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Crossing the Chasm: The XID Technologies Story

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Abstract

XID Technologies is a face processing start up company built initially around a disruptive face recognition technology. The technology innovation came from Kent Ridge Digital Labs, a publicly funded software research laboratory in Singapore. Face recognition is the least intrusive and harmless among the various biometric solutions available in the market. The basic approach to human face recognition is to identify a robust feature set that was unique enough to differentiate amongst the many millions of human faces that the system was required to verify. The technology innovation used by XID framed the problem differently and thereby overcame the challenges posed by poor lighting and tilted or rotated heads.

XID developed a pilot application that was in an undiscovered market. This new and yet undiscovered market gave the young company a protection from established face recognition solution vendors focused on well established biometrics markets. XID was emboldened to explore developing solutions for other markets once its initial solutions were accepted. It has now several parallel products under development even as its main offering is being brought to market by some of the large solution integrators. The paper describes the transition of XID from a young one product start up to its present position as a technology and new solution generator.

1. Background

XID was built initially around a face processing technology developed at the Kent Ridge

Digital Labs[1] (KRDL), Singapore by Dr. Roberto Mariani under the stewardship of Dr.

Arcot Desai Narasimhalu. KRDL was an IT software research lab funded by National

Science and Technology Board[2] of Singapore Government and focused on IT software

related research.

KRDL was founded in 1998 as a result of a merger between the Institute of Systems

Science and Information Technology Institute, both IT focused applied research institutes,

the former focusing on the creation of leading edge technologies and the latter focusing

on the development of innovative applications. KRDL had interest in several real life

applications one of which was biometrics. KRDL had several research collaborations

and one such major collaboration was with the Real World Partnership Program (RWCP).

RWCP was established by Japanese government arm, the Ministry of International Trade

and Industry[3] as a successor to the Fifth Generation Computing program. Biometrics was

one of the topics of interest to RWCP.

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[1] Kent Ridge Digital Lab has merged with other labs in the last two years and is presently renamed as
Institute for Infocomm Research or I2R. See www.i2r.a-star.edu.sg for more information about this
institute.
[2] National Science and Technology Board has since been reconstituted as the Agency for Science
Technology And Research. See www.a-star.edu.sg for more information. A*STAR has a
commercialization arm called Exploit Technologies Pte Ltd (ETPL).
[3] Ministry of International Trade and Industry has since been renamed as Ministry of External Trade and
industy. From MITI to METI.

Around 2000 KRDL applied itself towards creating technologies that would create a 10 X impact. 10 X impact would imply that technology development teams were required to produce technologies that had improvements of at least one order in magnitude. KRDL rightly believed that this new vision will help promote "out of the box" thinking and result in redirecting its researchers focus away from sustaining technology innovations to creating disruptive technology innovations.

This new vision was aligned with KRDL's desire to position itself as the incubation engine for information technology based new business creation in Singapore. KRDL's employees were inspired by the work reported in books such as [1, 2, 3, 4, 5]. This resulted in the creation of twenty new companies over a four year period. A list of companies created using KRDL's proprietary technology can be found at http://www.i2r.a-star.edu.sg/index.php?page=Spin_Offs&anchor=87:84.

KRDL's research group developing biometric solutions for RWCP took a fresh approach towards solving the face recognition problem. Most companies focused on generating a feature set for a face. They used this target feature and compared it with the feature sets of stored collections of faces to find a match. The 10 X drive by KRDL lead to discovering face synthesis based approach to as a new approach to solving the face recognition problem.   Dr. Mariani was one of co-inventors of this face synthesis technology. This technology synthesized multiple faces from a single facial image. The recognition engine developed by XID used the synthesized and the original facial images to recognize human faces under different lighting conditions and with different degrees of tilt. Its recognition rates were found to be much better than established face recognition solutions using traditional approaches.

