

Nurturing Entrepreneurial Talent: The NUS Overseas Colleges Program

Findings from the inaugural survey of NOC alumni

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ORGANIZATION PROFILE



NUS
Enterprise

ABOUT NUS ENTERPRISE

Innovating today, leading tomorrow

Entrepreneurs are both born and bred. At NUS Enterprise, we stoke the fires of those born with the entrepreneurial spirit and spark the flames of entrepreneurial passion in others. We offer a complete range of avenues and support to turn entrepreneurial dreams into reality through the synergies of experiential entrepreneurial education, active industry partnerships for technology and commercialisation, holistic entrepreneurship support and catalytic entrepreneurship outreach. As Asia's Thought Leader for Innovation & Enterprise, it augments and complements the University's academic programmes and acts as a unique bridge to industry well beyond Singapore's shores.



ABOUT NUS OVERSEAS COLLEGES

NUS Overseas Colleges (NOC) Programme is a unique and immersive means to gain entrepreneurial and international exposure. It is represented in twelve leading entrepreneurial hotspots across the globe - Beijing, Israel, Lausanne, Munich, New York, SE Asia, Shanghai, Shenzhen, Silicon Valley, Singapore, Stockholm and Toronto, providing an invaluable opportunity to take on the role of an entrepreneur at innovative start-ups, while attending courses at renowned partner universities.

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EXECUTIVE SUMMARY

Recognizing the increasingly important role of university to develop entrepreneurial mindset and skillset among its students, as well as the limitations of conventional classroom-based teaching, NUS pioneered in 2001 a new, experimental entrepreneurship education initiative - the **NUS Overseas Colleges (NOC) Program** -- that combines real-world experiential-learning and relevant classroom teaching of core knowledge of the startup and innovation process. In essence, the program sends undergraduate students regardless of faculties to undertake 6-month to 1-year full-time paid internships in early stage tech startups in leading entrepreneurial hubs around the world, so that they can learn firsthand from the entrepreneurial founders what it takes to start and grow a tech startup. The students also take entrepreneurship/innovation courses at leading partner universities in each location (e.g. Stanford University in Silicon Valley, Tsinghua University in Beijing), as well as immerse themselves in the host entrepreneurship ecosystem through participation in activities such as hackathons, startup business case writing and startup idea pitching.

Starting in Silicon Valley in 2002, the NOC program has since expanded to 12 locations globally, with over 2,800 alumni by July 2018. To understand the impact of the program and take stock of the current status of program participants, a survey of NOC alumni was launched in July 2018. The survey received 984 responses, achieving a response rate of 36.5%.

Career Paths & Roles in Innovation and Entrepreneurship (I&E) Ecosystem

While NOC alumni have pursued diverse career paths and taken on multiple roles over time since leaving university, a highly salient finding from the survey is that a very significant proportion of them have engaged themselves in innovation & entrepreneurial (I&E) ecosystem roles. One-third (33.6%) of graduated alumni have started up their own companies at some point of their career, with over 17% still currently actively running their startups. In addition, over half of them (54.3%) have opted to work as employees in startups, with 23.8% currently still employed by startups. Moreover, 45% have at some point in their careers worked in other parts of the startup ecosystem (venture investing, incubator/accelerator, professional services to startups, etc) with 20% still doing so. While not to the same extent as startup founders, NOC alumni who opted to work in startups and other ecosystem roles do exhibit entrepreneurial spirits like risk-taking and willingness to deal with a new and rapidly changing environment. Overall, 79% of NOC alumni have been involved in the entrepreneurship ecosystem at some point in their career, with over 50% currently still involved.

Among those who opted to work in established organizations outside of the startup ecosystem, a significant proportion (61%) was found to be playing innovation and new business development (I&NBD) roles. Including such roles, almost 90% of NOC alumni have been involved in I&E ecosystem roles at some point in their career, with 76% currently playing such roles.

The career paths of NOC alumni are quite dynamic - some alumni embark on their entrepreneurial careers immediately after graduating, while other transition into entrepreneurship after working in startups or established organizations. Conversely, some of those started up first later shifted to become employees in other startups or established organizations. Interestingly, even in the latter case, the majority are playing I&NBD roles rather than more routine operational roles.

Entrepreneurial Propensity

The overall entrepreneurial propensity rate among graduated alumni is 33.6% comprising 17.2% who are current entrepreneurs and 16.4% who are former entrepreneurs. The highest overall propensity levels are observed among alumni from Silicon Valley (42.7%) and Stockholm (38.2%). These two locations also boast the highest share of current entrepreneurs. Propensity levels are high across all the major faculties, with the School of Computing recording the highest propensity (38.5%) and the Faculty of Science the lowest (25.9%). Male alumni have much higher entrepreneurial propensity (38.5%) than their female counterparts (23.6%). Entrepreneurial propensity is also higher for alumni who are currently located overseas (38.7%) compared to those who are in Singapore (32.7%).

NOC Alumni-Entrepreneurs

Serial entrepreneurs account for slightly less than 30% of NOC alumni-founders, although the incidence of serial entrepreneurship is higher among currently active entrepreneurs (38%). Sizeable proportion of the alumni founders started up their first business before graduating from NUS and some were already entrepreneurs even before embarking on NOC (15%). However, the survival rates for startups founded pre-NOC and during NOC are relatively low, at 23% and 31% respectively. Comparably, over 60% of the first startups founded after university graduation are still alive, and the likelihood of survival is found to increase with the working experience of alumni.

Startup formation by NOC alumni ranges over a relatively long time horizon, with as many as 12% of alumni-founders starting up after more than 7 years post-NOC, and 11% after 5-6 years. While there is high propensity to start up immediately upon completing the program or graduating, around half of the alumni-founders pursue other career options before founding their first startups. In particular, there is higher propensity to start up between 4 and 6 years after returning from NOC.

Participation in the NOC program grants alumni access to an extended community of organizations and individuals in the global startup ecosystem. Alumni entrepreneurs can call on these networks to find necessary resources for their startups. Across all cohorts, 43% of entrepreneurs called on fellow NOC alumni to be involved in their first startup. We observe that the propensity to utilize NOC alumni contact networks is higher among more recent intake cohorts.

International Mobility of NOC Alumni

The NOC program aims to develop a global mindset among the students, equipping them with skills and capabilities to develop businesses that can scale globally. While the majority of NOC alumni are pursuing their post-university careers in Singapore, 13.9% of them are based overseas and are located in different regions all around the world. Active entrepreneurs and startup employees have higher probability of locating overseas (15.2% and 17.7% respectively) compared to those who are salaried employees and employed outside the startup ecosystem.

The international mobility of NOC graduates is not confined to NOC program locations. By and large, alumni based outside Singapore have moved to places other than the cities of their internship experience. Among the 15.2% of entrepreneurs who are based overseas, only 2.9% returned to their NOC internship city to establish their startups while the rest have ventured to other locations. The likelihood of returning to the NOC internship city is highest among alumni from Silicon Valley.

Alumni's Perception of NOC Program

Overall, NOC Alumni are very positive about their NOC program experience, with 98% either “satisfied” or “very satisfied”. Comparing across NOC locations, graduated alumni from the American campuses (NY, SV and BV Philadelphia) and Stockholm expressed highest satisfaction. Graduated alumni who are currently active entrepreneurs report higher satisfaction with NOC than those who were previously entrepreneurs and those who are non-entrepreneurs.

Alumni were asked to assess two forms of potential impact of the NOC program: impact on motivation and impact on capability. The ratings differentiated between **entrepreneurship** (developing a new business) and **intrapreneurship** (developing new activities within existing organizations). The findings reveal that the impact of NOC was very significant for both entrepreneurship and intrapreneurship.

Alumni were also asked to rate various elements of the NOC program. The most highly-rated aspects of NOC are the experience of living overseas in general and the internship experience in particular. Majority of the respondents agree that the NOC curriculum complemented the internship experience, and that it was helpful in enhancing their understanding of what it takes to start a business.

Entrepreneurial Intention

Entrepreneurial intention is defined as non-founders having given serious thought to starting a self-owned business. Over 90% of NOC non-founder alumni state that they have some interest to start their own businesses at some point. Around one-third expressed their intent to startup within the next 5 years. This group may be considered “aspiring entrepreneurs” as they have concrete short-to-medium term plans to realize their startup ambitions.

NOC Alumni Connections

Upon completing the NOC program, each student becomes a part of the community of NOC alumni. This community is a source of relationships and networks which alumni can call upon for social and professional support. The survey found that 94% of NOC alumni still keep in touch with fellow batch mates, with 39% being in frequent contact. Alumni were also asked whether and how frequently they draw on connections made through the NOC program. Around 70% of graduated alumni draw on NOC connections at least some of the time, and only 3.7% said they never use NOC connections.

Determinants of Entrepreneurial and Innovation Propensities

What factors may explain an NOC alumnus' propensity to become an entrepreneur, or to be working in an intrapreneurial capacity in an organization? We conducted binary regression analysis to investigate potential factors after controlling for effects such as gender, cohort year and program location. Results are summarized in the table below.

Summary of Logistic Binary Regressions

Dependent Variable	Significant explanatory factors in Binary Logistic Regression	
	Control Variables	NOC program factors
Overall Entrepreneurial Propensity	<ul style="list-style-type: none"> • Cohort year • Male gender • Faculty • Family business background 	<ul style="list-style-type: none"> • Impact on entrepreneurial motivation • Impact on entrepreneurial capability • Program location
Current Entrepreneurial Propensity	<ul style="list-style-type: none"> • Cohort year • Male gender • Faculty • Family business background • Serial Entrepreneur • Previously employed in startup 	<ul style="list-style-type: none"> • Impact on entrepreneurial motivation • Impact on entrepreneurial capability • Program location
Propensity to be Employed in Startup Ecosystem	<ul style="list-style-type: none"> • Faculty • Family business background 	<ul style="list-style-type: none"> • Impact on entrepreneurial capability • Impact on intrapreneurial motivation • Impact on intrapreneurial capability • Program location
Intrapreneurial Propensity (Innovation & NBD)	<ul style="list-style-type: none"> • Cohort year • Faculty • Based in Singapore • Previously employed in startup 	<ul style="list-style-type: none"> • Impact on intrapreneurial capability • Program location
Entrepreneurial Intention (among non-founders)	<ul style="list-style-type: none"> • Singaporean or SPR • Faculty • Family business background • Based in Singapore • Employed in Startup Ecosystem in career 	<ul style="list-style-type: none"> • Impact on entrepreneurial motivation • Keep in touch with professional contacts from NOC internship

Contribution of NOC to the Innovation & Enterprise Ecosystem

Using a combination of survey data, environment scanning information and self-reporting from alumni, we identified 556 NOC alumni-founders and 665 NOC alumni-founded startups. These figures are likely undercounting the actual numbers as we are not able to fully account for alumni in the survey-non-response group.

