

INDUSTRY LINKAGES@NYP - TRANSLATING INNOVATIVE APPROACHES INTO ACTION

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ABSTRACT

NYP leverages on its industry linkages to provide our students with relevant and realistic training in current and emerging technologies & best practices and to facilitate the capability development of our staff. In doing so, we also support industry in their R&D and product/ services development efforts through collaborative projects. Our approach for building strong industry linkages are (a) cultivate long term high value-added “win-win” partnerships with government and the private sector, (b) provide applied R&D platforms for collaborations to take place and (c) provide relevant Continuing Education and Training (CET) programmes that meet the upgrading needs of the industry. In NYP, industry project work is supported by the polytechnic, not just the individual staff. In this way, the best possible solution, typically involving cross-disciplinary expertise can usually be found and developed. Since the project work is support by the total system capability of the polytechnic, industry would enjoy a one-stop service approach and a higher level of confidence on the delivery of the project outcomes, within the specified time, performance and cost requirements. NYP's Teaching Factory™ as a pedagogy has guided our curriculum development and the approaches in course design and delivery NYP adopts are project based learning, context based learning, and multi-disciplinary integrated programs. Our innovative approaches to building strong partnerships with international and local partners through industry communities, centres of innovation, industry projects, applied R&D and incubators have also helped us to keep abreast with the latest in technology and knowledge and to feel the pulse of the industry, enabling us to continually tailor our training programmes to be relevant to the needs of industry and the nation. Our industry partners also provide real life industry projects that are developmental in nature for both staff and students.

KEYWORDS

Industry linkages, Teaching Factory, multidisciplinary, industry projects, innovative, capability development

INTRODUCTION

NYP leverages on its industry linkages to provide our students with relevant and realistic training in current and emerging technologies & best practices and to facilitate the capability development of our staff. In doing so, we also support industry in their R&D and product/services development efforts through collaborative projects. Our approach for building strong industry linkages are:

- Cultivate long term high value-added “win-win” partnerships with government and the private sector.
- Provide applied R&D platforms for collaborations to take place.
- Provide relevant Continuing Education and Training (CET) programmes that meet the upgrading needs of the industry.

In NYP, industry project work is supported by the polytechnic, not just the individual staff. In this way, the best possible solution, typically involving cross-disciplinary expertise, can usually be found and developed. Since the project work is support by the total system capability of the polytechnic, industry would enjoy a one-stop service approach and a higher level of confidence on the delivery of the project outcomes, within the specified time, performance and cost requirements. NYP's Teaching Factory™ as a pedagogy has guided our curriculum development and the approaches in course design and delivery NYP adopts are project based learning, context based learning, and multi-disciplinary integrated programs. By being close to industry, we can respond to industry needs as the needs change and provide practical and useful training to the students. So, as a result, our graduates are in great demand, very well-paid and skilled [1].

CULTIVATING LONG TERM, HIGH VALUE-ADDED “WIN-WIN” PARTNERSHIPS

NYP has an outstanding record of cultivating long-term, high value-added partnerships and successfully fostering strong regional and global links with governments, institutions and industry leaders. By leveraging on our capabilities, we are able to create value for industry and agencies in areas like industry projects, communities, incubators, applied R&D and CET courses. These partnerships are of immense benefit to staff and students in terms of staff capability development, learning and training opportunities, work placements/attachments and overseas development programmes for students. More than 160 staff had attachments with local and overseas companies in 2008. More than S\$7 million worth of state-of-the-art hardware and software has been donated to NYP by our industrial partners.

Industry Projects

A key tenet of the Teaching Factory® concept is the ability to attract industry partners who provide real life industry projects that are developmental rather than operational in nature, and hence of high learning value to the students. NYP works with more than 240 partners a year (Figure 1). Key partners include industry leaders Cisco Systems, HP, IBM, Microsoft, Rohde &

Schwarz, Autodesk, Oracle, Nokia, Agilent Technologies, Siemens, Matsushita, Yokogawa and Singtel.

