

Product-Centric	Customer-Centric
Emphasis is on best performance, bleeding-edge products	Emphasis is on the best solution for the customer
New cutting- edge products create value	A combination of product, technical support, consulting
Most important customer is the most advanced	Values most profitable and loyal customers
Portfolio of products	Portfolio of customers
Organized around product lines, teams , prod reviews	Organized around customer segments and teams
Most important process is new product development	Customer relationship management and new solutions
Power in hands of people who develop products	People with intimate knowledge of customer's business
Culture open to new ideas and experimentation	Relationship management culture-new customer needs?

To control the new support intensive mode of operation, Semiconductor companies have created whole division organized around key customers. Customer Services engineering divisions are being created to enhance the quality of customer technical support. The divisions are now staffed with engineers with different skill sets and expertise necessary to address any technical request from System design companies (e.g. Dell, HP, IBM, etc.). The engineers from the OSM then work collaboratively with the OEM engineers on Platform Specifications/Design, schematic reviews, board layout reviews, signal integrity, BIOS and S/W development. In addition to supporting the customers, the OSM engineers may be involved in other activities such as New Silicon Debug, Validation or developing marketing collateral.

There are no more phone numbers to call at these companies and get real technical questions answered. A good example of a Customer-centric leaning company is IBM. AMD and Intel are becoming more customer-centric than product-centric. The traditional Product-centric companies are not going to disappear completely because some customers still prefer to purchase stand–alone chips and do their own customization and integration. Some examples of Product–centric leaning companies include Micron and other memory vendors.

The current literature has dwelt more on the customer-centric and product-centric semiconductor corporations from an organizational point of view. They have done this very well from a high level looking at different Organization Breakdown Structures (OBS). However, they have not covered in detail what happens at the engineer to engineer level where most of the quality technical support issues arise. This is the area where the “rubber meets the road” and usually the source of customer dissatisfaction.

Chapter 3: Make Customer Technical Support a key deliverable at every stage of the Product's Life-Cycle

STUDY METHODOLOGY

By tracking customer technical issues on many projects over many years, it became apparent that different customers repeatedly made similar mistakes on different projects. These mistakes could be easily avoided if certain processes were adhered to at every stage of the project's life-cycle. On many occasions, I was assigned to work on a customer design project that had gone off-track and needed help to get back on track. There are predictable signs that a customer's project is getting off-track. Early warning signs that a customer's project is off-track include:

- Customer missed a key milestone (e.g. a customer demo) because the product does not work as specified.
- Newly built boards/systems are dead on arrival (DOA) from the fabrication house.
- Field failures have been reported at multiple sites (alpha and beta sites).
- One customer is reporting many Software /Hardware bugs not reported by other customers.
- Customer reports failures but is unable to reproduce them and wants the OSM to explain the intermittent failures.
- A lot of finger pointing between the OEM's engineers, OSM Field Sales, Marketing and the OSM internal teams.

- The strategic OEM customer has escalated the issues to the CEO and management is eager to assist.

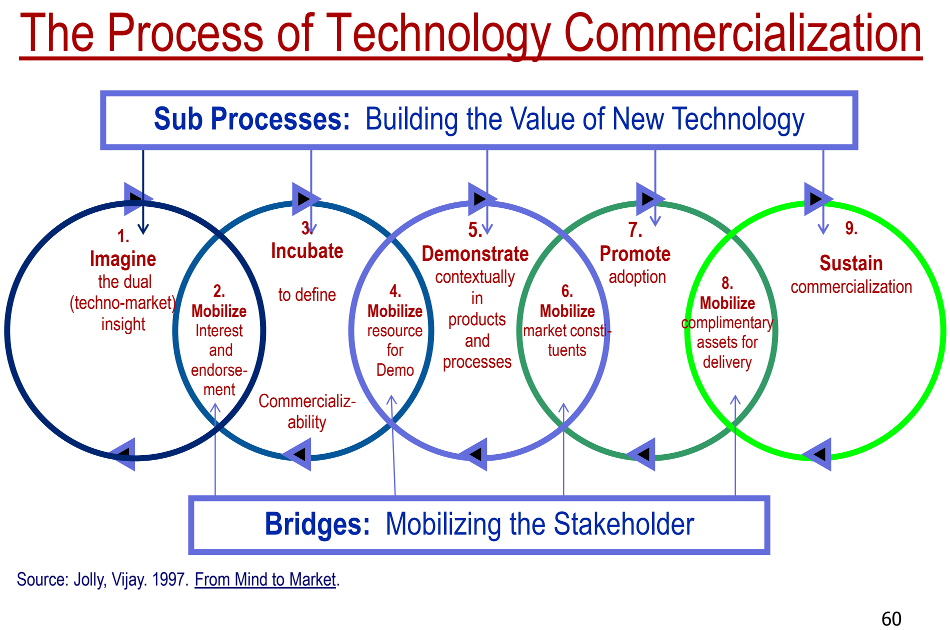
Although the customer is always right, here are some exceptions to the rule.

- The Customer did not follow all the recommendations for the device; did not get the design right the first time.
- Customer made some trade–offs (real estate, cost) that compromised signal integrity.
- The customer did not get the design reviewed by the OSM’s internal team before building the platforms.
- The customer did not implement a workaround for known errata assuming it was not specific to their applications.
- The customer’s very experienced design engineer did not need/ask for any help to get the design reviewed.

It does not matter whether the customer “messed” up; it is still the responsibility of the support team to set the customer on the right path by proactively asking the right questions so as to mitigate risky omissions by the customer’s engineering team.

In the Semiconductor industry, new technology goes through a series of phases before it gets to the final stage of commercialization. The first stage is called the imagining stage. This stage is where the ideas of a new piece of technology are conceived. The second stage is known as the Incubate stage followed by Demonstrate, Promote and Sustain. Here, the idea is transformed into a marketable product (Jolly, V., 1997). The following diagram shows the Jolly Model.

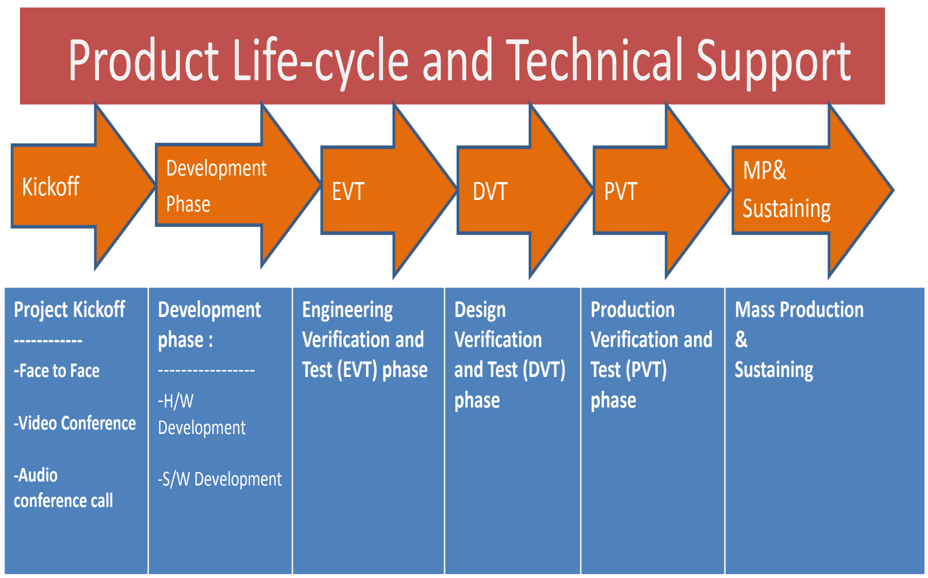
Figure 1: The Jolly Model



Similar to the Jolly model, a real life product life-cycle of a new Microprocessor or SoC goes through a series of milestones before the OSM/OEM partners can a solution. Each step builds on the previous one and adds value to the solution as it progresses through the various phases. There are important decisions about what technical support is required in order to take the technology to its next stage of advancement. It is very important to also get the stakeholders to recognize the need for superior technical support at every stage.

