Balancing Solution-Focus and Product-Focus and Technology-Focus Strategies in the High-Tech Industry

by

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ABSTRACT

Companies in the high-tech industry can pursue a range of strategies around delivering value to their customers. A technology focus strategy enables organizations to offer to their customers products that feature best-in-class performance along certain parameters. A solution focus strategy enables organizations to offer their customers an integrated set of products and services that are customized for their specific contexts. A tradeoff often exists between the two strategies and organizations have to choose the mix of resource allocation between technology investments and solution investments. Determining the appropriate balance between technology focus and solution focus is often an area of struggle for high-tech companies.

This thesis uses literature research to identify existing frameworks for determining where a company should be on the continuum between technology focus strategy and solution focus strategy and when a company should shift, expand, or contract its footprint along that continuum. The thesis will then examine a sample of companies that occupy varying technology/solution focus positions, evaluate the applicability of the frameworks in the case of these companies as well as use the frameworks to try to justify any repositioning that those companies may have undergone or are currently undergoing and possibly to make suggestions on a future strategic course.

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Motivation
Companies in the high-tech industry can pursue a range of strategies around delivering value to their customers. A technology focus strategy enables organizations to offer to their customers products that feature best-in-class performance along certain parameters. A solution focus strategy enables organizations to offer their customers an integrated set of products and services that are customized for their specific context. A tradeoff often exists between the two strategies and organizations have to choose the mix of resource allocation between technology investments and solution investments.

Determining the appropriate balance between technology focus and solution focus is often an area of struggle for high-tech companies.

This thesis uses literature research to identify existing frameworks for determining where a company should be on the continuum between technology-focus strategy and solution-focus strategy and when a company should shift, expand or contract its footprint along that continuum. The thesis then examines a sample of companies that occupy varying technology/solution focus positions, evaluates the applicability of the frameworks in the case of these companies as well as uses the frameworks to try to justify any repositioning that those companies may have undergone or are currently undergoing and possibly to make suggestions on a future strategic course.

Literature study will be the primary research methods used to obtain the data for evaluating the frameworks and for justifying any organizational repositioning.
1 Introduction

1.1 Technology
Technology is "a capability given by the practical application of knowledge."¹ In the remainder of this thesis, I will use technology to refer to capabilities that enable fundamental product or service differentiation along specific performance dimensions. For example, in the context of the semiconductor industry, technology may refer to the set of capabilities that enable a manufacturer to achieve automotive- or military-grade product reliability. Technology capability is usually developed over long periods of time and with significant investment.

1.2 Product and Product Development
Product is something produced or something that is marketed or sold as a commodity (i.e., economic good).²

Product development involves the design and realization of a product for addressing a set of application and market needs using available technologies and capabilities. It is important to emphasize the customer needs context and the technology and capabilities contexts of product development. As Steve Jobs said, "really great products come from melding two points of view—the technology point of view and the customer point of view."³

1.2.1 The Customer Needs Context of Product Development
Developing a thorough understanding of customer needs and incorporating, into the product, features and technologies to address those needs is an essential part of the product development process. The more successful a product development effort is at addressing the needs of customers, the better value the resulting product will deliver to those customers and the better chances the product will have for success in the marketplace. However, addressing the relevant needs of customers is challenging for several reasons, as will be discussed in the next couple of sections.

1.2.1.1 Difficulty in Identifying the Needs Information
Obtaining the needs information from customers is challenging because in many cases customers cannot articulate their needs. Furthermore, in some innovative industries such as high-tech, "customers' ability to guide the development of new products and services is limited by their experience and their

¹ (Technology)
² (Product)
³ (Burlingham & Gendron, 1989)
ability to imagine and describe possible innovations. How can [product development] companies identify needs that customers themselves may not recognize? 4

1.2.1.2 Shifts in Market Demands

The difficulty of addressing customer needs in rapidly-changing markets when the supplier’s product development cycles are long is a recurring theme that I observed from conversations with senior leadership in the programmable processor industry, where product development cycles can take 1 or even 2 years. Defining a processor product by engaging customers to try to find out what their needs are going to be in 2 year timeframe may not lead to a successful product when customers don’t necessarily have visibility into what their end market trends are going to be in that timeframe. Furthermore, the technology or product landscape can shift such that customer’s true needs can be better satisfied by competitive offerings. According to Steve Jobs, “You can’t just ask customers what they want and then try to give that to them. By the time you get it built, they’ll want something new.” 5 Under the circumstances of rapid shifts in market demands and long development cycles, which represent the most challenging quadrant in Figure 1, the requirements captured at the beginning of a product development project may no longer remain representative of market needs by product availability time.

![Shift in Market Demands Diagram](image)

Figure 1 - Product Development Cycle vs. Rate of Change in Market Demands

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4 (Leonard & Rayport, 1997)
5 (Burlingham & Gendron, 1989)
1.2.1.3 Determining Which Customers' Needs to Capture

The question of who to engage with when defining the driving needs for a product development is very important because the success of the product in the marketplace depends on the value that it delivers, or at least is perceived to deliver, to profitable customers. While in some industries the number of customers is limited and access to those customers is easy, it is often the case that products have a large addressable market with many potential customers. Furthermore, the opportunity size presented by different customers is far from static. Large customers may become less sizable opportunities or even exit the market altogether. This change happens, for example, when those customers fail to identify a market trend that renders their products uncompetitive. Similarly, a lead user, which used to have a very small opportunity size, may become a significantly more important player. In this context, we use Eric Von Hippel’s definition of lead users⁶:

members of a user population having two distinguishing characteristics: (1) They are at the leading edge of an important market trend(s), and so are currently experiencing needs that will later be experienced by many users in that market. (2) They anticipate relatively high benefits from obtaining a solution to their needs, and so may innovate.

Conventional wisdom suggests that in the short term, greater benefit may be derived from engaging customers with a large opportunity size in the needs identification process, while in the long term, identifying the needs of and engaging lead users is a better strategy for continued success.

1.2.2 The Technology Context of Product Development

In most cases, product development organizations attempt to address customer needs by mapping their requirements onto products that are based on the organization’s existing or attainable technologies. For example, it is often possible to achieve a particular customer application using a variety of processor technologies: field-programmable gate arrays (FPGAs), programmable processors, application-specific integrated circuits (ASICs), etc. It is often the case that a FPGA vendor and a programmable processor vendor will build products that target the same application. In such a case, the FPGA organization’s product development team will attempt to map customer’s needs onto a solution that is based on FPGA technology, while the programmable processor organization’s product development team will attempt to map customer’s needs onto a solution that is based on programmable processors.

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⁶ (Von Hippel, 2005)
1.2.3 The Importance of Technology Leadership

Different technologies exhibit different tradeoffs and have different performance envelopes as shown in Figure 2. When a technology, which addresses existing needs, improves upon existing technologies along one or more key performance parameters, products based on that technology usually become very successful. For example, a processor product that provides customers with comparable processing capabilities to existing products, but at a significantly lower power consumption envelope, can become an instant hit among processor product customers that target power-critical applications. Technology leadership, while not always attainable, can lead to very profitable products even when those products actually fail to address the needs of the original customers that they were intended for.

![Figure 2 - Technology trade-offs and performance envelopes](image)

Therefore, it is critical to consider the role of technology leadership when evaluating an organization’s technology development and product development processes.

1.3 Solution

“There is no unanimous and rigorous definition of solutions, but rather a number of often broad and generic descriptions that could be applied to a wide array of different offerings, if not generically.” This thesis uses the word solution to refer to an integrated set of products and/or services that are customized for the specific needs of one customer or of a set of customers and that provide incremental value over the sum of the individual offerings. A solution is therefore different from a simple bundling of products and/or services in that it features integration of those elements such that it adds value beyond the sum of the individual values of those elements. A solution features a degree of customization

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7 (Davies M. A., 2009)
8 (Nordin & Kowalkowski, 2010)
ranging from targeting to satisfy the intersecting needs of a set of customers to honing in on the specific needs of one customer. It is important to note that customer needs in the context of a solution are not only limited to product or service needs, but to business needs surrounding value delivery from said product or service, including evaluation, development, deployment, and operation.

1.3.1 Solutions vs. Vertical Integration

It is important to distinguish between moving from technology focus to solution focus and between integrating downstream in the value chain. The difference may be best explained by highlighting the difference in terms of outcome from the customer's perspective, but first, we elaborate on the concept of vertical integration in the value chain.

Vertical integration refers to a firm’s participation in different activities along the industry value chain. For example, the value chain in the apparel industry is depicted in Figure 3:

![Figure 3 - Value Chain in the Apparel Industry](image)

A company may engage in the business of fiber production, may expand into cutting, making and trimming of apparel, may expand even further into design and product development, or even into retail.

Whether or not an organizational change in terms of vertical integration is accompanied by a transition into the solution space is determined by the outcome as perceived by the customer. A survey of literature seems to indicate that the outcomes of a solution are: solved customer problem (expressed/latent), better or easier life for customer, and value for supplier/customer (e.g., economic/social/environmental).

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9 (Jacobides & Billinger, 2006)
10 (Nordin & Kowalkowski, 2010)
A company that expands its value footprint to encompass more of the value chain does not necessarily mean that it has moved further into the solution space. For example, a company that expands its operations from just the production of fiber to also engage in cutting, making, and trimming of apparel does expand its footprint from a vertical integration perspective, but does not necessarily become a better solution provider to its customers. In fact, it may become a competitor with its existing customer base of apparel cutters, makers, and trimmers. The company’s new cutting, making, and trimming of apparel business provides it with access to a new customer base of original brand-name manufacturers and with a new cut or trimmed clothing product. However, from the perspective of the new customer base of original brand-name manufacturers, the company’s vertical integration does not necessarily translate into better or easier life or into a better solution to their problems, especially if those customers could get a comparable or a better product from elsewhere.

