CO-OPETITION OF THIRD-PARTY SILICON IP PROVIDERS IN THE SEMICONDUCTOR INDUSTRY

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ABSTRACT

The semiconductor industry had gone through a process of changing from vertical integration to vertical disintegration. As silicon wafer process technologies continue to evolve and the trend of system-on-chip (SOC) or system-in-package (SIP), silicon intellectual property (IP), which is the reusable IC design component, has become an important approach to provide design cells with intellectual property for IC product innovation. Because IC design and manufacturing complexities continue to increase significantly, designers are facing increased time-to-market pressure and more expensive mask cost to rapidly introduce new products with limited life cycle, which shortens the time available for research and development. It is becoming less practical for an IC design house to internally develop all components and tools without depending on solutions provided by their third parties, called as third-party IP providers, including design service provider, stand-alone IP provider, and EDA tool provider. However. it is very time-consumed in both IP transaction process and the process for integration of various IPs into IC. an Although IP expected be was to

synthesizable with seamless integration into IC designs, IC design houses would not be able to license IP based on the requirements of specific designs because IP available from third-parties is often incomplete of alternatively fine-tuned for specific wafer Since most third-party IP processes. providers have different IP technology and core competences, more and more IP providers start to collaborate with one another in order to obtain complementary resources or abilities to provide complete IC design solutions to customers. A trend of inter-firm collaboration among competed third-party IP providers has been happening, to co-opetition relation. which leads However, the academic understanding of this issue is still a puzzle. The goal of this research is then to explore why third-party IP provider collaborates with one another and the difficulties occur during the collaboration under process the new business paradigm.

By exploring three typical cases of leading design service providers, whose core businesses are design service and turnkey service, of the design service industry in Taiwan, we intend to find that the collaboration processes and difficulties between the design service providers and other types of third-party IP providers with different business models. In-depth interviews were conducted within these three companies. Through interviews and secondary data collection for these three companies, we find that the most common inter-firm collaboration model in third-party IP providers is the collaboration between two companies to provide a complete total solution to customers by combining complementary IP services such as EDA tools, core IP technology, and design service. During the collaboration process, however, some difficulties might occur before and after the contract stage.

Transaction Cost theory is imported to explain why the collaboration will mostly occur and how to solve the difficulties during the collaboration process. In this paper, we elaborate the transformational organizations from the perspective of transaction cost facing the global demand of customized IC chips and the specific industrial context which is lacking of pioneering downstream applications and original upstream IP modules. We find that the transaction organizations are more complicated beyond the solely contracting from the IP spot market. The third-party IP providers must possess the IP sourcing with reconfiguration capability and the aftermath quality promise before they could attract the

application clients. Owing to the uncertain performance of IC designing from IP integration, there would be needed much verification and tuning work between the triangle partnerships of engineering chain: the third-party IP provider, the fables IC design house, and the dedicated foundry. No matter how the partnership links, the design service provider indeed stand in the gateway role and have to coordinate the collaboration relationship for the final IC product, especially, under the specific Taiwan context, a model infrastructure for the semiconductor industry. Without these collaborative intermediation transactions of third-party IP providers, Taiwan's foundry manufacturers could not launch diverse IC fabrication and make full use of production capacity, nor did the IC design house win the global IC application designing deals owing to the low IC defection rate. This research will enlighten the transactional arrangement for technology transfer and industry incubation under the institutional comparison of industry evolution. The results will give the researcher the industrial insights and contribute the practitioners with the strategic foresights while confronting the local specificity of globalization.

Keywords: inter-firm collaboration, co-opetition, total solution, silicon intellectual property (IP), design service, measurement cost