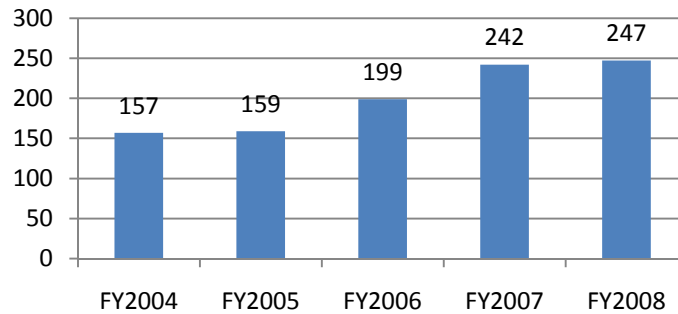


Figure 1. Companies engaged in industry project with NYP

The industry feedback survey conducted in 2009 (with 125 respondents) indicated that more than 92% of NYP’s industry partners found NYP to be innovative in the services it provides (Figure 2). More than 90% of these companies also rated NYP as “good or better” in its quality of services. In one case in engineering, by engaging NYP to provide the industrial and mechanical design and the prototype, the company was able to cut the development period by 50 per cent [2].

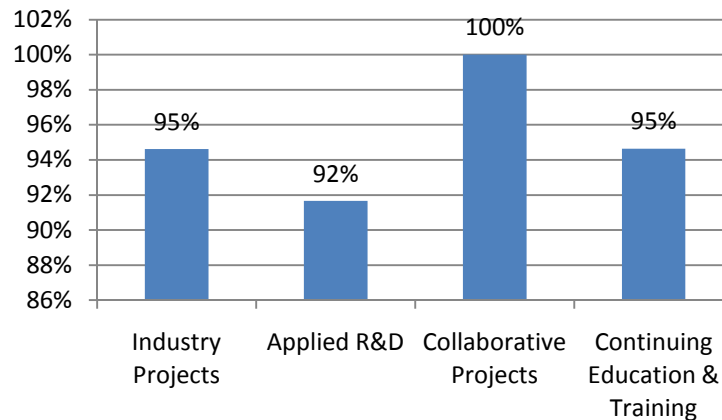


Figure 2. % of organisations which indicated that NYP is innovative

Industry Communities

Our ability to help nurture technopreneurs and start-up companies by hosting them in NYP and providing a comprehensive eco-system support environment is seen in various “Industry Communities” set up with key industry partners and with the support of the EDB. Since 2003, NYP has grown six communities, with 230 technopreneurs/start-ups and 58 partners (Figure 3).

These Communities aim to position Singapore as a place for innovations in Integrated Circuit (IC) Design, Games Design & Development, Wireless Products, Embedded Systems, IT Security and Medical Technology. Through these Communities, companies and technopreneurs have seamless access to a wide spectrum of support and services from product conceptualisation, design & development, test & measurement, manufacturing, commercialisation, consultancy, IP management to funding. Many commercial spinoffs have arisen out of these communities. For example, in the IC Community, companies such as Advino Technologies, IM Technologies, Candele Microsystems, Solomon Systech, Krypt Technologies and Qmargo have benefitted through the development of new products.