In certain cases, vertical integration is accompanied by enhanced solution offerings. This happens, for example, when a company is able to leverage some internal capabilities to provide additional values to its new and existing customers that those customers would not have been able to obtain otherwise. For example, if we consider the different industry of microcomputers, whose “value chain consists of five distinct activities depicting a product’s progression from upstream to downstream stages in the value chain (Grove 1996: 39-45): (1) chips; (2) computers (desktops and lap tops); (3) software: operating system; (4) software: applications; (5) sales and service.”1 A company can produce and sell only the programmable processors; may expand into building a hardware system that integrates both its programmable processors as well as other components; may decide to encompass a yet larger portion of the value chain by developing the operating system and application software to run on the hardware systems; or may even provide a package of acquisition, deployment, and operation services. It is conceivable that a programmable processor company that expands into hardware system design will be able to leverage its expertise in its own products as well as other companion electronic components to provide an offering that is more valuable to customers than that they would have been able to obtain otherwise. It is also conceivable that the learning that the company develops from building the hardware systems will enable it to produce improved programmable processors in the future that solve the customers’ problem better, that provide better overall value to customers and that make life easier for customers (i.e., that achieve the outcomes of a solution).

11 (Rothaermel, Hitt, & Jobe, 2006)
1.3.2 The Importance of Solution Leadership

There is no permanency to technology leadership. Knowledge disseminates, competitors catch up and emerging technologies render an organization's once leading technologies obsolete. This is stated very eloquently by Louis V. Gerstner Jr., Chairman and CEO of IBM in the company's 1998 annual report relative to the information technology industry:

> The greatest competitive advantage in the information technology industry is no longer technology.

> Without question, strength in basic and applied research remains essential in our industry – not only to achieve the breakthroughs that make new products possible, but also because they give the discoverer a unique ability to foresee, and shape, the future.

> However, technology changes much too quickly now for any company to build a sustainable competitive advantage on that basis alone. Someone is always inventing some software code or device that is a little faster or cheaper. More and more, the winning edge comes from how you help customers use technology – to steal a march on their competitors, to implement entirely new business models. That means creating integrated solutions that draw on the full range of products and, increasingly, services. And it means connecting the dots between what you learn in the lab and what you learn in the marketplace.

Gerstner makes a very compelling case for focusing on solution leadership, which means mastering not only the integration of technologies, products and services, but also the support and enablement of customers through to their value capture.

The customer enablement component of solution strategy is particularly important in the high tech industry where the technology and product landscapes change rapidly. It is not sufficient to provide products and services that meet or even exceed the technical requirements of customers, but to enable customers to easily derive the value of such products and services. The degree to which such enablement is necessary depends on the degree to which the offered products and/or services fit within the customers' existing use contexts. For example, if deriving value from a product requires the customers to depart from their established processes and existing ways of doing things, then the

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12 (IBM, 1999)
product company needs to master the support of its customers through the changes necessary in order to achieve value delivery.

In order to ensure continued success, an organization needs to have a crisp strategy for balancing and directing investments in technology leadership and in solution leadership, selecting the right customers for each approach and mastering the timing and process for transitioning between the two.
2 Degree of Solution Innovation Strategy

In the next few sections we define the levels that an organization can occupy along the scale between technology innovation strategy and solution innovation strategy. The levels that we propose, based on experience in the programmable processor industry are Technology, Product, Application or Market segment, and Solution.

![Figure 4 - Technology-Solution Scale](image)

2.1 Technology Organization

A technology organization is focused on conceiving and developing technologies that push the boundaries of existing performance parameters. For example, research groups both in industry and academia fall into this category. The output of a technology organization is usually not suitable for direct application within existing usage contexts, but rather is in need of a productization phase.

An example of a technology organization in the context of the programmable processor industry may be a processor architecture group that defines new processor instruction-set architectures (ISAs) or even complete processing units. There are not many prominent examples of companies that are merely comprised of technology organizations. It is a lot more common to have a company that is comprised of technology organizations in addition to product organizations. For example, Intel and ARM are both examples of companies that engage in technology development while also applying the technology in product development. ARM researches and develops programmable processor designs that are licensed and sold to semiconductor manufacturers and OEMs that utilize ARM’s designs to create semiconductor
chips suitable for modern electronic devices. Intel applies its broad range of technology innovations in programmable processor designs as well as in manufacturing technology into productizing and selling its processor products.

2.1.1 Success Factors in a Technology Organization
Success in a technology organization results from achieving a technology leadership position by pushing the performance envelope along one or more parameters that are critical to a target application and market while not diminishing the aggregate value delivered by the technology through too high a productization cost. Table 1, which depicts a hypothetical example, uses numerical values that represent units of aggregate measure of value. A larger numerical value in a technology’s “aggregate measure of value within a particular application/context” row means that a technology provides better overall value without consideration to the cost of productization. The costs to productizing the technologies are also expressed using the same units of aggregate measure of value. Subtracting the cost of productizing the technology from the aggregate measure of value yields the “net aggregate measure of delivered value.” A larger numerical value for the net aggregate measure of delivered value means that a technology provides better overall value. The hypothetical example of Table 1 shows that while technology B appears to have a better performance within a particular application/market context, it fails to measure up to Technology A and even to existing technologies with regards to anticipated delivered value after taking aggregate costs of productization into account.

<table>
<thead>
<tr>
<th></th>
<th>Technology A</th>
<th>Technology B</th>
<th>Existing Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate measure of value within a particular application/market context</td>
<td>7</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Aggregate costs to productizing (expressed in units of aggregate measure of value)</td>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Net aggregate measure of delivered value for the technology within a particular context</td>
<td>6</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 1 - Impact of Costs to Productizing over Delivered Aggregate Value of a Technology

Therefore, a technology organization should focus its resources on steering technological innovation towards achieving market needs, in terms of net aggregate delivered value, better than existing

13 (ARM Holdings)
technologies by improving upon the performance of any existing technologies along one or more key dimensions while reducing the cost to productization.

2.2 Product Organization

A product organization engages in the development of products to address a set of applications and market needs, relying in the process on available technologies.

A product organization in the context of the programmable processor industry may be a processor product development group that develops new processor products based on available micro-architecture and a variety of semiconductor manufacturing technologies. The product development teams within Tilera Corporation\textsuperscript{14}, which develop many-core processors and systems based on those processors, are examples of product development organizations. Note that Tilera Corp. as a whole occupies a more complex position along the technology-solution scale that includes technology organizations, product organizations, market segment organizations, and to some extent solution organizations.

2.2.1 Success Factors in a Product Organization

Success in a product organization results from delivering products that meet existing market requirements while improving upon existing products along one or more key performance criteria and while not increasing the cost of product usage. Implicit in this statement are the following arguments:

- A product that improves upon existing products but that fails to meet an existing market requirement will fail. For example, a processor product that achieves unprecedented performance capabilities, but that does not meet minimum safety standards cannot be adopted.
- A product that meets market requirements while also improving upon existing products along one or more performance parameter that are irrelevant or unimportant to the marketplace is unlikely to provide additional value that enables it to replace existing products. As Peter Drucker puts it: “There is nothing so useless as doing efficiently that which should not be done at all.”
- The performance parameters that are improved upon in a developed product relative to competing products need to be important enough to overcome any costs or undesirable behavioral shifts resulting from a switch-over from existing products to the developed product. This is articulated well by John Gourville and illustrated in Figure 5.

\textsuperscript{14} (Tilera Corp., 2013)
As explained earlier, different technologies have different performance envelopes and thus enable products, which in turn feature different performance characteristics. A product organization needs to choose, from among available technologies, the technologies that will enable it to develop products that meet existing market requirements, exceed the performance of competing products along key performance criteria, and reduce the degree of undesirable behavioral shifts on the part of users.

2.3 Market Segment Organization
A market segment is a set of customers that share certain attributes and are therefore combined into a common grouping.

While the literature on solutions strategy usually uses the two discrete terms of product and solution to describe the two ends of the spectrum along the technology-solution scale, the literature does discuss that the level of application of a solution strategy is not a one-size fits all; there are industry and company factors that influence the level of application of a solution strategy that is appropriate in a specific context. In this thesis, we chose to introduce an organizational level along the technology-solution scale called market segment organization for two main reasons:

15 (Gourville, 2006)
16 (Davies M. A., 2009)
There is a need to ensure balance between standardization of products and customizations of solutions in order to ensure repeatability of solution offerings. A market segment organization, which on our technology-solution scale is located between the product and the solution organizations is well-positioned to provide this balance.

There is a phase, in the evolution of organizations towards solution-strategy, where companies become more focused on understanding the attributes (e.g., needs) of select sets of customers and on using those attributes to guide product and technology developments and on offering value proposition messaging and integrated offerings that are targeted for those sets of customers. This phase is not quite at the solution level, but certainly further along on the technology-solution scale than the level that a product organization with a mass marketing strategy is at.

A market segment organization synthesizes the common needs of a particular market segment and uses those needs to inform product and technology roadmaps as well as to provide offerings that are optimized for the needs of such a market segment. For example, the automotive applications market segment division of an electronics supplier may develop an understanding of the specific needs of automotive customers and, consequently, drive the development of technologies and products that meet automotive grade reliability specifications.

The output of a market segment organization is an offering that integrates one or more products and/or services into an offering that is optimized for the specific needs of the particular applications of that market segment. For example, digital video encoding for video surveillance is an application that may rely on a combination of an image sensor, a digital signal processor (DSP), and digital video encoding software in order to capture raw video and transform it into compressed format suitable for transmission over bandwidth-constrained mediums for serving the needs of the video surveillance market. It is noteworthy that in our example multiple products (image sensor, DSP, and software) need to be made to cooperate in order to achieve the desired application of video encoding. A market segment organization attempts to enable easier customer adoption of products and services by performing some of the application and market-specific integration necessary, thus providing added value on top of simple bundling of individual products or services.

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17 (Davies, Brady, & Hobday, Charting a Path Toward Integrated Solutions, 2006)
To further clarify the concept of a market segment organization, we should first understand market segmentation.

### 2.3.1 Market Segmentation

When a company engages in the development of products and services that target a diverse set of applications, markets and customers, market segmentation can prove very helpful in order to develop an improved understanding of customer attributes and consequently deliver products with enhanced value to customers. Since the needs of different customers are rarely homogeneous, attempting to capture the needs of all current and potential customers becomes very challenging when the number of such customers is large. Therefore, market segmentation is often used in order to develop a better focused understanding of customer needs and delivering products that provide enhanced value proposition to customers.

