Common Platform Technology – Extraordinary Returns for the Semiconductor Industry?

The Common Platform™ technology initiative, with IBM, Chartered Semiconductor Manufacturing, and Samsung as members, has the potential to transform the semiconductor industry, fueling faster innovation and lower costs for foundries, solutions providers and end customers alike. For foundries, it can mean quicker transitions to new technology, shared development expenses, and broader markets. For semiconductor customers, the benefits include quicker time to market, more sophisticated designs, and lower overall costs. This GCG research report discusses the semiconductor industry as it exists today and how the Common Platform technology initiative could radically change the economic and competitive landscape of the industry.

Semiconductors are becoming the key component, and a major factor in product differentiation, in more and more devices. While much of the public spotlight is focused on the processors used in personal computers, semiconductors used in consumer products such as cell phones, PDAs, MP3 players, and gaming consoles – not to mention those used in industrial, business, and medical equipment – are becoming increasingly sophisticated and represent a significantly larger market in terms of sheer volume.

Technical advances in semiconductor design and manufacturing allow products such as cell phones to deliver higher levels of functionality, while at the same time enabling product miniaturization and controlling power requirements. For many products, their success in the market is dictated by the technical sophistication of their semiconductor components. This is, of course, driving the market toward much denser (in terms of circuits per chip), complex, and more difficult to manufacture semiconductors.

Product manufacturers, along with their design partners, are constantly striving to push the envelope on semiconductor design, looking to increase performance and reduce costs in order to stay ahead of their competitors. This is becoming an increasingly difficult and expensive endeavor. Most of the performance gains in semiconductors have come about from miniaturization; moving from 130nm processes to 90nm is simply reducing the distance between circuits and transistors, which makes room for more transistors and circuits, thus increasing functionality and performance. However, these benefits don't come cheap. The move from 130nm to 90nm semiconductor production has resulted in an almost 200% increase in development costs – including the cost of new chip fabrication facilities, new processes, tools, and equipment. On the customer side, costs for designing a 90nm part are almost three times as expensive as designing a 130nm part ($25 million vs. $9 million)

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according to industry experts. The upcoming move from 90nm to 65nm will likely require comparable or greater levels of investment. As semiconductor real estate becomes more densely populated, with more and more transistors and circuits packed into an increasingly limited space, the designs become exponentially more complex.

This higher complexity is significantly increasing the risks associated with semiconductor design and manufacturing. Even with the use of increasingly sophisticated tools, tools that simulate both the circuitry of the chip and the manufacturing process, real world yields can only be determined by actually producing the semiconductors. Evidence to date shows that the probability of a design failure, ie. manufacturing a semiconductor design that doesn't work, has risen to 55% with 90nm designs vs. 35% with the previous 130nm designs.

A design failure means a 'back to the drawing board' redesign which results in cost overruns and potentially causes disastrous product delays. While better tools and simulators can reduce the failure rate, closer initial collaboration on semiconductor design and manufacturing processes is obviously more efficient. The semiconductor industry, led by the Common Platform technology initiative, is now responding to this and other issues with an alliance approach that will help increase the speed of innovation, while at the same time reducing customer risk and costs. To put these issues and the industry response in context, it is important to first understand how the semiconductor industry works.

Foundry 101: Customer Perspective

Semiconductor manufacturers, or foundries, from an operational sense, resemble a series of balkanized islands. Each company has their own proprietary set of processes they use for manufacturing semiconductors. Perhaps the best way to explain the differences between foundries is to look at an example from the automotive world. Like a semiconductor, the engine and transmission of a car are the parts that actually make it move and perform useful work. Engines and transmissions can be identical in function and performance, but still radically different. An engine/transmission combo from Mercedes and Ford can be exactly the same in terms of horsepower, displacement, and gearing – but they aren't interchangeable; you can't put a Ford engine in a Mercedes car and expect it to work. By the same token, a Ford plant can't just start producing Mercedes engines or transmissions. This would require a complete retooling of the factory and retraining the workers.