2. Crossing the Chasm model

Crossing the Chasm is a model for marketing and selling high-tech products to mainstream customers and was introduced by Geoffrey A. Moore through a book carrying the same title and published by HarperBusiness first in hardcover in 1991 and later in paper back versions in 1999 and 2002. The model basically discusses about how high technologies often fall into a chasm after a promising start. One could use a bowling alley model based strategy to help the technology climb out of the pits on its way to reaching the masses. The following diagram captures the Crossing the Chasm and the model that followed – Inside the Tornado. The diagram shown in Fig. 1 is called Technology Adoption Life Cycle. It represents the movement of high technology from early markets falling into a Chasm and then rising from there using a Bowling Alley strategy starting the onset of a Tornado like market phenomenon. The markets will stabilize and market leaders will be identified at the end of a Tornado. A Tornado will be followed by Main Street which will then lead to the End of Life of the product of technology. The battle on the main street is fought on providing better bells and whistles.
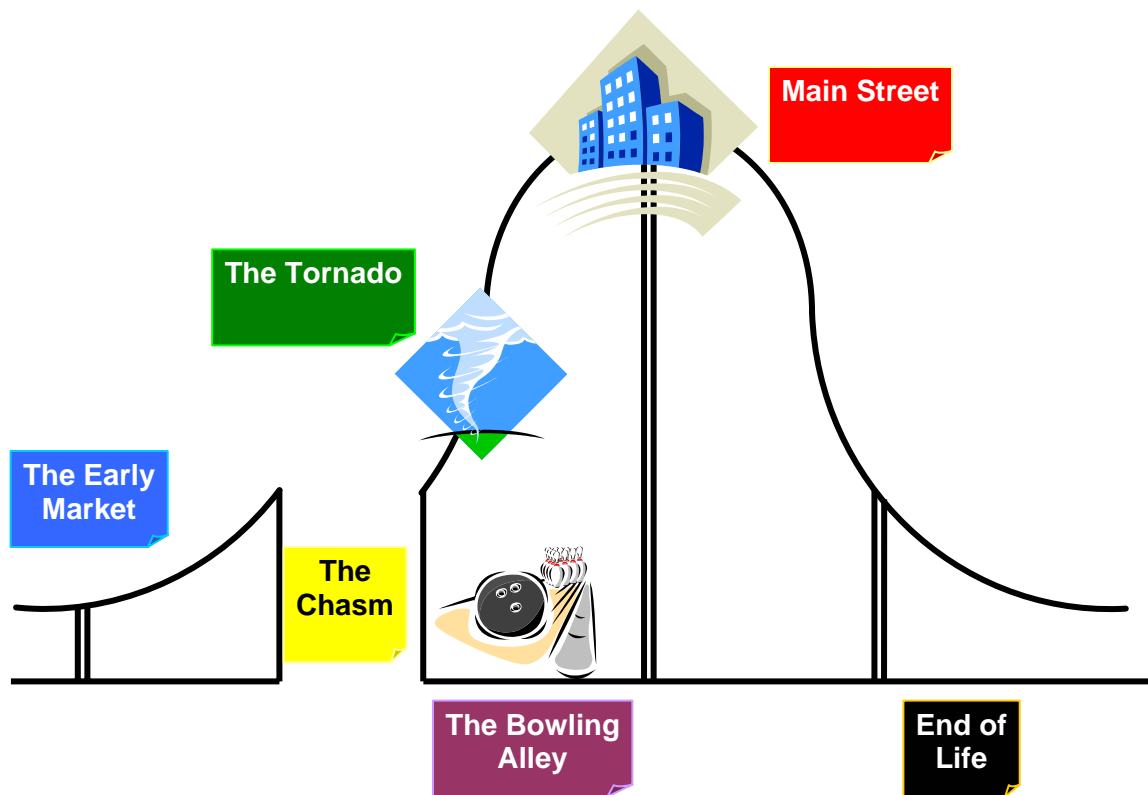
Figure 1: Crossing the Chasm using the Bowling Alley Strategy as a part of technology adoption life cycle curve.