Segmentation may be done along different vectors. “Most companies [in the business-to-consumer space] segment along lines defined by the characteristics of their products (category or price) or customers (age, gender, marital status and income level). Some business-to-business companies slice their markets by industry; others by size of business.”

Since, as mentioned earlier, a market segment organization synthesizes the common needs of a particular market segment and uses those needs to inform product and technology roadmaps, market segmentation strategies based on vectors that provide little insight into the needs of customers within the target market segments are ineffective. More effective market segmentation strategies include:

#### 2.3.1.1 Needs-Based Segmentation

Customer segment, according to Seldon and Colvin is “a group of customers with sufficiently homogeneous needs that the segment members can be won with a common value proposition and common marketing.” They propose an iterative process for customer segmentation: “Segment by needs and use profitability as a key tool to understand and refine the needs-based segmentation.” In other words, they propose:

1. Starting out by grouping customers into segments based on a hypothesis regarding commonality of needs;

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18 (Christensen, Anthony, Berstell, & Nitterhouse, 2007)
19 (Seldon & Colvin, 2003)
2. Understanding and tracking customer behaviors in response to actions aimed at better meeting their needs; and
3. Measuring profitability and ensuring focus on most profitable customers

### Segmentation Matrix

<table>
<thead>
<tr>
<th>Homogeneity of Needs</th>
<th>Profitability/Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Reinvest Low-Cost Value Propositions</td>
</tr>
<tr>
<td></td>
<td>Focus Elsewhere</td>
</tr>
<tr>
<td>High</td>
<td>SWEET SPOT Deliver Killer Value Proposition</td>
</tr>
<tr>
<td></td>
<td>Needs Sub-Segmentation</td>
</tr>
</tbody>
</table>

**Figure 6 - Needs-Based Segmentation**

2.3.1.2 **Job-Based Segmentation**

A "job" is the fundamental problem a customer needs to resolve in a given situation. Christensen et al. argue that job-defined markets are generally much larger than product category-defined markets and while needs change over time, the jobs that customers hire companies for are usually more stable. Furthermore, "[because] segmenting by job clarifies who the other job candidates are, it helps marketers to compare the strengths and weaknesses of each of the products that compete, in the customer’s mind, for the job and to derive the attributes and experiences that would be required to do the job perfectly." 

An example illustrating the difference between some of the mentioned segmentation criteria in the semiconductor industry may be that of a customer that needs a digital video decoding solution to be

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20 (Seldon & Colvin, 2003)
21 (Christensen, Anthony, Berstell, & Nitterhouse, 2007)
22 (Christensen, Anthony, Berstell, & Nitterhouse, 2007)
used in an automotive rear-seat entertainment system. A needs-based segmentation may categorize this customer as someone with a need for a digital video encoding solution; an industry-based segmentation may place this customer in the automotive category; and a job-based segmentation may define the job as rear-seat entertainment. A job-defined market, in this case rear-seat entertainment, does indeed make the market big as one may conceive of an iPad docking station, a book or even an Internet-enabled phone to be alternative solutions for the job of rear-seat entertainment.

It is noteworthy that the product needs for a market segment organization may change over time with changes in the introduction of products that are more suited for the new and emerging needs of the market segment. Therefore, it is important when deciding on a market segmentation strategy to consider the company’s capabilities and how those intersect with the trends and the trajectories of the market segments defined.

2.3.2 Success Factors in a Market Segment Organization
As in every other level along the technology-solution scale, success in a market segment organization depends on ability to create more value to customers. In an increasingly competitive product landscape, differentiation comes from getting a better handle on relevant customer needs and ability to find ways to address those needs. In other words, when casting a wide net over the entire market does not provide sufficient insight into the needs of the market place, market segmentation becomes imperative in order to develop a more precise understanding of the needs within each market segment and to deliver offerings that are more optimized for the needs of each of those market segments. How to perform this segmentation in such a way that enables the organization to focus on the important market segments that are best served by the company’s existing and attainable technologies, products and integrated offerings is crucial for the company to continue to create value and, in turn, capture value.

2.4 Solution Organization
A solution organization engages with customers to develop an intimate understanding of their specific needs and maps those needs onto complete systems, which utilize and integrate the technologies, products, and services that are most suited for addressing the customer’s needs. As mentioned earlier, this was Gerstner’s vision for IBM, as communicated in the company’s 1998 annual report:\(^{23}\)

\(^{23}\) (IBM, 1999)
More and more, the winning edge comes from how you help customers use technology – to steal a march on their competitors, to implement entirely new business models. That means creating integrated solutions that draw on the full range of products and, increasingly, services. And it means connecting the dots between what you learn in the lab and what you learn in the marketplace.

As a leading technology company with revenues from services significantly exceeding those from products, IBM is a great example of an organization that successfully reinvented itself and transitioned from technology and product focus to solution focus. IBM today is in the business of providing complete systems, which utilize and integrate technologies, products and services that are most suited for addressing the customer’s needs.

After investing in the development of a solution, a solution provider may then attempt to leverage the developed solution to attract other customers with similar needs.

2.4.1 Customer Classification
It is important to classify the customer base because different customers warrant and require different levels of engagement and go-to-market strategies. In many industries, including the semiconductor industry, it is common to classify customers in terms of opportunity size as follows:

- Tier 1 customers present large opportunities with strong purchasing power
- Tier 2 customers present medium-sized opportunities
- Tier 3 or mass-market customers present small-sized opportunities

Each of these tiers of customers usually requires a different level of support, market strategy and organizational structure. For example, in the semiconductor industry:

- Tier 1 customers may need to be served by dedicated sales organizations, customer teams or global account teams. Winning tier 1 accounts usually requires customization of offerings to fit within the customers’ specific business and operational needs. Therefore, tier 1 accounts are usually also served by customer-focused engineering solutions teams.
- Tier 2 customers may be served by a dedicated sales organization or through a mass-market support channel. Winning tier 2 accounts requires providing means for enabling quick time-to-market. Therefore, semiconductor processor companies usually provide some level of reference hardware and application software designs that enable quick adoption of their products.
Winning tier 3 business usually requires the least amount of support, which usually takes the form of published documentation, simple usage examples, and a mass-market support channel.

Note that in the above example, we only intended to present the relative, rather than the absolute, level of support required for each tier of customers. There are many variables that impact the required go-to-market strategy. For example, having superior technology that is very easy to apply and integrate in customers’ use-contexts may enable the supplier to win tier 1 accounts without the need for much customization.

### 2.4.2 A Better Way to Do Customer Classification

As mentioned earlier in the context of product development, the question of who to engage with when defining the driving needs for a product development is very important because the success of the product in the marketplace is based on the value that it delivers to profitable customers. Similarly, in the context of integrated offerings targeting market segments or focusing more precisely on individual customers, the question of which customers to engage with for driving the needs of such solutions becomes very important. Customer classification based on opportunity size alone ignores the dynamic nature of the marketplace and ignores the fact that opportunity size does not always equate to profitability. Jonathan Byrnes explains why managing revenues leads to the situation where “nearly 40 percent of every company is unprofitable by any measure, and 20 to 30 percent is so profitable that it is providing all the reported earnings and cross subsidizing the losses.”

In his book *Islands of Profits in a Sea of Red Ink*, Byrnes emphasizes the importance of strategies for managing profitability instead of those for managing revenues. Therefore, a better customer classification may be one based on profitability. When customers are classified based on profitability, a company’s largest customers in terms of revenue may no longer remain the true “Tier 1” customers. It may turn out that customers previously classified as “Tier 2” or “Tier 3” based on revenue-opportunity classification, are actually “Tier 1” in terms of true profitability and strategic importance. Examples of such customers may include small customers who are widely followed (i.e., provide a lot of publicity and marketing “profit” that subsidizes other customers) or small customers who require minimal support, but who have substantial growth potential.

Large customers may become less sizable opportunities or even exit the market altogether. This happens, for example, when those customers fail to identify a market trend or a disruptive technology.

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24 (Byrnes, 2010)
that renders their products uncompetitive. Similarly, a lead user, which used to have a very small opportunity size, may become a significantly more important player.

In the case of products and technologies, we mentioned earlier that conventional wisdom suggests that in the short term, greater benefit may be derived from engaging customers with a large opportunity size in the needs identification process, while in the long term, identifying the needs of and engaging lead users is a better strategy for continued success. The general concept remains true in the case of market segments and solutions where there is a need to identify the best customers to partner with around a solution strategy; the greatest benefit in the short term may be derived from engaging customers with large opportunity size while partnering with innovative emerging accounts in the long term. This is depicted in Byrnes’s service differentiation matrix shown in Figure 7.

![Service Differentiation Matrix](image)

The Strategic Accounts, which are both large and willing and able to innovate, would be ideal candidate accounts for solution partnership and integration in different dimensions. The Integrated Accounts, which are large accounts, “warrant significant care and resources, but not extensive customization”\(^\text{26}\). The Emerging Accounts would be the equivalents of the lead users discussed earlier. They have the potential of becoming strategic accounts. The Stable Accounts, which are small and unable to innovate,

\(^{25}\) (Byrnes, 2010)
\(^{26}\) (Byrnes, 2010)
are the least suitable for a solution partnership. They may be best serviced through the standardized offerings of a product or market segment organization.

2.4.3 Success Factors in a Solution Organization

At the solution level, similar to all previously discussed levels, success depends on ability to create more value to customers. In an increasingly competitive market landscape, the broad market segmentation strategies may not be sufficient. There is a need to focus even more precisely on identifying and partnering with specific strategic customers and to provide them an offering of integrated products, services, and even operational and business solutions. At the solution level, value may be created not only by providing a high-value integrated solution of products and services to the customers, but also by mastering the capability of seamlessly integrating such solutions into the customers’ organizations. At the solution level, being highly adept at supporting the change management of the client organization can provide value far exceeding that of the complex solution itself.

For example, it is well-known that delays in customers’ time-to-market (TTM) translate into substantial reductions in their revenues. The reasons are that:

- Product and/or solution life-cycles are finite; therefore being late to market shortens the life of customers’ products/solutions and the resulting life-time revenue potential.

- There are advantages to be had from gaining market share; being late to market reduces and eliminates any potential benefits from having market-share leadership position.

