COLLABORATIVE INNOVATION IN THE GLOBAL SEMICONDUCTOR INDUSTRY

A REPORT ON THE FINDINGS FROM THE 2010 WHARTON-GSA SEMICONDUCTOR ECOSYSTEM SURVEY

CONDUCTED BY

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GSA

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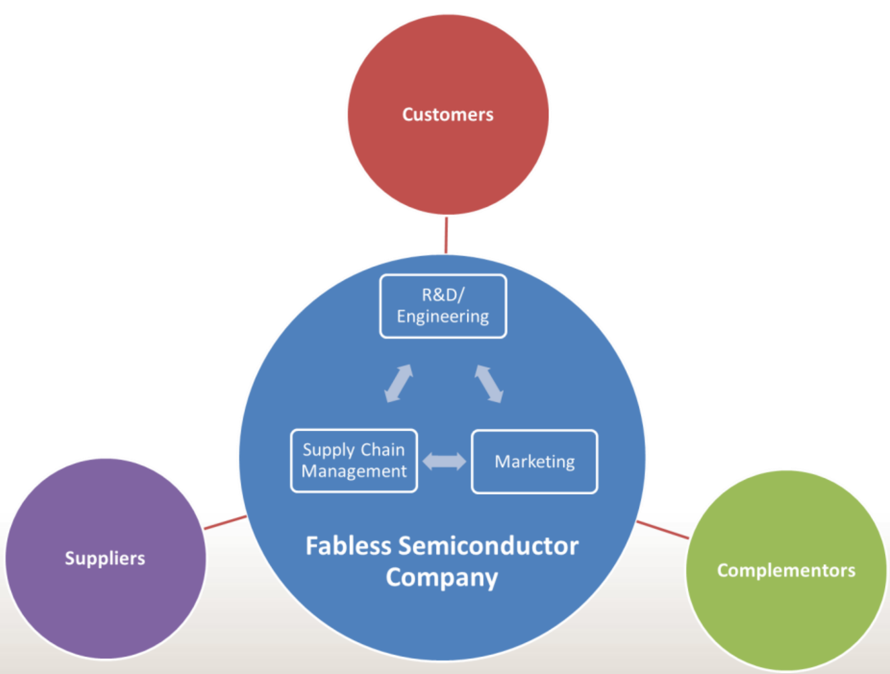
EXECUTIVE OVERVIEW

Semiconductor companies are embedded in a business ecosystem comprised of suppliers, customers and complementors (i.e., providers of complementary products). Each of these players exert an important influence on the ability of the semiconductor company to create value from its own products and technologies. Many companies acknowledging this interdependence are pursuing collaborative innovation models in which value is created not only within the company, but also at the collaborative interface between the company and its diverse set of partners. However, the success of such collaborative innovation models is often constrained by the technological and organizational challenges that companies face due to increasing complexity, greater competition and the quickening pace of change.

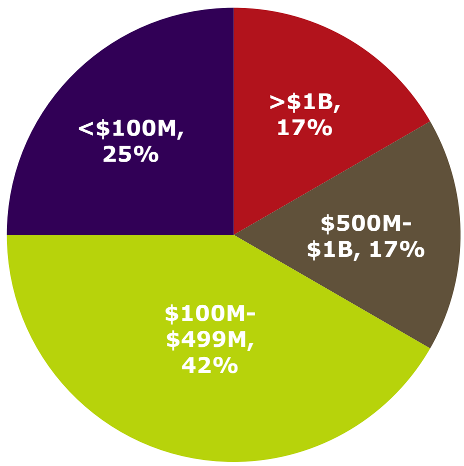
The 2010 Wharton-GSA Semiconductor Ecosystem Survey, part of a two-year research effort, was implemented to provide a systematic analysis of the nature of challenges and opportunities faced by fabless semiconductor companies within their ecosystem. There are several specific objectives that we hoped this survey would be able to address for the global semiconductor industry community. First, the findings provide a first of its kind inside-the-box view of the patterns of collaboration between semiconductor companies and key partners in their ecosystem. These partners include foundry and assembly and test (A/T) suppliers, original equipment manufacturing (OEM) customers, and providers of complementary products. This would allow semiconductor companies to benchmark their collaborative innovation models and take steps to maximize the value that they can derive from their ecosystem. Second, a company's success in developing and commercializing new innovations is shaped not only through collaboration with external partners, but also through collaboration between internal functional groups which link the company's internal activities with those of its upstream and downstream partners. The findings from the survey provide a comprehensive account of the patterns of cross-functional interaction that exist between the marketing, engineering and supply chain management functions within a semiconductor company. Finally, the reported results provide some key indicators of semiconductor companies' technology strategies and outcomes such as the different sources of intellectual property (IP), the extent of IP Reuse, the nature of competitive differentiation and the drivers of time-to-market.

Figure 1. Fabless Semiconductor Company and Its Ecosystem



The reported results are based on detailed responses received from senior engineering, marketing and supply chain executives from 37 publicly-listed and 25 private fabless semiconductor companies, with the publicly-listed companies representing 45% of total 2009 public fabless semiconductor industry sales. The revenue distribution of publicly-listed companies is shown in Figure 2.

Figure 2. Distribution of Public Fabless Companies by 2009 Annual Revenue (% of Companies)



Some of the key findings include:

Product Development

- Differentiation: Of the total number of engineers employed by a fabless semiconductor company, on average, 23% are software engineers and 20% are system design engineers (46% are IC design engineers and 12% are IC manufacturing and test engineers). The results suggest that software and system design are becoming an important driver of differentiation for semiconductor companies.
- IP Reuse: On average, a fabless semiconductor company reuses about 63% of design IP in the revision of an existing product design and about 44% in a new product design.
- Source of IP: Silicon foundries are becoming an important source of design IP for fabless companies in addition to third-party IP firms. On average, 18% of design IP blocks are from the foundry's portfolio/library, followed by 16% for third-party licensing firms.
- Time-to-market: The average time-to-market, defined as the period from design start to mass production, is about 14 months for a revision of an existing product design. It increases to about 19 months for a new product design. A shift to a new manufacturing process increases the time-to-market by about three months.

Supplier Relationships

- The extent of collaboration between fabless semiconductor companies and their manufacturing suppliers was evaluated in three different ways: (1) the extent to which a supplier shares different types of information with the fabless company, (2) the extent to which a supplier is involved in the fabless company's value-creating activities and (3) the extent to which both the fabless company and the supplier customize their activities towards each other.

- Foundry and A/T suppliers extensively share information on existing production, future technology development and capacity expansion. However, these suppliers are generally tight-lipped with respect to cost information.
- Both foundry and A/T suppliers are very involved in fabless companies' cost reduction and technology roadmapping activities. Their involvement is much lower for new product development and customer-based activities.
- Fabless companies, on average, seem to customize their products and operations more with respect to foundries than with respect to A/T suppliers. On the other hand, A/T suppliers seem to tailor their manufacturing processes and operations more extensively to the fabless company's requirements than do silicon foundries.
- There are large differences among semiconductor companies in the extent to which they collaborate with foundry and A/T suppliers. Firms that have high collaboration with foundry suppliers on any one of the dimensions (information sharing/supplier involvement/customization) also have high collaboration with A/T suppliers.
- Fabless semiconductor companies generally perceive their foundry and assembly suppliers' performance to be good or very good with respect to suppliers' technical competence, process quality, responsiveness to problems and inquiries, and capacity allocation. However, they seem less satisfied by the suppliers' price competitiveness, and this effect is stronger for foundries than for A/T suppliers.

Customer Relationships

- Customers of semiconductor companies extensively share information on volume projections and product development status, but information sharing is much lower for customers' product costs and overall business strategies.
- Following a trend that is similar to supplier relationships, semiconductor companies seem, on average, to be most involved in their customers' cost reduction and long-term technology roadmapping activities and less involved in short-term activities underlying product development.
- In general, customers tend to tailor their product designs and roadmaps to fabless companies' ICs and roadmaps. At the same time, fabless companies tend to customize their research and development (R&D) activities and product portfolio to their customers. However, on average, neither the fabless companies nor their customers seem to significantly tailor their manufacturing operations to each other.
- While large differences in the nature of collaborative relationships exist between semiconductor companies and their customers, these collaborative relationships tend to be strongly reciprocal. For example, customer relationships that are characterized by a high degree of semiconductor company involvement in customers' activities are also characterized by a high degree of information sharing by customers. Similarly, high customization by fabless companies for customers is typically associated with high customization by customers for fabless companies.

Complementor Relationships

- A vast majority of semiconductor companies identified other semiconductor companies (application-specific IC/application-specific standard product (ASIC/ASSP), microprocessor, graphics IC, etc.) as their complementors. Complementors also included companies developing application software, programming software and operating systems.
- Semiconductor companies vary significantly with respect to the department that has the primary responsibility for coordinating activities with complementors: 39% (marketing department), 37% (engineering department), 17% (separate dedicated department or executive) and 7% (no specific department).

- Semiconductor companies extensively share information on specific market applications and technology roadmaps with their complementors. They also interact through joint product development and customizing products to complementors. Companies report less interaction through standard setting and licensing, and least through making investments in their complementors.
- The greatest benefits from working with complementors include improvement in the performance of products followed by increasing sales to existing customers.
- There exists a high variance in the nature of collaborative relationships between semiconductor companies and their complementors. However, more collaborative relationships are associated with greater value creation by semiconductor companies. In addition, fabless companies that have strong collaborative relationships with their customers also tend to have strong collaborative relationships with their complementors.

Internal Cross-functional Relationships

- The majority of companies indicated the use of a dedicated "program"/"new product" management group to coordinate marketing, engineering and supply chain management activities. Some companies also indicated the use of temporary or permanent cross-functional teams.
- The primary responsibility of the program manager seems to be a liaison between the different functions and organizational levels, with much less influence over critical decisions or the allocation of resources for the project.
- On average, the marketing and engineering departments seem to enjoy a high degree of collaboration, followed by engineering and supply chain which is followed by marketing and supply chain.
- There seems to be a high level of joint action between all three departments for activities related to existing customer support, new product ramp-up and cost reduction. Activities related to new customer engagement, competitor benchmarking and technology roadmapping are carried out mainly through collaboration between engineering and marketing. Activities related to supplier selection and supplier performance evaluation are carried out mainly through collaboration between engineering and supply chain departments.
- Not only do companies vary in the extent to which the different functions collaborate, but perhaps, more interestingly, there seems to be a high degree of reciprocity in collaboration. The extent to which the marketing department collaborates with the engineering department on marketing activities/information is positively correlated with the extent to which the engineering department collaborates with the marketing department on engineering activities/information. This correlation is especially strong in the relationship between the supply chain and marketing departments.

The findings shed light on a broad array of challenges and opportunities that semiconductor companies face within their ecosystem. The results from the survey confirmed that companies are subjected to high technological complexity, short product life cycles and hard-to-change cost structures. In assessing the nature and the implications of these challenges, the survey uncovered the different drivers of time-to-market, companies' IP strategies and the nature of competitive differentiation.

The results reaffirmed that the ecosystem provides a rich set of opportunities for semiconductor companies to create value. However, while many companies have established extensive collaborative relationships with suppliers, customers and complementors, there are many others that seem to be working at an arms-length and perhaps not able to reap the full benefits from their ecosystem.