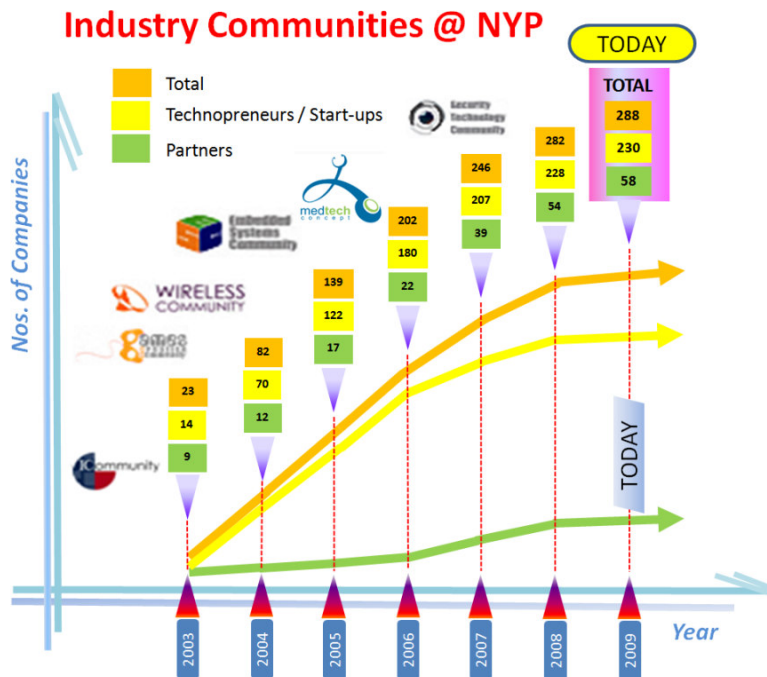


Figure 3. Industry Communities @ NYP

Specialist Laboratories and Centres of Innovation (COIs)

Organisations and companies have also set up specialised laboratories, life science incubators, specialist centres and business centres in NYP for higher-end innovations and development initiatives. Examples are Centre of Innovation for Electronics (COIE), InfoSecurity Innovation Centre, NYP-HP Green ICT Solutions Centre, NYP-DSTA Centre for Software Quality, NYP-CISCO IP Convergence Lab, NYP-Microsoft.Net Mobility Solution Centre, RosettaNet Architecture Centre of Excellence and NYP-DSO Innovation Centre. COIs are typically set up with a company or government agency. For example, COIE was set up in 2008 as a collaboration between NYP and SPRING Singapore. COIE serves as a one-stop centre to catalyse the growth of SMEs in the Electronics cluster through providing support for the development of innovation-led and market driven advanced products. SPRING Singapore provides the funding of up to S\$7 million while NYP provides the technical and business expertise.

Partnerships with Government Agencies

In 2002, NYP was appointed by the EDB to build and manage CPTC on Jurong Island to train manpower for the chemical and process industry. In 2005, WDA engaged NYP to manage CES, a National Centre for the training and assessment of workers under the Employability Skills System. In 2006, NYP set up SIRS with WDA to provide continuing education and training for the retail workforce in Singapore. In 2008, we supported the EDB's National Precision Engineering Manpower Development initiative. The initiative gave rise to a diploma in Digital & Precision Engineering.

APPLIED R&D PLATFORMS

Staff are involved in the design and introduction of new products and services through joint R&D projects. They work together with the industry partners such as DSTA, Hewlett-Packard, Eu Yan Sang to design and develop innovative solutions using new and emerging technologies. Additionally, industry partners are involved in the design and introduction process of new products and services through collaborative alliances on joint projects. Partnerships and alliances with these industry players have resulted in, for example, ground-breaking wireless technology projects with leaders such as Nokia and Motorola.

Many IP and patents have been generated as a result of our capability development and industry collaborations. As at end 2009, we have filed 158 patents, averaging 21 patents filed yearly (Figure 4) with 58 granted and covering a wide spectrum of disciplines. We have more patents than all the other polytechnics combined, being the only polytechnic which has consistently been among the top 10 patent applicants in Singapore in the last 10 years [3]. NYP was one of only nine recipients (out of 138 applications) of the inaugural National Research Foundation Proof-of-Concept (NRF-POC) scheme started in 2008. We are also the only polytechnic to be awarded a NRF-POC grant in 2008 and again in 2010.