![Figure 8 - Impact of TTM on Lifetime Revenues](RoweBots)

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27 (RoweBots)
Therefore, using a business-to-business context as an example, an organization that is highly adept at supporting its customer programs with the result of increasing the probability of its customers releasing their products or solutions to market on or ahead of schedule, can achieve great value and competitive advantage to its customers and, in turn, to itself.

2.5 Complex Positions of Organizations that Span Multiple Levels

In most cases, a company can occupy a complex position on the technology-solution scale. The way to analyze such a company is to examine it from the perspective of its technologies, products, market segments, and solutions. For example, Tilera Corporation spans the technology, product, market segment, and to some extent solution positions. Tilera develops its own processor architecture technology (vs. licensing it from a processor IP vendor such as ARM). Therefore, with regards to processor architecture, Tilera is a technology organization. On the other hand, Tilera is a fabless semiconductor company. This means that it relies on foundry partners for the semiconductor fabrication technology. Therefore, with regards to the semiconductor fabrication, Tilera is not a technology organization. Intel on the other hand is an example of a high-tech company that occupies the technology level for both processor architecture and semiconductor manufacturing technologies. Figure 9 illustrates the approximate positions of Tilera with regards to technology, product, market segment, and solution organizations. Tilera engages in the technology development of many-core processor architectures. It engages in the product development of processor products based on its many-core architectures,\(^{28}\) in the product development of platforms based on its processor products,\(^{29}\) and in the product development of software tools and application toolkits to enable the adoption of its processor and platform products.\(^{30}\) Tilera relies on internally developed application software as well as software developed by external partners in order to provide its customers with integrated hardware/software offerings that address the specific needs of its target market segments.\(^{31}\) Tilera also engages with select strategic customers at the solution level by providing custom support and development services.

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\(^{28}\) (Tilera Corp., 2013)
\(^{29}\) (Tilera Corp., 2013)
\(^{30}\) (Tilera Corp., 2013)
\(^{31}\) (Tilera Corp., 2013)
Figure 9 - Complex Organizational Position along the Technology-Solution Scale
3 Where Should a Company Be on The Technology-Solution Continuum?

There is a lot of attention in the literature on the subject of moving from product-centricity to solution-centricity, but there is little if any about when a transition along the technology-solution scale is appropriate and about transitioning from solution-centricity back to product-centricity. It is clear that some technological innovations that hit the market deliver so much value over existing alternatives that they overcome the behavioral resistance of consumers and business customers. However, it is also clear that technological advantages disappear with time and companies must provide incremental value through differentiation for specific market segments or even customization for specific customers.

It is important to emphasize that making a transition along the solution strategy continuum or the customer-focus continuum involves making tradeoffs in the allocation of company resources. For most companies, especially smaller companies, the decision is critical because focusing on solutions means that fewer of the company's precious resources are focused on products. Similarly, being customer-centric may, for example, mean that the information systems are structured and aligned to gather customer profitability data instead of product data.

3.1 Factors to Consider:

3.1.1 Extrinsic Factors:
Sometimes the surrounding environment dictates that a company moves up the solution scale.

3.1.1.1 Customer Landscape
When there are few customers with significant purchasing power, it sometimes becomes imperative for the suppliers to cater to the specific needs, schedules, and requirements of the customers. For example, the automotive industry is characterized by having very few large automotive manufacturers. Therefore, the OEM suppliers to automotive manufacturers have a need to be more customer-focused organizationally and to deliver solutions that are customized to the exact requirements of automotive manufacturers' end systems. On the other hand, when there are many customers none of whom have a clear "lead user" status or purchasing power, then there may be less need to move up the solution and customer-centricity scales.

32 (Galbraith, 2005)
3.1.1.2 Competitive Pressures
Even in cases where the customer landscape is even – where none of the customers have significant purchasing power or clear lead user status – companies sometimes find themselves in a position where they need to move up the solution scale. This condition happens, for example, when competitors provide a better overall value to customers even if their products or technologies are not superior. Consider the case where in a fast moving technology sector, a company provides products that are 6 months ahead of the competition in terms of performance. Even with inferior products, competitors can compete with the company if they themselves move up the solution scale by providing customers a package of services and implementation assistance that enable customers to move to market 6 months sooner. In other words, by providing better total solutions, competitors can erode the product advantage that a company may have and may force the company to move up the solution scale in order to protect its value advantage in that particular application or market space.

3.1.1.3 Customer Demands
Nordin & Kowalkowski summarize some of the drivers of the adoption of a solutions-based strategy that are presented in literature. One of the external drivers that is not mentioned already is “increasing customer demand due, for example, to financial pressure, changing customer business, and the problems experienced by customers on account of rising levels of technological complexity.”

3.1.1.4 Network Factors
In many high-tech businesses, the industry takes the shape of a network of players with a complex set of interconnections and relationships. It is important to consider the dynamics among the players of such networks when determining the balance of technology and solution focus and prior to embarking on a change that would create an imbalance in such a network.

3.1.2 Intrinsic Factors
Factors internal to an organization may sometimes make moving up the solution scale a natural choice.

3.1.2.1 Ability to Create Value
Under certain circumstances, a company may be in a position to create additional value to its customers by moving up the solution scale with relatively small investment in resources (i.e., favorable opportunity cost). For example, a company that already creates many of the elements that go into a customer’s end-system may be in a position to add value to the customer by combining those elements into an

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33 (Nordin & Kowalkowski, 2010)
34 (Chakravorti, 2004)
integrated offering. Note that merely having the scope of offering does not necessarily mean that a company can create value. The question that should be asked is: How much value can we bring to the customer through integration of offerings? Will we be truly adding value or simply cross-selling products and/or services? Also, as discussed earlier in the context of choosing customer needs, customer segments, and solution partners carefully, having the ability to add value to a particular application space, market segment, or customer does not always mean that a company should pursue those opportunities.

In addition to the product knowledge mentioned here, Nordin & Kowalkowski, in their survey of solution literature, also mention international connections as another example of an internal driver to a solutions strategy. “By exploiting such capabilities, service providers can generate outcomes for their customers that would not otherwise exist, and thereby become a more strategic business partner.”

If, for example, other competitors do not have the international connections, a company may be able to use its unique capability to bring value to customers.

3.1.3 Product and Product Context Factors:

3.1.3.1 The Technology Landscape

In some cases, the levels of technology and solution investments that are adequate for a particular context depend on the maturity of the technology in question. For example, a solution strategy for an organization that is engaged in the R&D of a technology whose feasibility has not been established yet usually makes no sense. Fernando Suarez’s technology dominance process uses the following technology dominance milestones:

1. Phase I - R&D buildup: begins when pioneer organizations start to engage in applied R&D
2. Phase II - Technical feasibility: begins with the appearance of first working prototype
3. Phase III - Creating the market: begins with the launch of the first commercial product
4. Phase IV - The decisive battle: begins with the emergence of an early front-runner
5. Phase V - Post-dominance: begins when a clear dominant technology emerges in the market

According to Suarez, success at each stage of the dominance process depends on different key factors as shown in Table 2 below:

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35 (Nordin & Kowalkowski, 2010)
36 (Suarez, 2004)
37 (Suarez, 2004)
In the R&D Build-up phase, “the emphasis is on technology and technological talent.”

In the Technical Feasibility phase, “technological superiority has its strongest effect.” This phase “is sometimes also affected by an environmental factor—an active regulator role.”

In the Creating the Market phase, “the launch of the first commercial product marks an irreversible change of emphasis from technology to market factors.” In this phase, “strategic maneuvering has the highest impact.” In addition, “it is at this stage that competing actors need to secure support for their specific trajectories in the form of complementary goods or services.”

In the Decisive Battle phase, installed base and credibility/complementary assets play the biggest role.

“In Phase V [Post-Dominance], a clear dominant technology has emerged in the market. Its large installed base acts as a strong defense against potential challengers, particularly in situations of environments with strong network effects and high switching costs.”

<table>
<thead>
<tr>
<th>Factor Type</th>
<th>Dominance Factor</th>
<th>Phase I</th>
<th>Phase II</th>
<th>Phase III</th>
<th>Phase IV</th>
<th>Phase V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm Level</td>
<td>Technological Superiority</td>
<td>***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Credibility/Complementary Assets</td>
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<td></td>
<td>Installed Base</td>
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<td></td>
<td>***</td>
<td>***</td>
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<tr>
<td></td>
<td>Strategic Maneuvering</td>
<td></td>
<td></td>
<td></td>
<td>***</td>
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</tr>
<tr>
<td>Environmental Level</td>
<td>Regulation</td>
<td>***</td>
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<td></td>
<td>Network Effects and Switching Costs</td>
<td></td>
<td></td>
<td>***</td>
<td>***</td>
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<tr>
<td></td>
<td>Regime of Appropriability</td>
<td>***</td>
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<tr>
<td></td>
<td>Characteristics of the Technological Field</td>
<td>***</td>
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<td></td>
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</tr>
</tbody>
</table>

Table 2 - Key Factors of Success at Each Stage of the Dominance Process

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38 (Suarez, 2004)
Suarez’s framework is particularly relevant in contexts where a technology firm is leading the efforts of driving a technology and disseminating products based on that technology. In such a contexts, the strategy that a company pursues in terms of technology-leadership and solution-leadership (and the timing of focusing on each) play an important role in driving technology dominance and, consequently, in increasing the odds of success for the company’s products that are based on such technology.

3.1.3.2 Integration
Is the product or service that the company is selling part of a highly-integrated end system? When that is the case, close collaboration between supplier and customer becomes imperative. Therefore, having the ability to assess which potential end customer(s) to engage with in such a highly-integrated relationship becomes extremely important in determining success.

3.1.4 Other Value Factors:
Nordin & Kowalkowski in their literature survey of drivers for the adoption of a solutions-based strategy mention two antecedents to solutions:39

3.1.4.1 Non-Economic Value Factors
“An increasing number of companies are driven by different kinds of non-economic values, such as concern for the environment.”