By benchmarking our NOC alumni survey data against various available information on tech startups by the general population of graduates of local IHLs in Singapore, NOC alumni are found to

contribute a disproportionately large share of tech startup entrepreneurs in Singapore. With less than a thousand alumni over the period 2013-17, the NOC program contributes a miniscule 0.5% share of total graduates from the local institutes of higher learning (IHLs) over the same period, but over 4% of technology-based startups operating in Singapore and 4.7% of Singapore “scale-ups” with funding in excess of USD 10 million. Funding raised by NOC startups accounts for 3.2% of funding raised by Singapore-based startups, but if funding raised by a number of foreigner-founded startups that raised very large amount (Grab, Lazada etc) are excluded, the figure increased to over 10%. NOC alumni is also estimated to be around ten times more likely to be starting up businesses within six months of graduation than an average NUS graduate.

While the above analysis has clearly confirmed the significant contribution of the NOC program to creation of tech startups and scale-ups in Singapore, we want to emphasize that the impact of the NOC program must be viewed not only in terms of number of startup entrepreneurs it created, but also in terms of its broader contribution to the development of the larger pool of entrepreneurial talent for Singapore’s I&E ecosystem. The NOC program was found to have made significant impact on its alumni in terms of enhancing their motivations and skills for both entrepreneurship and intrapreneurship. Besides the high proportion of alumni (one-third) who went on to start businesses, an even larger proportion had opted to work as employees in startups and other ecosystem supporting organizations such as venture investment firms and incubators. NOC also generates a significant pipeline of intrapreneurial talents for established organizations looking for individuals with motivations and capabilities in playing innovation and new business development roles. NOC alumni are also found to be internationally mobile and able to thrive in an increasingly globalized and connected world.

1

INTRODUCTION TO NUS OVERSEAS COLLEGES PROGRAM



1. INTRODUCTION TO NUS OVERSEAS COLLEGES PROGRAM

Introduction and Overview

Since the turn of the century, the strategic focus of economic development in Singapore has been the knowledge or information economy. Innovation and enterprise are emphasized as key drivers of growth. Evolving from cluster-based and industrial development approaches in the 1990s, policy-makers now recognize the importance of a vibrant Innovation and Entrepreneurship (I&E) ecosystem for Singapore to sustain economic growth in the future.

A thriving I&E ecosystem needs a strong supply of entrepreneurial talents. These are individuals with not only the skills to succeed in and contribute to the ecosystem, but more importantly, a mindset that is oriented towards risk-taking and innovation. Entrepreneurial talents go beyond startup founders. The ecosystem cannot be sustained with founders alone. It requires other people who embody the entrepreneurial spirit to take on different roles, including key hires in early-stage startups, venture investors, managers of incubators and accelerators, and employees with significant innovation or new business development (NBD) roles in established organizations.

As Singapore's first and largest public university, the National University of Singapore (NUS) plays an important manpower development role in Singapore. Recognizing the increasingly important role of university to develop entrepreneurial mindset and skillset among its students, as well as the limitations of conventional classroom-based teaching, NUS pioneered in 2001 a new, experimental entrepreneurship education initiative - the **NUS Overseas Colleges (NOC) Program** -- that combines real-world experiential-learning and relevant classroom teaching of core knowledge of the startup and innovation process.

In essence, the program sends undergraduate students regardless of faculties to undertake 6 month-1 year full-time paid internship in early stage tech startups in leading entrepreneurial hubs around the world, so that they can learn firsthand from the entrepreneurial founders what it takes to start and grow a tech startup. The students also take entrepreneurship/innovation courses at leading partner universities in each location (e.g. Stanford in Silicon Valley, Tsinghua in Beijing), as well as immerse themselves in the host entrepreneurship ecosystem through participation in hackathons, startup business case writing, startup idea pitching, etc.

The first NOC program was launched in the Silicon Valley in 2002 followed by Philadelphia in 2003, Shanghai in 2004 and Stockholm in 2005. These early programs required students to study for two semesters at partner universities while completing a year-long internship. Shorter programs of three to seven months were introduced in 2008, with the NOC Singapore and NOC India programs. Since inception, NOC programs have been launched in fourteen different locations. At present, NOC offers students a choice of year-long or shorter programs in twelve cities spanning eight countries (**Table 1-1**).

Table 1-1: Chronology of NOC Locations

Location	Pioneer Intake	Last Batch	Program duration	Partner University
Silicon Valley	Jan 2002	-	Year-long	Stanford University
Philadelphia	Jan 2003	Jan 2014	Year-long	University of Pennsylvania
Shanghai	Jan 2004	-	Year-long	Fudan University
Stockholm	Jul 2005	-	Year-long	KTH Royal Inst of Technology
Singapore	Jan 2008	-	7 months	
India	Jan 2008	Jul 2014	3 and 6 months	India Institute of Science
Beijing	Jul 2009	-	Year-long	Tsinghua University
Israel	Jul 2011	-	6 months	Tel Aviv University / IDC Herzliya
New York	Jan 2014	-	Year-long	NYU Tandon
Beijing 6mth	Jul 2014	-	6 months	Peking University
Lausanne	Jan 2017	Jan 2018	6 months	École polytechnique fédérale de Lausanne
Munich	Jan 2017	-	6 months	Technical University of Munich
Southeast Asia	May 2018	-	3 months	
Toronto	Jul 2018	-	Year-long	University of Toronto
Shenzhen	Jan 2019	-	6 months	Shenzhen University / SUSTECH

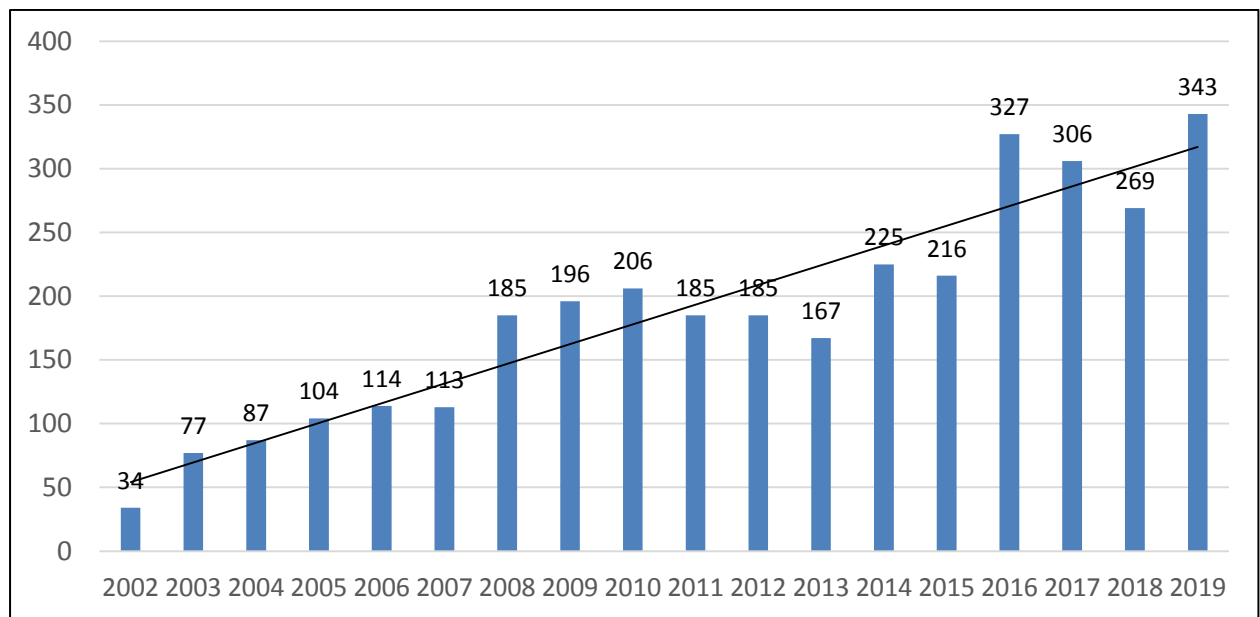
Trends in NOC Student Intake

There were a total of 34 students in the pioneer NOC intakes in 2002. Since then, annual intake of students into the NOC program has increased by ten-folds (**Figure 1-1**). The distribution of NOC students in various locations is shown in **Figure 1-2**. The longest-running program locations – Silicon Valley, Shanghai and Stockholm – collectively accounts for half the total intake to date.

Students in the NOC program are drawn primarily from six different faculties / schools in NUS, as shown in **Figure 1-3**. Close to 30% of NOC students came from the Faculty of Engineering (870 out of 2,995 students). The next largest faculty representation is from Arts and Social Sciences (552 students or 18%), followed very closely by the School of Computing (547 students or 18%) and the School of Business (481 students or 16%). Of the 4% of students who are not affiliated directly with the six main faculties/schools, many are enrolled in joint degree or multidisciplinary programs that span across faculties and a handful are from the Institute of System Science, the LKY School of Public Policy, and the Yale-NUS College.

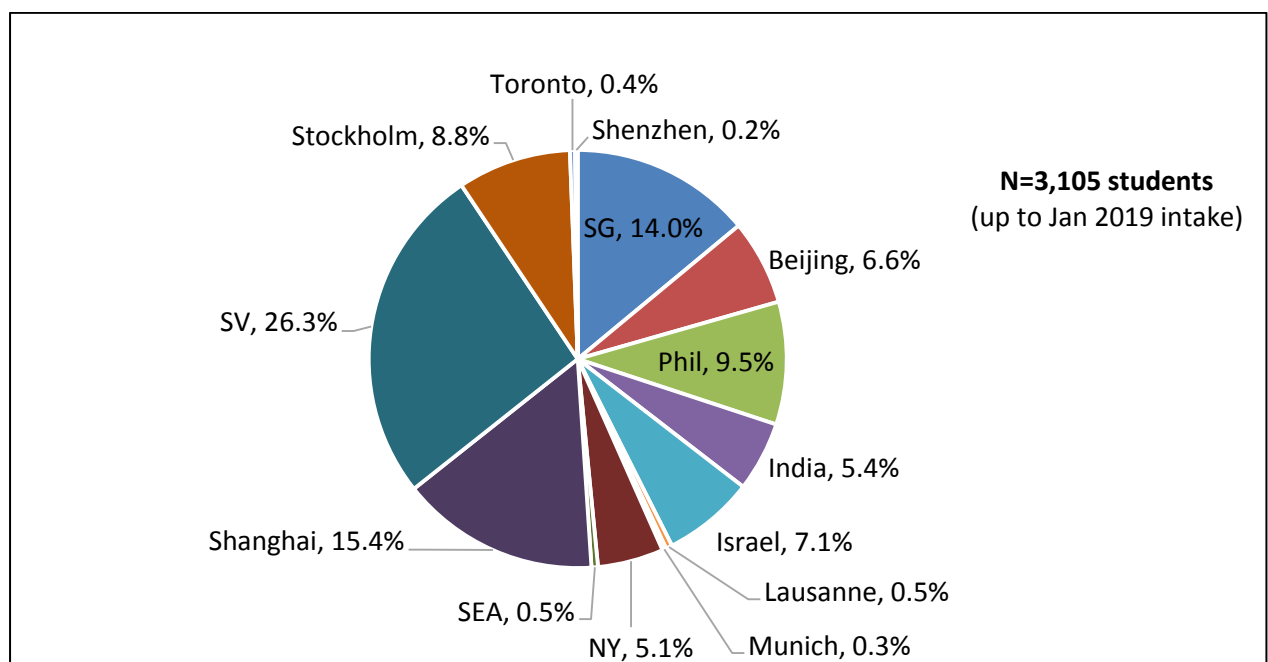
The NOC program has strived for diversity in gender representation. From **Figure 1-4**, the proportion of female students averaged in the low to mid 30% range in the early days of NOC. This improved substantially in the late 2000s, with the proportion rising to over 40% in the 2010 intake. Since 2010, female representation in annual intake has generally been above 40% albeit with occasional dips, as seen in 2012, 2015 and 2018.