It is precisely during these initial stages that effective and quality technical support is planned before the new technology goes to the advanced stages. Waiting to start a technical support group when the product is ready to go in production is a recipe for disaster and will not work in the more modern customer-centric organizations. In the following section, I have identified some key deliverables that are necessary to make customer technical support a success at every stage of the life-cycle of the product.

Figure 2: Product Life-cycle of a Semiconductor product and Technical Support



Setup the Technical Support Team and the Collaboration Database

Before the project kick-off, the Technical Project Manager needs to negotiate with department managers to agree on the makeup of the technical support team (Hardware, Software, BIOS, Product, Marketing and Sales) and how the internal engineering teams will collaborate with the system builders' (OEM/ODM) engineering teams. Prior to the project kick-off meeting, the technical support contact list should be shared with the team. The first step is to set up access and permissions to the NDA sites and Customer Technical Support Database (TSDB) for collaboration and tracking of technical issues. The customer will need access to the NDA documents directly and an area to share huge (schematics, layout files) documents is necessary.

Ideally, the customer should be able to ask technical questions via the Database where the relevant internal team are able to view the exchanges. In the database, the customer should also be encouraged to set priorities such as Critical, High, Medium, or Low to help assign resources accordingly. The objective here should be to avoid using email as a primary tool to collaborate with the customer's engineering teams.

Technical Support at various stages of the Product Life-cycle

Project Kick-Off

The Project kick-off is probably the most important event in launching a new OEM product and should be a face to face meeting between the OEM and OSM teams. If the meeting cannot be face to face, then a conference call should be arranged with all stakeholders. This is the right meeting to plan out the project between the OEM and

OSM. The right participants should include the Project Managers of both organizations, subject matter experts (SME) from both companies as well as the technical support teams. It is also a good opportunity for the engineers to meet and get to know each other on a personal level before the project starts.

Social events such as dinner and other informal activities can enhance the interaction between the teams and can serve as a network that will enhance collaboration in solving problems if one already knows the people involved. This is much better than trying to solve a challenging technical issue together with an engineer one has never seen before. In the current globalized environment with virtual teams, the face to face interaction may not be possible but a video or audio conference call can go a long way in making the kick-off meeting a success.

Depending on the complexity of the project, a kick-off meeting can be a few hours or can take a whole week. This is time well spent and will help avoid miscommunication about project scope and deliverables from the stakeholders and also avoid "feature creep" whereby the customer keeps adding new features that were not in the original plan.

It is not unusual to hear statements like "I did not know that this device performed this way." When you hear such statements from a design engineer on the customer's team, it is an indication that the kick-off meeting lays out a foundation for project success. The customer OEM/ODM should play a significant part in coming up with a final "Project Checklist." that is described later in this section. The customer should be provided with a portion of the checklist to fill up before the meeting. At the meeting, it should be part of the agenda to go over the list and get it finalized. The finalized document should be distributed to all relevant internal stakeholders and used as a reference to make sure there is product alignment between the OSM and OEM/ODM.

The process may take several iterations with both OSM and OEM making refinements to the plan until both parties agree on the final document. At the end of the kick-off meeting, both OSM and ODM should have the following checklist clearly defined and understood:

1. Get the platform Specification and Marketing Requirements Document (MRD).
    - Hardware (H/W) feature definition
    - Software (S/W) feature definition
2. Get development schedule and key milestones from the OEM (design schedule, customer demos, industry shows, et al.).
3. Get CPU/Chipset/BIOS and S/W deliverables (dates and quantity of samples).
4. Get any training requirements for the customer or ODM/OEM and schedule accordingly.
5. Define the development support model (where the platform will be designed/developed).
6. Build internal and external contact list (internal team, OEM/ODM teams).
7. Define engagement model with the customer (weekly calls or bi-weekly or monthly).
8. Get platform Approved Vendor List (AVL) for memory DIMMs, Cards, etc.
9. Get S/W driver schedules.

After the kick-off meeting, the project advances to the next phases described below.

Development Phase

1. Hardware development and review; provide design guidelines to the customer.
2. Review Customers schematics and layout and provide feedback before board build.
3. Provide reference platforms.
4. Coordinate S/W license agreements if required (with assistance from legal).
5. Coordinate BIOS and S/W development support and delivery.
6. Provide CPU and Chipset debug tools.
7. Coordinate new Silicon Validation/Test support.

Engineering Verification and Test (EVT) Phase

1. Deliver EVT Samples (CPUs, Chipset, reference boards).
2. Deliver bring-up BIOS and Software.
3. Schedule and provide board bring-up support for the customer.
4. Coordinate in-house and customer teams and partners for needed debug effort.
5. Coordinate and execute platform test services.
    - Stress testing
    - Reliability testing
    - Margining testing
    - Standards compliance
6. Confirm DVT exit, provide DVT report and update Tracking System.

Design Verification and Test (DVT) Phase

1. Review Customers schematics and layout and provide feedback before board build.
2. Verify that problems uncovered in EVT phase were fixed.
3. Deliver DVT Samples (CPUs, Chipset, reference boards).
4. Deliver DVT BIOS and Software.
5. Schedule and provide board bring-up support for the customer.

6. Coordinate in-house and customer/partner teams to participate in needed debug effort.

7. Coordinate and execute platform test services.

   - Stress testing
   - Reliability testing
   - Margining testing
   - Standards compliance

8. Confirm DVT exit and update Issue Tracking System.

Production Verification and Test (PVT) Phase

1. Review Customers schematics and layout and provide feedback before board build.

2. Verify that problems uncovered in DVT phase were fixed and product is ready for production.

3. Deliver PVT Samples (CPUs, Chipset, reference boards).

4. Deliver PVT BIOS and Software.

5. Schedule and provide board bring- up support for the customer.

6. Coordinate in-house and customer/partner teams to participate in needed debug effort.

7. Coordinate and execute platform test services.

- Stress testing
- Reliability testing
- Margining testing
- Standards compliance

8. Provide customer with on-site support to close any remaining issues.

9. Confirm PVT exit, provide PVT report and update Tracking System.

Mass Production (MP)

1. Confirm final Gerber is out.
2. Close all outstanding issues.
3. Deliver final Software and SBIOS, VBIOS and drivers.
4. Provide customer with on-site support for any remaining issues.
5. Confirm MP launch, join in the celebrations and update Issue Tracking System.

Sustaining to Obsolescence

The product has now been in production for some time; however, this is not the time to let your guard down. Most likely, the platform has been installed in a business where down time is unacceptable. The real world test has just begun and issues will be escalated quickly if there are any product failures in the field.

1. Schedule and execute "Lessons Learned" on the project and use this to improve the process.
2. Schedule add-on validation testing or upgrade validation testing as needed.
3. Manage Manufacturing issues and returns (RMAs) for testing.
4. Provide on-site manufacturing support and training as needed.
5. Confirm End of Life (EOL) for the product and update Tracking System.

Reviewing Customers' designs before building boards will enhance time to market

One of the key activities that contribute to excellent and efficient customer support is to review the customer's designs and catch any problems before they build their hardware platform. This will avoid mistakes and speed up time to market. Time to market is very critical to customers especially when trying to meet a certain market window. The customer is usually provided with many documents to help them design their CPU based platform but perhaps the most critical documents are the Motherboard Design Guide, the Schematic Checklist, and the Board Layout checklist.

Schematic checklist

Most design engineers believe that they will not make mistakes when designing boards. No matter how smart the System design engineer is, it is still necessary to review the customer's schematics for correctness and adherence to the OSM's specifications. Most design engineers believe that they are thorough and do not make careless mistakes. Even when this is true, customers tend to make a lot of trade-offs when it comes to platform design. Sometimes, trade-offs are made when selecting components because of cost or board space constraints. It is understandable why some customers will tend to choose cheaper components.