3.1.4.2 Economic Factors
“Service contracts enjoy longer life cycles and generate greater total revenue than making and selling products alone”

3.1.5 Required Capabilities:
In order to make an informed decision about transitioning into a solutions business, it is important to understand what capabilities and competencies the organizations will need to develop. For example, as the complexity of a customer offering and hence the complexity of articulating the value proposition to potential customers increases, the sales capability and process become essential.40 Some of the competencies discussed in literature include: Key Account Management, Risk Analysis and Management, Financial Acumen, Legal Skills, Information Management, Innovation Management, and Portfolio Management.41

39 (Nordin & Kowalkowski, 2010)
40 (Thull, 2010)
41 (Brady, Davies, & Gann, Creating value by delivering integrated solutions, 2005)
4 Case Studies
This section will present a number of case studies that examine the strategies pursued by three high-tech companies (Analog Devices, Broadcom and Intel) and how those strategies align with our framework of the various factors that we identified in the literature. The case studies will reveal that our proposed framework provides a useful tool for examining the technology and solution strategies that are pursued by high-tech companies. There is a very strong correlation between the factors of our framework and the focus strategies of the three companies that we examined.
4.1 Case Study 1 – Analog Devices

Analog Devices is a “a world leader in the design, manufacture and marketing of a broad portfolio of high-performance analog, mixed-signal and digital signal processing integrated circuits (ICs) used in virtually all types of electronic equipment.” It is a company that as of November 3, 2012, employed approximately 9,200 individuals and delivered $2.7 billion in yearly revenue. The company is “focused on solving the engineering challenges associated with signal processing in electronic equipment” and describes its industry as that of the semiconductor components, which “are the electronic building blocks used in electronic systems and equipment.” 42

The following sections quote information obtained from the company’s 2012 annual report and place that information in the context of our technology/solution focus framework.

4.1.1 Analysis of Analog Devices Inc. (ADI) According to our Framework

4.1.1.1 Extrinsic Factors

4.1.1.1.1 Customer Landscape

ADI has a very broad portfolio of customers; over 60,000 worldwide. While many of those customers are significant, “no sales to an individual customer accounted for more than 10% of fiscal year 2012, 2011, or 2010 revenue. ADI’s “largest single customer, excluding distributors, represented approximately 3% of [its] fiscal 2012 revenue. [ADI’s] 20 largest customers, excluding distributors, accounted for approximately 33% of [its] fiscal 2012 revenue.”

With such a large customer base and with none of its customers having a significant purchasing leverage over it, ADI has less pressure to provide customer-specific customizations and solutions to every single customer.

4.1.1.1.2 Competitive Landscape

ADI competes “with a number of semiconductor companies in markets that are highly competitive.” Competition in the semiconductor components industry takes place along different dimensions including product dimensions (e.g., performance, reliability, etc.), signal-chain dimensions (cross-selling companion or other semiconductor components), and business process dimensions (technical support, delivery capabilities, etc.). With many players in the semiconductor electronic industry, the competitive landscape is such that suppliers wanting to maintain competitiveness along product dimensions need to

42 (Analog Devices, Inc., 2012)
maintain high R&D expenditure in order to continually focus on new innovative products and technologies. This dynamic is reflected by ADI's R&D strategy and expenditure, which are articulated as follows in the company’s 2012 annual report:

Our markets are characterized by rapid technological changes and advances. Accordingly, we make substantial investments in the design and development of new products and manufacturing processes, and the improvement of existing products and manufacturing processes. [...] 

Our research and development strategy focuses on building technical leadership in core technologies of converters, amplifiers and RF, MEMS, power management, and DSP. In support of our research and development activities, we employ thousands of engineers involved in product and manufacturing process development throughout the world.

We expect to continue the development of innovative technologies and processes for new products. We believe that a continued commitment to R&D is essential to maintain product leadership with our existing products as well as to provide innovative new product offerings, and therefore, we expect to continue to make significant R&D investments in the future.

ADI’s R&D expenditure as a percentage of revenues is shown in Table 3.

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2011</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D Expenses as a % of Revenue</td>
<td>19.0%</td>
<td>16.9%</td>
<td>17.8%</td>
</tr>
</tbody>
</table>

Table 3 - ADI’s R&D Expenses as a % of Revenues

With a number of existing and emerging competitors in the semiconductor component industry, suppliers focusing on product differentiation, including ADI, find themselves needing to:

1. Focus on customizing the products to fit the needs of specific applications or market segments. This enhanced market focus is evidenced by a recent organizational restructuring at ADI where starting from the end of 2009 a new group that is focused on end markets was added alongside
the group that is focused on products\(^\text{43}\). The roles of the product and end market groups are articulated in the company’s 2012 annual report as follows:

The product group is focused on core technology development and leadership in converters, amplifiers and RF, MEMS, power management, and DSP. The end market-focused organization is dedicated to understanding, selecting, and resourcing initiatives that are more customized to a particular market or application. The focus of this team is to apply the full expanse of our broad technology portfolio to more integrated and targeted product strategies for the industrial, automotive, consumer, and communications markets. The end market group includes our sales organization.

2. Focus on competing along business process dimensions in order to enable adoptability of ADI’s products while reducing the impact to the customer organization. ADI adopts a range of approaches along the business process dimension. For products that are sold through its distributors (“[ADI] derived approximately 55% of [its] fiscal 2012 revenue from sales made through distributors”), the company focuses on product documentation and engineer-to-engineer notes. For products that are sold directly to global and tier 1/tier 2 customers, the company also provides dedicated technical support resources.

In summary, the competitive landscape in the semiconductor components industry is such that suppliers, including ADI cannot build sustainable advantage by focusing only on products without elevating their R&D expenditure, without moving into some level of market-specific focus or without competing to some extent along the business process dimension.

4.1.1.3 Customer Demands
Increasing technological complexity in the high-tech industry drives customers to demand means for easing the adoption of their suppliers’ products. It is therefore necessary in the semiconductor electronic industry to provide adequate product documentation, engineer-to-engineer implementation notes, and even on-site (field applications engineering) support.

We publish and distribute product catalogs, applications guides, technical handbooks and detailed data sheets for individual products. We also provide this information and sell products via our website. We maintain a staff of field application engineers who aid customers in

\(^{43}\) (Analog Devices, Inc., 2010)
incorporating our products into their products. In addition, we offer a variety of web-based tools that ease product selection and aid in the design process for our customers.

### 4.1.1.2 Intrinsic Factors

**4.1.1.2.1 Ability to Create Value**

*Applying intrinsic knowledge:* As a supplier of a broad portfolio of semiconductor electronic products, ADI is well-positioned to use its breadth of product portfolio in order to provide more of its customers’ signal-chain needs and to thus capture greater portion of its customers’ system value. For example, ADI’s customers often use Analog-to-Digital Converters (ADCs) and amplifiers together in a variety of end circuits. Having expertise in those individual products as well as in the interfacing of those products together, ADI can add value by combining the individual ADC and amplifier components that it already sells into circuits that have been designed and tested to enable faster integration into customers’ end systems. In other words, ADI can leverage its expertise to provide value by integrating its individual products into an application-level offering.

### 4.1.1.3 Product and Product Context Factors

According to the company’s annual reports from recent years, ADI aims through its product development activities to become a technology leader. “Our research and development strategy focuses on building technical leadership in core technologies of converters, amplifiers and RF, MEMS, power management, and DSP.” ADI’s pattern of acquisitions and divestitures is consistent with the technology leadership strategy. For example, ADI engaged in or acquired companies that are engaged in product and technology innovations with the intent of offering technology-leading products:

- **In fiscal 2012,** we acquired privately-held Multigig, Inc. (Multigig) of San Jose, California. The acquisition of Multigig is expected to enhance our clocking capabilities in stand-alone and embedded applications and strengthen our high speed signal processing solutions.

- **In fiscal 2011,** we acquired privately-held Lyric Semiconductor, Inc. (Lyric) of Cambridge, Massachusetts. The acquisition of Lyric gives us the potential to achieve an order of magnitude improvement in power efficiency in mixed signal processing.

ADI has also divested product lines that are not aligned with its technology leadership strategy and its goal of offering innovative products with differentiated capabilities. For example, ADI divested its

\[\text{44 (Analog Devices)}\]
“baseband chips product lines as well as some of [its] cellular handset baseband support operations.”

Doug Freedman of American Technology Research suggested that the product line is headed towards strong competition: "We believe it is prudent for ADI to sell the wireless division [...]. We believe competition will emerge [...] and challenge the segment's profitability for all but the lowest cost providers."

“This transaction will allow ADI to focus our resources in areas where our signal processing expertise can provide unique capabilities and earn superior returns,” said Jerald Fishman, Analog Devices president and CEO, in a statement. “In addition, it unlocks the value of the Othello and SoftFone operations by creating the scale needed to support the R&D investment required for sustainable, long-term success.”

The articulated product development strategy and the pattern of acquisitions and divestitures at ADI indicate a strategy of focusing on technology leadership and a tendency away from products that require the increased levels of R&D and solution investments, which are usually necessary in the case of products that are not differentiated based on technology edge. This focus on differentiated technology is supported by ADI's high gross margin and net income percentages shows in Table 4 for the past three years.

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2011</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Margin %</td>
<td>64.5%</td>
<td>66.4%</td>
<td>65.2%</td>
</tr>
<tr>
<td>Net income / Revenue</td>
<td>24.1%</td>
<td>29.0%</td>
<td>25.8%</td>
</tr>
</tbody>
</table>

Table 4 - ADI's Gross Margins and Net Income %

4.1.1.3.1 Integration
ADi produces and markets several thousand products with “the ten highest revenue products, in the aggregate, accounted for approximately 9% of [its] revenue for fiscal 2012.” This diversity of product offering makes the level of integration of the semiconductor components that ADI sells equally diverse.

There are some products such as embedded processors, which require some coordination between supplier and customer. However, the majority of products have well-defined interfaces that require little coordination between supplier and customer. Product datasheets and manuals are usually all that is

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45 (EE Times, 2007)
necessary for customers to integrate such products into their systems. This means that for the most part there is little need, from a product integration standpoint, for ADI to move up the solution-focus strategy scale. The low need for coordination is supported by the fact that ADI sells a large portion of its products through resellers, who are usually one level removed from the supplier:

We sell our products globally through a direct sales force, third-party distributors, independent sales representatives and via our website.