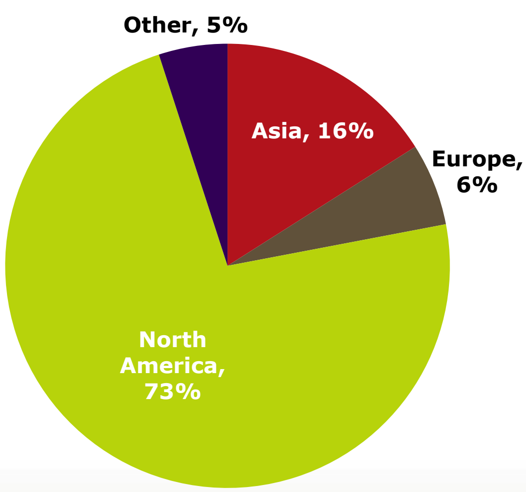
The survey findings also showed the important role played by complementors in enhancing the semiconductor company's competitive position. Complementors are often other semiconductor companies that develop complementary ICs used in the customer's application. However, managing relationships with complementors seems organizationally more complex than managing relationships with suppliers or customers. While there are well-defined departments for managing relationships with suppliers and customers, the relationship with complementors seems to be managed in very different ways, both within and across companies. Hence, in addition to suppliers and customers, semiconductor companies pursuing collaborative innovation models need to explicitly consider different types of complementors and develop organizational structures to effectively manage these new types of relationships.

Finally, the survey indicates that companies need to manage both external dependencies with suppliers, customers and complementors, as well as internal dependencies between supply chain management, marketing and engineering functions so as to ensure that they are able to maximize value from all collaborative linkages. The results caution executives that it may only take one ineffective collaborative link to undermine the total value created by the firm within the ecosystem.

RESEARCH METHODOLOGY & DEMOGRAPHICS

To ensure that the findings of the survey are both reliable and relevant to the industry, a multi-step research methodology was followed. The first step entailed in-depth interviews with more than twenty executives from fabless semiconductor companies, original equipment manufacturing (OEM) customers, foundries, assembly and test providers, and third-party IP suppliers. These interviews were meant to understand the nature of coordination and technical challenges that exist within the semiconductor ecosystem so as to guide the design of the survey. This was followed by the development of a detailed online survey. The survey was comprised of three different sections—engineering, marketing and supply chain—and each section was to be filled by a senior manager in the respective functional role in the company. Next, the survey was pretested on a number of executives, and their feedback was used to refine the survey design. Given that the questions assumed that the companies have established product lines and collaborative processes, only large private and publicly-listed fabless companies were surveyed during this stage. The survey was implemented through a secure Web site link that was sent to supply chain, marketing and engineering executives at fabless semiconductor companies. The survey was completed by senior executives from 62 companies (25 private and 37 publicly-listed) with an overall survey response rate of 46%.

Figure 3. Regional Breakdown (% of Companies)

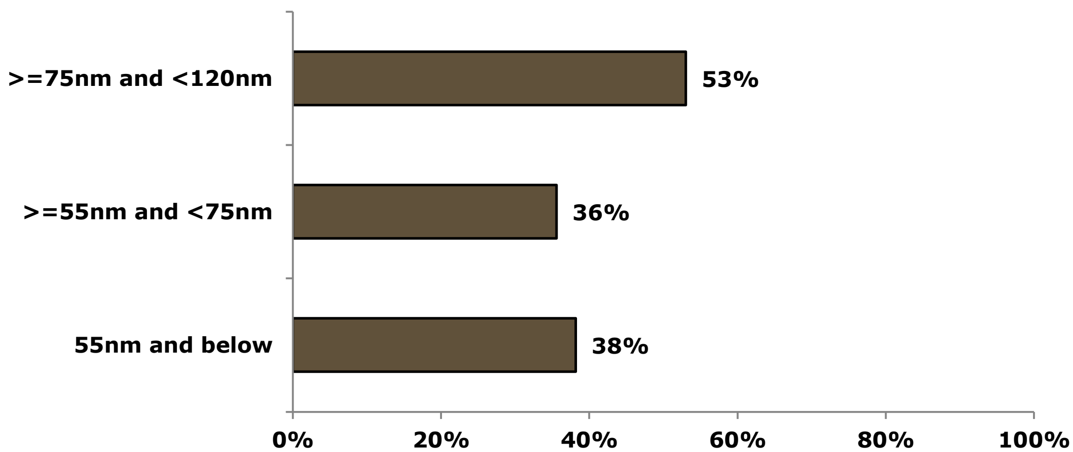


SURVEY RESULTS

Fabless Companies are Competing in a Technologically and Economically Challenging Environment

The high degree of product complexity in the semiconductor industry is evident from the fact that 38% of fabless semiconductor companies reported as having products in production that use process nodes of 55nm or below (Figure 4).

Figure 4. Product Complexity



Besides technological complexity, fabless companies also face significant cost pressures from their suppliers as illustrated in Figure 5. On average, services provided by silicon foundries account for about 54% of total product post followed by 21% for assembly, 15% for test and 7% for third-party IP suppliers. The crucial role played by silicon foundries is also illustrated from the findings regarding different sources of IP for fabless semiconductor companies, with foundries contributing, on average, 18% of total design IP, followed by 16% for third-party IP firms (Figure 6).

Figure 5. Fabless Company IC Product Cost

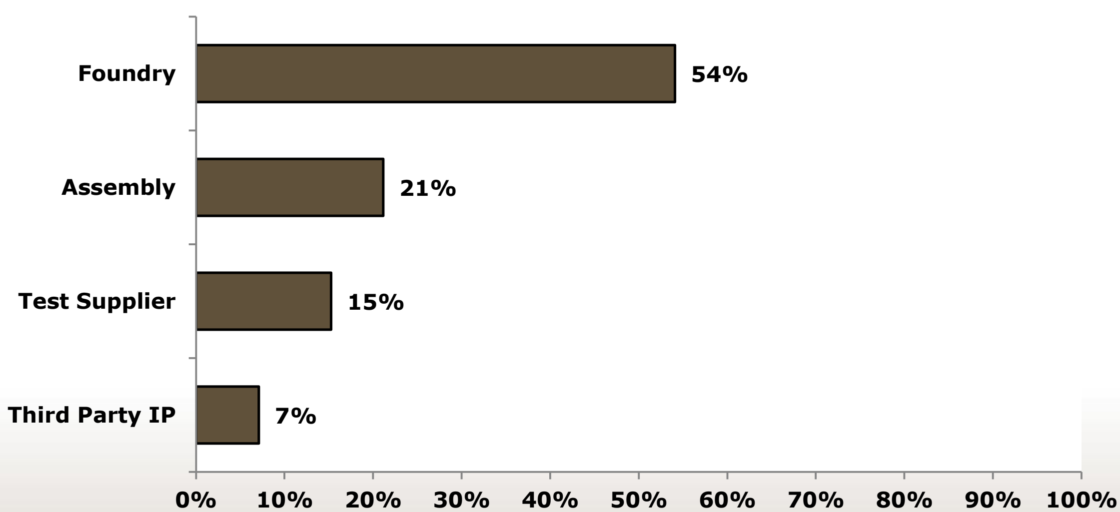
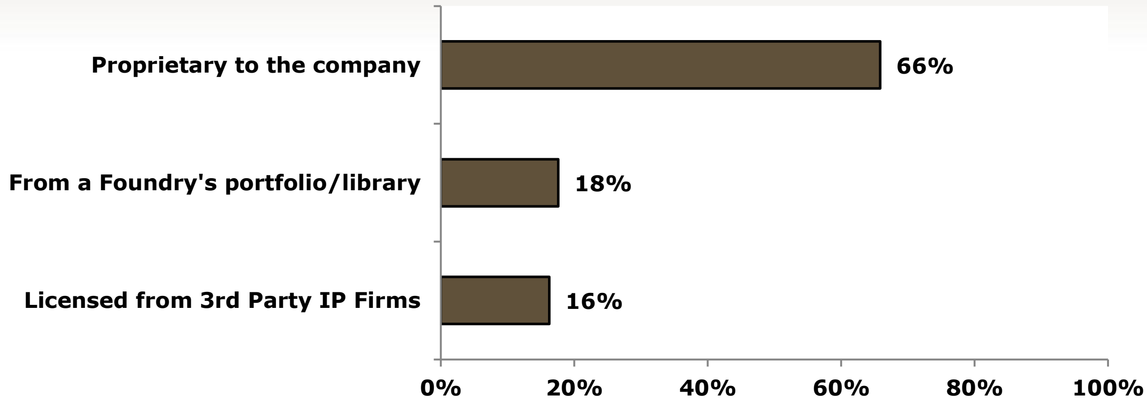
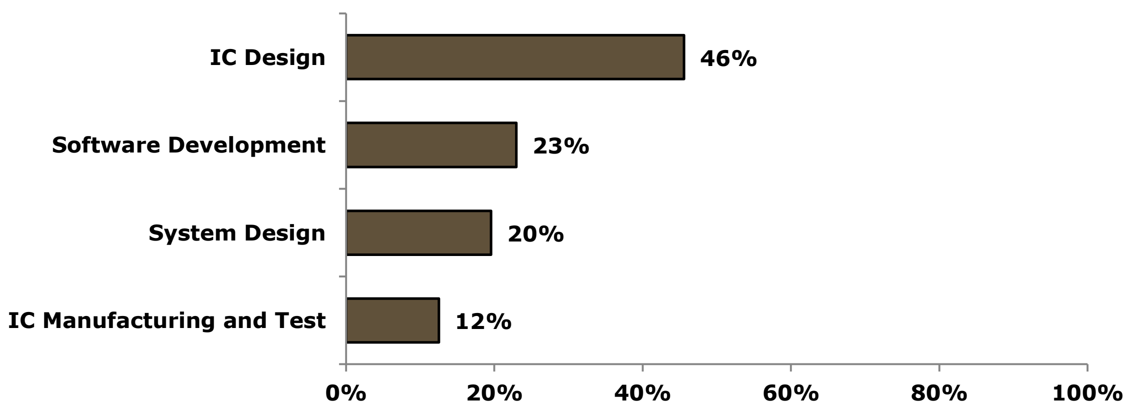


Figure 6. Sources of IP



Given these trends, it is not surprising that fabless semiconductor companies are employing a large proportion of their engineers in software development (23%) and system design (20%), suggesting that software and system design are becoming an important source of differentiation for fabless semiconductor companies.

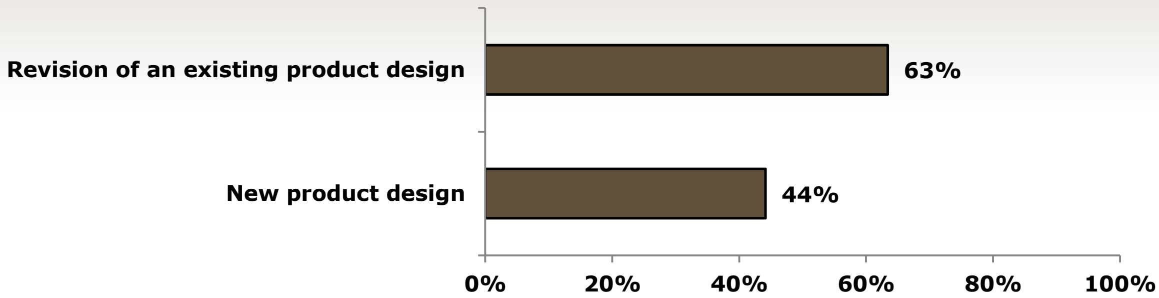
Figure 7. Breakdown of Engineers Employed



New Product Development

The extent to which semiconductor companies achieve economic efficiency by reusing existing design IP in new products is shown in Figure 8. On average, companies reuse about 63% of their design IP in product revisions, and this value goes down to about 44% for new product designs.