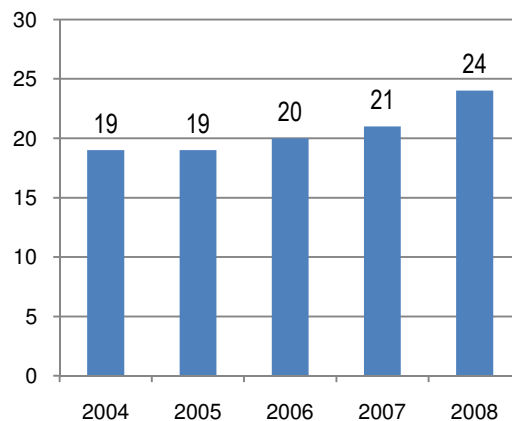


Figure 4. Number of patents filed

PROVISION OF CET PROGRAMMES

The Professional Development Centre (PDC) is the CET arm of NYP that is committed to facilitating CET for adult learners. Comprising a small team of 8 staff, PDC supports the Schools in their CET offerings. NYP has access to a potential resource pool of more than 800 full time lecturers and 480 part-time associate trainers to help deliver its CET courses. Three types of CET programmes are offered. They are:

- Formal CET programmes at the diploma, specialist diploma and advanced diploma levels.
- Workforce Skills Qualification courses such as the Diploma in Mould Tool Making, Higher Certificate in Mechatronics & IT and Certificate in Integrated Jigs and Fixtures Design.
- Customised professional development programmes.

In FY08, we conducted more than 160 formal and non-formal CET courses with more than 3,600 participants. For five consecutive years, more than 93% of our CET participants rated the course “Good or Better” (Figure 5). Over the last 5 years, training places also increased by 30% as compared to FY08. NYP and WDA have also set up the Singapore Institute of Retail Studies (SIRS) to raise the professionalism of the retail industry workforce. SIRS offers 58 WSQ certificate, advanced certificate and diploma programmes as well as over 1,000 Certificate Service Professionals courses. Over the past 3 years, SIRS has conducted training for 14,000 participants.

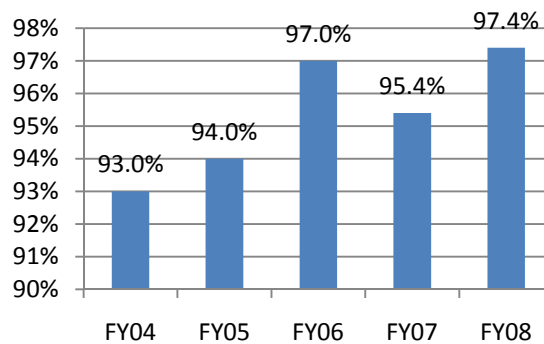


Figure 5. Customer satisfaction - CET participants

INNOVATIVE APPROACH IN COURSE DESIGN AND DELIVERY

NYP's Teaching Factory (Figure 6) approach to technologist education has become a unifying philosophy of teaching and learning in NYP. It involves the emulation of a real-world work environment on campus to provide students an authentic experience of the nature of their future work and of the workplace. An important and integral component is industry project work where staff and students work closely as a team on real-life industry projects with cost, quality,

reliability and deadline constraints, and often requiring multi-disciplinary capabilities residing in different schools [4].

The Teaching Factory creates a powerful effect on the quality of teaching and learning as well as the attitude and mindset of staff and students. In NYP, implementing this concept has contributed greatly to the creation of an environment for teamwork, innovation, strong linkages with industry and a strong focus on capability development, among many other advantages elaborated on by others [5],[6]. It has enabled NYP to forge strong collaboration partnerships in applied research in cutting-edge technology and undertake development projects for the training and development of staff and students. NYP has also provided technical facilitation and designed the course curricula for Suzhou Industrial Park (SIP) Institute of Vocational Technology (IVT). Our Teaching Factory became the model for the IVT's Value-Added Programme, in which suitably qualified graduates of specialised secondary or vocational schools are recruited to undergo a year's programme designed especially for them [7].