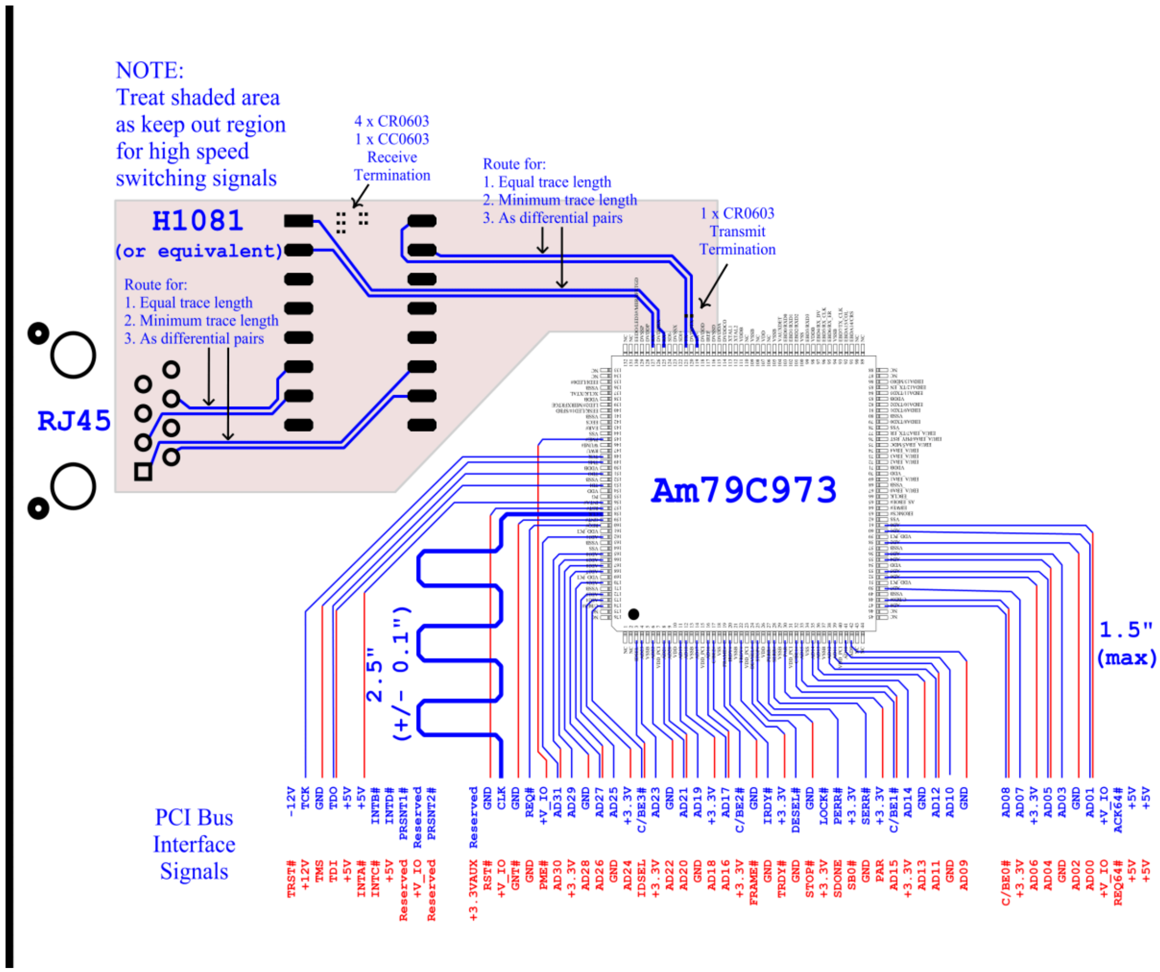
If possible, it is better to do schematic reviews with a group of several engineers and go page by page while noting down the schematic errors. The design recommendations to customers are normally provided in a document referred to as a design checklist. The customer must be encouraged to complete the checklist before requesting a schematic review. This should be done as a standard procedure. By working through the schematic review checklist, the customer will go through the design process to make sure the design captures knowledge about how to design a robust system. The more carefully and accurately the customer completes the checklist, the fewer mistakes the customer will likely make. The schematics are usually in PDF format and are unique to the CPU, SoC, or Chipset used. To make the review process easier, schematics should have off page reference designators in order to thoroughly and effectively check the design. The Applications engineer or the Technical Project Manager must follow up with the customer to make sure that all the recommended changes were implemented. There is an equivalent Board Layout checklist that the customer must also complete.

Board Layout Checklist

The primary objective of the layout review is to ensure that the layout requirements outlined in the Motherboard Design Guide and Layout Checklists are adhered to. The review is very important to both the customer and the chip vendor because it avoids, unnecessary time lost due to debug of careless mistakes. Once the board is built, it is more difficult to find problems that show up as subtle intermittent problems. It is usually acceptable to submit Allegro, Mentor Expedition, or PADs files for review although different OSMs may have other preferences.

Normally, there are tools available at the OSM to support review of layout files (e.g. Allegro). The tool will extract information such a trace length and compare it with the layout recommendations contained in the checklist for a specific processor. Board stack-up information is also very useful in properly reviewing a design. For example, if the board does not follow the recommendations, problems that show up may include issues such as memory not running at full speed. For completeness, the PCB check should include the following standard interfaces (PCI, PCIe, Hyper Transport, and Memory) for proper trace length, spacing, et al. The customer should be strongly encouraged to follow the Motherboard Design Guide and layout examples. In providing customers with layout examples, a picture may be worth more than a thousand words as the following layout example of a PCI Network device illustrates how to properly route the PCI clock and Ethernet differential signals.

Figure 3: Board layout considerations (AMD, 2000)



Source: AMD.COM

Providing customers with clear examples as shown in Figure 3 will help avoid common mistakes such as letting the computer auto route sensitive analog signals that are best controlled by custom routing by hand.

Lessons Learned and Project Closure

After celebrating the milestone of successfully getting a customer product in production, it is time to reflect back on what worked right and what went wrong for the benefit of future projects. This final step will help the internal teams refine the technical support processes in place. This is also the right time to do a post mortem of the completed project before the team members are assigned to other projects. The information should be solicited from the Project Manager as well as other key engineers on the team; preferably representing Software, Hardware, and field support teams. The Project Manager should compile all the input in one area that is accessible to other internal teams. That way, they can use the information on similar projects and avoid repeating the same mistakes. Here are three examples of “Lessons Learned” from a customer project after going into production.

1. The project did not have a formal project kick-off checklist. As a result, the project scope kept changing. The OEM kept requesting additional features and as the market demands changed the customer tried to adapt the same product to changing markets.

2. The OEM engineers contacted the OSM engineers directly, leaving out the FAE and Project Manager from distribution. This caused delays and lack of a prioritized issues list.

3. The customer used incompatible memory that resulted in a “production lines down” situation. This could have been avoided if an Approved Vendor List (AVL) for memory was made available to the customer early in the design phase.

Chapter 4: Factors that Influence the Quality of Technical Support

OVERVIEW

No matter how good the customer technical support of a Semiconductor company is, if the quality of the product is poor, it will tax company resourced to the limit. Therefore, it is imperative that before going into mass production, the product is thoroughly tested to avoid finding bugs after product launch. Although it is not possible to get all the bugs out of a complex device like a Microprocessor or a SoC, all the known problems should be clearly documented and communicated to all customers in a timely manner. Any workarounds should also be made available to all customers big and small who use the product. To illustrate how costly a missed bug in a chip can be, two examples come to mind.

First, in 2007 AMD launched the Quad Core Opteron Server Processor that was expected to repeat and also solidify earlier success with the Dual Core Opteron server CPUs. However, after launch, AMD discovered an erratum in the TLB (translation look aside buffers). Although AMD tried very hard to reassure customers that the “bug” was extremely rare, the damage was already done. Even though a workaround was found and implemented in the BIOS, customers had already formed a perception that Barcelona quality was very poor and it would take a new revision of the CPU to change most customers negative perceptions. Once the quality of the CPU was suspect, customers were disappointed and skipped the product which provided a good opportunity for AMD’s main competitor (Intel) to win more business from AMD customers (ChannelWeb, 2007). How did AMD retain the big customers in spite of Barcelona? One thing AMD did right was to be upfront and honest about the TLB bug with the customers. AMD continuously updated customers on detailed planned changes to Barcelona in order to regain customers' confidence. It is possible for a company to recover from a product setback if the customer is kept in the loop and the quality of customer service is good. However, the cost of putting out fires from many customers consumed so many resources on top of losing designs.