The purpose of this paper is not to explain this model but to show how XID managed to cross the Chasm in its bid to bring its innovate high technology to the mass market. We will assume that the readers are familiar with this model or they are directed to the book listed in [4] for getting a comprehensive understanding of this model.

3. XID Technologies

XID was set up on 22nd December 2002. The company managed to license the face synthesis technology from KRDL through A*STAR's commercialization arm called Exploit Technologies Private Limited[4] on 15th April 2003.

XID's early focus was to build applications to demonstrate the power of their disruptive technologies. The XID solution was initially benchmarked by Hitachi against all the then available commercial face recognition solutions and found to be the most robust. From its inception XID was fortunate to have had Sharp Electronics work with them for developing proof of concept solutions. These early solutions were showcased at the CARTES trade exhibition held in France in 2003 and 2004. These solutions were also exhibited in Singapore, India, Philippines, Malaysia and Thailand through a collaboration with SUN Microsystems.

XID's face synthesis algorithm was considered to be an innovative technology. It bagged a prize at the Defense Technology Prize 2002 Awards ceremony organized by the Ministry of Defense in Singapore. It was given an award at the Asian Innovation Awards 2003 event. And it was also a nominee for the World Technology Award 2004.

XID Technologies in the mean time was getting attention from several organizations sourcing for biometrics solutions that were alternatives to the then popular biometric solution based on finger print recognition. Although fingerprint recognition technology based biometric solutions were considered to be mature they suffered from taboos. For example, only criminals and foreigners were fingerprinted in countries such as Japan.

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[4] http://www.exploit-tech.com

Further, Fingerprint based solutions were considered intrusive since they required subjects to voluntarily submit their finger prints for verification purposes. Face recognition technologies were rising up to the challenge as a non-intrusive substitute for fingerprint recognition.

This was also during post 9/11. Several organizations were in search for robust solutions for access control. There was in general a greater demand for biometrics based access control solutions across multiple market segments. More information about XID technologies can be found from its website http://www.xidtech.com/