To stretch our analogy a little further, customers who need custom semiconductors must design their 'engine' from the very start in such a way that it can be manufactured by a particular foundry. It has to be designed so that it conforms to their processes, geometries, and tolerances.

The decision to select a particular foundry is irrevocable (at least in the short-to-medium term). The cost to redesign a chip so that it can be manufactured using a different process is considerable. If you wanted to change a design that can be manufactured using process "A" to a design that can be produced using process "B", the amount of redesign work required could be considerable. The exact amount of rework required will vary from chip to chip, with the final tally unknown until the work is well underway. When the new design is finally ready, the customer still runs the risk that the new chip will turn out to be a design failure, or will not achieve satisfactory performance or yield, any of which may necessitate even more work. The consequences to a bungled foundry switch - late products, defective products, and missed opportunities - can be disastrous.

Given that the task of switching foundries is very expensive, time consuming, and entails significant risk, it follows that selecting the right foundry partner is a critical decision. It is important to select a foundry that has the necessary capacity both today and in the future to handle anticipated production needs. As important, the foundry of choice needs to have the capacity to handle unanticipated extra production, just in case the product turns into a runaway hit. Customers also need to ensure that their prospective foundry partner has a solid roadmap for developing their process so that it can produce newer and more complex semiconductors to keep up with advances in technology. Last, but not least, the customer needs to make sure the foundry can deliver all of the above on time and at an economically viable price.

The high switching costs and risk involved in switching designs between foundries takes much of the choice and control over their products from semiconductor (i.e. buyers) customers. This 'foundry lock-in' makes the market for semiconductors less competitive, constrains customer profitability, and inhibits innovation. All of the above can be a barrier to innovation and is certainly a constraint on profitability – less flexibility and fewer choices always has a detrimental impact on innovation and profits.

Foundry 101: Foundry Perspective

While foundry customers face high risks and costs, as discussed above, life for the foundries isn't all that easy. Semiconductor manufacturing is hideously expensive, with high fixed costs that need to be amortized over the greatest number of chips possible. Foundries need to invest heavily in R&D in order to continually develop and refine their proprietary manufacturing processes. Each successive generation of technology, 130nm to 90nm to 65nm to 45nm, requires new fabrication equipment, tools, and processes. The costs associated with each technology jump are rising as the technology becomes more complex and difficult to manufacture.

Much of the success of a foundry is contingent on utilization rates. A fabrication plant is a huge capital expenditure that has a limited life – in general, a fab (and associated tooling) is only able to produce parts corresponding to a particular generation of technology (130 nm vs. 90 nm, for example). Thus it is important for the foundry to ensure that their fabs are running as close to full utilization as possible. Foundries need to constantly juggle capacity in order to satisfy demand from a diverse set of customers and keep their utilization rates high.

The risk/reward ratio for chip makers is becoming less favorable over time. Research and development costs, which are crucial to ongoing success, are rising at a 12% clip, while revenues are only increasing at a 6% rate.

The challenges facing the semiconductor industry are serious and complex. Its customers demand faster delivery of increasingly complex parts in highly varying quantities at an ever lower price per part. Foundries are continually racing to provide better manufacturing processes in order to satisfy customer demand. They then need to make huge capital expenditures on new fab capacity, and, for all this trouble, are finding their margins squeezed by high - and rising -development and manufacturing costs.

As economic pressure has increased for both foundry customers and the foundries themselves, a new industry collaboration, the Common Platform technology alliance, has the

potential to radically change the semiconductor industry – to the benefit of customers and foundries alike.

Enter Common Platform Technology

The Common Platform technology alliance of IBM, Chartered Semiconductor Manufacturing and Samsung has at it's foundation a joint development agreement for process technology development at 90nm, 65nm and 45nm which includes the contributions and efforts of Infineon Technologies. The Common Platform technology alliance expanded this initial collaboration beyond joint development to the synchronization of manufacturing facilities. The end result is that a customer can use any (or all) of the three companies for manufacturing, without having the make any adjustment or changes to their chip design.