Figure 1-1: Annual Intake of NOC students



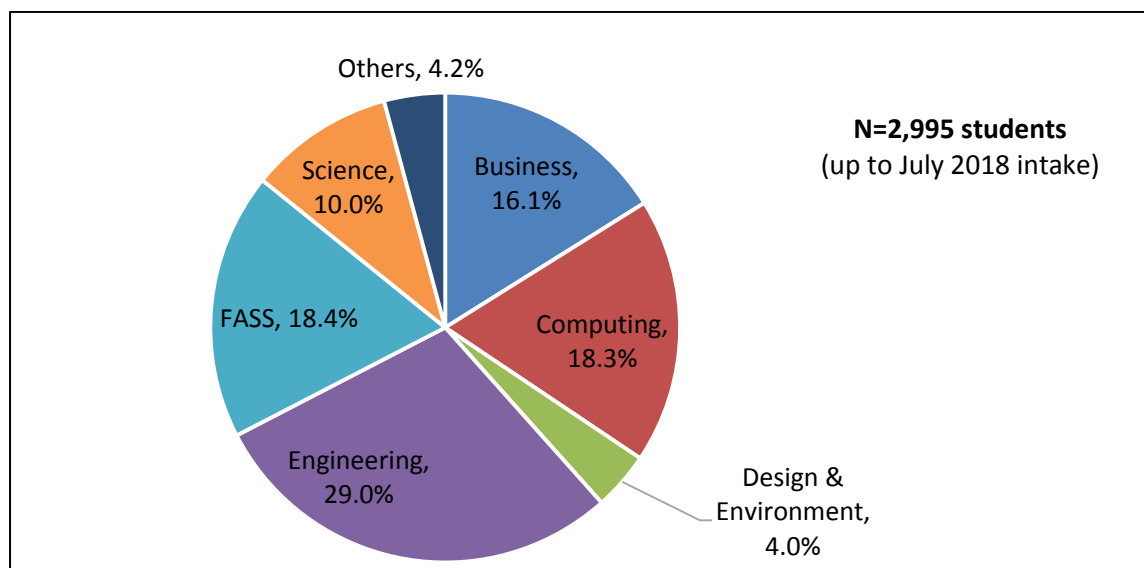
*Updated based on May 2019 data, includes July 2019 intake.

Figure 1-2: Distribution of NOC Students by Location



*Updated based on Jan 2019 data, excludes July 2019 intake. Students who went on multiple programs are counted multiple times.

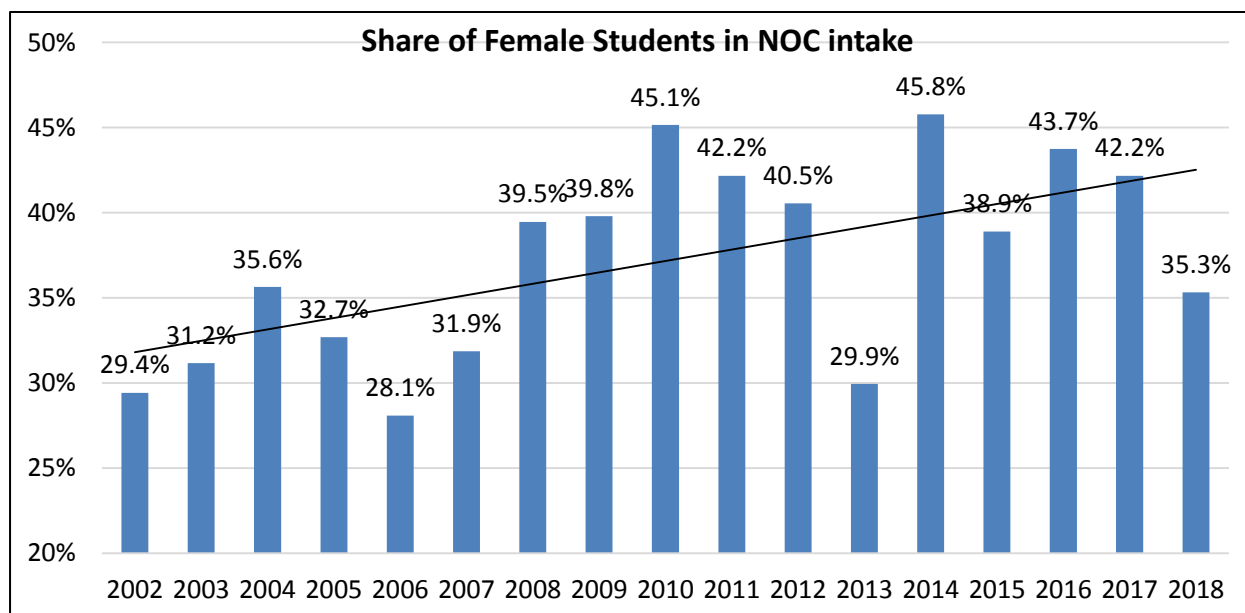
Figure 1-3: Distribution of NOC students by Faculty Affiliation



*Updated based on Jan 2019 data, excludes 2019 intake. Students who went on multiple programs are counted multiple times.

** Others include joint degree programs, LKY SSP, ISS, Yale-NUS

Figure 1-4: Share of Female Students in Annual NOC Intake



Profile of NOC Internship Companies

In the last seventeen years, over 1300 organizations have taken NOC students as interns. Around four in ten are companies in ICT-related sectors (**Figure 1-5**). Apart from the concentration in ICT, NOC internship companies represent a broad range of sectors and technologies.

The sectoral composition of internship companies varies by program location (**Figure 1-6**). As would be expected, ICT firms dominate strongly in the Silicon Valley and New York. The ICT-related sectors are generally well-represented in all the locations, but to a lesser extent compared to the American locations. In Shanghai, companies in Professional Services and Business Intelligence outnumber ICT firms, and firms in Lifestyle and Entertainment sectors are also prominent. In Israel, there is relatively high share of firms in clean tech and electronics and engineering sectors. The health and biomedical sectors are significant among internship companies in Stockholm.

The composition of internship companies has become more diversified and evenly distributed in the last decade (**Figure 1-7**). With the expansion of NOC into more locations, the number of internship companies increased from 410 in the period 2002-2010 to 711 in 2011-2018. While the ICT-related sectors still dominate in the latter period, we observe that there have been shifts towards certain sectors which were previously less well-represented, specifically Education, Agriculture & Clean Tech, Venture Capital and Lifestyle & Entertainment.