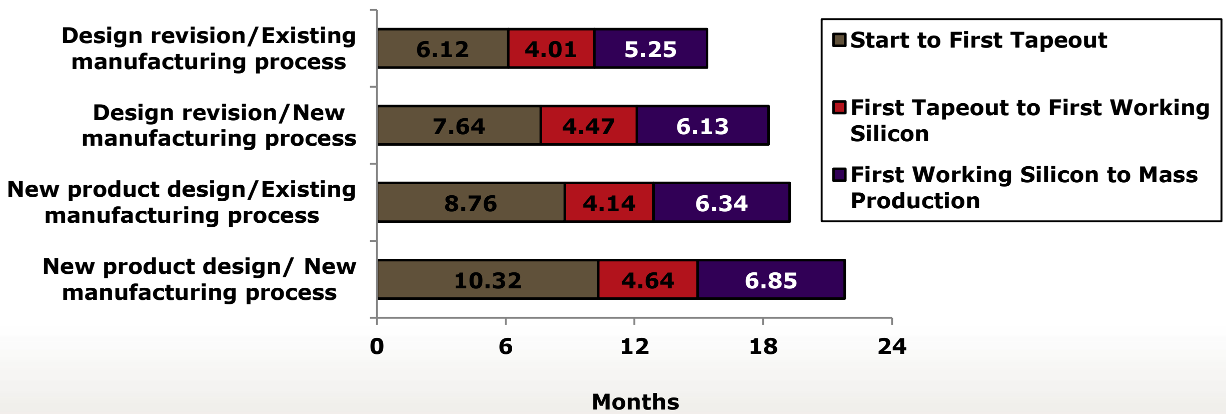
Figure 8. Design IP Reused



An important parameter for new product development activities is the company's time-to-market. In this study, it is defined as the period between the start of IC product design to the time when the product reaches mass production stage. Time-to-market is not only a critical source of competitive advantage for semiconductor companies, but also an important metric used to allocate resources and make strategic commitments. In the survey, respondents were asked to provide an approximate time-to-completion for three different stages that underlie a product's time-to-market: (1) design start to first tapeout, (2) first tapeout to first working silicon and (3) first working silicon to mass production. To assess differences in timelines between different types of projects, four different projects were listed in the survey based on whether product development is for a design revision or a new product design, and whether it is based on an existing manufacturing process that the company has used before or a new manufacturing process. The average values are reported in Figure 9.

The average time from design start to first tapeout increases by about three months from pursuing a revision of an existing design to pursuing a new product design, and increases by about two months from using an existing manufacturing process to using a new manufacturing process. The average time from first tapeout to first working silicon increases by about a month from using an existing manufacturing process to using a new manufacturing process. The average time from first working silicon to mass production increases by about a month from using an existing manufacturing process to using a new manufacturing process or from pursuing a design revision to pursuing a new product design. Overall, the average time-to-market is about 14 months for a revision of an existing product design. It increases to about 19 months for a new product design. A shift to a new manufacturing process increases time-to-market by about three months.

Figure 9. Time-to-Market Milestones



Relationship with Foundry and A/T Suppliers

The extent of collaboration between fabless semiconductor companies and their manufacturing suppliers was evaluated in three different ways: (1) the extent to which suppliers share different types of information with fabless companies, (2) the extent to which suppliers are involved in fabless companies' value-creating activities and (3) the extent to which both fabless companies and suppliers customize their activities towards each other. Each survey participant had an option to provide their response for two different foundry and A/T suppliers.

Figure 10 presents the findings on information sharing. Generally, both foundry and A/T suppliers share extensive information with semiconductor companies. However, they are more measured in their exchange with respect to proprietary technical and cost information.

Figure 10. Extent of Information Sharing between Suppliers and Fabless Companies

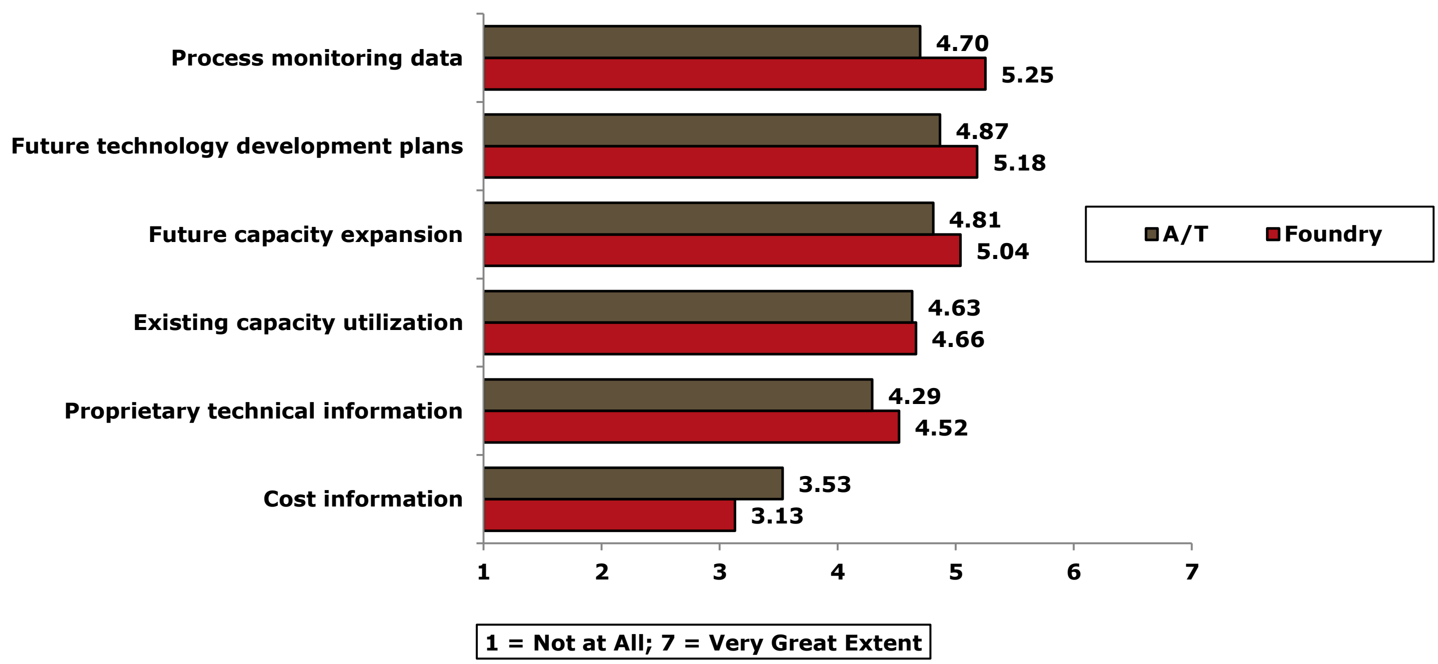
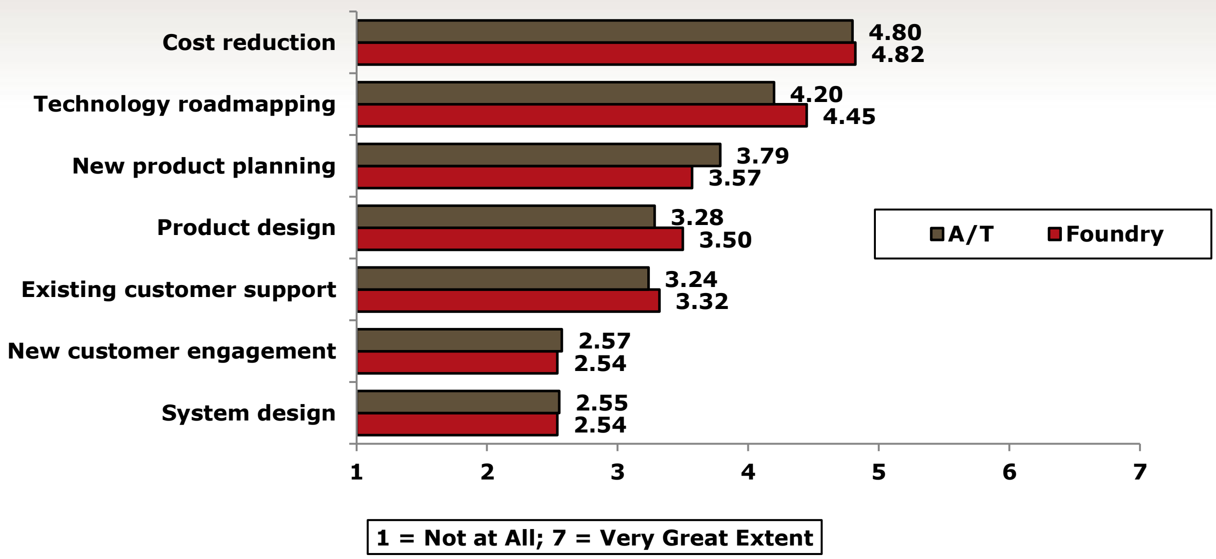


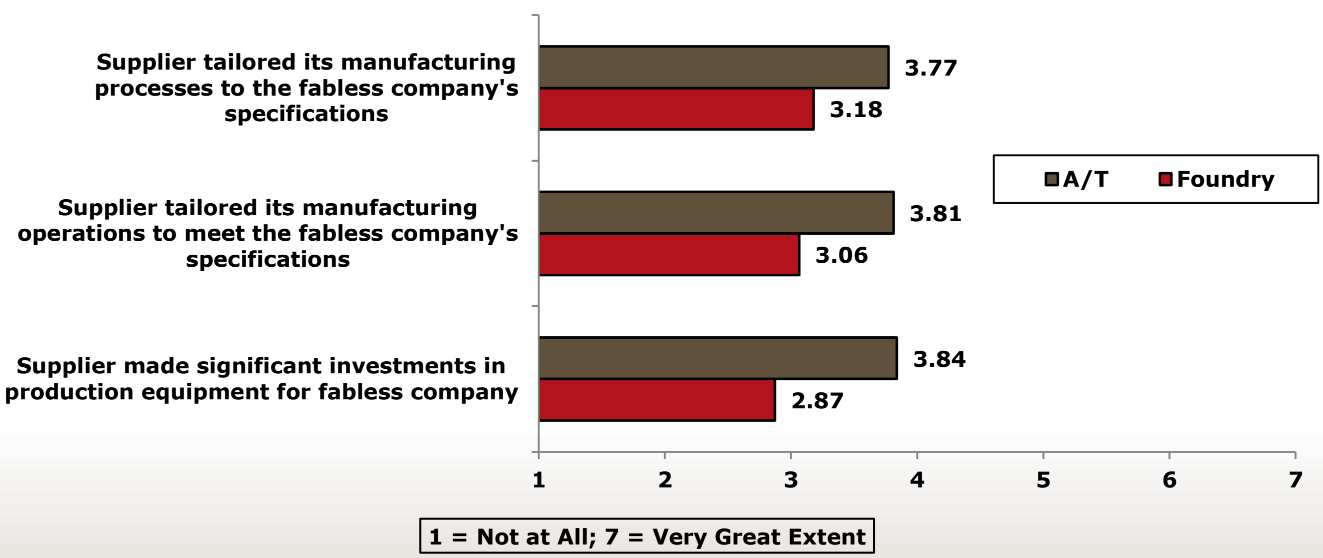
Figure 11 presents the findings on supplier involvement. On average, suppliers are considerably involved in semiconductor companies' cost reduction and long-term technology roadmapping activities. However, there involvement seems to be much more limited in product planning, design and customer-based activities.