We derived approximately 55% of our fiscal 2012 revenue from sales made through distributors.

4.1.2 Summary of Analysis of Analog Devices, Inc.
The analysis of the references examined seems to indicate that ADI pursues a technology-focused strategy spanning both the level of product organization, in which it supplies highly-capable products that address the needs of general-purpose applications, and the level of market segment organization, in which it supplies application-specific and market-segment specific products:

Our product portfolio includes both general-purpose products used by a broad range of customers and applications, as well as application-specific products designed for specific clusters of customers in key target markets. By using readily available, high-performance, general-purpose products in their systems, our customers can reduce the time they need to bring new products to market.

While ADI is especially focused on serving customers with needs for products with high-performance signal-processing capabilities, using Byrnes’s framework, ADI spans positions across the entire service differentiation matrix.

ADI is adept at addressing the needs of “stable accounts,” which are customers that do not drive enough volume for custom semiconductor products but have technically-challenging needs that ADI’s technology is able to address:

Given the high cost of developing more customized ICs, our standard products often provide a cost-effective solution for many low to medium volume applications.

In support of “stable accounts,” ADI provides a number of enablers, including, as mentioned earlier, “applications guides, technical handbooks and detailed data sheets for individual products” in addition to a “variety of web-based tools that ease product selection and aid in the design process.”
ADI also engages larger “integrated accounts” that it is able to work with on defining more specialized, application-specific products:

However, for some industrial, automotive, consumer, and communications products, we focus on working with leading customers to design application-specific solutions.

In support of “integrated accounts,” ADI provides “a staff of field application engineers who aid customers in incorporating [ADI’s] products into their products.”

For all of its customers, ADI also provide increased value by integrating its individual products into an application-level offering as mentioned earlier.46

Our assessment of ADI’s primary positions along Byrnes’s service differentiation matrix is depicted in Figure 10.

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46 (Analog Devices)
4.2 Case Study 2 – Broadcom

Broadcom® “is a global leader and innovator in semiconductor solutions for wired and wireless communications.” It is a company that, as of December 31, 2012, employed approximately 11,300 individuals and delivered $8.01 billion in yearly revenues. It was founded with the mission of Connecting everything® and it believes that “an estimated 99.98% of all Internet traffic touches at least one Broadcom chip.” Broadcom provides “the industry’s broadest portfolio of state-of-the-art system-on-a-chip, or SoC, and embedded software solutions.”47

The following sections quote information obtained from the company’s 2012 annual report and place that information in the context of our technology/solution focus framework.

4.2.1 Analysis of Broadcom Corporation (BRCM) According to our Framework

4.2.1.1 Extrinsic Factors

4.2.1.1.1 Customer Landscape

Broadcom competes in the “semiconductor industry in general, and wired and wireless communications markets in particular.” While those industries are characterized by having a large number of customers, Broadcom actually has a very concentrated customer base with few customers making up a significant portion of its revenues:

A small number of customers have historically accounted for a substantial portion of our net revenue. Contributions to our net revenue by these customers have increased in the last several years. Sales to our five largest customers represented 47.2%, 42.6% and 38.6% of our net revenue in 2012, 2011 and 2010, respectively. In 2012, 2011 and 2010 sales to Samsung and Apple represented 17.3% and 14.6%, 10.0% and 13.1%, and 10.0% and 10.9% of our net revenue, respectively.

This concentration of customer base appears to be the result of Broadcom’s strategy rather than a characteristic of the industry. Nevertheless, winning design wins with such major customers requires not only product capability (i.e., technology leadership), but support capability (i.e., solution leadership) in order to enable customers’ adoption of products into their end-systems:

47 (Broadcom Corporation, 2012)
Our sales and marketing strategy is to achieve design wins with technology leaders by providing quality, state-of-the-art products, superior engineering execution, and superior sales, field application and engineering support.

4.2.1.1.2 Competitive Landscape
The semiconductor industry and the wired and wireless communications markets, in which Broadcom compete "are intensely competitive and are characterized by rapid change, evolving standards, short product life cycles and price erosion." In such a dynamic landscape, value is provided to customers not only through product capabilities, but by enabling them to integrate those products into their systems and thus helping them get to market quicker. In other words, technology focus alone is not usually sufficient in such rapidly-changing markets; as customers’ time-to-market becomes increasingly important, so does moving up the solution focus scale.

As mentioned earlier for the semiconductor components industry in the context of ADI, the competitive landscape is such that suppliers wanting to maintain competitiveness along technology/product dimensions need to maintain high R&D expenditure in order to continually focus on new innovative products and technologies. This need for high R&D expenditure is even truer in the intensely-competitive and rapidly-changing wired and wireless communications markets that Broadcom operates in and can be observed both in Broadcom’s high R&D expenditure as a percentage of revenues, shown in Table 5, as well as in Broadcom’s listing of the principal factors of competition for integrated circuit providers listed below:

<table>
<thead>
<tr>
<th>R&amp;D Expenses as a % of Revenue</th>
<th>2012</th>
<th>2011</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>29.0%</td>
<td>26.8%</td>
<td>25.9%</td>
</tr>
</tbody>
</table>

Table 5 - Broadcom’s R&D Expenses as a % of Revenues

We believe that the principal factors of competition for integrated circuit providers include:

- product quality and reputation
- product capabilities
- level of integration
- engineering execution and scale
- reliability
- power efficiency
- market presence
- standards compliance
- system cost
- intellectual property
- customer interface and support
- time-to-market
Noteworthy in this list of competition factors that Broadcom believes are principal for IC providers is that while several factors are clearly technology and product related (i.e., product quality and reputation, product capabilities, and power efficiency) several other factors are focused on higher levels of the solution spectrum (i.e., level of integration, engineering execution and scale, customer interface and support and time-to-market).

As noted earlier in the case of Analog Devices, when competition heats up in the semiconductor industry, product suppliers find themselves needing to:

1. Focus on customizing the products to fit the needs of specific applications or market segments.
2. Focus on competing along business process dimensions in order to enable adoptability of products while reducing the impact to the customer organization.

We find these trends even more pronounced in the case of Broadcom where:

1. Broadcom’s products are focused at the wired and wireless communications market and specifically the following sub-segments:
   - Broadband Communications (Solutions for the Home)
   - Mobile and Wireless (Solutions for the Hand)
   - Infrastructure and Networking (Solutions for Infrastructure)

2. Broadcom is highly focused on supporting its customers’ enablement and time-to-market as evidenced by its “Reference Platforms” strategy:

   To assist our customers in developing products, we develop reference platforms designed around our integrated circuit products that represent prototypical system-level applications. These reference platforms generally include an extensive suite of software drivers, as well as protocol and application layer software. By providing reference platforms that may ultimately be incorporated into our customers’ end products, we assist our customers in transitioning from initial prototype designs to final production releases. We believe this enables our customers to achieve easier and faster transitions from the initial prototype designs through final production releases. We believe these reference platform designs also significantly enhance customers’ confidence that our products will meet their market requirements and product introduction schedules.
In summary, the competitive landscape in the semiconductor industry and the rapidly-evolving communications market is such that suppliers, including Broadcom, cannot build sustainable advantage by focusing only on product differentiation without market focus (i.e., targeting their products for the needs of specific market and sub-market segments) and without solution focus (i.e., providing turnkey solutions to enable end-customers to compete effectively in their rapidly-advancing end-markets).

4.2.1.1.3 Customer Demands
Broadcom’s customers are “leading wired and wireless communications manufacturers”:

Our leading customers currently shipping wired and/or wireless communications equipment and devices incorporating our products include:

- Alcatel-Lucent
- Apple
- Cisco
- Dell
- EchoStar
- Hewlett-Packard
- Huawei Technologies
- Humax
- Motorola Mobility
- Netgear
- Nokia
- Pace
- Samsung
- Thomson
- ZTE

It is therefore natural for customers to demand a more comprehensive product offering that includes integration of cutting-edge technologies, product capabilities, turnkey solutions and implementation assistance. According to Broadcom’s 2008 Annual Report: “We sell products in markets that are characterized by ... increasing demand for higher levels of integration.” In other words, Broadcom’s leading customers demand both technology-focus and solution-focus.

4.2.1.1.4 Network and Industry Factors
The dynamic of the wireless communications industry is such that large OEMs, primarily Apple and Samsung, “collectively held over 50% of the smartphone and tablet markets in 2012” and that those powerful OEMs are starting to take on more of the CPU development in-house because “in today’s system-on-chip (SOC) world, these two OEMs realized that the CPU is the system and thus they needed

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48 (Broadcom Corporation, 2008)
their own CPUs to truly differentiate their products.” As Apple’s and Samsung’s shares of Broadcom’s net revenues have been increasing in recent years and represented 14.6% and 17.3% of Broadcom’s net revenues in 2012 respectively, these industry factors are significant for a merchant silicon vendor such as Broadcom relative to solution and technology focus:

- On one hand, these trends illustrate the need by leading OEMs to differentiate beyond the offerings that are available to them from merchant silicon vendors like Broadcom. In other words, this trend may illustrate that Broadcom may benefit from even more solution focus in order to cater to the specific needs of the leading OEMs and to help them differentiate their end products.
- On the other hand, in the long term, merchant silicon vendors may have an advantage over integrated OEMs like Apple or Samsung because the OEMs may have a hard time keeping up with the rapid technological changes in the semiconductor silicon industry. In other words, in the long-term, it seems that a technology focused strategy may position a merchant silicon vendor like Broadcom better.

A dual strategy of focusing on both technology and solution leadership may be needed given the current factors in the wireless communication industry.

4.2.1.2 **Intrinsic Factors**

4.2.1.2.1 Ability to Create Value

Broadcom possesses a wide spectrum of capabilities, including as articulated in the companies’ 2009 annual report:

> We have developed and continue to build on the following technology foundations:

- proprietary communications systems algorithms and networking protocols;
- advanced microprocessor and DSP hardware architectures;
- proprietary SoC design methodologies and advanced library development for both standard cell and full custom integrated circuit design;

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49 (Bauer, Goh, Park, Schink, & Thomas, 2012)
50 (Bauer, Goh, Park, Schink, & Thomas, 2012)
51 (Broadcom Corporation, 2009)
- high performance radio frequency, analog and mixed-signal circuit design using industry-standard CMOS processes;
- extensive software reference platforms and board-level hardware reference platforms to enable complete system-level solutions.

