Evolution of NanoGram Corp.[1]

Nanogram was chosen as a unique example of the development and commercialization of radical nanomaterials technology because it has demonstrated rapid value creation through an innovative business model. It does so through the creation of separate subsidiaries commercializing their generic technology in predominant market verticals, thereby allowing for a focused strategy from each subsidiary, and further investment, alliance, and acquisition possibilities. NanoGram itself currently employs an IP business model and technology incubation function for its spin-out and subsidiary companies, which thus far are in the market sectors of telecommunications, medical devices, and energy. NanoGram owns over 100 nanomaterials and nanoparticle manufacturing process patents (granted or pending).

NanoGram was founded in 1996 by Dr. Nobuyuki Kambe and Dr. Xiangxin Bi to commercialize their novel nanoparticle manufacturing process. Nanogram relocated from Kentucky to San Jose, California, in late 1996, in part because of better access to outside financing. The aim of NanoGram was to enable the production of nanostructured materials for a broad range of markets, including medical devices, planar optical devices, fuel cells, solid state lighting, information displays, high resolution imaging and

[1] This case study was based on four primary source interviews conducted on August 9 and August 19, 2005, Feb 26, 2006, and April 13, 2006, from secondary source information from NanoGram's website www.NanoGram.com and from other sources cited within the case study.

solar cells. The initial revenue model was in-house manufacturing and manufacturing with out-sourcing. In 1998, Tim Jenks joined NanoGram as CEO and began to develop a strategy for strategic alliances.

The initial rational for an in-house manufacturing revenue model was that customer adoption was the most important issue for NanoGram, and the adoption of their technology was initially limited by demand. NanoGram felt the need to manufacture product to demonstrate its potential to customers. However, the decline of the technology sector in 2000 and 2001, and the subsequent uncertainty after Sept 11, 2001, led to a massive decline in the availability of investment capital. Most ventures, including NanoGram, re-examined their revenue models and looked for ways to lower operating costs and capital intensity. Jenks recalls "We knew it would be impossible to fund all of our applications – a narrow focus was essential, yet we knew we had a very powerful platform." Thus, NanoGram was forced to make tough decisions between maintaining sufficient resources and exploiting the breadth of their technology.

NanoGram first responded by narrowing its focus to their technology competencies with films and the application development of novel circuits for optical networks in the telecommunications industry. To reflect this altered focus, NanoGram changed its name to NeoPhotonics Corporation. But, as Jenks describes, more favourable market conditions in late 2002 led them to spin out another applications company, NanoGram Devices Corporation, in Jan 2003, for the development and commercialization of medical battery devices. At this stage, there were two application companies, NeoPhotonics and NanoGram Devices Corporation (NDC).

These new applications companies, however, had the potential for conflict over common IP. Thus, it was decided to form a parent company with a licensing revenue model which would focus on technology incubation and fuller exploitation of their broad

platform of technologies which had applications across multiple industries. This new company was renamed NanoGram Corporation. Jenks describes the revenue model change as follows:

> Then, two market-focused companies were sharing common intellectual property – IP that defined a powerful multi-facet platform. The licensing model derived from these two decisions – we formed NanoGram as a platform company with initial application licenses to the two market-focused companies, thereby enabling the two market focused companies to succeed. NanoGram has been highly successful since, continuing forward as a platform IP and discovery company." (Tim Jenks, Feb 26, 2006).

Thus, although NanoGram was founded in 1996, the current form of NanoGram was established in 2003 (see **Tables 1 and 2**).

The two application companies, NeoPhotonics and NDC, were successful in raising funding independently and in developing alliances specific to their industry. NeoPhotonics, with Tim Jenks as president and CEO, raised $25 million in 2002, $40 million in 2004, and merged with a Chinese active component manufacturer for the telecom industry, Photon Technology Co., in 2005. This merger resulted in a sharp upturn in customers, revenue, and employees. NanoGram's other applications company, NanoGram Devices Corporation, which spun out in January 2003, quickly raised $10 million in venture financing. Led by CEO Barry Cheskin, NanoGram Devices (NDC) established a strategic alliance partnership with the dominant incumbent in the medical power market, Wilson GreatBatch Technologies in 2003. Successful development and commercialization of NDC's silver vanadium oxide battery technology, licensed from NanoGram Corp., led to NDC's acquisition by Wilson GreatBatch for $45 million in March of 2004. It was anticipated that Wilson GreatBatch would be investing a further $7 million in the year following acquisition to further the development of NDC's implantable battery devices.