Second, Intel had the Pentium P5 already in production when a customer discovered a bug due to a floating point unit (FPU) error in the divide algorithm. Intel lost reputation in the way it handled the problem and it was also very expensive to replace all the CPUs affected. I will devote the next section on the importance of having a robust Validation in place to catch bugs early on in the product life-cycle.

FIND THE BUGS IN THE PRODUCT BEFORE YOUR CUSTOMERS DO

Good, effective quality customer support is preceded by a good System Validation Methodology that catches all the chip bugs before the product is in the hands of customers. Why is this so critical? Simply put, a chip that has not been thoroughly tested will present a technical support nightmare when the product gets to the customer. For this reason, I have included more details to describe the System Validation process and what contributes to an effective methodology. There are other benefits to a good validation methodology. It is also the best way to train the technical support engineering staff. Engineers who have gone through the Validation process will be the most familiar with the product. Having gone through the process of setting up and debugging functions of the product, they are better prepared than the chip designers in supporting the customers. The best engineers to support customers will normally be the Systems Engineers who are comfortable with both hardware and software in addition to capability in using Lab equipment such Oscilloscopes and Logic Analyzers.

An Effective Validation Methodology is a prerequisite for effective customer support

In a study done at IBM (Cohen, M. & Chard, J., 2009), the cost of finding and fixing a problem in a product gets higher depending on where in the life-cycle of the product the problem or "bug" is discovered. If the flaw is discovered in the early stages, the cost is manageable; however, the cost goes up by magnitudes (Table 2) if the bug is discovered in the production phase.

Table 2: The increasing costs of fixing a defect (IBM, 2009)

Defect Removal Activity	Expected defects distribution (valid and invalid, best in class	Cost Multiplier (US$120)
Requirements review	4 percent	1
High level design review	7 percent	4
Detailed requirements review	9 percent	2
Detailed design review	6 percent	7
Unit test	12 percent	10
System Test	23 percent	16 (expensive)
User acceptance test	36 percent	70 (very expensive)
Production	3 percent	140 (outrageously expensive)

Source: IBM Global Business Services

Validation Goals

A good Validation methodology should have the following goals (using the example of a SoC device).

1. Find the SoC bugs in the product before the customers do.
2. Verify that the SoC performs as described in the Specification/Databook and as advertised by Marketing (revise Databook accordingly).
3. Verify the SoC's functionality against Industry Standards (PCI, PCIe, Ethernet, JEDEC, etc.) and verify that the SoC peripherals can interoperate with other vendors' products.
4. Approximate the end customer's environment as much as possible to verify performance & stress tests.
5. Cover boundary conditions by running as many combinations of tests as possible.
6. The Validation team should help correlate "bench" results with "factory tester" results.
7. Set up test equipment and S/W to demonstrate bugs for the design issues missed in simulation and help setup scenarios for the chip designers who may not be familiar with customers' applications and environment.
8. Understand the SoC peripherals well enough to help customers design-in the product.

The extra benefit for good Validation job is if all the bugs are caught in the validation phase, it will free up technical support team to work on more interesting future projects instead of repetitively putting out "fires" that result from a customer discovering bugs in a product.

The Validation Test Plan

The Test Plan is an essential document that includes the setup, procedures and test results for each block in the SoC and should be written in such a way that a technician or a new engineer can follow it and run the tests. For completeness, the test plan should be reviewed by the design engineers who are very familiar with the detailed design of the SoC blocks. The chip designers' feedback will ensure full test coverage.

The Validation test plan should include a way to thoroughly test the product features as specified in the product specification document. The procedure for each test as well as inputs and expected results should be spelled out clearly. The engineer to execute the test and the test tools to be used as well as pass/fail criteria should not be ambiguous. At the end of the test, the results should be clearly documented with a view of providing them to customers if necessary. Sometimes, the customer will run into issues while performing their own internal tests. When customers come across a problem during their internal testing, the first thing suspected is the chip before they suspect their own hardware. It is therefore prudent to have a copy of the *Test Report* that can be passed on to the customer to show how a specific functional test was performed.

A comprehensive list of any suspected anomalies reported should be tracked to make sure the engineer doing the test can reproduce the problem and demonstrate it to the validation/design team. The Issues list will in the end help the team to come up with the SoC *Errata List* and workarounds for bugs. Issues should be considered open and only closed after both the Design Engineer and the Validation engineer agree. It is better to do a good job "and possibly work yourself out of a job because you did find all the bugs", than deal with the wrath of angry customers because they discovered a bug at one of their key installations and have to stop shipping the product. Here is a typical summary of the test results after the System Validation phase.

Table 3: Validation Status Report- Example

Sect	Test Description	Completion Status (%)	Assigned Engineer	Comments (Pass/Fail, etc.)
1	PCB (Evaluation Board) Testing			
1.1	PCB Confidence Tests– DDR board	100%		PASS
1.2	PCB Confidence Tests– SDR board	100%		PASS
2	CPU Core			
2.1	Verify CPU Core functionality	100%		PASS
2.2	MIPS AVP-Little Endian/Big Endian	100%		PASS
2.3	MIPS REX	100%		PASS
3	DDR Memory Controller			
3.1	Memory Controller Register Read/Writes	100%		PASS
3.2	Read/ Write Memory	100%		PASS
3.3	DDR Memory Thrash Test	100%		PASS
3.4	Boot Diags from DDR (99MHz, CPU 396MHz)	100%		PASS
3.5	Configure DDR @ 99 MHz(DDR200),CPU @396MHz	100%		PASS
3.6	Configure DDR@ 198 MHz(DDR400),CPU @396 MhZ	100%		PASS
3.7	Configure DDR@200 MHz(DDR400),CPU @ 600MHz	100%		PASS
3.8	SDRAM CTRL Register Test	100%		PASS
3.9	DDR SDRAM Address Test	100%		PASS
3.10	DDR SDRAM Thrash Test	100%		PASS
3.11	SYS ID Test	100%		PASS
3.12	DDR SDRAM Size Test	100%		PASS
3.13	DDR SDRAM Addr Test	100%		PASS
3.14	DDR SDRAM Noise Test	100%		PASS
3.15	DDR SDRAM W/R Test	100%		PASS
3.16	16/32 bit SDRAM BUSModes----Little/Big Endian	100%		PASS
4	SDR Memory Controller			
4.1	Memory Controller Register Read/Writes	100%		PASS
4.2	Read/ Write Memory	100%		PASS
4.3	Boot Diags from SDR	100%		PASS
4.4	SDRAM CTRL Register Test	100%		PASS
4.5	SDR SDRAM Address Test	100%		PASS
4.6	SDR SDRAM Thrash Test	100%		PASS
4.7	SYS ID Test	100%		PASS
4.8	SDR SDRAM Size Test	100%		PASS
4.9	SDR SDRAM Addr Test	100%		PASS
4.10	SDR SDRAM Noise Test	100%		PASS
4.11	SDR SDRAM W/R Test	100%		PASS
4.12	16/32 bit SDRAM BUSModes----Little/Big Endian	100%		PASS
5	STATIC Bus Controller			
5.1	PCMCIA (in WinCE)	100%		PASS
5.2	FLASH BOOT	100%		PASS
5.3	SRAM – Run Diags from SRAM	100%		PASS
5.4	ROM Boot	100%		PASS
5.5	SRAM/NAND(basic)	100%		PASS
5.6	Endianess	100%		PASS
5.7	Timing config parameter permutations (all bits)	100%		PASS
5.8	PCMCIA	100%		PASS
5.9	NAND FLASH	100%		NAND FLASH Boot ---FAILS
6	DDMA			
6.1.1	DDMA Register Read/Write	100%		PASS
6.1.2	Memory to Memory XFERs	100%		PASS
6.1.3	Memory to FIFO XFERs	100%		PASS
6.1.4	FIFO to Memory XFERs	100%		PASS
6.1.5	FIFO to FIFO XFERs	100%		PASS

Table 3, cont.