Figure 11. Extent of Supplier Involvement in Fabless Company Activities



Figures 12a and 12b plot the extent to which fabless companies and foundries or A/T suppliers customize their activities towards each other. Fabless companies, on average, seem to customize their products and operations more with respect to foundries than with respect to A/T suppliers. On the other hand, A/T suppliers seem to tailor their manufacturing operations more extensively to fabless companies' requirements than do silicon foundries. The overall level of customization between fabless companies and A/T suppliers seems more balanced (i.e., reciprocal) than the level of customization between fabless companies and foundry suppliers. This also suggests that a specific fabless company may be more dependent on their foundry suppliers than foundry suppliers on the fabless company.

Figure 12a. Extent of Customization between Fabless Companies and Suppliers



12b. Extent of Customization between Fabless Companies and Suppliers

There seems to be large differences among semiconductor companies in the extent to which they collaborate with foundry and A/T suppliers. These differences can be seen in the scatter plots in Figures 13a to 13c. Each data point corresponds to a specific semiconductor company, and the plotted values are the sum of the scores for the different survey items for information sharing, supplier involvement and customization. Very interestingly, firms that have high collaboration with foundry suppliers on any one of the dimensions (information sharing/supplier involvement/customization) also have high collaboration with A/T suppliers. This suggests that there is significant heterogeneity among firms (rather than the suppliers) in the way they manage collaborative relationships in their supply chain. While some firms create strong collaborative links, others seem to interact more at an arms-length.

Figure 13a. Differences in Information Sharing among Semiconductor Companies When Collaborating with Foundry and A/T Suppliers

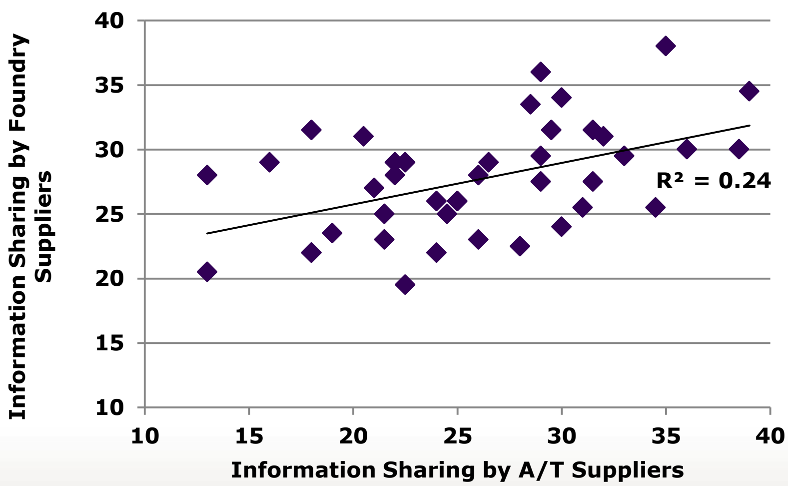


Figure 13b. Differences in Supplier Involvement among Semiconductor Companies When Collaborating with Foundry and A/T Suppliers

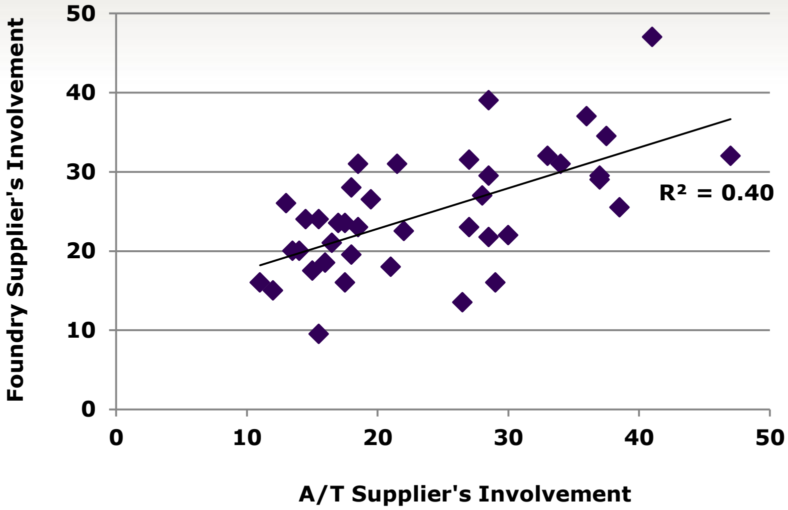
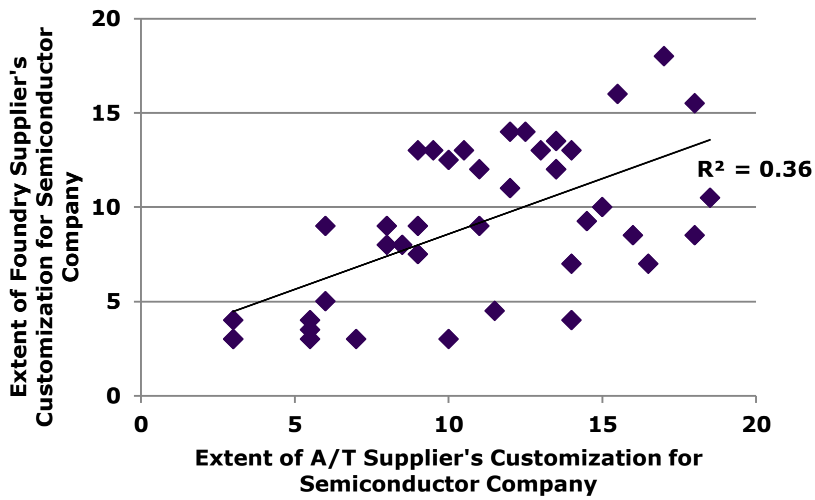


Figure 13c. Differences in Supplier Customization among Semiconductor Companies for Foundry and A/T Suppliers



Finally, fabless semiconductor companies generally perceive their foundry and A/T suppliers' performance to be good or very good with respect to the suppliers' technical competence, process quality, responsiveness to problems and inquiries, capacity allocation and manufacturing cycle time (Figure 14). However, they seem less satisfied by the suppliers' price competitiveness, and this effect is stronger for foundry suppliers than for A/T suppliers. This suggests an underlying tension between technological complexity and economic constraints faced by suppliers and fabless companies. While manufacturing processes have become more capital- and resource-intensive over time, fabless companies are subjected to greater competition and shorter product life cycles.

Figure 14. Perceived Performance of the Supplier

Relationships with Customers

The extent of collaboration between fabless semiconductor companies and their customers was evaluated in three different ways as well: (1) the extent to which customers share different types of information with fabless companies, (2) the extent to which fabless companies are involved in customers' value-creating activities, and (3) the extent to which both fabless companies and customers tailor their activities towards each other. Each survey participant had an option to provide their response for two different customers.

Survey participants provided information on their relationships with customers from a variety of market segments, ranging from consumer and industrial electronics to wired and wireless communications, industrial, automotive and defense electronics. The three largest customer segments include consumer electronics, identified by 36% of respondents, and wireless and wired communications, identified by 30% and 21%, respectively (Figure 15). Note that the total exceeds 100% because many customers are present in multiple market segments.

Figure 15. Customer Market Segments Identified by Fabless Semiconductor Companies

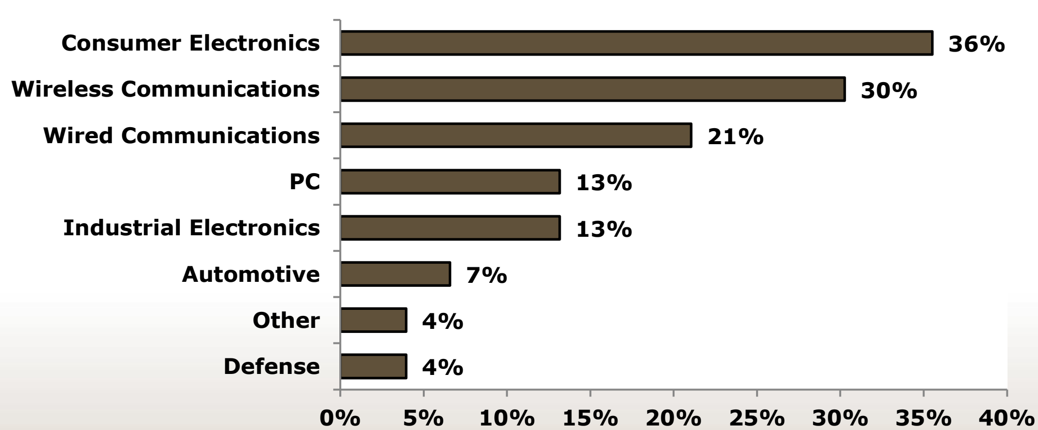


Figure 16 presents the findings on information sharing. Generally, customers of semiconductor companies, on average, share information extensively on volume projections and product development status, but tend to be more tight-lipped about product cost and overall business strategy. Figure 17 presents the findings regarding semiconductor companies' involvement in customers' value-creating activities. Interestingly, following a trend that was similar to supplier relationships, semiconductor companies seem, on average, to be most involved in their customers' cost reduction and long-term technology roadmapping activities and less involved in short-term activities underlying product development.