4. XID Crossing the Chasm

XID technologies had a range of marketing options as shown in Fig. 2, for introducing its high technology into the commercial world. XID technologies chose access control market as the head pin for its bowling alley strategy. This market offered multiple application deployment opportunities, although the overall market size was smaller than other markets. This was a disruption that was not addressed by established companies.
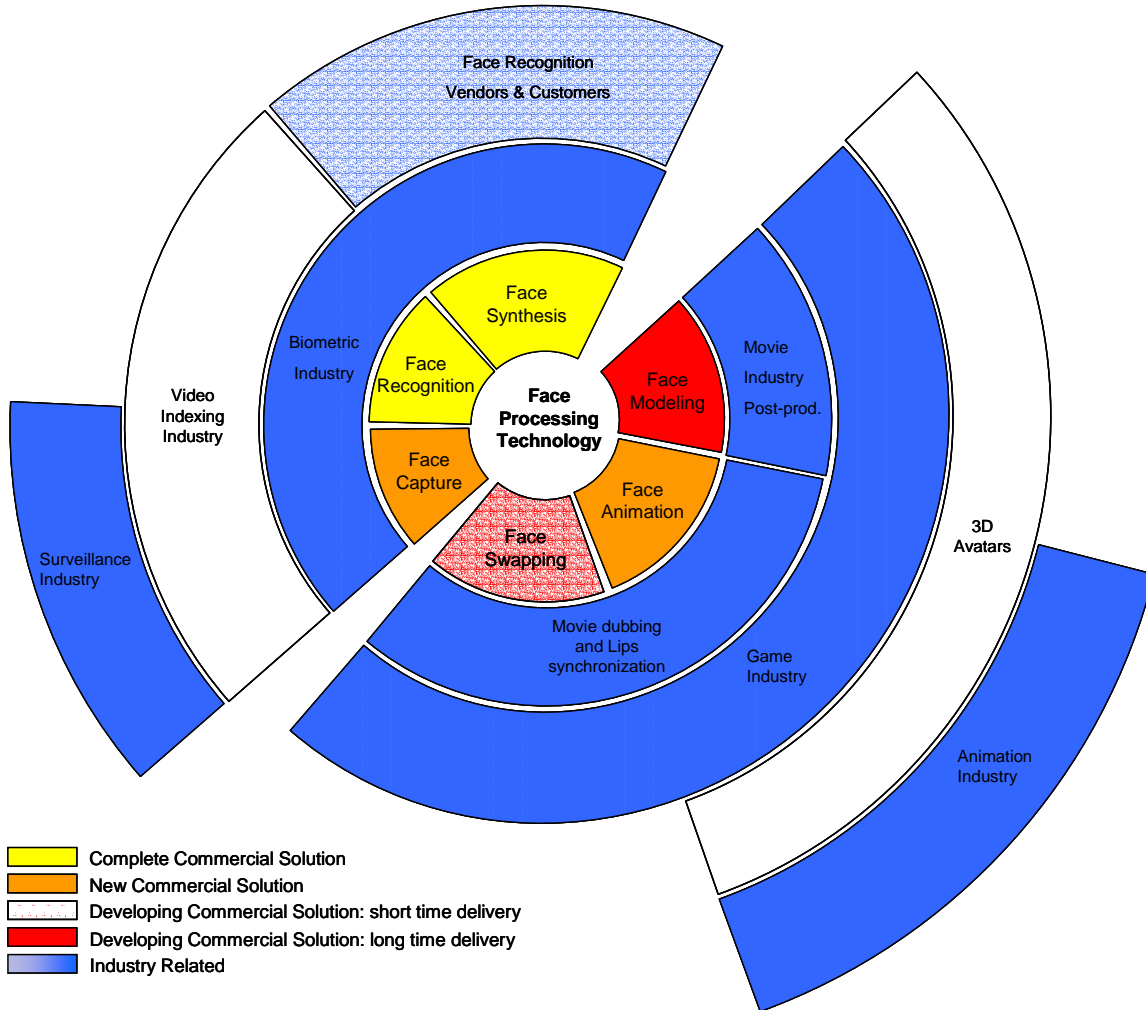
Figure 2. Portfolio of options for XID technologies.

Figure 3 provides a list of application deployment scenarios that XID could have addressed. Markets such as airport security control including biometric passport were the prime target for established biometric solution companies with less robust access control solutions. XID had to therefore identify a series of early deployment opportunities either too small for those big players or neglected by the big players since they were too focused on existing and popular market opportunities.

XID's intellectual asset was its Predictive Face Synthesis algorithm. Figure 4 gives a sample of faces generated by this algorithm using a single facial image as the starting point. XID had to identify different application development scenarios as well as rapid market penetration strategies for each of these scenarios.

Smart ID Documents	Immigration - Passport, Visa & Boarding Pass; National ID Cards, Driving Licenses, Health Cards ....
Identity Theft Prevention	Banking - ATM
	Computer and Internet
Access Management (White & Blue Collar)	Manufacturing & Processing Plants
	Petrochemical & Nuclear Sites
	Healthcare
	Human Resource Management
	Workers Dormitories & Construction Sites
Mobile Authentication Device	Telecom Industry (access to premium content)
	Law Enforcement