Figure 1-5: Sectoral Distribution of NOC Internship Companies

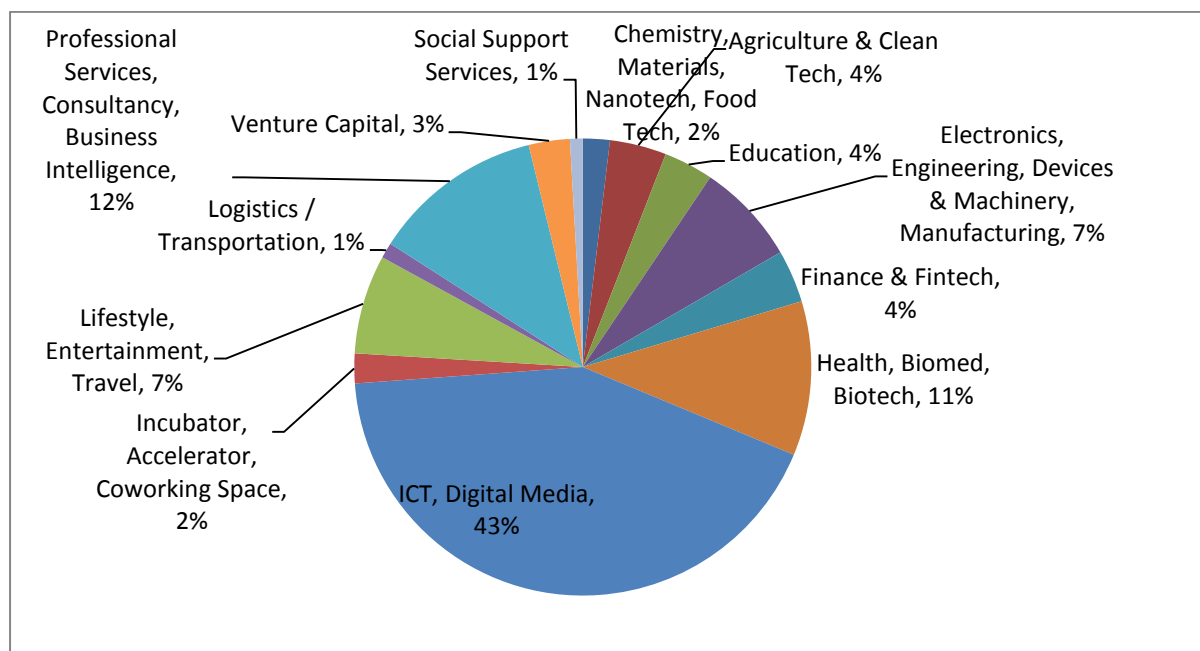


Figure 1-6: Sectoral Distribution of NOC Internship Companies, by location

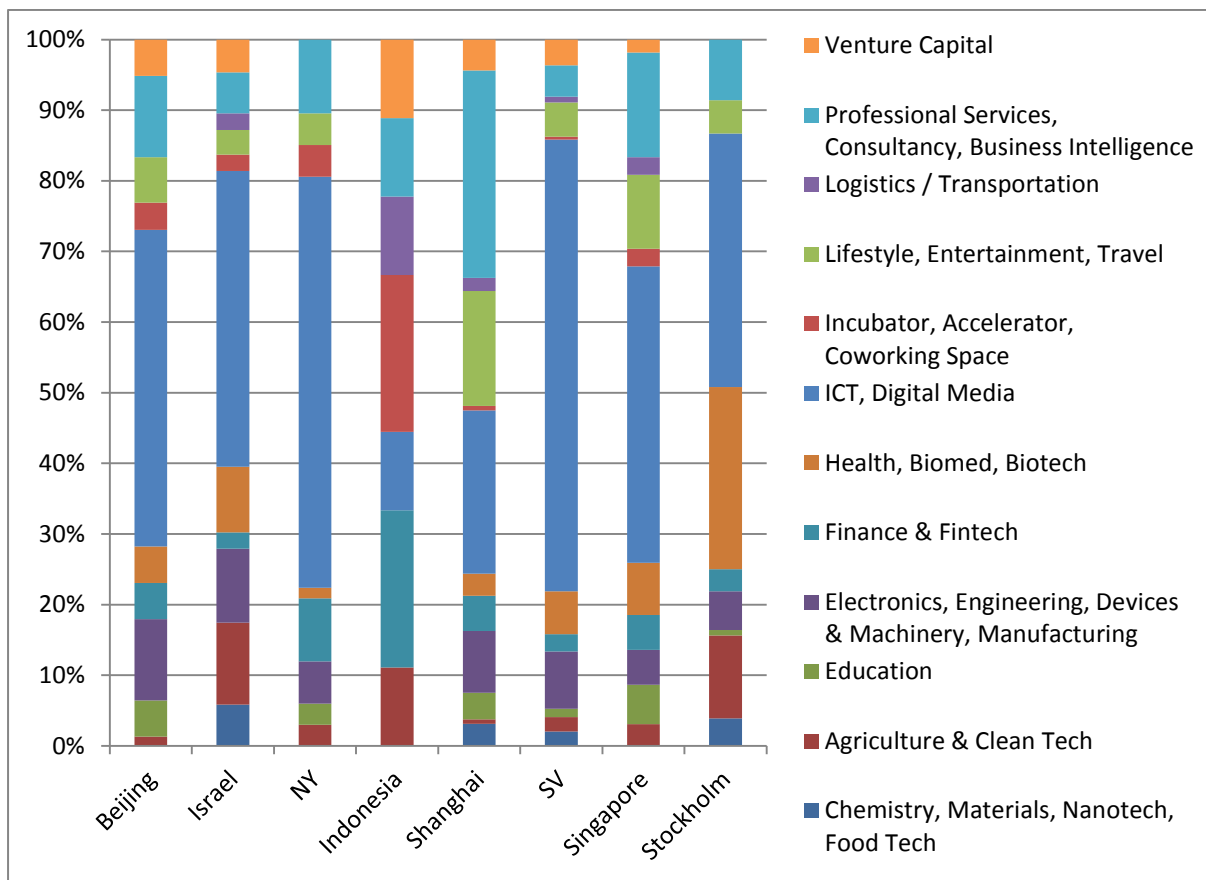
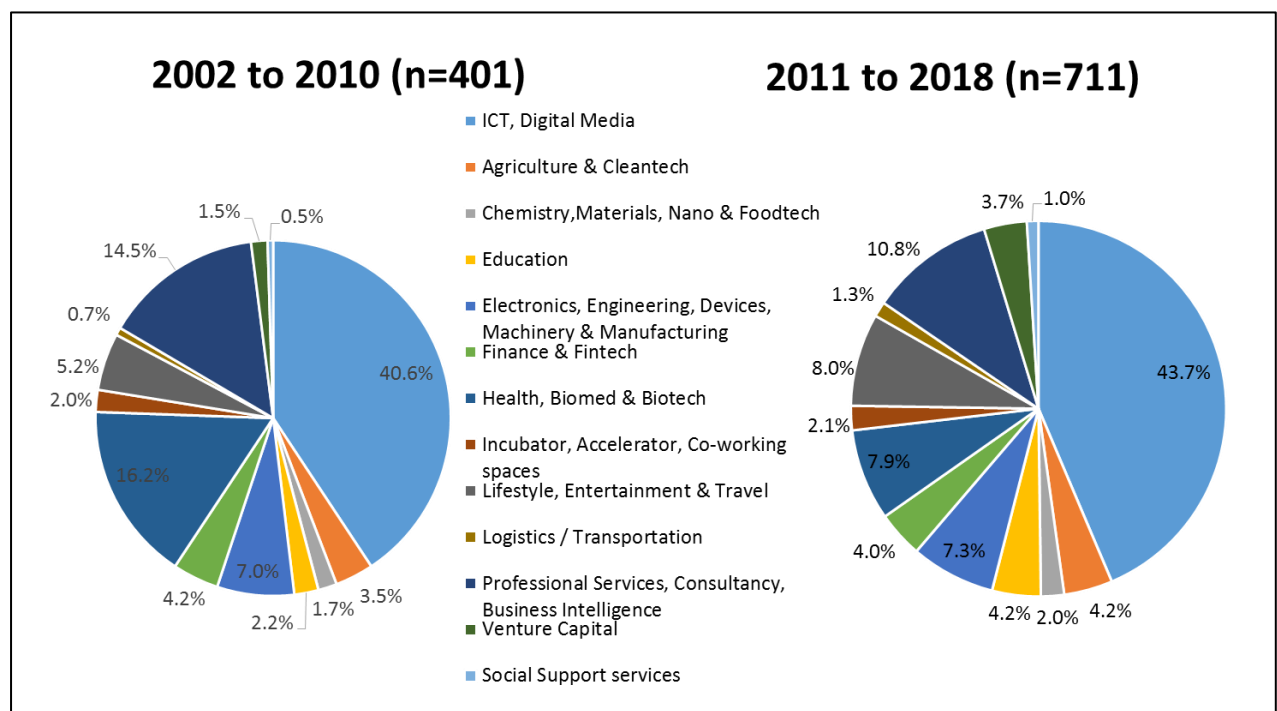
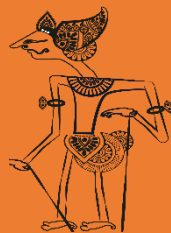
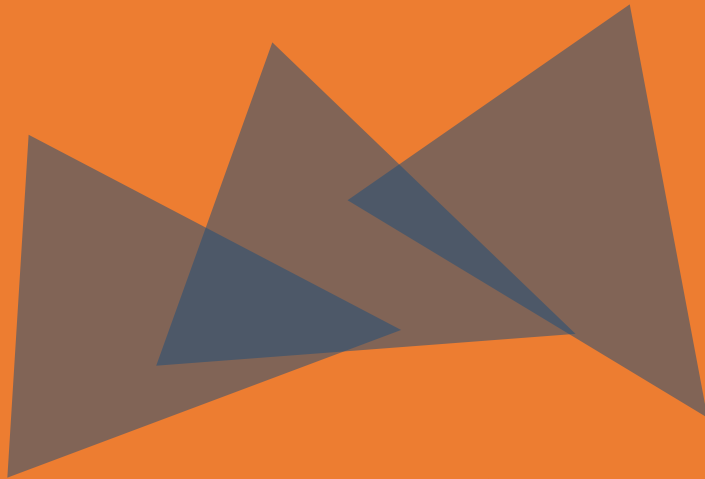


Figure 1-7: Sectoral Distribution of NOC Internship Companies, over time



2

METHODOLOGY



2. METHODOLOGY

Over the last 16 years, more than three thousand NUS students have participated in the NOC program. To understand the impact of the program and take stock of the current status of program participants, a survey of NOC alumni was launched in July 2018.

Survey Administration

The survey was administered through an online questionnaire. The sampling frame consisted of all NOC alumni who could be contacted. Before the survey was launched, a database was constructed in mid-2018, comprising every student who had completed the NOC program to date since 2002. Using a combination of web-based research and direct communications, the current contact details of alumni were updated. Email addresses were prioritized as the survey was disseminated via email. Of 2,746 alumni, only 52 were non-contactable, yielding a final sampling frame of 2,694 alumni.

An initial email was sent in end July 2018 to all contactable NOC alumni, inviting their participation in the survey. The survey link was also posted to relevant social media platforms such as the NOC Facebook group. In August 2018, the survey was extended to the newly-returned participants of the inaugural NOC Southeast Asia program. From September to December, occasional reminder emails were sent and NOC also made follow-up contact with selected alumni to boost response rate.

The survey was formally closed in December 2018 with 984 responses received from 2,694 alumni who were contacted directly, achieving a response rate of 36.5%.

Respondent Profile

Table 2-1 summarizes the response sample collected in the two categories of NOC alumni: undergraduates and graduates. “Undergraduates” refer to alumni who had completed a NOC stint but were still pursuing their undergraduate studies at NUS at the time of the survey. “Graduates” are NOC alumni who have graduated from NUS with their Bachelor degrees.

As at August 2018, there were 2,694 NOC alumni who were contactable, of which 362 were still studying as undergraduates. The sample of 984 respondents comprised of 187 undergraduates and 797 graduates. The response rate among undergraduates was understandably much higher (52%, compared to 34% for the graduated cohort). This report will separately present findings for the two sub-samples of undergraduates and graduates, with more focus placed on the graduated cohort.

Table 2-2 presents a summary profile of the survey respondents. Comparing the graduates and undergraduates sub-samples, demographic profiles other than age are very similar. We observe that two thirds of respondents are male and over 90% are Singaporean citizens or Permanent Residents. More than a third of respondents come from family business backgrounds. This is defined as having an immediate family member, ie. a parent or a sibling, who has started a business. Among alumni who have graduated from NUS, 14% are now based overseas and 15% have obtained postgraduate degrees.

Table 2-1: Survey Sample Size

	Total	Of which are	
		Undergraduates	Graduates
Students who completed NOC program (as at Aug 2018)	2,746	362	2,384
Contactable NOC Alumni	2,694	362	2,332
Survey sample	984	187	797
<i>Response Rate</i>	36.5%	51.7%	34.2%

Table 2-2: Profile of Respondents

	Total Sample (N=984)	Graduates	Undergraduates
Age	27.6	28.9	22.6
% Male	65%	66%	63%
% with Family business background	39%	40%	36%
% Singapore or SPR	91%	92%	93%
% with postgraduate degree	12%	15%	0%
% based overseas	11%	14%	0%

Table 2-3 shows that the respondents represent the full range of NOC locations. Respondents from NOC Silicon Valley form the largest group. Among the graduated alumni, sizeable share of responses were from alumni of NOC Shanghai and NOC Stockholm, as well as the now-ceased NOC Philadelphia (Bio Valley) program. Among the alumni who are still undergraduates, there is strong representation of the more recently-established NOC locations, namely New York and Israel. Comparing the sample distribution with that of the NOC alumni universe, there is slight under-representation of NOC Singapore and India, while Beijing, Silicon Valley and Stockholm are slightly over-represented. The disparity is however small, and statistical weighting by NOC location was applied as a correction in subsequent analysis.

Table 2-4 reports the profile of respondents by NOC intake year. As expected, there are more respondents from more recent batches, a natural consequence of increasing intake sizes as the NOC program grew and expanded to more locations. Nonetheless, one third of the graduates sub-sample comprises alumni who embarked on NOC prior to 2010. Compared to the universe of NOC graduated alumni, the most recent batches are slightly over-represented in the survey sample.

The Faculty of Engineering contributed the largest share of survey responses (31% of overall sample, 34% of graduates sub-sample), as shown in **Table 2-5**. Other faculties with significant representation are Computing, Business and Arts & Social Science. This is in line with the actual faculty distribution in the universe of NOC alumni.