Sect.	Test Description	Completion Status (%)	Assigned Engineer	Comments (Pass/Fail, etc.)
6.2.1	Chained Circular descriptors	100%		PASS
6.2.2	Block and Stride	100%		PASS
6.2.3	Literal Write	100%		PASS
6.2.4	Alignment Transfers	100 0%		PASS
6.2.5	Arbitration Pool	100%		PASS
6.3	DDMA with onboard peripherals	80%		Limited Test environment
7	IPsec (CryptCore)			
7.1	Register Read/Write			PASS
7.2	Diags (non-OS) Encryption/Decryption Tests			PASS
7.3	UDM (Universal Driver Model) Packet tests-r Linux			PASS
7.4	Performance Benchmarks with and without Encryption	100%		Linux Environment meaningful
	PCI			
8.1	Read/Write PCI Configuration Space	100%		PASS
8.2	Memory Read/Write @33MHz	100%		PASS
8.3	I/O Read/Writes @33MHz	100%		PASS
8.4	Memory Read/Write @66MHz	100%		PASS
8.5	33Mhz card plugged in a PCI slot- detect	100%		PASS
8.6	RealTek 33Mhz(32Mhz) PCI network card	100%		PASS
8.7	PCI Posted Reads (New feature)	100%		PASS
8.8	Basic Config, I/O, Mem cycles (33MHz and 66MHz)	100%		PASS
8.9	33MHz PCI Network Card	100%		PASS
8.10	66MHz Card (ATI)	100%		PASS
8.11	Basic Posted Read Functionality	100%		PASS
8.12	CMEM window; cacheable accesses	100%		PASS
8.13	Driver Mode Bit	100%		PASS
8.14	DDMA Posted Read	100%		PASS
9	Ethernet 0 /Ethernet 1			
9.1	MAC Register Read/Writes	100%		PASS
9.2	MII Interface			
	-Autonegotiation with a 100Mb Full duplex switch	100%		PASS
	-Autonegotiation with a 100Mb Half duplex hub	100%		PASS
	-Autonegotiation with a 10Mb Half duplex hub	100%		PASS
9.3	Basic Transmit and Receive			
	-Transmit --Ping Packets of different byte lengths	100%		PASS
	-Receive -- Ping Packets of different byte lengths	100%		PASS
9.4	-Downloads (ftp)	100%		PASS
9.5	MULTICAST RCV	100%		FAIL
9.6	10/100BASE-T FD Transmit (60-1514 bytes)	100%		PASS
9.7	10/100BASE-T FD Receive (60-1514 bytes)	100%		PASS
9.8	10/100BASE-T HD Transmit (64-1518bytes)	100%		PASS
9.9	10/100 BASE-T HD Receive (64-1518bytes)	100%		PASS
9.10	IPG Measurements	100%		PASS
9.11	Collision Tests	100%		PASS
9.12	Jumbo Packet	100%		PASS
9.13	VLAN Tests	100%		PASS
9.14	Address Filtering Tests (Broadcast, Multicast, Unicast, Promiscuous)	100%		PASS
9.16	Flow Control	80%		Limited Test environment
9.17	Performance- SmartBits Throughput, Latency, dropped packets etc.	100%		Worst case throughput for 64 byte packets is 20 Mbps. For large packets throughput is 90Mbps

PROTECTING PROPRIETARY INFORMATION AFFECTS THE QUALITY OF TECHNICAL SUPPORT

Customer Support and IP/Proprietary Information Protection

The Issues of Intellectual Property (sometimes used interchangeably with Proprietary information in this document) play a big role in restricting the free flow of information between OEM customers and OSMs thus limiting the type of information that can be shared with customers. On the one hand, the customer strongly believes that they need certain information to successfully bring their product to market; on the other hand, it is understandable that the OSMs need to protect their IP, otherwise the companies stand to lose a lot of revenue and shareholder value if hard earned IP leaks out. For example, the OSM may be developing some new products based on still evolving standards. As a result, they are very protective of who gets access to detailed technical information based on the "need to know." Sometimes, the OEM may request some information before it is "customer ready". For example, preliminary performance data given out too early can be misused by competitors if not properly controlled. IP issues sometimes degrade the quality of information shared with customers even when NDAs have been signed. In an effort to improve the quality of customer experience as designs get more complex and technologies continue to evolve, it is necessary to work collaboratively with the customers as they develop new products. What happens when big OEM customers, especially the biggest revenue generators, demand more details about certain chip design details considered proprietary while at the same time the customers may be designing-in products from a competitor?

Customers/Partners may also be Competitors where IP is concerned

Proprietary information needs to be protected from competitors as well as customers. With semiconductor companies now having to provide “solutions” instead of components such as Microprocessor and Graphics components (CPUs/GPUs, etc.), it is necessary to form partnerships between multiple companies. This complicates protection of company proprietary information and effective technical support. For example, in order for AMD or Intel to sell CPUs, they have to partner with Operating System (OS), BIOS, and software Applications vendors to come up with innovative products and solutions. This requires the need to share some proprietary information across many teams and across geographical regions, further complicating control of sensitive information and trade secrets. Managers can play a key role in avoiding litigation by setting up secure processes and setting the correct protocols for employees. There are several ways to control the flow of information by setting up Non-Disclosure Agreements (NDAs) sites (well secured databases) where approved customers can share documents, specifications and software releases when designing a new product. To protect company confidential and proprietary information, employees with the need to access this information must apply for access rights from the appropriate administrator for the site. However, it is not enough to have an NDA site. For effective customer technical support, the NDA site is only good for exchanging documents and nonproprietary source code/

drivers and other marketing collateral. For more detailed exchanges (schematics, layout files, etc.) between the company and a customer, it is also necessary to have a separate Technical Support Data Base (TSDB) to support this effort. Later on, I will describe two types of TSDB's that try to balance protecting Company proprietary information and avoid relying on email for customer support.

Role of the Manager in Protection of Proprietary Information

It is the responsibility of the manager to make sure that direct reports are familiar with the policy of protecting company proprietary information. If necessary, the manager should arrange for a class or seminar presented by the legal department which explains each employee's responsibilities with respect to protection of proprietary information, the value of proprietary company information against the competition, and the consequences of unauthorized exposure. The proper way to handle confidential documents, NDAs and trade secrets must be clearly explained to avoid confusion. Not only will this training avoid exposing hard earned IP while an employee is with the company but will also sensitize the engineers to avoid unnecessary litigation when they change jobs and join another company. The manager is also responsible for making sure that the engineers and other team members hired are not ethically challenged. Thorough background checks and references can go a long way in getting the right candidates.

Avoid Email use for exchange of Proprietary Information

To quote one contractor I worked with on a customer project:

> As a contractor, I feel it is my responsibility to make the company aware of the issue and to state my view that plain text communication (whether FTP, HTTP, email, etc.) is unsuitable for protecting even the most modest secrets.

While the division repeatedly raises concerns about protecting proprietary company information, they recommend clear text password protected sites as secure distribution mechanism. A security leak could result in liability and responsibility for breach of contract to other technology partners. In addition, the use of email is not only inefficient in supporting partners and customers' technical needs; it is also hazardous to the customer's proprietary information. Proprietary information can easily be misplaced or easily get into the wrong hands by mistake. Some engineers use email efficiently while others carelessly forward email to parties internal or external that do not need to have that information. The only way to avoid this is to use an alternative system to manage collaboration between the company and its customers' teams. As an alternative to using email, different databases should be used for collaboration between OSM internal engineering teams and the OEM. Some of the databases should be restricted to internal teams while others can be accessible by customers.

A Secure Customer Technical Support Data Base

The AES Technical Support Data Bases (TSDB) is used to support AMD Embedded Customers to design in AMD CPU and graphics products (GPUs). The internal AMD TSDB is only accessible to internal AMD engineers and field application engineers (FAEs). This makes it easy to protect Proprietary information from leaking because all the information is funneled through the FAEs. The FAE only provides what is necessary and the flow is well managed and controlled. The engineers never talk to customers directly and the customers' correspondences are filtered by the FAEs (very familiar with NDAs). There are several disadvantages to this level of control although proprietary information is clearly well protected. This process is very inefficient for customer technical support. Delays are very real and frustrating because of this extra level. On the extreme, there is a version of the TSDB that allows pre-approved customers to directly exchange information between the internal AMD engineers and a customer's engineering teams. This is only a viable arrangement because extra layers of security have been added to balance between efficient support and tight security on information. Each customer has a view that cannot be accessed by any other customer. Even for internal engineering staff, access to a customer's or AMD confidential information can only be accessed on a "need to know" basis with access controls. This is a good compromise for AMD and its major customers on protection of confidential information.