This “broad base of core technologies encompassing the complete design space from systems to silicon” coupled with “superior engineering execution” provide Broadcom with the ability to develop highly-integrated and comprehensive solutions for addressing application needs in the wired and wireless networking spaces. As noted earlier, Broadcom applies those capabilities to provide its customers with reference platforms, which enable customers’ designs to progress faster, easier and with more confidence. In other words, Broadcom uses its intrinsic ability to create greater value to its customers.

4.2.1.3 Product and Product Context Factors

4.2.1.3.1 The Technology Landscape
As the rate of change is very rapid in Broadcom’s markets, products addressing them travel quickly through their lifecycles and the technologies underlying those products travel quickly through the technology dominance milestones. According to the company’s 2011 Annual Report 52: “We sell products in markets that are characterized by rapid technological change, evolving industry standards, frequent new product introductions and short product life cycles.”

Given its technology landscape backdrop, Broadcom, consistent with Suarez’s key dominance factors, demonstrates adopting a technology-focused strategy in the early phases of R&D Buildup and Technical Feasibility and demonstrates adopting a solution-focused strategy in the subsequent phases of Creating the Market, the Decisive Battle and Post-Dominance.

Broadcom’s technology leadership is evident through its active role in shaping industry standards and pioneering products that meet emerging standards. Examples include:

- “Emerging wireless standards, with the company’s products being among the first to obtain certification and selection for the Wi-Fi CERTIFIED™ Wi-Fi Direct™ test suite.” 53

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52 (Broadcom Corporation, 2011)
53 (Broadcom Corporation, 2010)
Automotive networking standards, with the company “leading innovation in the automotive market and spearheading industry-wide efforts to develop automotive networking standards.”

As technologies progress through their dominance phases increased competition takes place “as industry standards become well known and as other competitors enter [the] business.” The significance of technology leadership in such a context diminishes compared to that of solution leadership and it becomes more important to companies leading the efforts on competing technologies to secure support for their technologies in the form of complementary goods or services. In Broadcom’s case, this solution leadership is demonstrated by providing, as mentioned earlier, a set of reference platforms that “generally include an extensive suite of software drivers, as well as protocol and application layer software.”

By being involved in the early stages of industry standards development, and by providing its customers with comprehensive reference platforms, Broadcom and its customers are able to be among the first to market with products around emerging networking technologies. Thus, Broadcom through a combination of technology and solution strategies is able to provide and capture value despite the rapid technology maturity trajectory in the wired and wireless communications market.

4.2.1.3.2 Integration
Broadcom is a vendor of system-on-chip (SOC) products that address leading-edge applications. As such, Broadcom’s hardware products are highly integrated with the software complements that are necessary to take advantage of the hardware. This high level of integration necessitates a higher degree of solution focus, which Broadcom pursues both through its development of an extensive set of software drivers and application software as well as through a high-degree of field support and direct sales presence. According to Broadcom’s 2009 annual report: “We dedicate sales managers to principal customers to promote close cooperation and communication.”

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54 (Broadcom Corporation, 2012)
55 (Broadcom Corporation, 2012)
56 (Broadcom Corporation, 2009)
4.2.2 Summary of Analysis of Broadcom Corporation

All companies feature a solution strategy to some extent. However, contrasting the contexts of different companies is most informative. For example, contrasting Broadcom with Analog Devices reveals few differences right away:

The concentration of customer base: Broadcom has a significantly more concentrated customer base, which makes up a large portion of its revenues. Analog on the other hand has a significantly more diverse customer base and no single customer makes up a large portion of ADI’s revenues.

The product: Broadcom supplies a large number of system-on-chip products, which usually require complementary software for them to derive their value. We therefore see Broadcom engaging in solution development in the form of integrating a larger portion of the system and providing its customers with an integrated hardware/software offering.

The technology: Analog Devices focuses on investing in technologies that will provide it with long term competitive advantage whereas Broadcom is adept at acquiring new technologies and at applying them in the creation of integrated products and solutions that will enable it and its customers to move to market quickly in a highly dynamic market.

All of the above factors make it necessary for Broadcom to adopt a higher level of solution focus than that which is necessary for ADI. In fact, our assessment, based on the analysis of the references examined, is that Broadcom pursues both a technology strategy that is highly focused at the level of market segment organization, in which it supplies application-specific and market segment-specific products and a solution strategy that is intended to enable customer adoption of Broadcom’s technologies in the highly-dynamic wired and wireless communications markets.

From a solution-strategy perspective, Broadcom seems to be especially focused on serving customers who are leaders in the communications industry. Using Byrnes’s framework, while Broadcom may span positions across the entire service differentiation matrix, it is especially focused on “integrated accounts” and “strategic accounts.”

In support of “integrated accounts” and “strategic accounts,” Broadcom provides an integrated offering of silicon products and complementary software reference platforms that enable customers to move to market rapidly. In addition, Broadcom provides a customer support team to assist customers in their integration of Broadcom’s solutions.
Our assessment of Broadcom’s primary positions along Byrnes’s service differentiation matrix is depicted in Figure 11.

Figure 11 – Primary Position of Broadcom along the Service Differentiation Matrix
4.3 Case Study 3 – Intel Corporation

Intel Corporation is “a world leader in computing innovation. The company designs and builds the essential technologies that serve as the foundation for the world’s computing devices.”\textsuperscript{57} As of December 29, 2012, Intel employed approximately 105,000 employees worldwide and delivered $53.3 billion in yearly revenue.\textsuperscript{58} Intel is a dominant processor vendor in the PC market as well as cloud computing and the data center. However, the tremendous growth, in recent years, in mobile computing is shifting the center of gravity of the computing industry. According to the company’s 2012 annual report:

The combination of the proliferation of mobile devices connecting to the Internet and a build-out of the cloud infrastructure that supports these devices is driving fundamental changes in the computing industry. As a result, we are transforming our primary focus from the design and manufacture of semiconductor chips for PCs and servers to the delivery of solutions consisting of hardware and software platforms and supporting services across a wide range of computing devices.

To that end, Intel has set the following key objectives:\textsuperscript{59}

\begin{itemize}
  \item strive to ensure that Intel\textsuperscript{®} technology remains the best choice for the PC as well as cloud computing and the data center;
  \item maximize and extend our manufacturing technology leadership;
  \item expand platforms into adjacent market segments to bring compelling new System-on-Chip (SoC) solutions and user experiences to mobile form factors including smartphones and tablets, as well as embedded and microserver applications;
  \item develop platforms that enable devices that connect to the Internet and to each other to create a continuum of personal user and computing experiences thereby offering consumers a set of secure, consistent, engaging, and personalized computing experiences; and
  \item positively impact the world through our actions and the application of our energy-efficient technology.
\end{itemize}

\textsuperscript{57} (Intel Corporation, 2013)
\textsuperscript{58} (Intel Corporation, 2013)
\textsuperscript{59} (Intel Corporation, 2013)
Noteworthy in Intel’s key objectives are the differing strategies in the cases of its established markets and applications (i.e., the PC and server segments) vs. the markets and applications that Intel is trying to expand into (i.e., the mobile segment). In our analysis of Intel Corporation in the next section, we will highlight the differences in Intel’s strategies between those established segments (i.e., the PC and server segments, which generate the majority of Intel’s revenues—64% and 20% respectively for a total of 84%) and its target segment (i.e., the mobile segment, which is a very rapidly growing segment that Intel faces incumbent players in).

The following sections quote information obtained primarily from the company’s 2012 annual report and place that information in the context of our technology/solution focus framework.

4.3.1 Analysis of Intel Corporation According to our Framework

4.3.1.1 Extrinsic Factors

4.3.1.1.1 Customer Landscape

Intel’s customer base is very diverse and varied in terms of share of its revenues. Intel sells its products primarily to OEMs and ODMs. “In 2012, Hewlett-Packard Company accounted for 18% of our net revenue (19% in 2011 and 21% in 2010), Dell Inc. accounted for 14% of our net revenue (15% in 2011 and 17% in 2010), and Lenovo Group Limited accounted for 11% of our net revenue (9% in 2011 and 8% in 2010).” Intel also sells its products to “other manufacturers, including makers of a wide range of industrial and communications equipment. In addition, Intel’s customers also include “those who buy PC components and [its] other products through distributor, reseller, retail, and OEM channels throughout the world.”

Despite the fact that some of Intel’s customers make up a large percentage of its revenues, the leverage that those customers have had on Intel in terms of making it move up the solution scale has not been as strong as their high shares of Intel’s revenues might suggest. This softness in customer pressure on Intel is due to the intersection of a number of conditions:

- The majority of Intel’s revenues from its largest customers is from PC sales where the x86 architecture has been the dominant architecture for many years.

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60 (Intel Corporation, 2013)
• Intel dominates the x86 processor market, where it enjoys more than 80% market share, due, among other factors, to its scale economies in research, chip fabrication, and consumer marketing.

According to AMD’s 2012 Annual Report: “Intel exerts substantial influence over computer manufacturers and their channels of distribution through various brand and other marketing programs. Original Equipment Manufacturers (OEMs), that purchase microprocessors for computer systems are highly dependent on Intel, less innovative on their own and, to a large extent, are distributors of Intel technology.”

Despite not being as pressured by its customers to move up the solution scale, Intel does work closely with its large OEM/ODM customers and customizes its business processes to meet their needs. For example, Intel customizes its supply chain and manufacturing operations in order to better meet its larger customers’ needs:

Over time, our larger customers have generally moved to lean-inventory or just-in-time operations rather than maintaining larger inventories of our products. We have arrangements with these customers to seek to quickly fill orders from regional warehouses.

Intel also offers a boxed processor program to meet the needs of its smaller customers:

We have a boxed processor program that allows distributors to sell our microprocessors in small quantities to these systems-builder customers; boxed processors are also available in direct retail outlets.