Initially developed at the EDB institutes of technology by Mr Lin Cheng Ton, the founding principal of NYP who was then EDB's director of manpower, the Teaching Factory® concept has been adapted to suit the needs of various schools and manifests itself in different forms such as Specialist Centres in the SEG, Centre for Information Technology Innovation (CITI) in the SIT, Teaching Enterprise in the SBM, Teaching Clinics in SHS, BioInnovation Centre (BIC) in the SCL(Life Sciences), Pilot Plants in SCL(Chemical), 360° Project in the SDN and Teaching Studio in SIDM. The approaches in course design and delivery NYP adopts are project based learning, context based learning, and multi-disciplinary integrated programs.

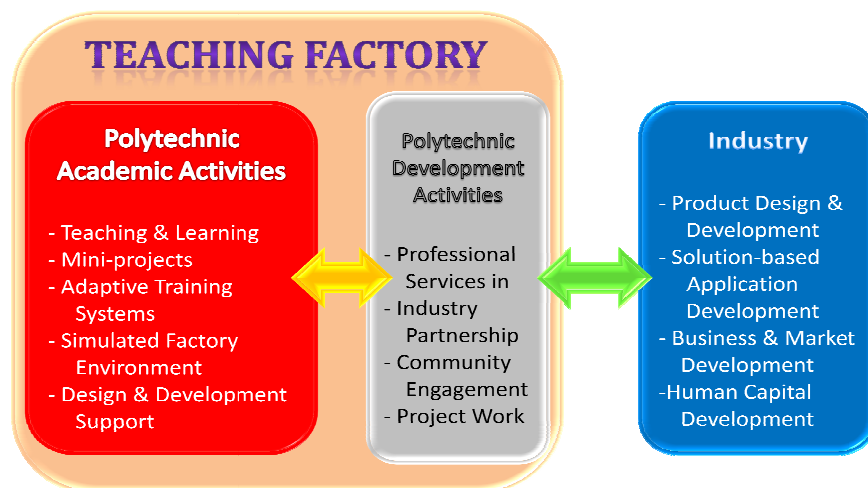


Figure 6. Teaching Factory™

Project based learning

Through close networking and collaboration with industry partners, NYP is able to continuously fill its industry project pipeline. To facilitate industry participation, the schedules for students' involvement in projects are planned such that there are project teams working on industry projects the whole year. Industry project provides an effective training and evaluation platform for students. It demands that all aspects in the project have been taken care of, including

performance, cost, quality as well as on-time delivery. Students have to understand that acceptance of project by the customer is not based only on the technical content, and they cannot finish the project with just a passing mark of, say 63, because they have to ensure that the final details of the project have been taken care of until it is accepted by the customer. Immersing students in such a culture of conducting applied research, collaboration and communication further fosters the acquisition of cognitive and self-regulation strategies [8].

Context based learning

The specialist centres, set up jointly with industry partners, provide a comprehensive range of services for engineering companies, from conceptualization, prototyping and product innovation, to technological consultancy services, incubation spaces and market development. In other disciplines, a Centre of IT Innovation (CITI) at its School of Information Technology, a Teaching Enterprise Programme (TEP) at its School of Business Management, several Teaching Clinics at its School of Health Sciences and a Bio-Innovation Centre at its School of Chemical & Life Sciences also serve to engage the industries to provide students with real-life problems relevant to their training.

Multi-disciplinary integrated program

Furthermore, schools set up Industry Project Groups (IPGs). These IPGs draw expertise not only from their own schools, but also from other schools – hence resulting in multi-disciplinary capabilities. It serves as an effective platform for project work which enables staff to develop their capabilities, and at the same time, facilitate students to draw from the pool of knowledge and skills learned and apply them in multi-disciplinary environment. As a result, our staff and students have achieved significant success at prestigious local and international competitions like the World Skills competition (Albert Vidal award in 2005 and 2009), RoboWorld cup soccer (World champion since 2005) and more recently, a winner at IDF Dairy Innovation Awards- an inaugural programme designed to reward and champion innovation and excellence in the global dairy industry which attracted over 170 entries from 29 countries in 12 categories [9].