The basic idea behind the Common Platform technology alliance is fairly simple: collaboration between partners on manufacturing processes, fab synchronization, and the development of key intellectual property to speed innovation and reduce costs. In turn, this will allow the partners to offer their customers faster time to market and increased flexibility, while reducing manufacturing and development costs. Additional manufacturing partners will likely join soon as well.

The term "Common Platform technology" refers to a set of common processes that multiple foundries, along with semiconductor design tool software vendors, and the rest of the ecosystem can use – thus eliminating the 'foundry lock-in' on the customer side, and allowing foundries to pool their IP and development expertise. This significantly reduces their ongoing investment in R&D, while ensuring they have equal access to cutting-edge technology. Full GDS II (a database format representing the final output of the semiconductor design cycle) compatibility ensures that a part designed with the Common Platform process technology can be successfully manufactured in any Common Platform fabrication plant, be it owned by IBM, Chartered, or Samsung. This, for the most part, eliminates the 'foundry lock-in' that hobbles customer flexibility and innovation.

Common Platform Technology: The Players

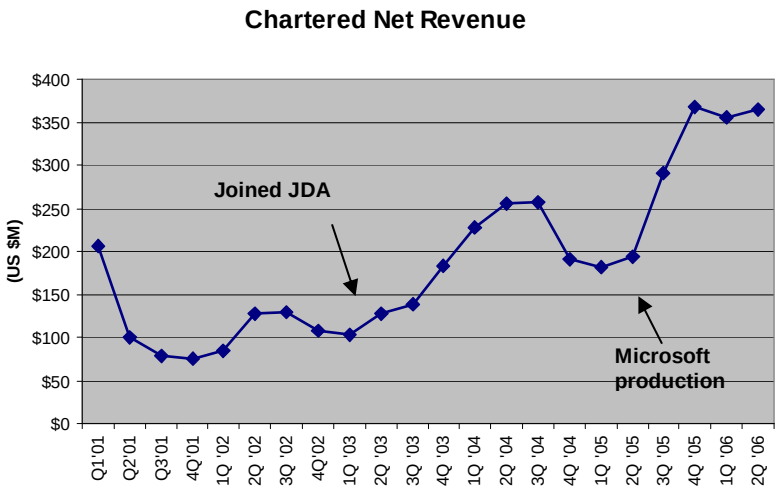
The level of cooperation and collaboration between Common Platform technology partners is unprecedented in the semiconductor industry. IBM's participation as one of the founders of the Common Platform technology was prompted by their analysis of the industry and subsequent discovery that customer needs for increased innovation and speed were on a collision course with the rising costs associated with increasingly complex semiconductor fabrication technology. IBM, as both a producer and large consumer of products, foresaw the benefits that could be realized from foundries pooling process technology – benefits that include lower process development costs for all, faster-paced innovation, and more choices for customers.

For the 'old' IBM, initiating a Common Platform technology approach would be an unnatural act. However, the 'new' IBM is focusing more and more on collaboration and partnership as methods they can use to solve customer problems – and ultimately reap benefits of their own. The IBM Technology Collaboration Solutions unit was expressly designed to allow IBM to collaborate with customers in order to speed customer innovation. Many of these engagements require custom technology solutions and need the speed-to-market and

flexibility that designing under the Common Platform technology can provide. IBM itself will, as a customer, benefits from the model as they move towards what they call a 'fab-lite' business model: fabricating their own cutting edge chips, b outsourcing volume production of semiconductors beyond their own capacity limits. IBM has been very successful in the foundry business, particularly on the high-end, but their internal and external OEM semiconductor needs have begun to outstrip their internal manufacturing capacity. Common Platform technology will allow IBM to fuel its growing semiconductor business by using their partners to fab chips that IBM has designed based on an outsourced manufacturing model.