In summary, Intel’s customers in the PC segment, while some of which are responsible for a large percentage of its revenues, have not historically been responsible for pushing Intel towards a solution strategy. Nevertheless, Intel does provides a level of solution offering as demonstrated by supply chain customizations to better address the business needs of its customers, both large and small.

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61 (Wilkins, 2011)
62 (Porter, 2008)
63 (Advanced Micro Devices, Inc., 2013)
64 (Intel Corporation, 2013)
4.3.1.1.2 Competitive Landscape

Intel competes across a wide spectrum of computing segments and its competitive landscape is varied accordingly.

The primary competition in Intel’s established PC and server segments is Advanced Micro Devices, Inc. (AMD). According to Intel’s 2012 Annual Report, “[new] competitors are joining traditional competitors in our core PC and server business areas where we are a leading provider.”

In the mobile segments that Intel is pursuing, it faces incumbent competitors, mainly “ARM architecture licensees from ARM Limited, such as QUALCOMM Incorporated, NVIDIA Corporation, Samsung Electronics Co., Ltd. and Texas Instruments Incorporated.”

Particularly noteworthy is how Intel’s strategy in terms of technology-focus vs. solution-focus is shaped by the competitive landscape. In the PC and server segments where Intel is a “leading provider”, its strategy has been technology-focused as articulated in the company’s key objective of “[striving] to ensure that Intel® technology remains the best choice for the PC as well as cloud computing and the data center.” In the mobile segment where Intel has not traditionally had much presence and where it faces strong competition from incumbents such as QUALCOMM, Samsung, Broadcom and others, Intel’s strategy appears to add a solution-focus dimension to its traditional strategy of technology-focus:

A key characteristic of these adjacent market segments [such as smartphones and tablets] is low power consumption based on SoC products. We are making significant investments in this area with the accelerated development of our SoC solutions based on the Intel® Atom™ microarchitecture. Additionally, we are building mobile reference designs to help the adoption of Intel architecture in these adjacent market segments. Examples include our smartphone reference designs, which were launched by multiple global partners in 2012.

Stronger competition in the mobile computing segment is therefore correlated with Intel moving up the solution scale by providing “reference designs to help the adoption of Intel architecture” while maintaining its focus on technology leadership through devising technologies and delivering products that address the low power consumption requirements of the mobile segment.
4.3.1.3 Customer Demands

Beyond the technology leadership, Intel’s customer support and account management are rated highly positively by Gartner\(^{65}\):

Intel’s direct customers are OEMs and original design manufacturers (ODMs). Account management for these customers includes financial investment, IP and joint road map planning. Product support extends beyond OEMs and ODMs to include large accounts, with which Intel has historically been willing to work closely to resolve technical problems, and to understand how future Intel products could improve productivity and total cost of ownership.

However, as was discussed in Broadcom’s case study, the mobile market is highly dynamic and time-to-market is of the utmost importance. Therefore, Intel’s push into the mobile segment is introducing new customer demands that Intel aims to address, as articulated in one of its key objectives according to the company’s 2012 Annual Report, by bringing “compelling new System-on-Chip (SoC) solutions and user experiences to mobile form factors including smartphones and tablets.” In other words, customer (i.e., market) demands in Intel’s new market are leading it to provide an expanded offering of complete System-on-Chip and reference designs.

4.3.1.2 Product Factors

4.3.1.2.1 The Technology Landscape

From a technology maturity model, the ISA (Instruction Set Architecture) technology underlying the PC industry is in the post-dominance phase where “a clear dominant technology has emerged in the market. Its large installed base acts as a strong defense against potential challengers.”\(^ {66}\) The x86 ISA has been the clear dominant ISA technology in the PC industry and the competition in the space has been between two companies, Intel and AMD, producing processors based on the same x86 architecture technology (i.e., within-standard competition), as articulated by Suarez:

> Competition in this post-dominance phase is often an intense "within-standard” competition (Gallagher and Park, 2002) between several firms that have licensed production rights based on the dominant technology. It is therefore often based on production capabilities and process innovation (Utterback and Abernathy, 1975; Utterback and Suarez, 1993)

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\(^{65}\) (Gartner, Inc., 2013)

\(^{66}\) (Suarez, 2004)
Consistent with Suarez’s statement, we do indeed find it to be the case that competition between Intel and AMD is primarily based on production capabilities and process innovation where Intel has a clear advantage—it enjoys more than 80% market share due, among other factors, to its scale economies in research, chip fabrication, and consumer marketing.

As the x86 architecture, backed primarily by Intel, starts to enter the mobile space, which is dominated by the ARM architecture, backed by ARM and its licensees, the technology dominance confrontation in the mobile space begins. The key success factors in this Decisive Battle phase include, according to Suarez, credibility/complementary assets, installed base, and network effects and switching costs. These factors are key to success because technological products are increasingly a part of a complex ecosystem of complementary products, systems and services. The success of a company’s products in the market place depends not only on the products themselves, but also on the overall eco-system that surrounds these products. For example, relative to processors for the mobile market, the value of the processor is only derived when the processor is integrated with other components into a mobile device and when software applications are available to make use of such a device. A belief shared by experts relative to the battle for dominance in the mobile processor space between x86 and ARM is that “the robustness and success of each architecture’s ecosystem—the OEMs, original design manufacturers, and software vendors that build the device and services around a chip—will determine the outcome, rather than technical superiority.” Technology companies therefore need to consider the overall ecosystem of their products when defining their strategies. A technology leadership position alone may not be sufficient for Intel to win the battle in the mobile processor space. Instead, a holistic solution leadership approach will be undoubtedly necessary.

As was discussed earlier regarding the distinction between solution leadership and vertical integration, a solution leadership in the context of complex ecosystems does not necessarily mean that the company itself has to expand its footprint to encompass the entire value chain. The differing approaches taken by ARM and Intel in the mobile processor space, which are illustrated in Figure 12, depict this distinction. ARM has become a dominant player in the mobile processor industry. This achievement is to a large extent attributable to the fact that ARM and its licensees have enabled and built a rich ecosystem of SoCs (Systems-On-Chip), applications, middleware, and operating systems that complement ARM’s

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67 (Wilkins, 2011)
68 (Porter, 2008)
69 (Bauer, Goh, Park, Schink, & Thomas, 2012)
architecture technology, thus enabling ARM's licensees who produce ARM-based products to benefit from the rich and diverse ecosystem and to reap the benefits of network effects. Intel has pursued in the PC space, and appears to be pursuing in the mobile space, a vertically-integrated strategy where it is able to leverage its complementary assets and capabilities in, among other things, chip fabrication.

Figure 12 - The x86 vs. the ARM Ecosystems in the Mobile Space

70 (Bauer, Goh, Park, Schink, & Thomas, 2012)
4.3.1.2.2 Integration
As Intel shifts its focus from the PC space, where the overall system architecture was highly modular (i.e., little need for integration), to the mobile space, where there is greater variety of system architectures, Intel, we do expect Intel to work closely with OEMs and partners to enable the adoption of Intel architecture in the mobile space.

4.3.2 Summary of Analysis of Intel Corporation
The analysis of the references examined seems to indicate that Intel has, in its established PC segment, been pursuing a highly focused technology strategy with significant centers of gravity in its technology and product organizations. Intel’s solution offerings included supply-chain arrangements with its large customers to address their business process needs as well as highly rated customer support and account management services. Therefore, using Byrnes’s service differentiation matrix, while Intel spans positions across the entire service differentiation matrix, it is especially adept at addressing the needs of integrated and stable accounts.

Our assessment of Intel’s primary positions along Byrnes’s service differentiation matrix is depicted in Figure 13

![Service Differentiation Matrix](image)

Figure 13 - Primary position of Intel along the Service Differentiation Matrix

Intel’s expanded focus into the mobile space will likely be associated with an expanded focus on solution leadership, in addition to Intel’s traditional strength in technology leadership.
5 Conclusion

In this thesis, we proposed a framework for examining technology companies from the perspective of focusing on technology-leadership vs. solution-leadership. We used our framework to analyze the technology-focus and solution-focus strategies pursued by three publicly-traded, US-based high-tech semiconductor companies serving a number of end-markets. In our examination of the three companies, we relied on data obtained primarily from these companies’ annual reports as well as from a variety of other sources.

We postulated that the balance of technology-leadership and solution-leadership strategies that are appropriate for a particular company depend on a number of extrinsic, intrinsic, and product context factors:

- Extrinsic factors include the customer and competitive landscape as well as market demands.
- Intrinsic factors include the company’s capabilities and assets.
- Product context factors include the degree of integration between the company’s products and its customers’ end solutions as well as the characteristics of the landscape of the technologies underlying the company’s products.

The analysis revealed that our proposed framework does indeed provide a useful tool for examining the technology and solution strategies that are pursued by the companies that we examined. There is a very strong correlation between the factors that we postulated and the focus strategies of the companies examined. Some of the observations we made that are particularly noteworthy are:

- A company does not pursue an either/or strategy. Instead, companies often occupy complex positions along the technology-solution continuum. A single company, as we found in the case of Analog Devices, can pursue both a technology-leadership strategy while exhibiting a solution orientation.

- The strategies pursued by companies may be enabled and shaped by the intrinsic capabilities of those companies, but the extrinsic factors tend to be more forceful in shaping a company’s strategy. For example, the highly dynamic wired and wireless communications market that Broadcom plays in makes time-to-market extremely important to Broadcom’s customers. This market dynamic, in turn, necessitates a very focused solution approach on the part of Broadcom.
The products and services that companies supply do not exist in isolation, but are part of a larger technology landscape and ecosystem. The strategies that are appropriate for a particular product in one context may not work for a similar product in a different context. We observed, for example, that a technology leadership approach has served Intel’s processors very well in the PC space, whereas a holistic approach of technology and solution leadership may better serve Intel’s processors as they battle their way into the mobile space.

Our evaluation of the proposed framework was limited to three companies: Intel, Broadcom and Analog Devices. While we learned valuable lessons from each of those case studies, these three companies are all large, publicly-traded, US-based high-tech semiconductor companies that are mainly suppliers of products (i.e. as opposed to services). There would be value to future work examining the applicability of the framework to a broader and more diverse sample of companies, including for example, small companies, companies in other industries, suppliers of services in addition to products, etc.
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