Core Modules, Prescribed and General Studies/Complementary Electives

All courses offered at NYP follow a modular and credit-based academic system. Our curriculum is flexible and students can choose areas of study to match their interests and aptitudes and adapt their academic workload to suit their pace of learning[10]. Each course has a combination of modules broadly classified as follows:

- Core Modules: These ensure students receive a good foundation in the central discipline of their studies.
- Prescribed Electives: These help students to develop focus and fields of specialisation within their own chosen study programme.
- General Studies & Complementary Electives: These are options to expose students to subject areas outside their main discipline of study.

An example of students' suite of subjects is shown in Table 1. Students can choose their general studies electives, complementary electives and specialisation programmes (group a/b/others).

Table 1. Choice of Modules (sample only) for Diploma in Manufacturing Engineering

Year 1	Year 2
12 Common Core Modules	10 Common Core Modules + Project Based Path
Year 1 Electives	Year 2 Electives – General Studies
Complementary modules : English Language 1 or 2, Math 1 or 2, Physics 1, etc	Cost Accounting Essentials, Cost Accounting Essentials, etc
General Studies Cluster: Cross Cultural Communication, Cyber Awareness, Green Energy Tech, French Lang 1, etc	Japanese Language 2, Business Mandarin, etc
	National Education, S'pore & World in Perspective, etc
Year 3	
5 Common Core Modules + Industrial Attachment Programme (IAP/OIPP) + Full Time Semestral Project	
Year 3 Electives – General Studies	
Fitness & Wellness, Current Affairs & Community Issues, People Skills, etc	
Year 3 Prescribed Electives - Choose either group	
Group A	Group B
Machines Elements & Mechanisms	Advanced Machining & CAD/CAM/CAE
Automated Machine Design	Product Innovation & Rapid Prototyping
Computer-Aided-Design and Analysis	Mould Design & Flow Analysis
Manufacturing Systems & Simulation	Advanced Metrology & Quality Assurance

Semestral Projects and Industrial Attachment Programme (IAP)

Most IHLs are able to take on projects only during specific times of the year due to a fixed schedule for the IAP. NYP adopts a flip-flop model where the schedule for students' involvement in projects and attachments are planned to ensure there would be project teams working on projects and students available for attachment throughout the whole year. Companies are screened to ensure that the attachment is relevant to the student's course of study. For example, students from the Diploma in Chemical & Pharmaceutical Technology undergo IAP with MNCs such as Exxon-Mobil, Shell Eastern, Schering-Plough, Pfizer and SMEs such as Control & Applications, Setsco Services etc. Even with the current economic slowdown, our strong links with companies have ensured that we are able to obtain Industrial Attachment places for the majority of our students.

Overseas Industry Placement Programme (OIPP)

Successful partnerships with overseas organisations have resulted in opportunities for overseas industry placements for NYP students. OIPP allows the students to do a project overseas, develop an appreciation for diverse cultures & working styles and broadens their international outlook. The following examples provide an indication of the placement opportunities overseas:

- SIDM students worked at MIT Gambit Labs, USA to realise computer gaming ideas from concept to commercialisation and at Honor Games International (HGI), Xiamen, a company that develops Massive Multiplayer Online Role-Playing Games.
- SBM students were attached to TATA group of companies in India, Spring City Golf Resort China and Ria Bintan Resort in Indonesia.
- SEG/SIT students have attachment opportunities at the Beijing IT College, where NYP has set-up the NYP Student Project Centre within the IT School of BITC.
- SHS places its students with the University of Pennsylvania Hospital (USA), Royal Prince Alfred Hospital (Australia), St Thomas Hospital (UK), Diakonie Klinikum Hospital (Germany), the Hong Kong Polytechnic University Physiotherapy Clinic and Brightwater Brain Injury Rehabilitation Centre (Perth).

Overseas Exchange Programmes

NYP also maintains close collaborative partnerships with leading tertiary institutions overseas to facilitate students' overseas exchange programmes. These educational institutions include the University of Stirling, Groupe ESIEE, the University of Sydney, Potsdam, Fachhochschule-Esslingen, Groupe CERAM, University of New South Wales, Sheridan College, Dundalk Institute of Technology and South Karelia University of Applied Sciences.