Figure 16. Extent to Which Customers Share Information with Fabless Companies

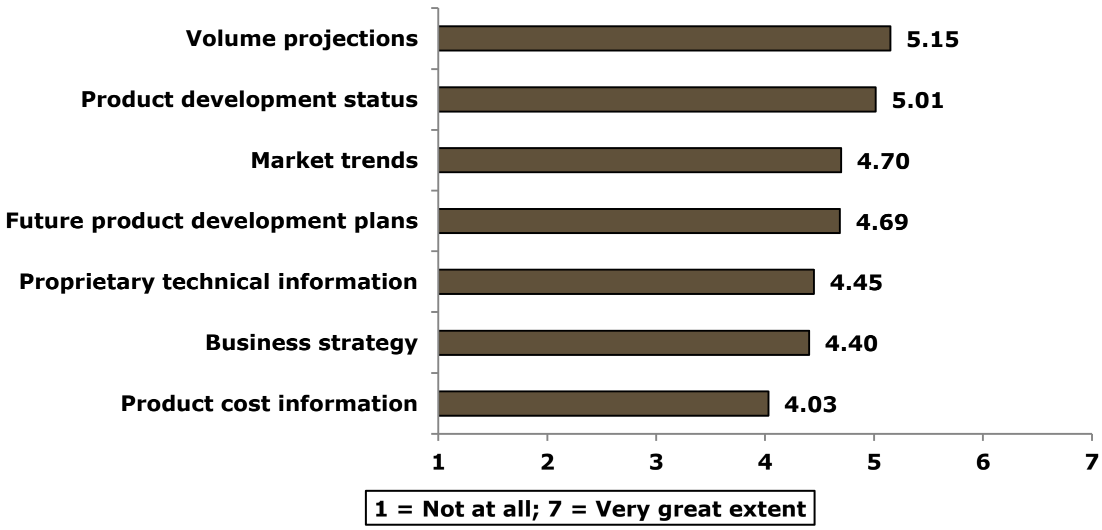
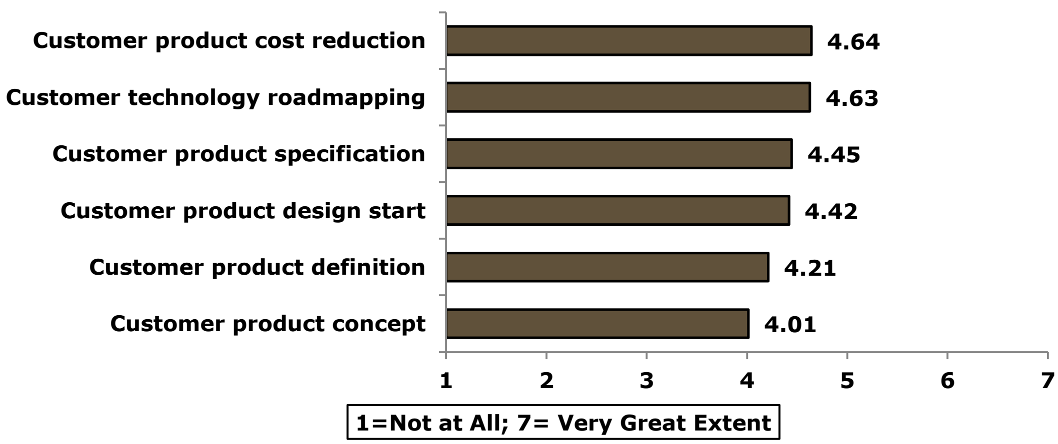


Figure 17. Extent to Which Fabless Companies are Involved in Customers' Developmental Activites



Figures 18a and 18b plot the response from fabless companies regarding the extent to which fabless companies and customers tailor their activities towards each other. In general, customers tend to customize their product designs and roadmaps to fabless companies' ICs and roadmaps. At the same time, fabless companies tend to customize their R&D activities and product portfolio to their customers. However, on average, neither fabless companies nor their customers seem to significantly tailor their manufacturing operations to each other.

Figure 18a. Extent of Customization between Fabless Companies and Customers

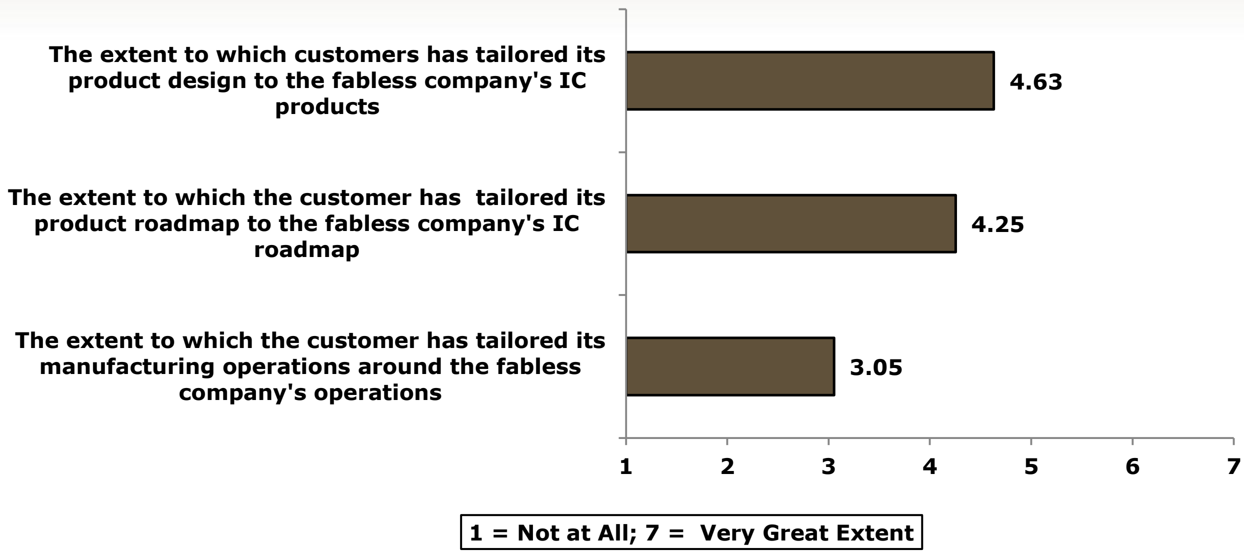
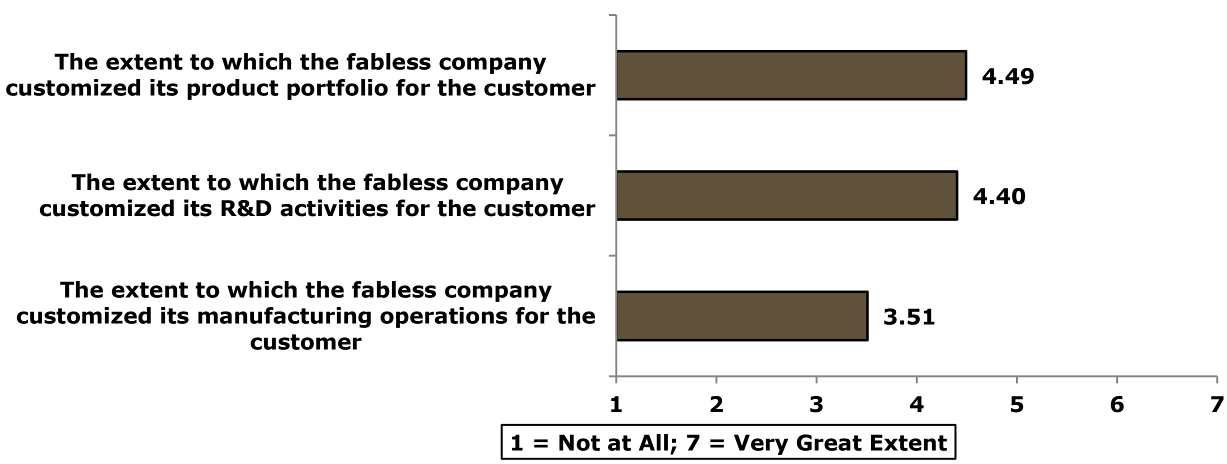
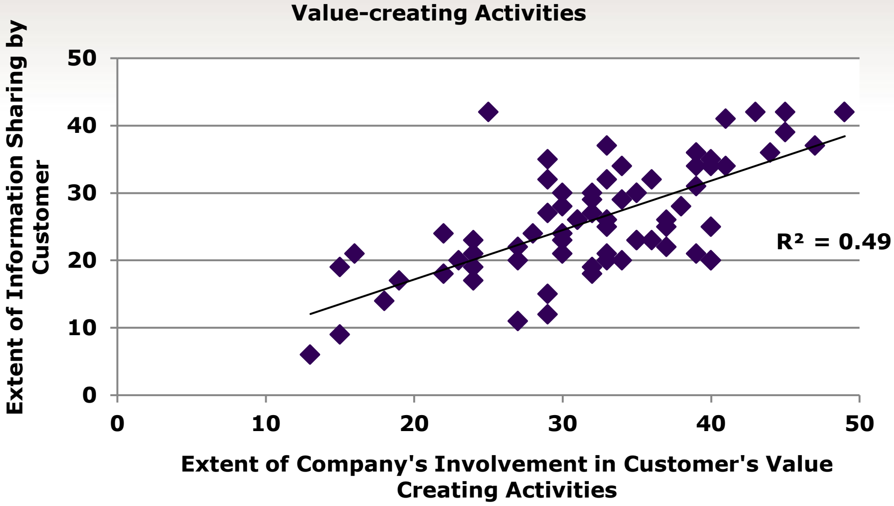


Figure 18b. Extent of Customization between Fabless Companies and Customers



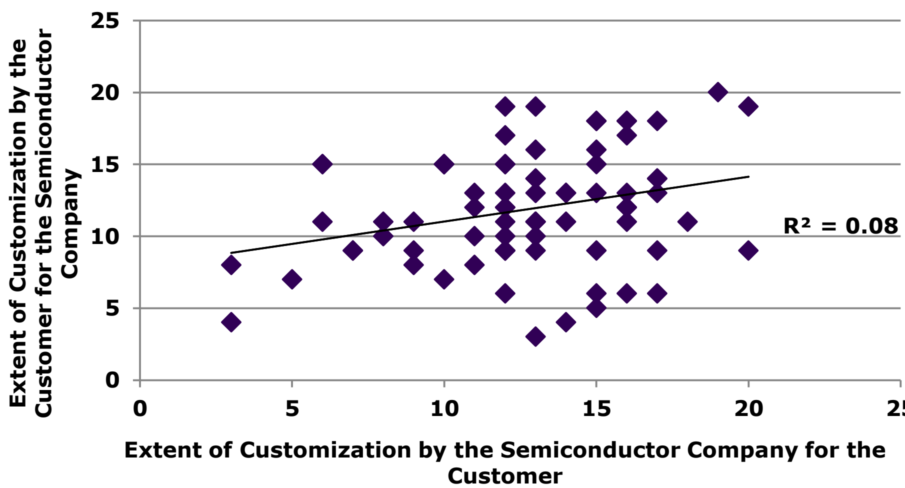
Finally, there seems to be large differences among semiconductor companies in the extent to which their customer relationships are collaborative. Figure 19 plots the extent of information shared by the customer against the extent of the company's involvement in the customer's value-creating activities. Each data point corresponds to a specific semiconductor company's customer relationship, and the plotted values are the sum of the scores for the different survey items for customer information sharing and company involvement in customer activities. As can be seen from the figure, customer relationships that are characterized by a high degree of semiconductor company involvement in customer activities are also characterized by a high degree of information sharing by the customer. Hence, while there exists large variance in the nature of collaborative relationships between semiconductor companies and their customers, these collaborative relationships tend to exhibit strong reciprocity.

Figure 19. Extent of Information Shared by the Customer against the Company's Involvement in the Customer's Value-creating Activities



Similarly, when the sum of the customization scores for the customer and the fabless company are plotted in a scatter plot (Figure 20), the two show a significant positive correlation (i.e., high customization by the fabless company for the customer is typically associated with high customization by the customer for the fabless company). However, the positive correlation is weaker than the correlation between customer information sharing and company involvement in customer activities.