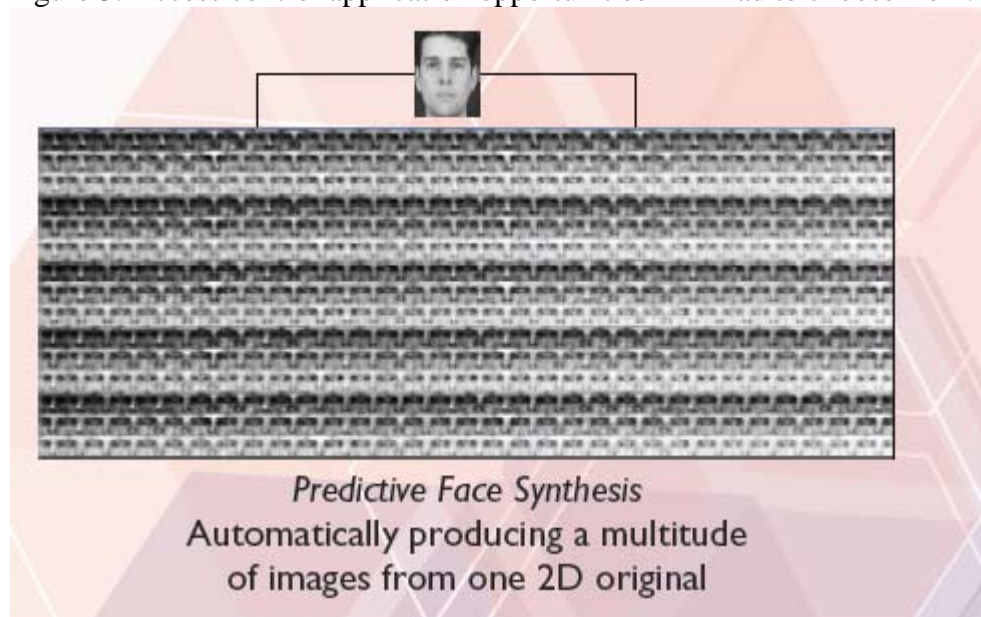Figure 3. Access control application opportunities XID had to choose from.

Figure 4. An example of the multitude of faces generated from one two dimensional face by XID's Predictive Face Synthesis algorithm.

4.1. Market development strategies

While starting small, XID had to think through its vision for addressing future market opportunities as well. As a start up company it could not do everything itself and had to

define a strategy for rapid expansion into the different markets of interest. The following were the approaches XID identified for rapid market entry.

4.1.1   Packaged solutions

XID's packaged solution offering was targeted at small scale users who would require well tested and robust ready made solutions that could "plug and play". XID developed access control devices using combined hardware and software solutions as a product to address this market. This market was further split into in-situ and mobile solutions. In-situ applications would address installation of XID's devices in buildings and campuses whereas mobile solutions were required in temporary work sites that required access control. Figure 5 shows an access control device that was developed to address in-situ market where as Figure 6 presents a kiosk using the same access control device targeted at mobile markets.

Figure 5: An XID Access control Device developed for in – situ building installation

Figure 6: An XID Mobile Kiosk product for access control

4.1.2 Large scale project licenses

Very large technology suppliers preferred to integrate XID's products into their own solutions. Hence XID established a program to work with such partners in their bid to win large scale national and industrial contracts through competitive bidding. Establishing a few key reference sites was critical to the acceptance of XID solutions for large scale applications. This approach allowed XID to become the preferred business partners of large system integrators.

4.1.3 OEM software license

Some vendors preferred to embed XID's core technology into their own products. XID would then become a OEM software licensor to such product developers. This allowed XID to deploy its software in applications that it cannot itself address.

4.1.4 Add-on software licenses

Some vendors serviced legacy systems. These typically involved upgrading of software on previously installed hardware. Such a partnership allowed XID to collaborate with existing solution providers who might have been once considered their competitors.

4.1.5 Vertical businesses

XID also realized that the Predictive Face Synthesis could be applied to markets other than access control. XID was eager to work with young start up companies exploring new markets that it could not address itself. This policy allowed other companies to license XID's core technologies. XID recognized that start up companies often had to

struggle with their cash flows and hence was willing to license its technology in exchange for equity in the start ups.

4.2. Developing XID technology based solutions

Once XID had identified its market development plans it then had to develop different types of applications and software development kits that could be licensed to the different business partners.

4.2.1. XID SmartID

XID developed a face recognition engine called XID SmartID using its award winning technologies. SmartID was the core component for all of XID's verification systems and solutions.

At the core of XID SmartID is *Predictive Face Synthesis* algorithm that assures robust performance even in uncontrolled, outdoor environments. XID SmartID overcomes the problems associated with conventional systems that were sensitive to nuances such as changes in lighting conditions, facial rotations and the addition of glasses or beards.