In August of 2003, NanoGram created another subsidiary company, Kainos Energy Corp., for the development of low-cost membranes for solid oxide fuel cells. Kainos Energy has yet to raise external financing as a separate entity, and is operating as a wholly-owned subsidiary of NanoGram. Kainos has obtained a Phase I SBIR government grant and is actively pursuing applications and alliance partnership in the energy sector.

NanoGram Corporation raised financing of $7 million in June, 2004. Under new CEO Kiernan Drain, NanoGram has focused on maximizing profits through NanoGram's licensing model by helping their customers scale up volume. Drain explains that "in this manifestation of the company, with a technology licensing business model, we'll never become a big company unless our customers manufacture in big quantities." Thus, Drain's first senior hire was for a VP of Manufacturing and Engineering, with the mandate of achieving higher throughput for NanoGram's processes, to enable their licensees to scale up volume more easily and efficiently. NanoGram's investors demonstrated support for Drain's strategic direction, investing an additional $18.7 million in Jan 2006.[2]

NanoGram Corporation can be held up as a success story, as they have utilized organizational innovations to overcome challenges to nanomaterials commercialization and have created and captured substantial value. NanoGram, like most nanomaterials ventures, faced high technology and market risk and uncertainty at their founding. They had the chance to be successful because they creatively reduced risk, accessed financing and complementary assets, and demonstrated value in specific applications. NanoGram's major strengths have been their technology, their adaptability, and their creative alliance and financing strategies.

[2] Further evidence of NanoGram's continuing success was provided by a recently raised $32 million third round of funding in January 2008, and an announcement that NanoGram plans to IPO in 2009 or 2010

NanoGram's founders developed and patented a radical generic technology which has been NanoGram's first competitive advantage. In order to protect and leverage that technology, NanoGram has patented extensively. IP in the form of patents have been of particular importance to NanoGram because of their transition to a licensing business model and because of the additional bargaining power patents can provide in alliance creation with large incumbent firms.

NanoGram has also reaped the rewards of their adaptability. After facing extreme financial pressures in 2001, NanoGram's leadership rethought their original in-house manufacturing strategy and the feasibility of one organization effectively developing technology applications and partnering with large customers across the broad range of industries to which their technology could be applied. Their subsequent change to a licensing and technology incubation business model, while also creating market oriented application spinouts with manufacturing business models, allowed for greater access to financing and complementary assets. It did so by allowing each application venture to focus specifically on product development, alliance creation, complementary innovation, and financing within one target market. NanoGram's continued focus on technology development has strengthened their patent portfolio and enhanced their licensing business model.

This organizational innovation and NanoGram's leadership led to their current creative alliance and financing strategies. Alliance creation has been key to NanoGram's commercialization strategy. Strategic alliances allow access to complementary assets, including design and production capabilities, marketing and established customer relationships, all of which are necessary to create and capture value from a nanomaterials technology. NanoGram cultivates and develops the alliances through their AccessNano™

partnership program, and steers alliance partners to its application companies as appropriate. Each application company need only to concentrate on those partners within their own industry and own value network.

Similarly, access to financing has been eased by NanoGram's organizational innovation. Venture capitalist and many corporate investors prefer financing a venture focussed on a single industry. One of NanoGram's independent application companies, NeoPhotonics, raised $65 million over two rounds of venture capital financing in 2002 and 2004, and achieved rapid growth through a merger with a Chinese active component manufacturer for the telecom industry. As NeoPhotonics is also a licensee of NanoGram, so their recent success and growth directly benefits NanoGram. The other independent application venture, NanoGram Devices Corporation, rapidly raised $10 million in venture capital financing and was subsequently acquired by their alliance partner, generating $45 million in revenues from the acquisition, and increasing the growth potential of future licensing royalties.