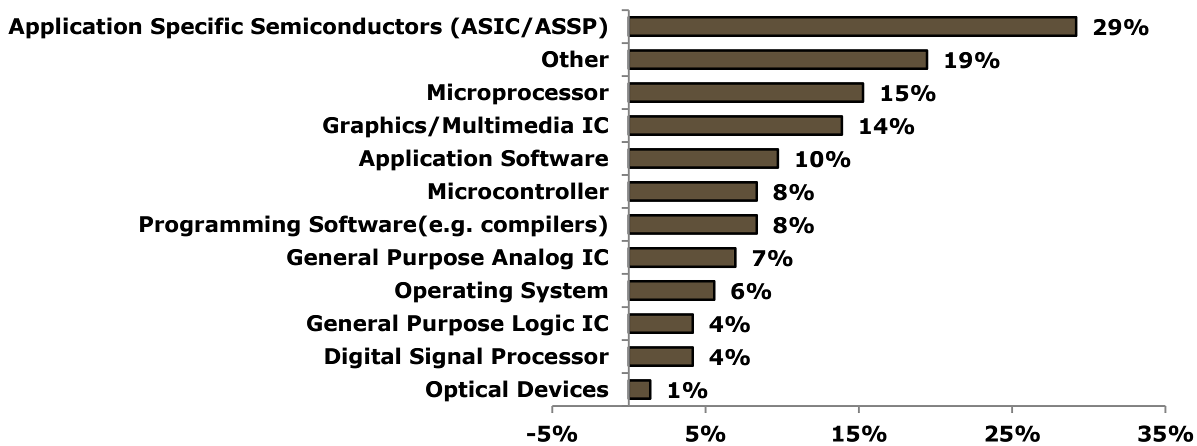
Figure 20. Extent of Customization by the Customer for the Semiconductor Company against Customization by the Semiconductor Company for the Customer



Relationship with Complementors

In addition to suppliers and customers, complementors are an important part of any semiconductor company's ecosystem. These are companies that provide complementary products that are integrated in the customer's application. For example, Intel and Microsoft are complementors in the PC market. Survey respondents (i.e., executives in marketing and business development) provided information on the type of complementors and the nature of their company's collaboration with complementors. As shown in Figure 21, a vast majority identified other semiconductor companies (ASIC/ASSP, microprocessor, graphics IC, etc.) as their complementors. Complementors also included companies developing application software, programming software and operating systems. Note that the total exceeds 100% because some complementors are present in multiple market segments.

Figure 21. Complementary Products Identified by Fabless Semiconductor Companies



Note: "Other" products include IP, FPGA, memory ICs and RF devices

When asked about the department that was primarily responsible for managing the relationships with complementors, there were significant differences among companies (Figure 22). 39% of companies surveyed manage their complementor relationships through the marketing department, 37% through the engineering department, 17% through a dedicated department or executive, and 7% mentioned no specific department. While there are well-defined departments for managing relationships with suppliers and customers, the relationship with complementors seems to be managed in very different ways both within and across companies. This suggests that managing relationships with complementors may perhaps be organizationally more complex than managing relationships with suppliers or customers.

Figure 22. Department Which is Primarily Responsible for Coordinating Activities with Complementors

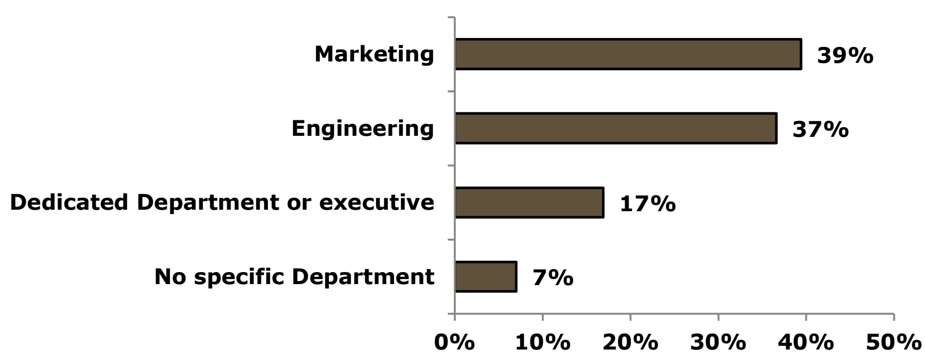
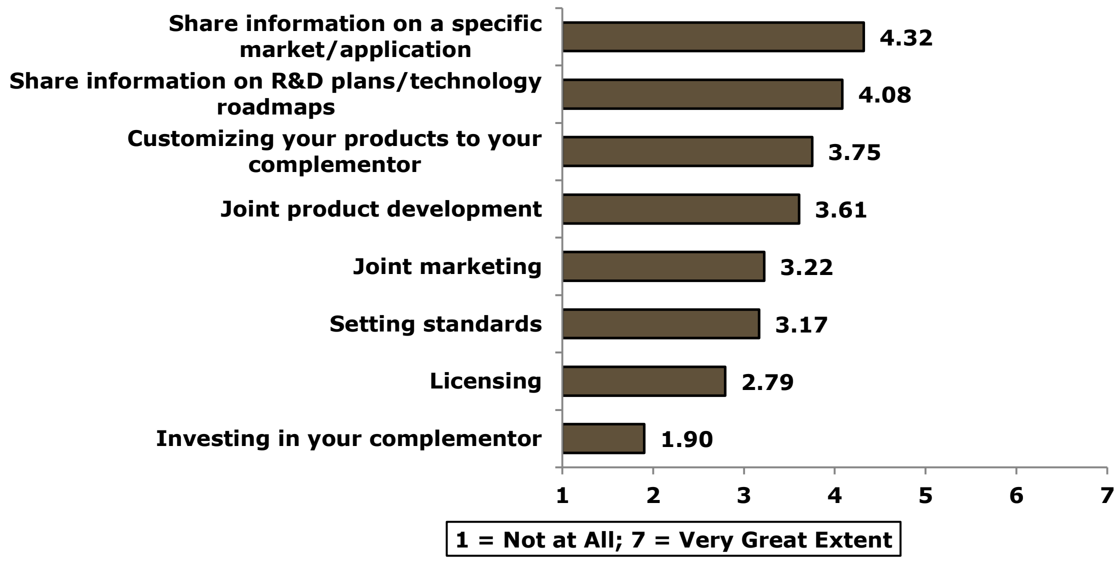


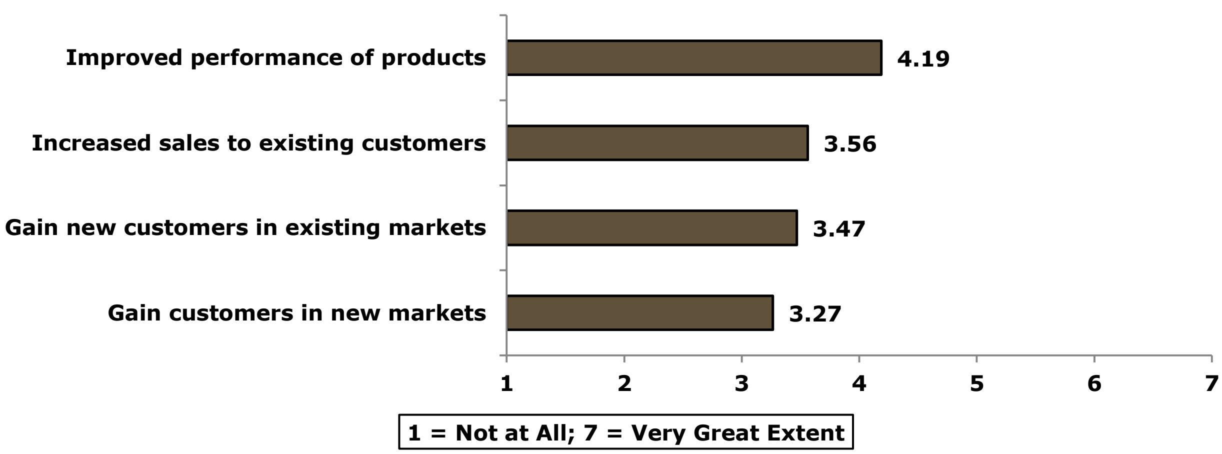
Figure 23 presents the findings on the different ways by which fabless companies collaborate with their complementors. Generally, semiconductor companies interact with their complementors more by sharing information on market-specific applications and R&D plans/roadmaps. Companies report less interaction through standard setting and licensing, and least through making investments in their complementors. There were moderate interactions through product customization and joint product development.

Figure 23. Means by Which Fabless Companies Interact with Their Complementors



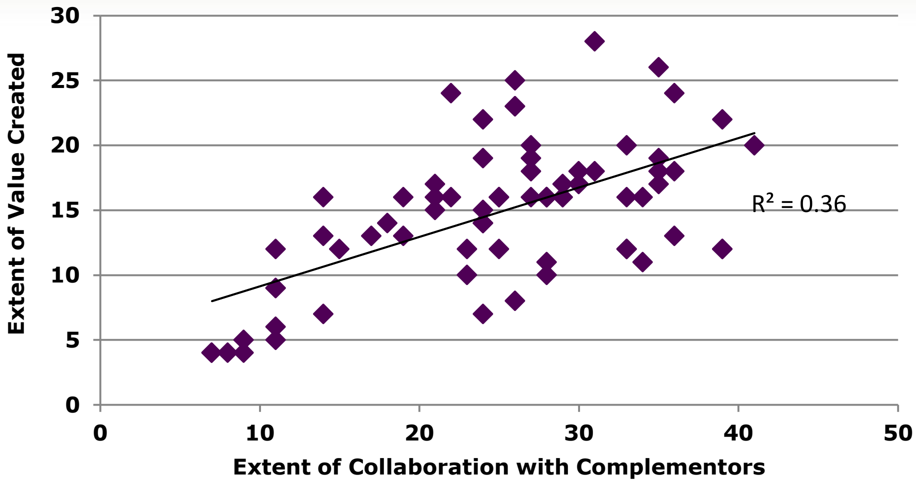
The different ways in which companies were able to create value from their relationships with complementors is shown in Figure 24. Collaboration with complementors, on average, seems to have the greatest effect on improving the performance of companies' products. The effect seems to be somewhat lower in increasing sales to existing customers and lower in helping companies gain new customers in existing and new markets.

Figure 24. Benefits of Company Relationships with Complementors



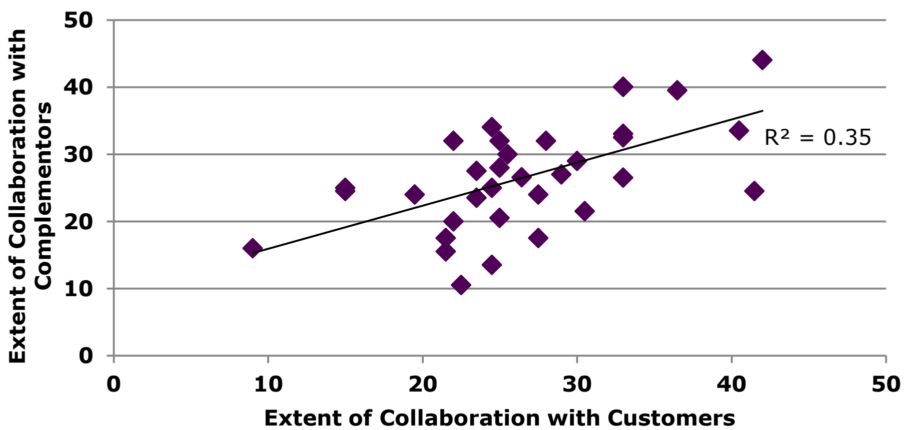
In exploring the link between the extent of collaborative relationships with complementors and the benefit of such relationships, we plotted the sum of items for collaboration against the sum of items for value creation. Note that the "investing in your complementor" item was excluded from the collaboration score because it is not strictly a collaborative process and was not an important mode of interaction reported by survey respondents. Figure 25 shows a significant positive correlation between the extent of collaboration between the company and the complementors and the extent of value creation. Hence, having strong collaborative relationships with complementors seems to help companies create greater value.