XID SmartID used memory cards and smart cards to store an individuals' ID. XID recognized the need to develop an embedded version of SmartID for use in Smartcards, Mobile phones, PDAs and access controllers and has developed an embedded version of its face recognition engine for such purposes.

4.2.2. XID WorkWear for access control to buildings, worksites and other residential quarters.

XID WorkWear (XID's patent pending product) used XID's core technology to secure access and prevent security breaches within a facility such as a factory or a worksite without the need for smart cards.

XID WorkWear, a ground breaking product, was developed to provide two factor authentication of individuals by combining XID's core face recognition technologies with simple tags. These tags contained no electronic components and were therefore easy to generate and could be printed simply and quickly on standard paper even at temporary locations such as exhibition registration counters. These tags could also be sewn on to a worker's uniform for long term use such as in factories. XID WorkWear offered a highly scalable, cost effective, efficient solution.

XID's biometric security system offered a highly secure method of authenticating every person that entered a building. Most biometric security systems at that time could only handle indoor, white collar security requirements. Yet blue collar environments perhaps had an even greater need for security. For example, the magnitude of damages incurred by a petrochemical plant or a nuclear site can be enormous if a corrupt employee were to trade his or her security badge with a malicious infiltrator. XID saw this as an

unexploited market and therefore has developed and deployed WorkWear based security systems that cater specifically to blue collar environments. These systems can incidentally also be used for access control for white collar workforce.

4.2.3. Visitor registration

Singapore and other countries in the ASEAN region suffered significant economic losses when SARS (Severe Acute Respiratory Syndrome) hit these countries in February 2003. SARS symptoms surfaced only some days after an individual was infected. In the mean time, those who had come into contact with infected persons could have themselves contracted the disease. When a person showed the symptoms of SARS and was found to have contracted SARS, it was necessary to identify and monitor all those who came into contact with him or her. Healthcare organizations were most affected because they serviced infected persons.. During the SARS period all organizations were required to keep track of visitors to their facilities in order to efficiently trace and manage potential infections. XID's technology was piloted for such visitor registrations. Visitors were issued with XID tags and were registered using these tags every time they entered a facility.

XID's tag based solutions significantly speeded up the registration process required for patients and visitors resulting in time and cost savings to the healthcare organizations.

4.2.4.   Border control

International travel poses possibly one of the greatest threats to the security of a nation. People are able to fly from one country to another faster than ever before. Identity theft and the fraudulent misuse of passports are on the rise. Biometrics based solutions offer a secure method of verifying the identity of every traveler. Specifically, biometric data embedded in a passport could be automatically verified against the live data of a person at an immigration counter or check point.

XID participated in biometric passport standardization in partnership with SHARP Electronics and a leading biometric vendor, IRIS Corporation.   Such contributions ensured that XID remained at the forefront of border control technologies and solutions.

4.2.5.   Computer login

Most people use passwords to log into their computers. The weaknesses of the password login are obvious and some of these are listed below.

Users often

- Use the same password for multiple applications
- Write their passwords on scraps of paper to be found next to their computers.
- Share their passwords with friends and colleagues to allow for temporary access but then forget to change the password afterwards

XID combined its previously developed two factor authentication system and a monitoring system to address this problem. A registered user can login to a computer using the XID solution. The monitoring system captures user's face every few seconds for verification. The keyboard is frozen and the screen is blacked out when the user leaves the computer for longer than a predetermined interval of time. The user needs to be re-authenticated for continued use of the computer.

4.2.6. Automatic Teller Machine authentication

XID has developed an ATM verification system that authenticates each transaction at every machine using its face recognition engine. This solution ensures that an ATM card cannot be used by anyone other than the owner.

This solution requires that the person initiating a transaction look at a camera embedded in an ATM kiosk. The user's face is stored in his or her ATM card. The ATM machine can then verify whether the person at the terminal was indeed the owner of the ATM card.