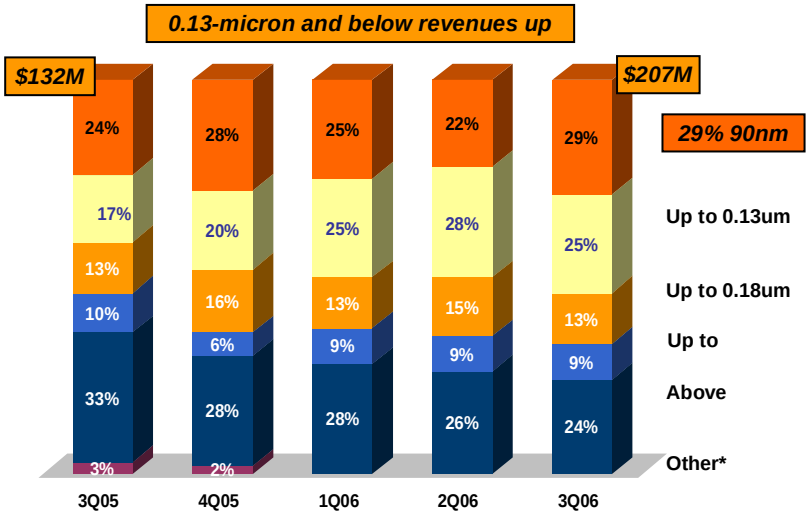
IBM isn't pulling back in semiconductors; they will still be pushing the frontier in development, providing advanced technology that their process technology brethren will be able to use while IBM relies on them more and more for actual semiconductor production.

Chartered, a founding partner in the Common Platform initiative, holds a unique position in the alliance as the 'pure play' foundry partner. By this we mean that the vast majority of Chartered's business is manufacturing logic chips for third parties.



Chartered has realized significant benefits from its participation in the Common Platform technology alliance. As can be seen from the chart at left, Chartered net revenue has almost tripled since they co-founded the initiative.

Of particular note is the revenue spike that resulted from one of the first Common Platform technology design wins – production of chips for Microsoft's Xbox video game console.



Chartered has also significantly improved its product mix over time. As can be seen on the chart at left, Chartered's sales of advanced technology 90nm chips has grown by almost 60% in just the last year, in the process moving from a quarter to almost a third of Chartered's revenue mix. This is important in that it shows Chartered is back on track in terms of producing and selling higher margin, cutting edge chips.

Chartered has played a significant role in one of the Common Platform technology alliance's highest profile design wins by co-manufacturing processors used in Microsoft's Xbox videogame console. Chartered, through an outsourcing agreement with IBM, handled much of the fabrication work for the initial launch of the Xbox (at 90nm) in 2005. Through their collaborative efforts, IBM and Chartered were able to ramp production in record time – from concept to design to volume manufacturing in an astounding 24 months.

The third foundry partner, Samsung, joined the alliance in mid-2005. Samsung is a major player in a wide variety of industries, including telecommunications, business equipment, computer components, and consumer products. Samsung's involvement with the Common Platform technology started with their collaboration with Chartered and IBM with 90nm technology, which has extended to 65nm and 45nm. The advantages the Common Platform technology alliance provides to Samsung are considerable, according to K.P. Suh, Executive VP at Samsung: "The arrangement that we have with IBM and Chartered to provide mutual design enablement and increase compatibility among our fabs will be a great benefit to our internal users and external customers."

Participation in the Common Platform technology alliance should yield significant benefits to Samsung's growing foundry business unit. As one of the largest semiconductor manufacturers and consumers in the world, the pooling of development efforts with IBM and Chartered will allow Samsung to get much more bang for their R&D investments.