CASE STUDY OF THE AMD EMBEDDED SYSTEMS DIVISION (AES)

The AMD Embedded Division provides a very interesting case study of the issues involved in providing effective quality technical support to customers that are small to medium-size businesses (SMB) and not in the elite class of the big OEMs (HP, DELL, ACER, etc.). The big OEMs obviously get the technical support they need because they generate more revenue for the company. Even though the small to medium size customers do not generate as much revenue, they tend to be more innovative and are also eager to be early adopters for new technology and many have great potential to become the next Google or Facebook. The partnerships also enable customer alpha and beta sites where the product can be tested for robustness before going into production.

The embedded market has additional special challenges when it comes to the quality of customer support delivered by AES. Not only are the design cycles longer than for standard parts (3 years), the components used also require a longer product life-cycle. Compared to the mainstream Microprocessors and graphics chips sold in the general Computer market for Desktops and laptops, the embedded market requires Microprocessors and graphics chips with higher temperature specifications and longevity guarantees. The CPUs/GPUs need to have a longevity period of 5-7 years. However, once designed in, these products have a long life-cycle and are therefore a source of steady cash flows for AMD and the customers selling the products. One way to guarantee this cash flow is to provide high quality technical support.

The main category of embedded customers is made up mostly of smaller Commercial Embedded Systems companies which sell mostly to Industrial, Automotive, Telecommunication, and specialized high performance computing providers. These customers are also similar to what G.A. Moore (page 41) describes as "*Early Majority: The Pragmatists*" in the technology adoption life-cycle. Moore goes on to state (page 43) that:

> When pragmatists buy, they care about the company they are buying from, the product of the quality they are buying, the infrastructure of supporting products and system interfaces and the reliability of the service they are going to get. In other words, they are planning on living with this decision personally for a long time to come.

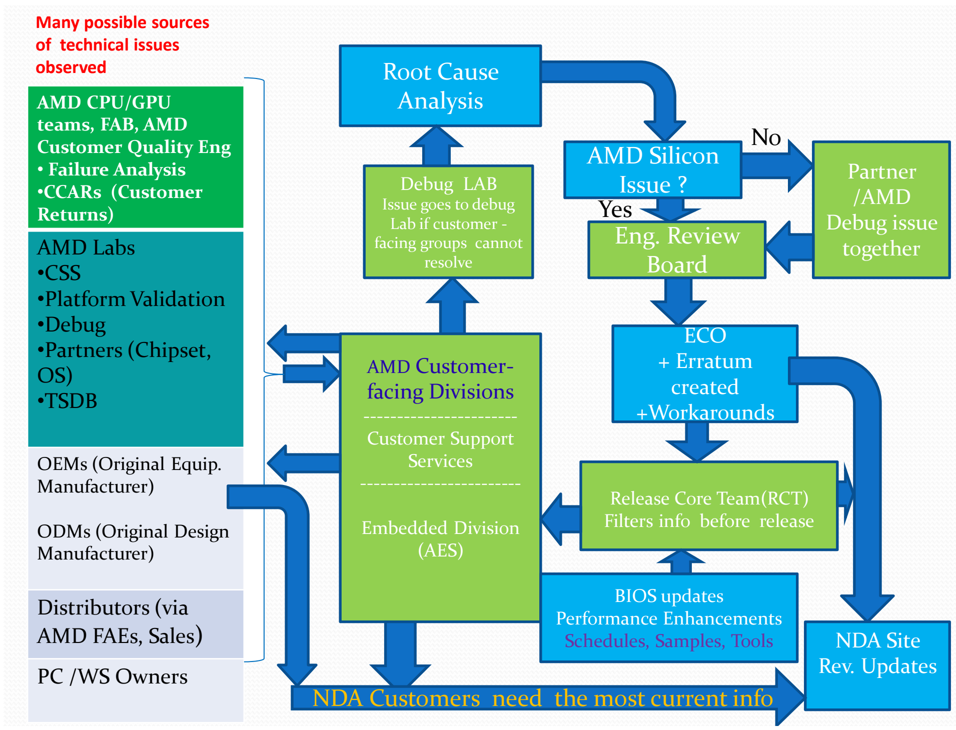
The AES division has a small staff of about 10 engineers and two Program Managers with a charter to support at least more than 200 small to medium-size business (SMBs) customers. How does a small staff of ten engineers support a customer base of greater than 100 small and medium size OEMs and still deliver quality technical support? The Technical Project Management model that I will describe below appears to work just right.

The Technical Project Management based Customer Technical Support

The AES division utilizes a "Technical Project Management" model to manage their Tier 1 customers. For example, a Technical Project Manager for a Tier 1 OEM customer will engage with the customer early on in the "Pre-charter" phase of the project and participate in the initial specifications and early design reviews and stay on the project throughout the life-cycle of the product. His role is varied and he/she has to wear many "hats" such as: Technical Problem solver, Design Engineer, Debug Engineer, People Manager, Standards Architect, and Chief Negotiator. The Technical Project Manager also acts as a spokesman and advocate on behalf of the customer, cutting through the internal "red tape" breaking down barriers across divisions such Marketing, Silicon Design, Software, and Hardware. Using the AMD example (Figure 4), technical issues can originate from many unexpected sources. Any of the technical problems reported can potentially affect key customers. A Technical Project Manager is needed to keep track of all the issues on behalf of key customers.

The Technical Project Manager adds value to both the OSM and OEM/ODM by managing technical project trade-offs across the different functional groups for cost, schedule and quality within the scope of customer support services. Frequently, the Project Manager also has to reset customer expectations when problems arise as the project progresses from Development, Production to the Sustaining phases. This model has worked well to improve the quality of service to AES customers. By helping resolve technical issues and managing tasks in the critical path, the product development cycle is shortened. This translates in effective quality of technical support if customers' products are introduced in the market place on time and within budget.

Figure 4: Sources of technical issues tracked by a TPM on behalf of customers

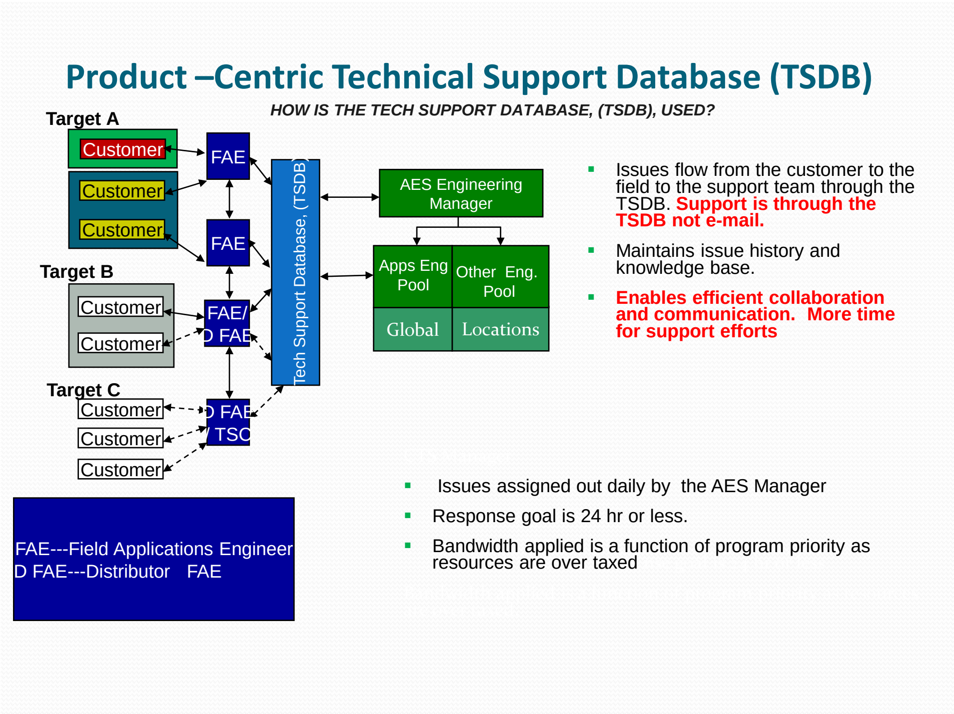


The AES Technical Support Database (TSDB) for Effective Customer Collaboration

In the current AES organization, the Field Applications Engineers (FAEs) have owned the customer relationships and have been the primary interface between the customers and the internal AES engineering staff. All the customer requests for technical support have also been managed by the FAEs or Sales personnel.