Figure 25. Benefits of Collaborating with Complementors



Interestingly, when the extent of collaboration with customers and with complementors is plotted on an individual firm basis, a positive relationship is also discovered. That is, companies who generally have strong collaborative relationships with complementors also seem to have strong collaborative relationships with customers. The findings suggest that while certain companies have built strong relationships with both customers and complementors, there are many others that are unable to capitalize on the opportunities for collaboration in the ecosystem and possibly undermine the value that they can create in the market.

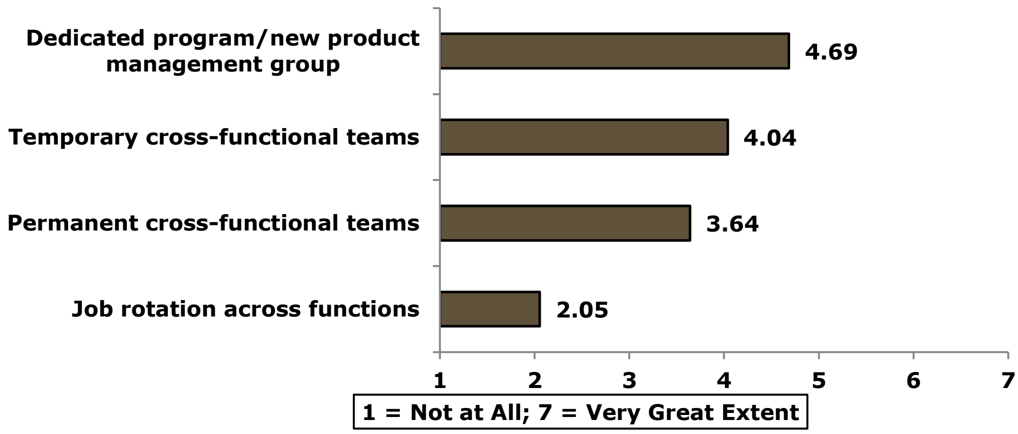
Figure 26. Extent of Collaboration with Customers and Complementors



Internal Relationships among Engineering, Marketing and Supply Chain Departments

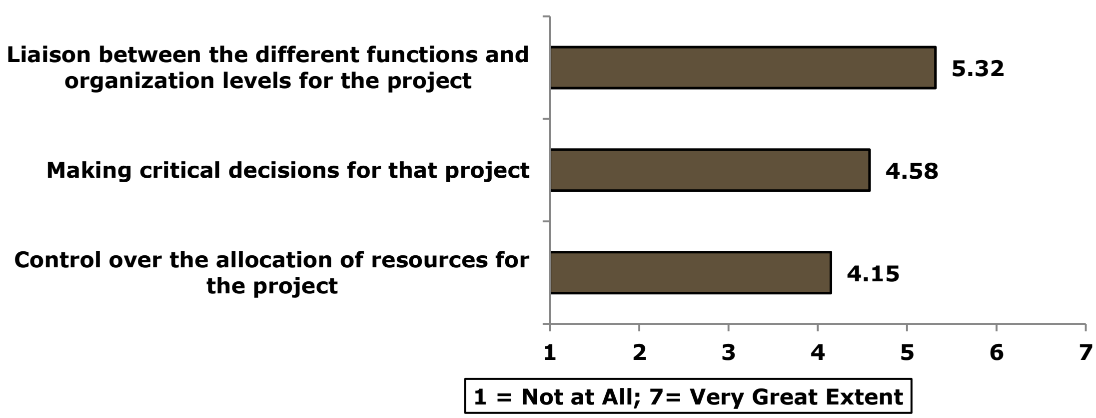
Companies use a variety of organizational mechanisms to coordinate activities between marketing, engineering and supply chain functions. The findings from the survey indicate that a majority of companies rely on a dedicated "program" or "new product" management group to manage such coordination (Figure 27). Companies also use temporary and permanent cross-functional teams.

Figure 27. Organizational Choices Employed by Fabless Companies to Coordinate Marketing, R&D and Supply Chain Activities



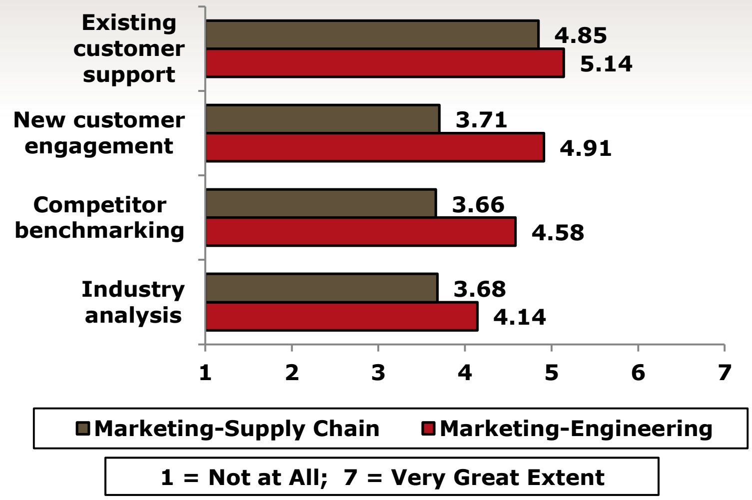
The primary responsibility of the "program" or "new product" manager seems to be a liaison between the different functions and organizational levels, with much less influence over critical decisions or the allocation of resources for the project (Figure 28). This suggests a possible organizational challenge as companies try to create an organizational structure based on information processing and management (i.e., liaison-based integration mechanisms) rather than on hierarchical control (empowering program managers with decision making and/or resource allocation) which may be essential for effective cross-functional integration.

Figure 28. Responsibility of the Program or New Product Manager at Fabless Companies

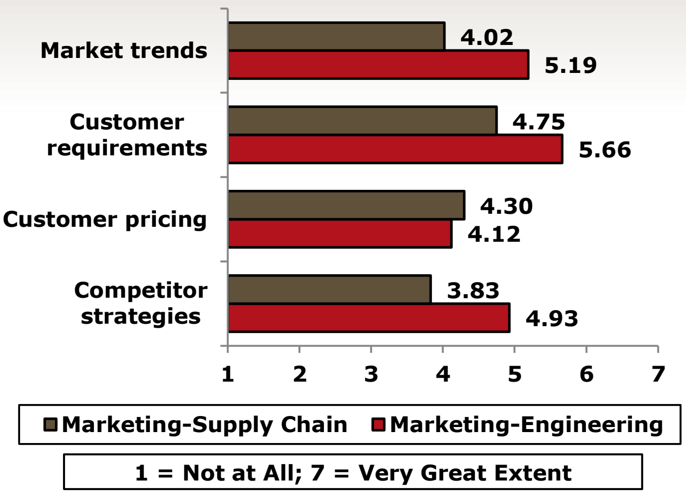


The extent of collaboration between the functional units was evaluated in two different ways: (1) the extent to which the functional divisions jointly carry out activities (joint action) and (2) the extent to which the functional divisions share information with each other (information sharing). Based on the industry interviews and survey pretest, several types of activities and information related to marketing, engineering and supply chain functions were identified. Figures 29, 30 and 31 present survey findings regarding joint action and information sharing for marketing, engineering and supply chain functions, respectively.

Figure 29a. Joint Action for Marketing Activities



29b. Marketing Information Sharing



On average, the marketing and engineering departments seem to enjoy a high degree of collaboration, followed by engineering and supply chain, and then marketing and supply chain. There seems to be a high level of joint action between all three departments for activities related to existing customer support, new product ramp-up and cost reduction. Activities related to new customer engagement, competitor benchmarking and technology roadmapping are carried out mainly through collaboration between engineering and marketing. Activities related to supplier selection and supplier performance evaluation are carried out mainly through collaboration between engineering and supply chain departments. There seems to be a high level of information sharing between the three departments for information related to product development status, supplier capabilities and pricing. Information related to technology development plans and product technical specifications tend to be more selectively shared between marketing and engineering departments.