Table 2-3: Respondents' Profile – NOC Location

	Graduates (N=797)	Undergraduates (N=187)	Total Sample (N=984)	Universe of NOC Alum (N=2,746)
Beijing	6.3%	15.0%	7.9%	6.3%
Bio Valley (Philadelphia)	12.3%		10.0%	10.5%
India	4.0%		3.3%	5.9%
Israel	6.0%	13.4%	7.4%	6.7%
Lausanne	1.1%		0.9%	0.3%
Munich	0.4%		0.3%	0.1%
New York	2.8%	10.2%	4.2%	3.9%
SE Asia (Jakarta)		3.7%	0.7%	0.5%
Shanghai	15.8%	13.9%	15.4%	15.8%
Silicon Valley	29.9%	26.7%	29.3%	26.6%
Singapore	10.3%	6.4%	9.6%	14.5%
Stockholm	11.2%	10.7%	11.1%	8.7%
	100.0%	100.0%	100.0%	100.0%

Table 2-4: Respondents' Profile – Intake Year

	Total Sample (N=984)	Universe of NOC Alum (N=2,746)
2005 and before	10.1%	11.0%
2006-2009	19.3%	21.8%
2010-2013	20.0%	26.4%
2014 and after	50.6%	40.8%
	100.0%	100.0%

Table 2-5: Respondents' Profile – Faculty or School

	Total Sample (N=984)	Universe of NOC Alum (N=2,746)
Arts & Social Sciences	15.0%	18.3%
Engineering	31.2%	30.0%
Law	0.3%	0.3%
Science	10.0%	10.4%
Business	15.8%	15.7%
Computing	19.0%	18.1%
Design And Environment	4.2%	3.9%
Yale-Nus College	0.1%	0.2%
Medicine	0.2%	0.1%
ISS	0.4%	0.1%
NGS	0.1%	0.04%
Joint Programs & Others	2.5%	2.9%

Statistical Weighting

Among the 2,694 alumni in the sampling frame were 334 individuals who were known pre-survey to be entrepreneurs. They had been identified to be startup founders via different means; including self-declaration by the alumni, having received startup assistance from NUS Enterprise and mentions in media reports. Of the 334 known entrepreneurs, 180 responded to the survey, representing a response rate of 53.9%. This high response rate far surpasses the response rate among the segment of the sampling frame for which entrepreneurial status is not definitively determined.

To adjust for potential bias towards startup founders in aggregate analysis, statistical weighting was applied. The weighting factor was computed based on (i) shares of known entrepreneurs in the sampling frame and the respondent sample, and (ii) distribution of program locations in the sampling frame and the respondent sample.

All figures in subsequent chapters of this report are computed by applying statistical weighting. The Annex provides more details on the computation of the weighting factor, and a comparison of estimates obtained with and without statistical weighting.

3

CAREER PATHS OF GRADUATED ALUMNI

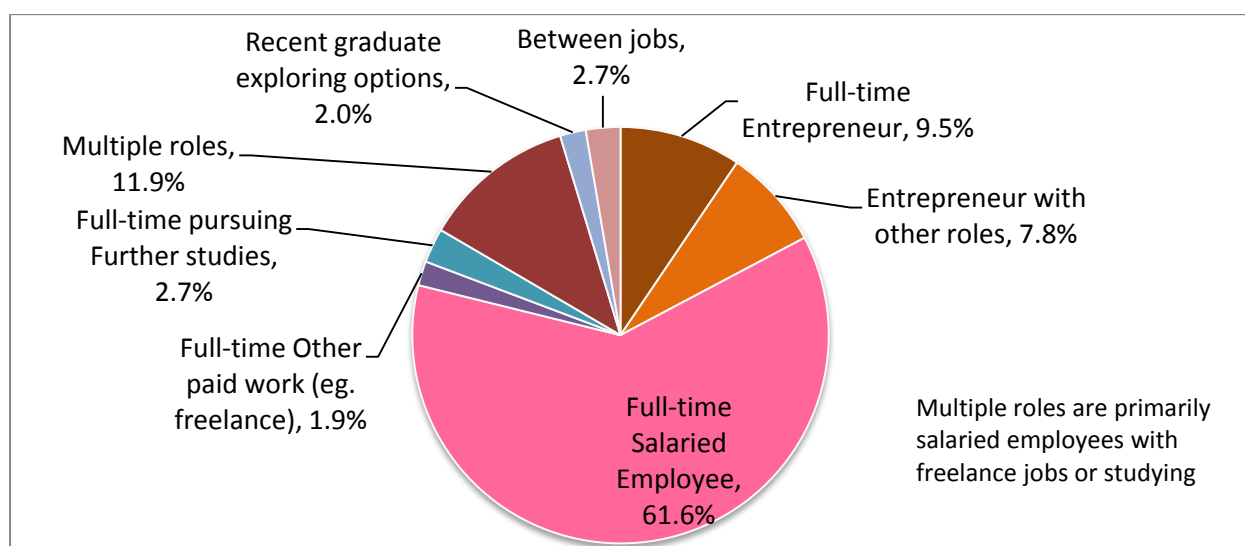


3. CAREER PATHS OF GRADUATED NOC ALUMNI

This chapter examines the career-related activities pursued by NOC alumni after graduating from NUS. By definition, survey respondents who were still undergraduates when surveyed are excluded from this analysis.

Figure 3-1 shows that 61.6% of alumni are currently working full-time as salaried employees. Significantly, full-time entrepreneurs constitute 9.5% of graduated NOC alumni, with another 7.8% pursuing entrepreneurship while holding other roles. In total, 17.2% of NOC graduates are currently active entrepreneurs. This compares favorably against estimates of startup propensity for Singapore as a whole. Latest available figures for Singapore in the Global Entrepreneurship Monitor (GEM) project indicate that around 11% of Singapore’s adult-aged population in 2014 were engaged in early stage-entrepreneurial activity.

Figure 3-1: Current Career Status of Graduated Alumni



The current status of graduated NOC alumni located overseas and in Singapore is compared in **Figure 3-2**. Alumni who are located overseas appear to have higher propensity to be active full-time entrepreneurs (12.6%, compared to 9.0% of Singapore-based alumni). However, the difference in local and overseas propensities was found to be statistically insignificant based on the Chi-squared statistic for testing independence of distribution.

Including those who are entrepreneurs while holding other roles, overall entrepreneurial propensity is 19% for overseas-based alumni versus 17% among locally-based alumni. Correspondingly, the share of full-time employees is higher for Singapore-based alumni (62.8%) compared to their counterparts abroad (55%). The difference between local and overseas proportions was statistically significant, albeit weakly at 10% level of significance. As expected, sizeable proportions of those located abroad are pursuing further education. Among overseas-based alumni, 7.2% are studying full

time and another 9% are studying while working. The proportion of full-time students overseas is significantly higher than among locally-based alumni (statistically significant at 1% level).

Figure 3-2: Current Career Status of Graduated Alumni, by Current Location

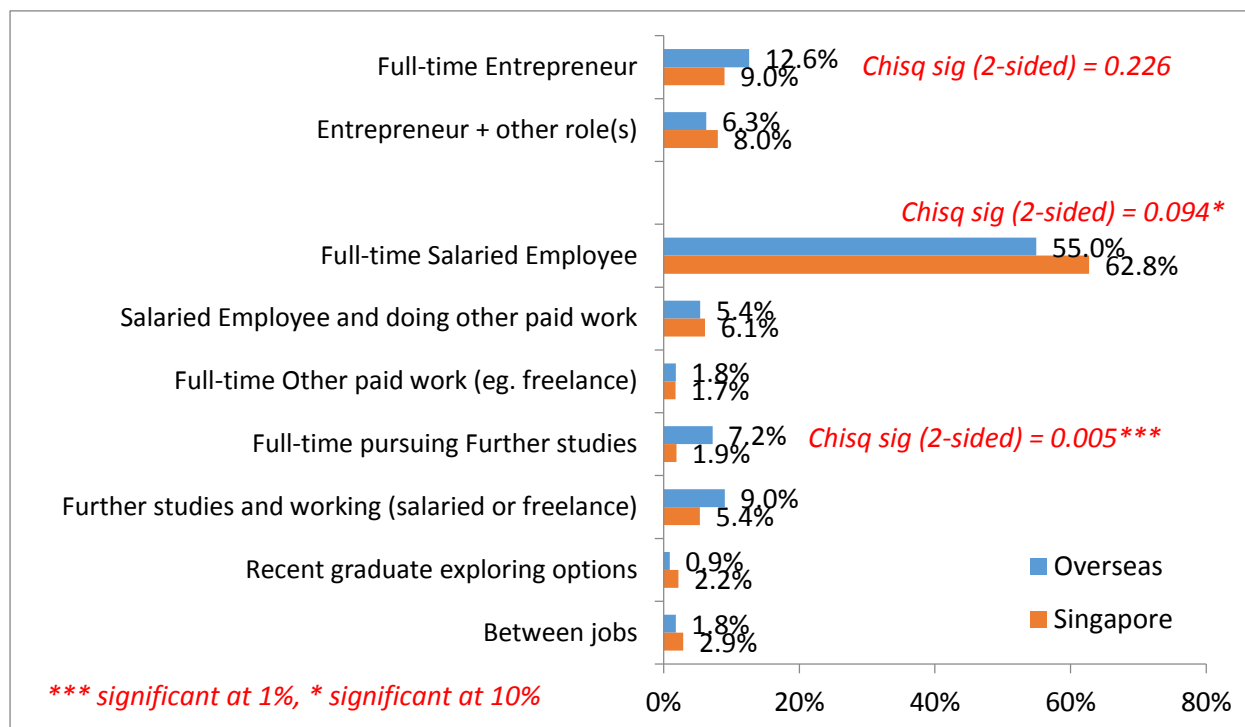


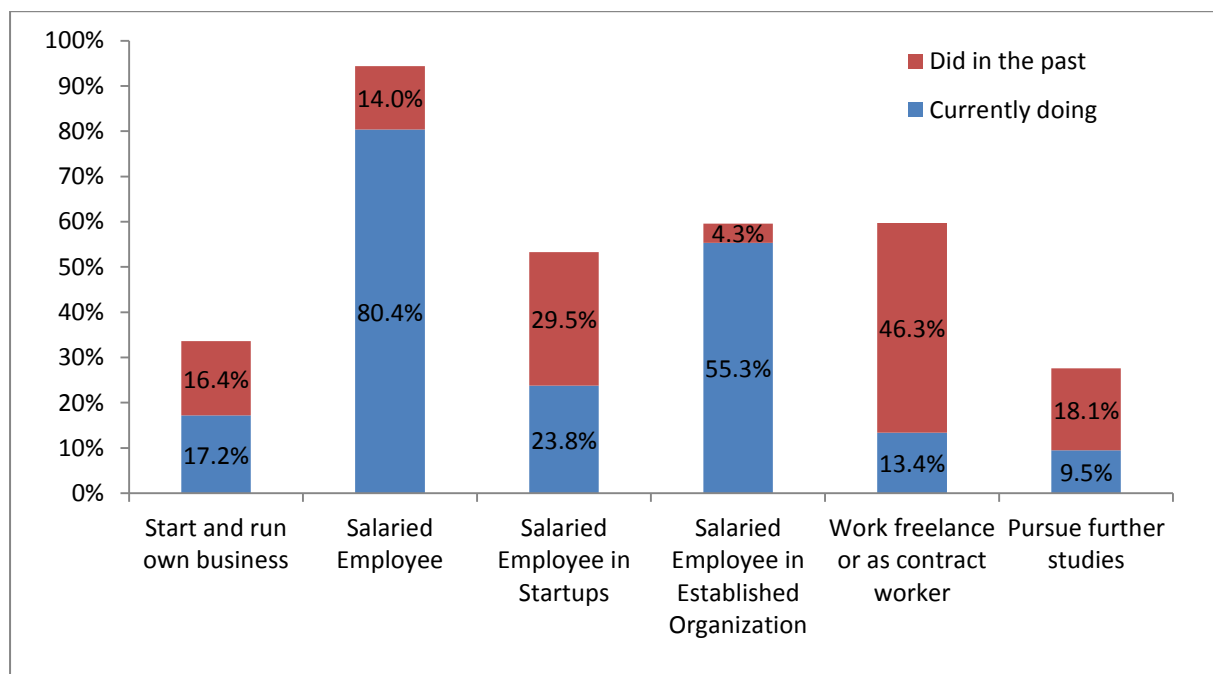
Figure 3-3 shows that NOC alumni have taken different career paths and played different roles since leaving university. This spans from being entrepreneurs to working in large corporations. Reflecting the burgeoning gig economy, a relatively high proportion of alumni (60%) have engaged in freelancing or contract jobs, with 13.4% still involved in such activities.