The diagram below (Figure 5) illustrates how the TSDB is currently used for customer support. The most efficient way to organize the TSDB for customer support is shown in Figure 6.

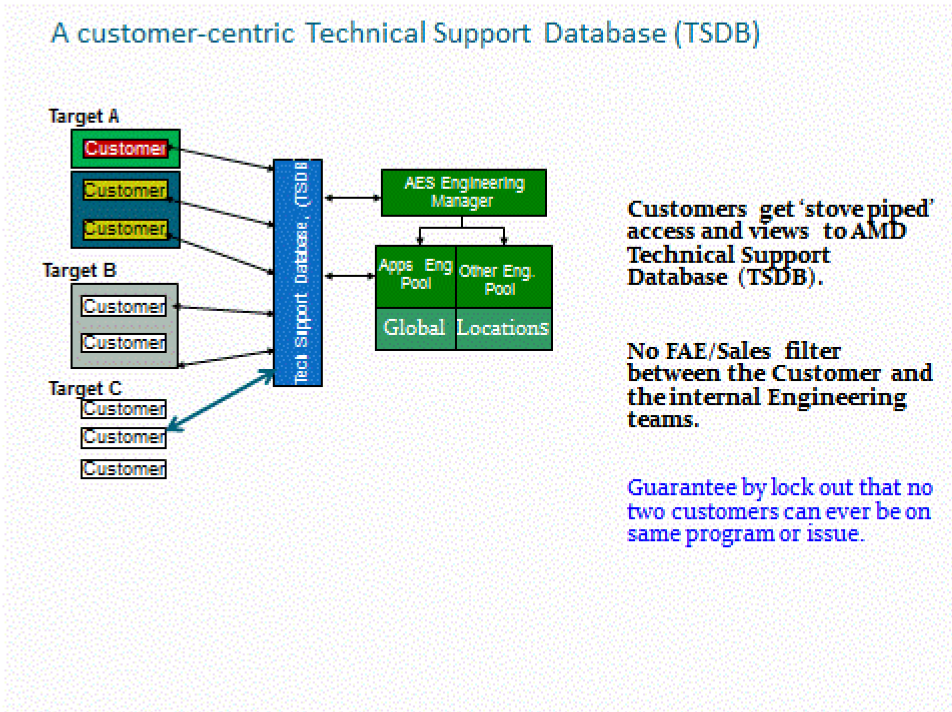
Figure 5: AES has a Product-centric Technical Support Database (TSDB)



The Product-Centric Database:

- Customers have no access to the engineers or the Database.
- FAEs communicate issues to AES Engineering staff via the Database (TSDB).
- Can result in poor design support and lost design wins if not properly managed.
- Not enough FAEs means slow response.

Figure 6: The Ideal Technical Support Database (TSDB)



The Customer-Centric Collaborative Database:

- Allows Customers secure, direct access to the TSDB and Staff.
- Customers love it.
- Engages the Engineering staff to communicate directly to customers' engineering teams.
- Improves quality of support, improved time to market for customers.

Chapter 5: Recommendations and Conclusion

OVERVIEW

In the Case Study presented in the previous chapter, I discussed how the AMD Embedded division is organized in such a way that a small group of technical support Engineers can support a large number of customers (one-to-many). In recommending how to make the technical support team more efficient, it is important to first examine the strategic goals of the AMD Embedded Systems division (AES), the capabilities of the division, as well as the levers employed by the division to manage the quality of technical support for the large pool of embedded customers. It is possible to improve the quality of customer support to "world class" standards without increasing staff and at minimal cost.

Historically, the AMD Field Applications Engineers (FAEs) have owned the customer relationships and have been the primary interface between the customers and the internal AMD Engineering staff via the "AMD Embedded Customer Technical Support Data Base (TSDB)". Since all the customer requests for technical support have also been managed by the FAEs or Sales personnel, in the recent economic downturn, the FAE staff was drastically reduced and the division has been relying more on Distributor FAEs and sales people to carry more of the support load. This has turned out to be a bigger problem than previously anticipated and increased exposure to risk of losing design wins and customer loyalty because of the following reasons.

Partnerships and Compensation Issues

First, the AES division has formed partnerships with world-wide electronics distributors to sell AMD embedded products. The distributors are susceptible to picking and choosing which customer and problems they will focus on based of the way they are compensated. For example, a distributor FAE is not going to put much effort on resolving a Software issue when they are making a commission on selling Hardware. The distributor may not realize how intertwined the Software and hardware are when selling CPU/GPU products. Therefore, field personnel who are paid by commission have incentives that do not match with AES's overall strategy of selling complete solutions not just CPU/GPU hardware components.

Personnel Issues

Second, without enough AMD FAEs to support key customers, the current embedded customer support process will likely deteriorate further because all the customer requests for technical support are processed by the FAE or Sales personnel. Critical technical information from AMD to customers also has to be communicated to customers via the FAE. There are simply not enough Applications Engineers dedicated to supporting customers on all ongoing projects. At any given time there may be hundreds of customer development projects in progress. There are only about ten engineers to support all these designs so it is understandable that AES has to rely heavily on Distributors to service the embedded customer base. The distributor at the same time may also be selling a competitor's (e.g. Intel) products; thus there is a lot of potential for conflicts of interest on which product the salesperson will support.

Performance Management

The AMD Performance management tool is used for internal teams and does not include the sales force. The benefits of the AMD performance tool are to align goals, provide feedback to employees and make sure that the employees are engaged. However, this tool is not used to assess how the Distributor's FAEs and Sales people responsible for selling the company products performed. This is another example where the levers used are not synchronized to the capabilities and strategy desired by the AES division. Applying the "Human Capital Framework" model shown in Figure 7 below, the AES Strategy, Capabilities and Levers would appear as in Table 4.

Figure7: Human Capital Framework (Lewis, K., 2011)