Figure 30a. Joint Action for Engineering Activities

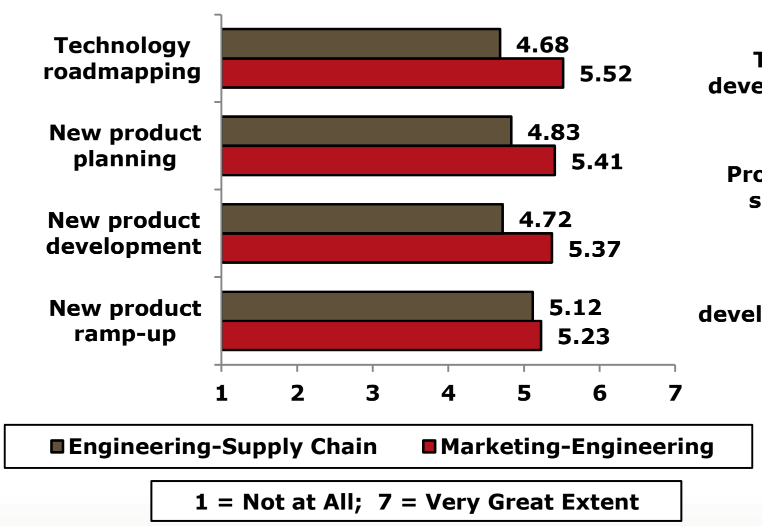


Figure 30b. Engineering Information Sharing

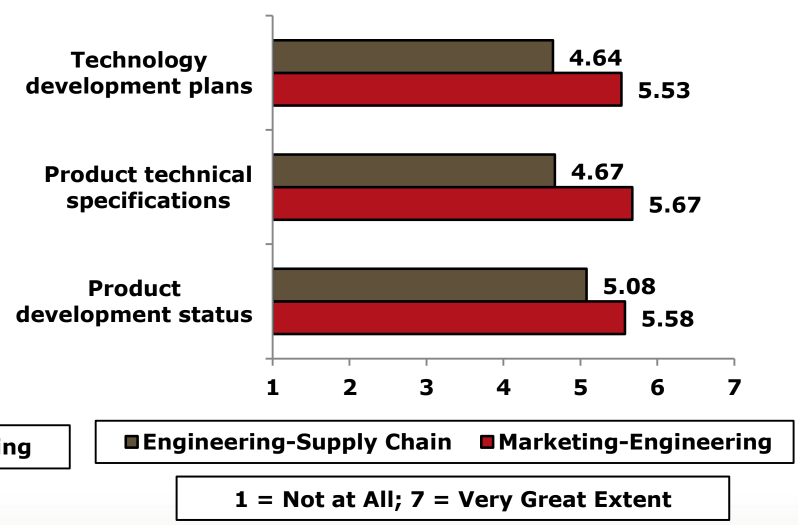
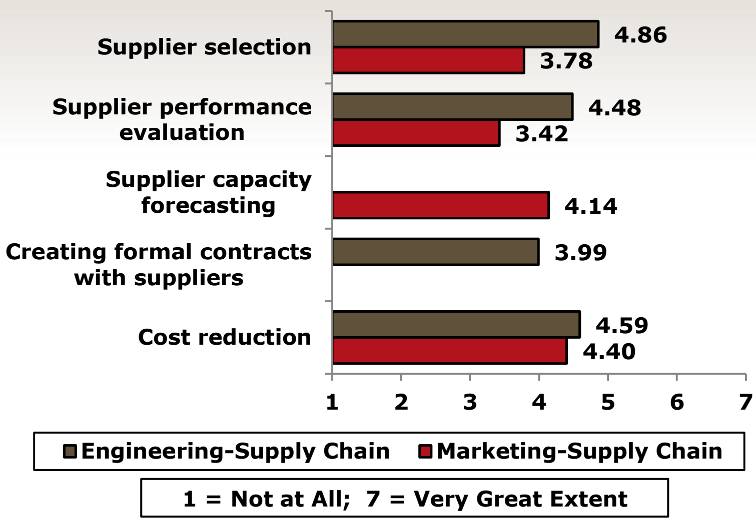
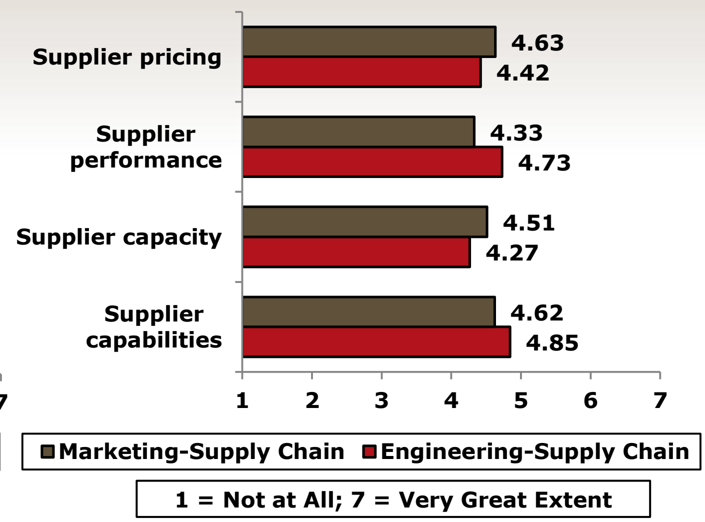


Figure 31a. Joint Action for Supply Chain Activities



31b. Supplier Information Sharing



The findings from the survey also showed significant differences in the cross-functional collaboration between companies. Figures 32, 33 and 34 plot the means of the items for joint action and information sharing for each functional pair in a company (engineering-marketing, engineering-supply chain and marketing-supply chain). For example, Figure 33a plots supply chain department's involvement in engineering activities against the engineering department's involvement in supply chain activities for the joint action analysis, and Figure 33b plots engineering information shared with the supply chain department and supply chain information shared with the engineering department for the information sharing analysis. Not only do companies vary in the extent to which the different functional groups collaborate with each other, but perhaps, more interestingly, there seems to be a high degree of reciprocity in collaboration. The extent to which the marketing department collaborates with the engineering department on marketing activities/information is positively correlated with the extent to which the engineering department collaborates with the marketing department on engineering activities/information. This correlation is especially strong in the relationship between supply chain and marketing departments.

Figure 32a. Joint Action (Marketing-Engineering)

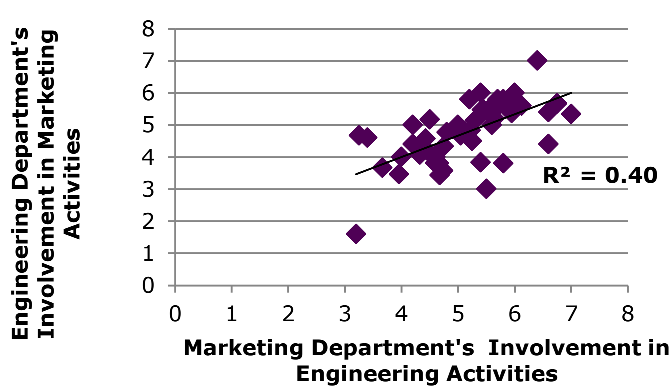


Figure 32b. Information Sharing (Marketing-Engineering)

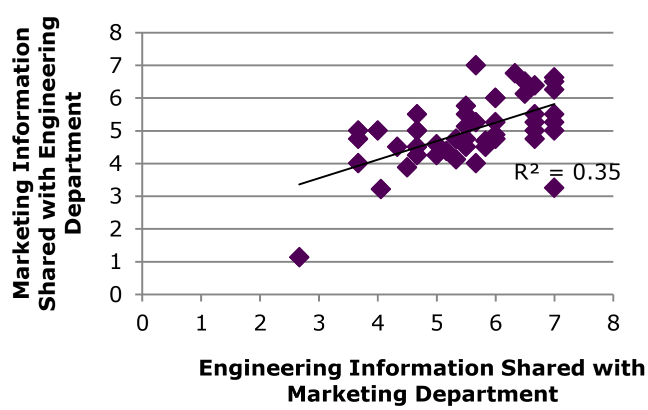


Figure 33a. Joint Action (Engineering-Supply Chain)

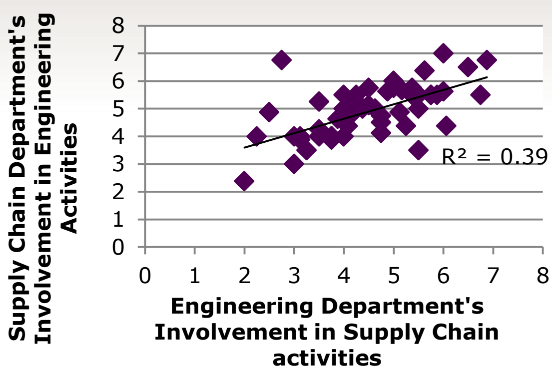


Figure 33b. Information Sharing (Engineering-Supply Chain)

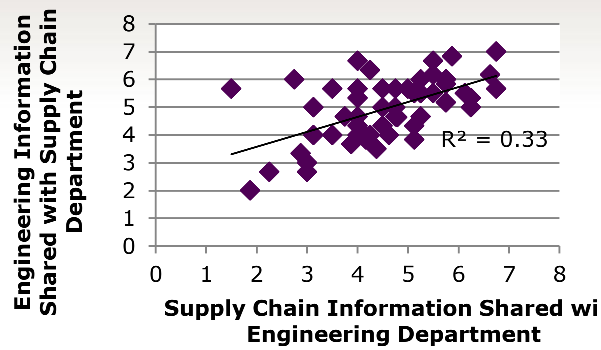


Figure 34a. Joint Action (Marketing-Supply Chain)

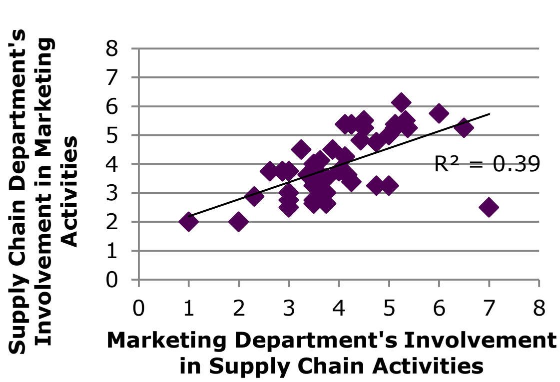
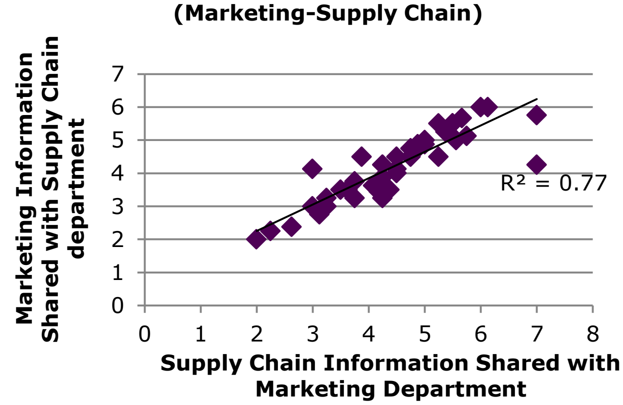


Figure 34b. Information Sharing (Marketing-Supply Chain)



SUMMARY

The ability of semiconductor companies to create value from their own products and technologies is critically shaped by the web of relationships with actors in their business ecosystem. These actors include suppliers, customers and providers of complementary products (i.e., complementors). Many semiconductor companies are pursuing collaborative innovation models in which efforts towards development and commercialization of new innovations are geared not only inside the company, but also at the collaborative interface between the company and its partners in the ecosystem. However, setting up and managing such collaborative networks in the face of increasing product complexity, greater competition and the rapid pace of change presents firms with significant technological and organizational challenges.

The 2010 Wharton-GSA Semiconductor Ecosystem Survey was implemented to provide an extensive and systematic analysis of the patterns of collaboration practiced by fabless semiconductor companies within their business ecosystem. The survey was administered to public and private fabless semiconductor companies with established product lines. It was comprised of three different sections that were completed by senior executives in engineering, marketing and supply chain management, respectively. Detailed responses were received from 62 fabless semiconductor companies (25 private and 37 publicly-listed), with the public companies representing 45% of total 2009 public fabless semiconductor industry sales.

The findings shed light on a broad array of challenges and opportunities that semiconductor companies face within their ecosystem. They uncovered how and why semiconductor companies are subjected to intense pressures with respect to time-to-market, product differentiation, cost structure and IP management. The results also showed that many semiconductor companies have tried to neutralize the effect of these challenges by recognizing the value-creating opportunities in their ecosystem. These companies have formed extensive collaborative relationships with their suppliers, customers and complementors. However, there are many others that seem to be working at an arms-length and perhaps not benefiting from the synergies that exist in a collaborative ecosystem.

A majority of respondents identified the important role played by complementors in enhancing a semiconductor company's competitive position. These complementors are often other semiconductor companies that develop complementary ICs used in the customer's application. Managing relationships with complementors seems organizationally more complex than managing relationships with suppliers or customers. While there are well-defined departments for managing relationships with suppliers and customers, the relationship with complementors seem to be managed in very different ways both within and across companies.

Finally, a company's ability to effectively develop and commercialize new innovations is enabled not only through collaboration with external partners, but also through collaboration between internal functional groups that often lie at the interface between the company and partners in the ecosystem. The findings from the survey indicate that companies differ significantly in the extent to which the marketing, engineering and supply chain groups collaborate with each other inside the company. The results caution executives that semiconductor companies need to manage both external dependencies with suppliers, customers and complementors as well as internal dependencies between supply chain management, marketing and engineering functions so as to ensure that they are able to maximize the value from all collaborative linkages. It may only take one ineffective collaborative link to undermine the total value created by the firm within the ecosystem.