A highly salient finding from the survey is that a very significant proportion of NOC alumni have engaged themselves in innovation & entrepreneurial (I&E) ecosystem roles. As shown in **Table 3-1**, four out five (79%) NOC alumni have been active in the entrepreneurial ecosystem during their careers, with more than half (51%) still currently involved. One-third (33.6%) of graduated alumni have started up their own companies at some point of their career, with over 17% still currently actively running their startups. Notably, over half of alumni (54.3%) have opted to work in startups, with 23.8% currently still employed by startups. Moreover, 45% have at some point worked in other parts of the startup ecosystem (venture investing, incubator/accelerator, professional services to startups, etc) with 20% still doing so. While not to the same extent as startup founders, NOC alumni who opted to work in startups and other ecosystem roles do exhibit entrepreneurial spirits like risk-taking and willingness to deal with new and rapidly changing environment.

Among those who opted to work in established organizations outside of the startup ecosystem, a significant proportion (61%) was found to be playing innovation and new business development

(I&NBD) roles. Including such roles, almost 90% of NOC alumni have been involved in I&E ecosystem roles at some point in their career, with 76% currently playing such roles (**Table 3-1**).

Figure 3-3: Career Paths after Graduating from NUS



Note: Percentages do not sum to 100 across career options as alumni may have multiple roles

Table 3-1: Involvement of NOC Alumni in Innovation and Entrepreneurial (I&E) Ecosystem Roles

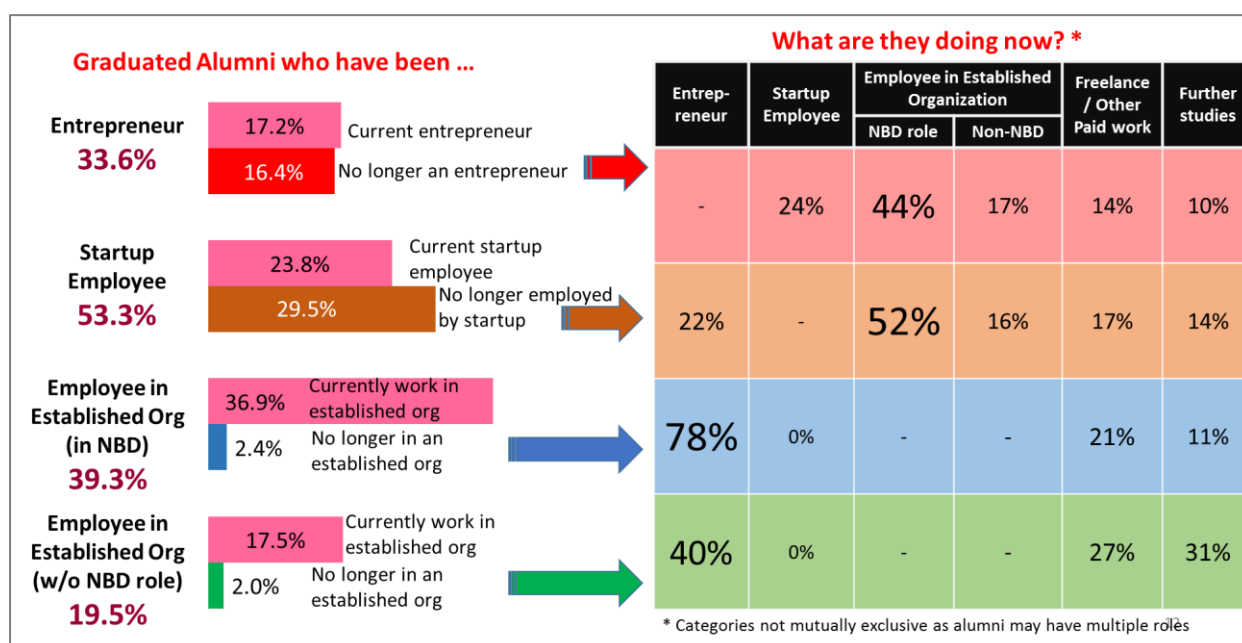
	Involved at some point in career	Currently Involved
Involved in Innovation & Entrepreneurial Ecosystem	89.8%	76.2%
Entrepreneurial Ecosystem Roles	79.0%	51.3%
Entrepreneur	33.6%	17.2%
Startup Employee	53.3%	23.8%
Working in other parts of Ecosystem (venture investing, incubator/accelerator, professional services to startups, etc)	44.6%	19.6%
Innovation & New Business Development (I&NBD) Roles		
Working in I&NBD roles in other established organizations	46.9%	37.3%

Career paths of NOC alumni are quite dynamic. As shown in **Figure 3-4**, many alumni have transitioned from one career category to another since university graduation. We first consider the 33.6% of NOC alumni who have become entrepreneurs. Around half of these entrepreneurs (16.4% of alumni) are no longer running their own companies. We are interested to see what these former entrepreneurs are doing in the current careers. Around one-quarter (24%) of these former entrepreneurs are now working in startups, thus remaining in an entrepreneurial environment. The majority (61%) are employed by other (non-startup) organizations, while 14% are working as freelancers or on a contract basis. Importantly, the majority of the former entrepreneurs working in established organizations are employed in intrapreneurial new business development (NBD) roles rather than more routine operational roles.

More than half (53.3%) of graduated NOC alumni have been employed in startups since leaving university, with 29.5% being former startup employees. These former startup employees tend to transition to jobs in established organizations (68%), of which most (52%) are in NBD-related roles. There is however also high entrepreneurial propensity among this group of former startup employees, with 22% now running their own businesses.

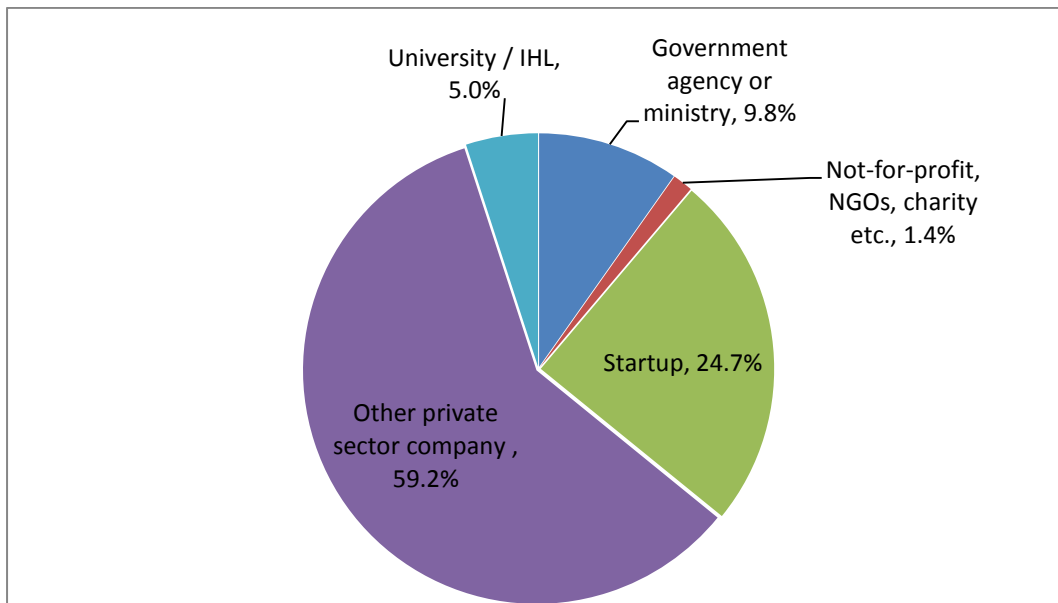
The majority (59%) of NOC alumni have worked in established organizations since university graduation, two-thirds (39%) of which were in NBD roles. There are relatively few who transitioned out of jobs in established organizations to work elsewhere. Only 4.4% of graduated alumni fall into this category. Among this small group, we observe a very high propensity to become entrepreneurs. More than half of those who were in NBD roles in established firms (78%) and 40% of those in non-NBD roles disclosed that they are now running their own startups. Meanwhile, 21.2% have chosen to work in a more independent mode as freelancers or contractors.

Figure 3-4: Career Transitions



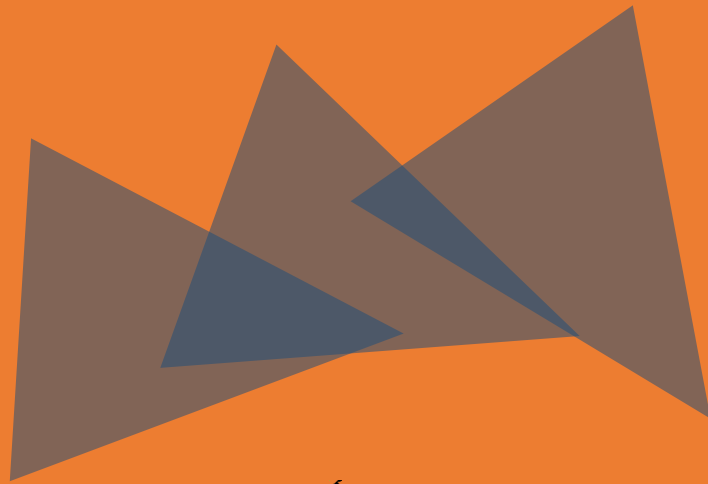
As established in **Figure 3-3**, over 80% of NOC alumni are currently working as salaried employees, either full-time or while holding other roles. From **Figure 3-5**, the overwhelming majority of employed alumni are working in the private sector, with 24.7% of them employed in startups and 59% employed in other private sector companies. Among those who are employed in the non-startup segment of the entrepreneurship ecosystem, 7.7% are working in Institutes of Higher Learning (IHLs) and 14.1% are working in public sector organizations.

Figure 3-5: Employer Type of Currently Employed NOC Alumni



4

ENTREPRENEURIAL PROPENSITY



4. ENTREPRENEURIAL PROPENSITY

Entrepreneurial propensity measures the proportion of NOC alumni that have founded and run their own startups. In the survey, respondents were informed that a startup is defined as an incorporated business entity operating on a for-profit basis. A current entrepreneur is an individual alumnus who is at present running an active startup which they founded. A former or past entrepreneur previously founded and ran a startup, but is at present no longer carrying out entrepreneurial activities. The startup founded by the former entrepreneur may now be inactive or have exited, or is active but the NOC alumni has withdrawn from the business.