Specialist Centres at School of Engineering (SEG)

SEG is the host of the Centre of Innovation for Electronics (COIE) and 4 industry communities. The COIE was set up to spearhead innovative product design and development in the electronics industry. The industry communities provide a holistic environment for technopreneurs with a comprehensive range of support to bring them from conceptualisation through product development & manufacturing to commercialisation (Figure 7). Industry leaders can also tap on the latest business or product ideas from these technopreneurs, creating more opportunities for growth. Integrated within the SEG environment, these industry communities provided an excellent platform for students and staff to interact with industry leaders as well as technopreneurs across different industries, enriching their NYP experience.

With 16 specialist centres areas, SEG provided an effectively integrated teaching and learning eco-system for staff and students to develop innovative solutions. The “Specialist Centres” are set up to carry out final-year specialisation teaching, professional training for practitioners as well as collaborative industry project work. With the state-of-the-art facilities and relevant expertise among their staff, the specialist centres are effective connectors between NYP and the industry [4].



Figure 7. Industry Communities at SEG

CONCLUSION

After many years of innovations and development, Nanyang Polytechnic has evolved and developed itself into an outstanding institution of higher learning of the world [11]. Our innovative approaches to building strong partnerships with international and local partners (Sony Computer Entertainment, CISCO Systems, Agilent, Oracle, IBM, Microsoft, EDB, Spring Singapore, etc) through industry communities, centres of innovation, industry projects, applied R&D and incubators have helped us to keep abreast with the latest in technology and knowledge and to feel the pulse of the industry, enabling us to continually tailor our training programmes to be relevant to the needs of industry and the nation. Our industry partners also provide real life industry projects that are developmental in nature for staff and students.

NYP's Teaching Factory™ has become the extended developmental arm for many of its industry partners, providing them with relevant knowledge and effective & innovative solutions to their operational and developmental activities. Many partners capitalise on this value proposition from NYP and benefited from it by engaging NYP in their new products and services development, so that they can concentrate on other aspects of their business such as market development and customer relationship development [12].

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Biographical Information

Angeline de Roza is a Dy Manager at the School of Engineering (Manufacturing)(SEG(M) at Nanyang Polytechnic (NYP). She coordinated the planning and development of workforce skills qualifications (WSQ) programmes as well as pedagogy and elearning matters for the school. From 1 May 2010, she will take on a new role as Manager/Centre for Quality to coordinate, review and plan for various organizational excellence initiatives and frameworks within NYP.

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Nanyang Polytechnic (NYP) Singapore

Established in 1992, Nanyang Polytechnic (NYP) (www.nyp.edu.sg) is a premier tertiary institution that offers quality education in Engineering, Information Technology, Design, Interactive & Digital Media, Business Management, Health Sciences and Chemical & Life Sciences. Currently, it offers 47 full-time diploma courses and a suite of customised courses for continuing education.

The Polytechnic's unique "Teaching Factory Concept", complemented with other innovative pedagogies, enables students to learn within a training environment that emulates the workplace. It is also an excellent platform to engage in industry projects and collaborations. NYP has also developed the award-winning Accumulated Experience Sharing (AES™) knowledge management system which provides a rich reservoir of intellectual resources and best practices to support its learning needs. NYP constantly collaborates with the industry in cutting-edge technology projects, so as to provide relevance and a firm foundation for its students.

NYP was conferred the 2009 Innovation Excellence Award (I-Award) by the Singapore Quality Award Governing Council. The I-Award is the highest accolade given to the most innovative organisations in Singapore. In 2005, NYP was also conferred the People Excellence Award by the same. These awards have been established using international benchmarks (e.g. Malcolm Baldrige and European Quality Award as benchmarks for its Business Excellence awards). These awards have provided NYP with external validation that we are a premium institution highly regarded by our peers and external agencies.