4.3. XID's business partners

XID's primary interest was to get its technology and applications widely adopted and deployed in the shortest possible time. This was only feasible through establishing partnerships with existing businesses. XID had therefore set up the following partnerships with system integrators, resellers and OEMs.

4.3.1. System integrators

XID worked closely with system integrators for small to large scale deployments in a

variety of environments and scenarios- from national level projects to localized corporate projects. XID trained all of its partners and jointly executed the first project for each vertical to ensure complete knowledge transfer to the partner's team. XID's strategy was to pursue open architecture and standards that allowed easy integration of its offerings with the solutions of its business partners.

4.3.2. Resellers

XID sought partnerships with value-added resellers to define country and vertical specific applications. Resellers were selected based on territorial reach and market coverage, customer base and sales force strength. Resellers were provided with sales kits including demonstration software and were assisted by XID's team in all aspects of the technology, operations, integration and sales and marketing.

4.3.3. OEM

XID worked with OEMs to develop custom built solutions that met their customer needs. XID carried out customized design and development of a variety of face recognition enabled products for its OEM customers.

4.3.4. Some of XID's Partners.

XID had or is exploring business relations with the partners listed below. It is continuously exploring the possibilities of establishing business relationships with other vendors interested in adopting, promoting and deploying its technologies.

- A4vision
- Accenture
- Aquatelgna

- Atlas G.A
- Barcode Technology Inc.
- Biometric Soluzioni per l'indentificazione
- Blue Force
- CISCO Security
- CM Sistem
- Comat
- Cyber Extruder
- Digital Embrace
- Hitachi
- IMCI Technologies
- Integrated Decision Systems
- Intel Agents LLC
- IRIS Corporation
- Logos
- Miltrade technologies
- RFID Technologies
- Sagem Morpho Inc.
- Sharp Electronics
- Sun Microsystems
- Thakral Corporation Ltd.
- Thales
- Tonson Technologies
- Tyco
- Unisys
- UPEK
- Wincor | Nixdorf

4.3. Testimonials

Many of the business partners have been very impressed with XID's solutions. The following three are examples of the testimonials for XID and its products.

"Having good partners with unique and innovative technologies is key to SHARP Electronics Singapore strategy for meeting the growing demand of highly integrated electronic devices with intelligent software. XID's solid technologies and dynamic team are what we cherish and highly value."

Toshifumi Nakai, Director, SHARP Electronics Singapore

"With more than 20 years of experience working with best of breed partners to deliver proven solutions to customers, Sun Microsystems is constantly building successful partnerships with companies providing leading edge technologies. XID offers innovative face recognition technologies and we are confident of a long, fruitful partnership."

Lionel Lim, Vice President & Managing Director, Asia South, Sun Microsystems

"Our experience was referenced by ICAO for defining a new standard for electronic passport and allowed us to identify two new biometric requirements, the iris scan and the facial recognition. In our quest for a common Multimodel Biometrics Platform, we have recognised XID as the preferred complimentary facial recognition technology provider."

Lee Seng Hoong, Sales & Marketing Director, IRIS Corporation Berhad

5. Lessons learned

XID's experience shows that developing good technology is only the beginning. It used the bowling alley strategy to identify its head pin and the other follow on pins. It then established good business partnerships for growth purposes. However, many start up companies that wish to grow organically face a conundrum. While they face significant market demand for their products, their cash flow situation often limits the rate of their growth. An ideal positioning would be for the business partners to also be investors in the start up so that they will be interested in seeing the start up company grow. And growth may not be occur in the country a start up was created and hence it is important to find investors from markets that offer better growth prospects.

6. Going forward

XID started with access control as the initial markets that it will explore. XID has since acquired and developed other technologies that will fuel its growth beyond recognition based solutions. It has redefined itself to address a broader range of products under the label "face processing solutions." It is currently planning to offer new products and

services in animation and media industry. Several companies including Sony

Corporation have expressed interest in this new direction.

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