From **Table 4-1**, the overall entrepreneurial propensity rate among graduated alumni is 33.6%, comprising 17.2% who are current entrepreneurs and 16.4% who are former entrepreneurs. Student entrepreneurship is observed in the undergraduate subsample which registers 15.8% entrepreneurial propensity, of which 9.4% are current entrepreneurs. As student entrepreneurs face different founding conditions and challenges, the rest of the analysis in this section will focus on the entrepreneurial propensity of graduated alumni.

Figure 4-1: Entrepreneurial Propensity of NOC Alumni by Graduation Status

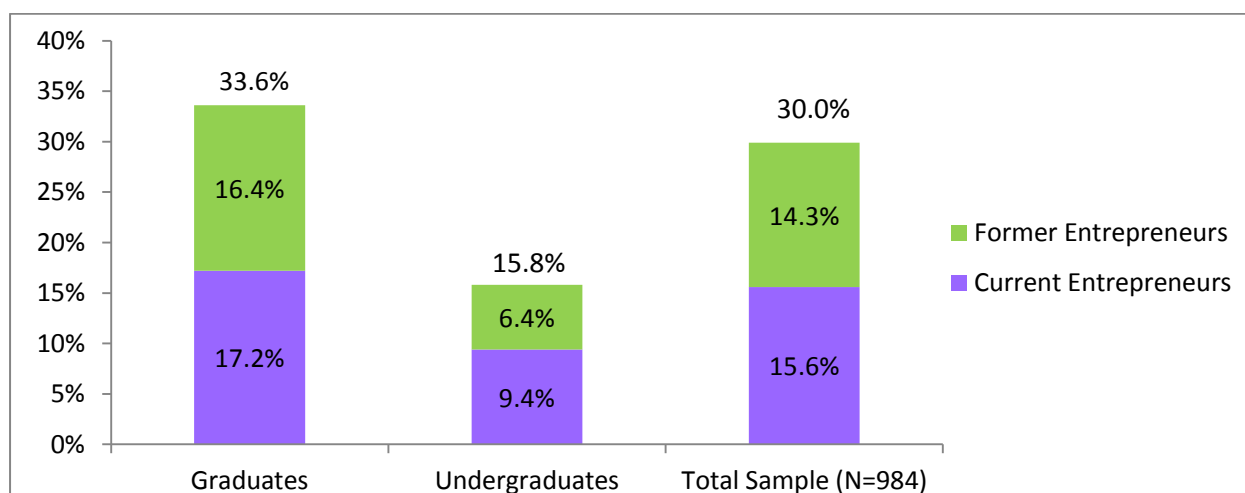
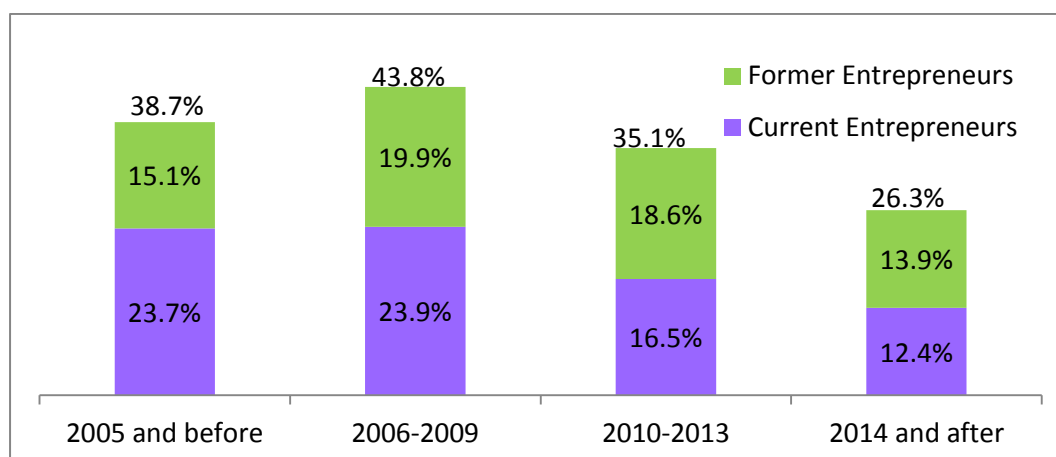


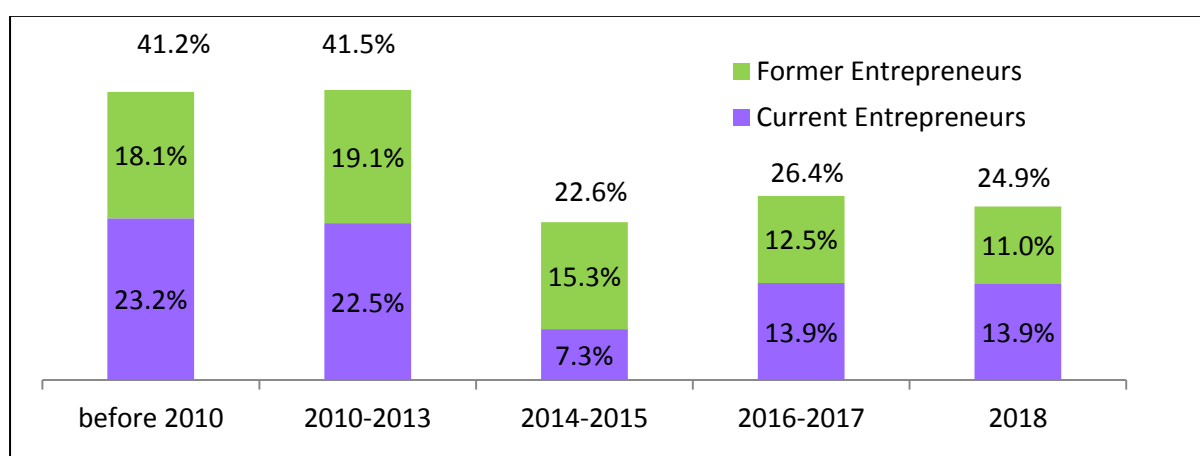
Figure 4-2 shows that entrepreneurial propensity tends to be higher for earlier batches and declines for more recent batches. This trend is observed for both current and past entrepreneurial propensity levels. Overall propensity is highest for the cohorts which started NOC in the years 2006-2009, and lowest for those who were in the program in the last five years. The downward trend is expected because alumni from older batches have more time to realize their entrepreneurial ambitions.

Figure 4-2: Entrepreneurial Propensity of Graduated Alumni by Intake Year



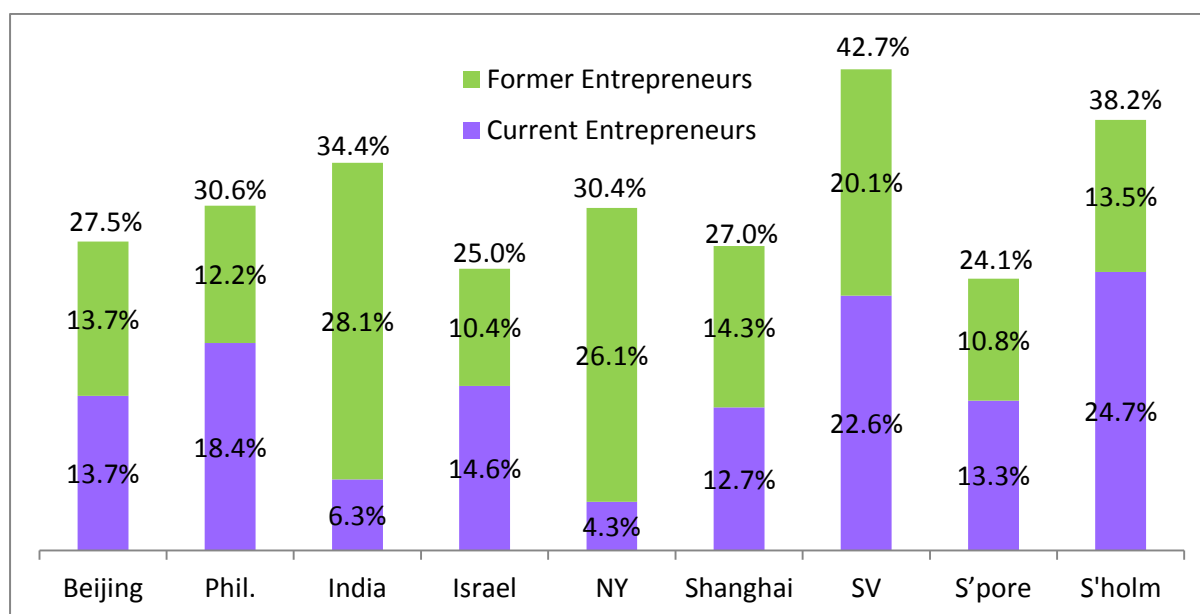
Entrepreneurial propensity is also shown to be higher among alumni who have been in the workforce for more than five years. As seen in **Figure 4-3**, over 40% of those who graduated before the year 2013 have at some stage founded their own startups, and over 20% of them are still active entrepreneurs today. This compares to overall propensity rates of 22% to 27%, and current propensity rates of 7% to 14% among graduates who left NUS more recently, after 2014.

Figure 4-3: Entrepreneurial Propensity of Graduated Alumni by Year of University Graduation



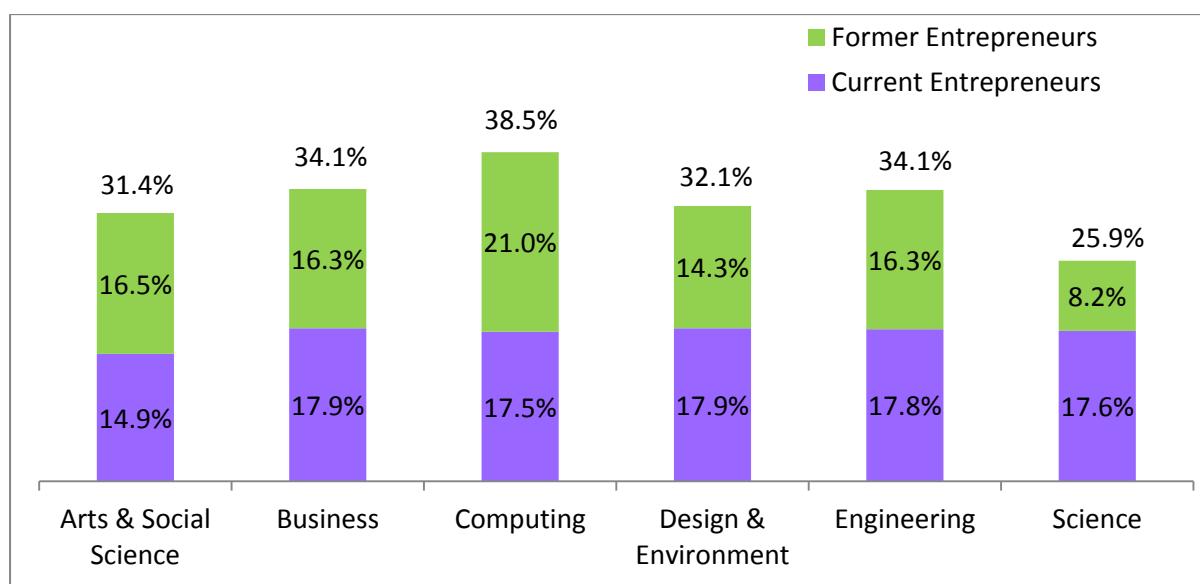
The level of entrepreneurial propensity varies across the different NOC program locations (**Figure 4-4**). The highest overall propensity levels are achieved by Silicon Valley (42.7%) and Stockholm (38.2%). These two locations also boast the highest share of current entrepreneurs. Notably, while four in ten alumni from SV have founded startups, around half these entrepreneurs are now pursuing other career paths. This is seen to an even more extreme degree among alumni from India and New York. Overall entrepreneurial propensity levels in these locations exceed 30%, but more than four-fifths of these are no longer active entrepreneurs.