(source: IBS, Global System IC Service Management Report)	**180nm**	**130nm**	**90nm**	**65nm**	**45nm**	**32nm**
Process Development Costs ($M)	$172	$237	$329	$416	$612	$857
Process Ramp-up Costs ($M)	$106	$155	$237	$342	$481	$735
Total Cost (2 year development cycle)	**$278**	**$392**	**$566**	**$758**	**$1,093**	**$1,592**

As can be seen from the chart above, process development and ramp costs are high and rising over time as chips become smaller, more complex, and more difficult to manufacture. It is interesting to note that total process costs almost double when comparing 45nm process development to 90nm, and almost triple when comparing 32nm to 90nm. Non-Common Platform technology foundries will be have to bear these costs alone, while Common Platform technology partners will be able to avoid much of these development expenses by virtue of the Common Platform technology sharing agreement. These savings will be particularly relevant to Samsung as industry sources indicate that Samsung is expected to spend as much as $33 billion to build as many as six new 300mm semiconductor fabrication facilities. Some portion of this investment (Samsung isn't saying how much) will be devoted to facilities producing chips using Common Platform technology. When completed, Samsung's 300mm fabs will give them plenty of capacity to devote to their new merchant foundry unit. Samsung has stated that they will no longer develop their own process technologies at nodes past 90nm for any of their System LSI offerings, but will instead rely on jointly developed Common Platform process technology.

In addition to cost savings, Samsung's membership in the Common Platform technology alliance will give them access to technology that will enable faster semiconductor innovation. This will give Samsung products advanced capabilities with a quicker time to market. All of the main foundry partners, IBM, Chartered, and Samsung, are collaborating on 90nm, 65nm,

and now, 45nm processes. In fact, these companies recently delivered some of their first 45nm parts. Full qualification of 45nm is planned for the end of 2007 in all partner fabs.

The foundry partners, while vital, are only one aspect of the Common Platform technology alliance. For customers to successfully develop and design products for manufacture using Common Platform process technology, they need support from a host of other players who are forming an ecosystem. Since inception, the ecosystem has grown to include a full slate of libraries (Virage, ARM), and semiconductor enablement partners (Cadence, Mentor, Synopsys, Magma, plus others). The Common Platform technology ecosystem is robust, giving customers the ability to choose between industry standard tools and IP, each of which have been custom tuned to the underlying process technologies.

Additionally, there is a full Design for Manufacturability (DFM) toolkit, which will not only verify designs for manufacturing but will also help increase part yields. These tools also more clearly illustrate the trade-offs inherent in each design. Linking chip design closely to the manufacturing process will increase both early and long-term yields, improve time to market, and reduce the risk of design failures.

The Common Platform technology alliance just received a solid vote of confidence from wireless and electronics giant QUALCOMM when the company announced that it would source production of 90nm chips from all three foundry partners – IBM, Chartered, and Samsung. QUALCOMM is the largest fabless semiconductor company in the world, thus their endorsement of the initiative goes a long way towards confirming the inherent value in the Common Platform technology approach.

Common Platform Technology: The Pay-off

Customers designing chips for manufacture by Common Platform technology partners will see considerable advantages vs. the alternative of designing for a single, proprietary fabrication process. The chief benefit is the ability to design a particular part once, and then have it manufactured by any (or multiple) Common Platform technology partners. They will be able to select the right fab partner for their purpose, according to their individual specialty, capacity, or cost. Full GDSII compatibility ensures that a part designed with Common Platform technology can be manufactured by any of the participating foundry partner. The time and costs associated with redesigning a part for manufacture under a different process will become a thing of the past. With only one process to deal with, designers can spend more time working on design innovations rather than dealing with process issues or the need to understand multiple processes.

Customers utilizing Common Platform technology partners for their foundry needs will also be mitigating the risks inherent in relying on a single foundry in a single geographic location. IBM, Chartered, and Samsung facilities are located almost equidistant across the globe. This means that any forseeable natural disaster or geopolitical instability will only impact a single partner, and that production can be seamlessly shifted to unaffected partners. This dispersion also means that production or design work can continue 24 hours a day.