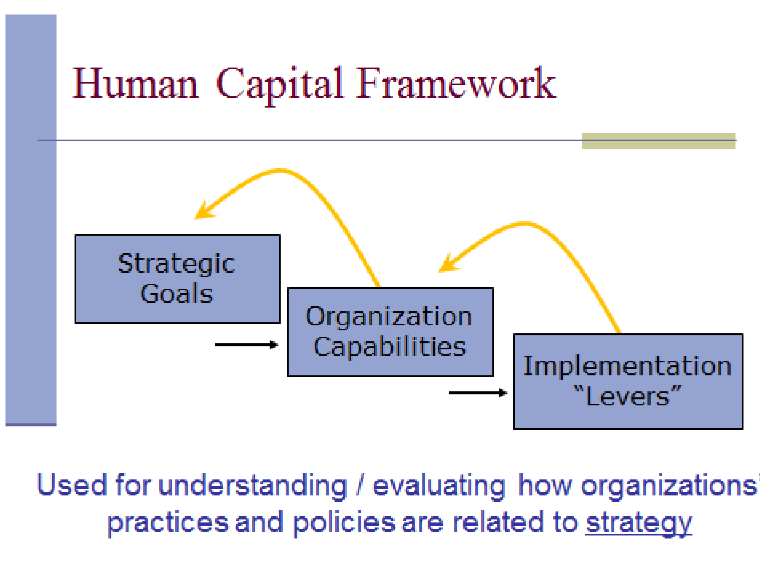


Table 4: Strategic Goals, Capabilities and Levers for AES division

<table>
<tr><th>Strategic Goals</th><th>Capabilities (What AES must know / know how to do). Capabilities to achieve strategic goals.</th><th>Levers (Things AES is doing, with respect to managing people). Three different Human Capital Levers that AES uses</th></tr>
<tr><td>1. Grow Revenue to >300M/yr.</td><td>1. Sell more products worldwide through the distributors and Sales representatives. Increase the Field Applications Engineering force to manage Customer relationships better.</td><td rowspan="4">1. Partnerships
-Form partnerships with world-wide Distributors of Electronic products such as Arrow and AVNET and use their sales teams to sell AMD products and support AES customers.
- Hire experienced Field Applications engineers.
- Equip internal Engineering teams of Applications engineers to support customers, FAEs and the sales force in the field via the TSDB.
2. Compensation:
-Sales Commission for distributors and sales representatives
-Good salaries, bonuses & annual raises for AES Engineering staff.
3. Performance Management
-AMD Performance management tool is used for engineering teams but does not include the sales force.</td></tr>
<tr><td>2. More world-wide design wins for AMD embedded, low power products.</td><td>2. Provide total solutions (Hardware and Software) and reference designs instead of discrete products. Provide Industrial temperature APU/CPU/GPU products with longevity of 5-7 years.</td></tr>
<tr><td>3. Delight customers with world class technical support.</td><td>3. Help customers design in AMD products that work right the first time and reduce customer time to market for products due to superior technical support.</td></tr>
<tr><td></td><td>4. Enhanced Technical Support Database (TSDB) for Engineering, FAE and Sales staff to manage customer technical support.

-24 hour response time to customers’ requests.</td></tr>
</table>

In view of the problems stated above and looking at the Human Capital Framework, it becomes clear what is needed to align the strategic goals with the capabilities and levers needed to fix the division's problems. This can be achieved with a solution that is very simple to implement and cost effective.

RECOMMENDED SOLUTION

The recommended solution to enhance quality of technical support would be to allow Tier 1 &2 customer direct access to the TSDB for collaboration. This would at the same time solve problems that customers and AMD field personnel have always complained about: slow response, lack of follow up, and insufficient technical information in a timely manner. Allowing the customers direct access to the TSDB would not be a panacea to all the problems encountered in supporting the amorphous embedded customer base, but it would be a big step forward toward solving the support problems and making AMD more competitive.

My proposal does not require the purchase of any new equipment and Software and nor does it require any retraining of the current engineering staff; however, the customer would need some basic training of a few hours at most to be comfortable using the system. The customer would then be able to access the TSDB directly and enter their own questions in the tracking system.

When the AES engineer responds, the customer is automatically notified to check the TSDB for a response. The customer can immediately ask follow up questions if the initial answer is incomplete and needs further clarification. This way, the customer is in control of communicating their technical issues instead of relying on the FAE or a Salesperson. There is no information lost in translation between the customers and the FAE/Sales people before it reaches the engineer working the issue.

This solution would also reduce the customer's development cycle time and reduce time to market and enable quick payback on investment. Customers would be able to build their prototype in a shorter time and meet their schedules for customer demos. By engaging with AES engineers earlier on in the specifications phase and getting early feedback from AES engineers on key issues of performance, unique features and BIOS, customers are more likely to get the design right the first time. Using the TSDB, the customers' schematics and layout can be reviewed for adherence to AES specifications and recommendations before their platforms are manufactured. When the boards come back from the assembly house for bring-up, an AES engineer would be ready to help in the board bring-up. All this can only be accomplished if the customer collaborates directly with an AES Engineers via the Database and with minimum Field Applications Engineer involvement.

No major changes are required to implement this proposal except for the TSDB administrator to set up a "stove pipe" security access for each customer so that one customer cannot see another customer's issues and communication. Before responding to a customer, engineers will need to think about their answers carefully and also remember that the customer has copies and records of all their communications. All communication on technical issues must be well researched and to the point so as to reflect a "world class" technical support group. The justification given for keeping this system closed to customers is that it “enables engineers to freely exchange and debate issues amongst themselves” without the fear of exposing themselves to customers. However, by allowing customers access to this critical database, it puts the customer in control of managing their technical issues thus increasing efficiency and quality of support. To quote Guy Kawasaki, in his book (Kawasaki, G., 2008) “Reality Check”, this is what he states about the art of customer service:

> Put the customer in control. The best customer service happens when management enables employees to put the customer in control. This requires two leaps of faith: first, trusting customers to not take advantage of the situation; second, trusting employees to make sound decisions. If you can make these leaps, then the quality of your customer service will zoom…..

For the embedded customers, the control has been in the hands of the Field Applications engineer and the Sales Representative. Clearly, this is the right time to make the transition from FAE control to customer control and create a world class support organization.

Discourage the use of email for solving technical issues

At many Semiconductor companies, the use of email is by far one of the most popular and easiest forms of communication besides the telephone; however, there is a big problem when email and the telephone are used as primary means of communication between Semiconductor company engineers and customers’ engineering teams to collaborate on a design. Today’s teams are dispersed geographically and simply picking up the phone and calling a customer in Asia or Europe may not always be the most practical way because of the time difference. Information can easily get lost because engineers do not always use email efficiently. Some engineers respond quickly and have a good filing system while others are sloppy and delete emails prematurely. When an engineer is sick or on vacation, customer issues get dropped or customers do not get answers to their critical questions in a timely manner and get frustrated. Unless the engineer takes the initiative to copy all the team members, some of the team members will have only pieces of the puzzle and this will jeopardize the project in the long run. The shortcomings of using email and the telephone is another reason a Technical Support Database (TSDB) is essential for effective technical support.

Matrix Organization is the most effective for Customer Technical Support

A matrix organization is the best form of organization to leverage different skills across different functional groups. Scarce engineering resources can be easily shared on different projects in this type of organization. It is also the most efficient for technical support in a customer-centric organization. What does it mean to be on a matrix team?

The engineers on a matrix team may report to two different bosses while supporting a key customer project. The first boss is usually their department manager in the functional group (e.g. BIOS Engineering). The second boss may be the Program/Project manager responsible for a key OEM customer. The Technical Project Manager has to work with the functional manager and coordinate the workload for the BIOS engineer to ensure resource availability. In most cases, the engineer will be supporting multiple customers. Subject matter experts in their areas and key engineers can also be shared on different projects. However, the matrix organization presents more challenges for managers and requires more creativity in managing teams and people.

CONCLUSION

Solutions instead of stand-alone products-the "value-add"

Today's customer-driven business environment has brought to the forefront the importance of customer-centric partnerships between businesses to provide solutions for their targeted customers and markets. This is a win-win partnership for both the OSM and the Original Equipment Manufacturer (OEM). However, this mode of operation requires intensive technical support to make the partnership successful. With businesses demanding solutions instead of stand-alone products, semiconductor companies are quickly moving from being product-centric to customer-centric although one can still find a hybrid of both. When an OSM helps an ODM design a complex product solution by bundling Hardware /Software, development tools and consulting services, it adds a lot of value to the partnership and results into long term customer satisfaction.

Support throughout the product life-cycle

Quality in technical support is only possible if it is planned well at every stage of the product life-cycle. In the past, customer support engineers would be added after the product was in production. Sometimes, semiconductor companies cut corners on test time in order to get a product to the market faster. This is a big mistake because it makes good technical support hard to achieve. During the validation phase, catching all bugs during the early stages will make the difference between a successful or mediocre product. A quality product will guarantee that there are no unnecessary “fire fights” and “pain points” for the customer. The golden rule here is “find all the Chip bugs before the customer does”.

The more customer-centric future

Customer-centricity is here to stay and is winning over the legacy product-centric way of doing business. When semiconductor companies become more customer focused, they allow customers secure, direct access to their Technical Support Databases and engineering staff. It allows the engineering staff to communicate directly to customers’ engineering teams. For a customer-facing organization to be more effective in providing quality customer technical support, it is necessary to organize in a way that serves their most loyal customer base. A matrix organization is the right one for effective, quality technical support. Not only does the culture of the organization have to change to be more customer-centric, the management teams have to be more innovative in deploying the scarce resources efficiently. The improved quality of support leads to improved time to market for customers. Customers love the direct access and expect it.

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Vita

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