Another benefit that can't be underestimated is the unique sharing of intellectual property. Each of the players in the Common Platform technology alliance has dedicated significant R&D resources towards advancing the state of the art in semiconductor process technology. New technical enhancements are tested and refined by each of the partners, with the resulting benefits shared by all. Contrast this to a single foundry, where they only have the resources of their own R&D organization to draw upon. Any technological advances gained

by this isolated R&D organization are used only for the benefit of that individual foundry, rather than shared with a host of players who may be able to add important enhancements or refinements and improve the overall result.

Over time, the Common Platform technology members should reap a 'collaboration dividend', i.e. an increase in their speed of innovation and decrease in associated costs, resulting from pooling their individual R&D horsepower and intellectual property. As the alliance expands, the benefits from the collaborative relationships will only increase as more brain power is applied to the challenge of designing and manufacturing better semiconductors, faster and cheaper. Customers utilizing Common Platform technology will receive huge benefits from having access to advanced process technology sooner. To them, this will translate into competitive advantage in the design, capabilities, and cost of their end products.

For semiconductor manufacturers, the Common Platform technology iniative has the potential to turn the business upside down. Non participating-foundries will find themselves competing against an expanding consortium of large, innovative, major industry players. Over time, they may find themselves losing ground in the technology race as their individual efforts fail to keep pace with the larger and geographically diverse Common Platform technology partners. The geographic element is important in that the Common Platform technology partners are spread across the globe, which means that collaborative R&D can take place 24 hours a day. Individual foundries will also find it difficult to compete on the cost front. Common Platform technology partners, by virtue of their shared development agreements, will be able to reduce their own development expenses, but the amount of development investment as a whole should still dwarf the amounts invested by individual non-participating foundries.

Of course, a winning strategy for individual foundries might well be to join the Common Platform technology partnership. While membership for foundry partners isn't free, it is considerably less expensive than developing unique manufacturing processes individually. To fully participate, foundries need to license or participate in joint process technology development and synchronize their manufacturing facilities with the rest of the foundry partners. This synchronization ensures that a chip designed for manufacture with Common Platform processes can be fabbed in any (or all) of the alliance fabs – a key benefit for foundries and customers alike. Membership for ecosystem partners is free and open. The Common Platform technology alliance is aggressively recruiting ecosystem players to ensure that the platform continues to enjoy a broad and deep set of design tools and intellectual property. To participate, ecosystem partners only need to tune their tools or intellectual property to the Common Platform technology base.

Each of the alliance members will also be able to expand their respective markets. As discussed above, any part designed under the Common Platform technology can be produced by any participating fab. This means that member foundries will be able to act as a second source for customers needing extra capacity – a bit of business that they might not have been able to compete for or win if process switching costs (and time requirements) were factored into the deal. On the other hand, Common Platform technology foundries can also outsource production to other members, giving them the ability to take pressure off of their own production schedules or take on higher margin work. This type of seamless second sourcing can also remove management burdens from customer shoulders. A customer can contract with a single Common Platform technology partner for a particular task and then that partner can then engage other Common Platform technology partners, if needed, to fulfill contractual requirements. Individual foundries do not have this ability since their proprietary

processes, and the costs to port designs to their processes, make it more expensive for them to compete for second source business.

Summary & Recommendations

We believe the Common Platform technology initiative may signal a fundamental change in the semiconductor industry. There are many examples, both in technical and non-technical fields, of how shared standards, shared processes, and collaboration both speed innovation and reduce costs for all. As the Common Platform technology alliance expands, the benefits from common processes, tools, and shared development will fuel productivity gains on the manufacturing side. These gains translate into greater flexibility, quicker time to market, and lower costs for customers designing parts under the Common Platform technology standard. In time, these efficiencies will be more and more difficult for proprietary fabs to compete against.

As for immediate action items, we would advise clients who design custom semiconductors to explore the potential benefits of utilizing Common Platform technology. The advantages of multi-source fabrication and subsequent elimination of "foundry lock-in" may well justify the move to Common Platform technology.

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