Figure 4-4: Entrepreneurial Propensity of Graduated Alumni by NOC Location



Comparing across schools and faculties in **Figure 4-5**, the School of Computing records the highest shares of entrepreneurs (38.5%) and the Faculty of Science the lowest (25.9%). It is however noteworthy that more than half the founders from Computing are no longer active entrepreneurs. The current entrepreneurial propensity rate is at comparable levels across most faculties at around 18%, with the exception of Arts & Social Sciences where current propensity is slightly lower, at 15%.

Figure 4-5: Entrepreneurial Propensity of Graduated Alumni by Faculty



Male alumni have much higher entrepreneurial propensity (38.5%) than their female counterparts (23.6%), as seen in **Figure 4-6**. Entrepreneurial propensity is further seen in **Figure 4-7** to be higher for alumni who are currently located overseas (38.7%) compared to those who are in Singapore (32.7%).

Figure 4-6: Entrepreneurial Propensity of Graduated Alumni by Gender

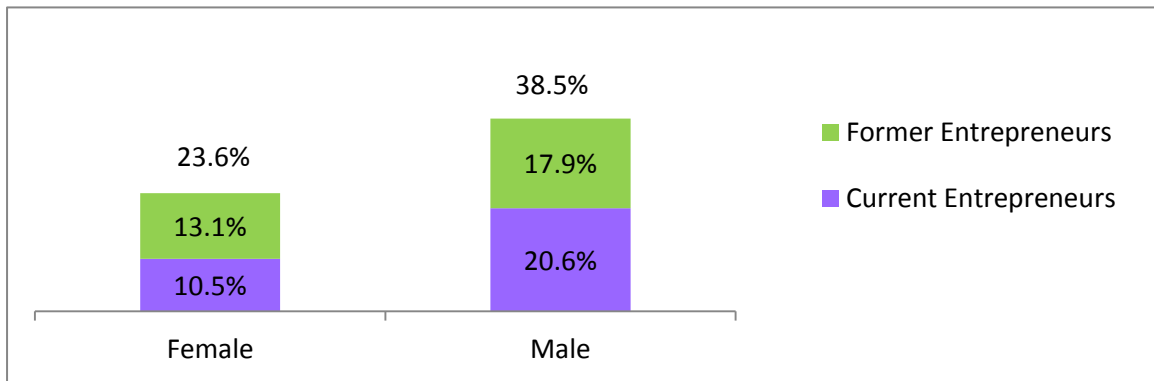
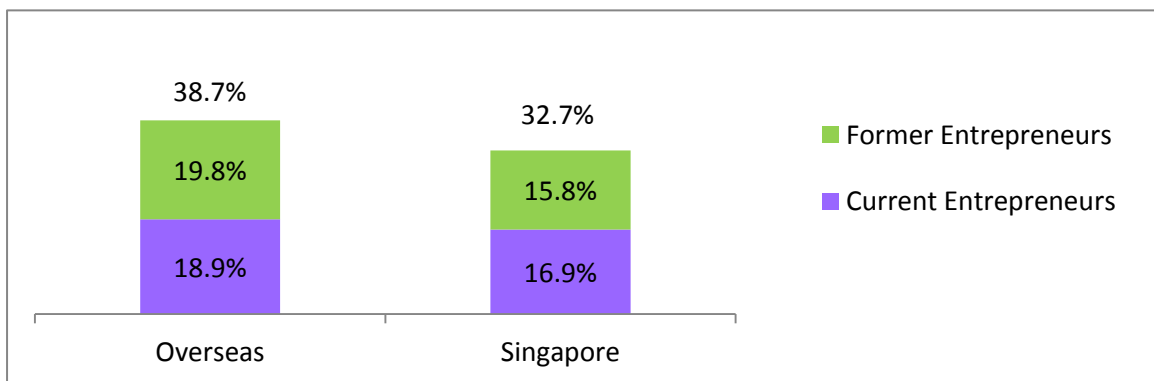


Figure 4-7: Entrepreneurial Propensity of Graduated Alumni by Current Location



5

NOC ALUMNI-ENTREPRENEURS (GRADUATES)



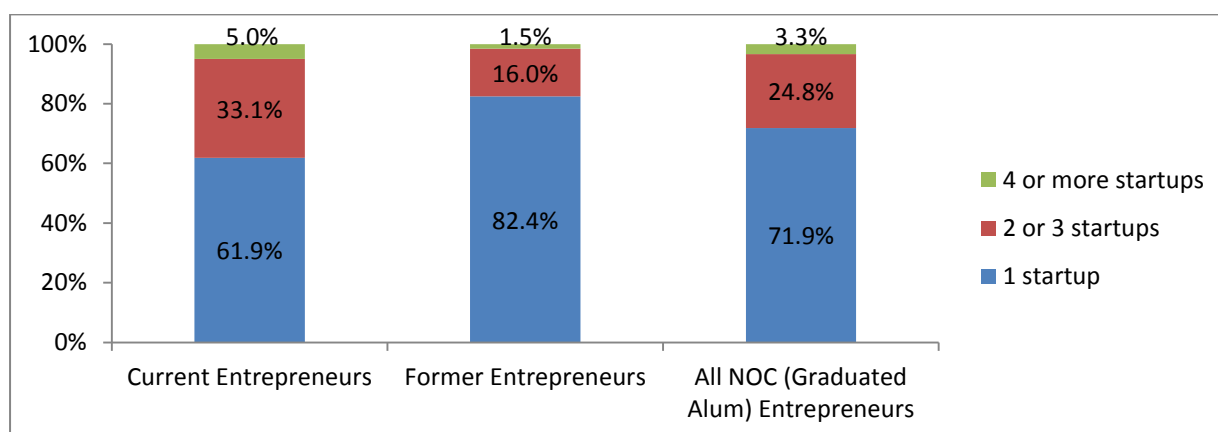
5. NOC ALUMNI-ENTREPRENEURS (GRADUATES)

Profile of Alumni-Entrepreneurs in Survey

This section will examine the 33.6% of graduated alumni who have founded and run their own startups (sample size = 268). Identification of alumni-entrepreneurs is based on self-reporting in the survey. Of the 33.3% of alumni who reported founding startups, 16.4% indicated that they are no longer active in running a startup. It should be noted that while the majority of such former startups have ceased operations, about 5.3% of these were reported to have been acquired and hence represent likely successful exits for the alumni-founders (e.g. tenCube, Zopim and TechSailor). In other words, not all former startups that no longer exist are failed ventures, and indeed some of the former entrepreneurs have become quite well-off and are active as angel investors.

Serial entrepreneurs account for less than 30% of these founders, as depicted in **Figure 5-1**. The incidence of serial entrepreneurship is higher among current entrepreneurs, with 38% having started up multiple businesses, of which 5% have founded 4 or more startups during their career. Among those who have ceased being active entrepreneurs, serial entrepreneurship is rarer (18%).

Figure 5-1: Number of Startups Founded by Graduated Alumni



Sizeable proportion of the alumni founders started up their first business before graduating from NUS (**Table 5-1**) and some were already entrepreneurs even before embarking on NOC. These student entrepreneurs are more prominently represented in the most recent intake batches. This is expected due to the truncation effect for newer cohorts, whose post-NOC period for starting up is much shorter. Even in the older cohorts, between 30% and 40% of entrepreneurs founded their first startup during their NOC stint or shortly after completing the program. This finding potentially testifies to the influence of the NOC experience.

Contrasting currently active and former entrepreneurs, the disparity is most pronounced among the newer cohorts, 2010 and later. There is much higher propensity for current entrepreneurs from post-2010 batches to have waited till after graduation to set up their first business (**Figure 5-2**). In contrast, more than two thirds of former entrepreneurs from the new cohorts were students when first starting up (**Figure 5-3**). The vast majority also did not start other businesses after the cessation of their first startups (82%, from **Figure 5-1**). This could explain why some former founders are no longer actively pursuing entrepreneurship; they were student entrepreneurs who have since graduated and pursued non-entrepreneurial careers when their initial startups ceased. **Table 5-2**

supports this proposition, showing that founders who waited till after graduation to start up have a higher likelihood of still being active entrepreneurs at present. However, it should be noted that not all startups that have ceased are failed ventures; as pointed out earlier, some of these were acquired and represent successful exits.

Table 5-1: When was the First Startup Founded?

	% of NOC Alumni-Entrepreneurs
Before embarking on NOC program	14.9%
Upon joining NOC / During NOC program	11.9%
After NOC and before university graduation	29.4%
After university graduation	43.5%
Total	100%

Figure 5-2: When was the First Startup Founded for Current entrepreneurs (by Intake Year)?

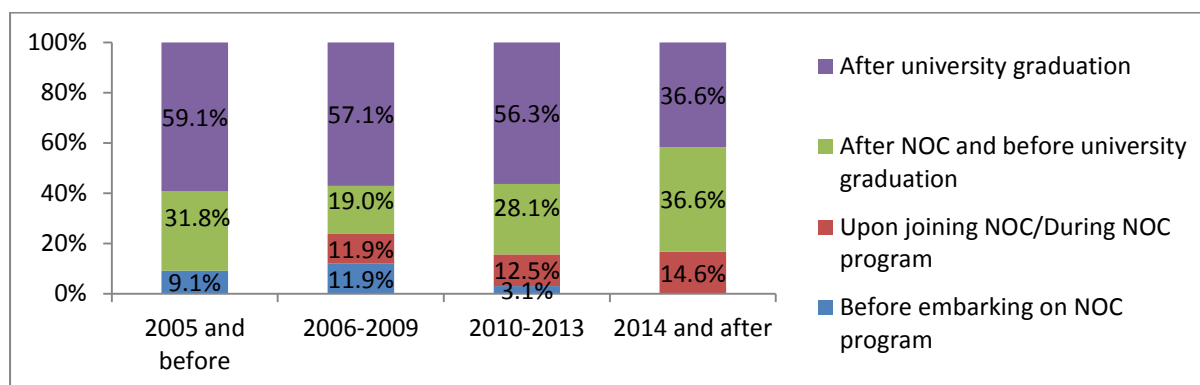


Figure 5-3: When was the First Startup Founded for Former entrepreneurs (by Intake Year)?

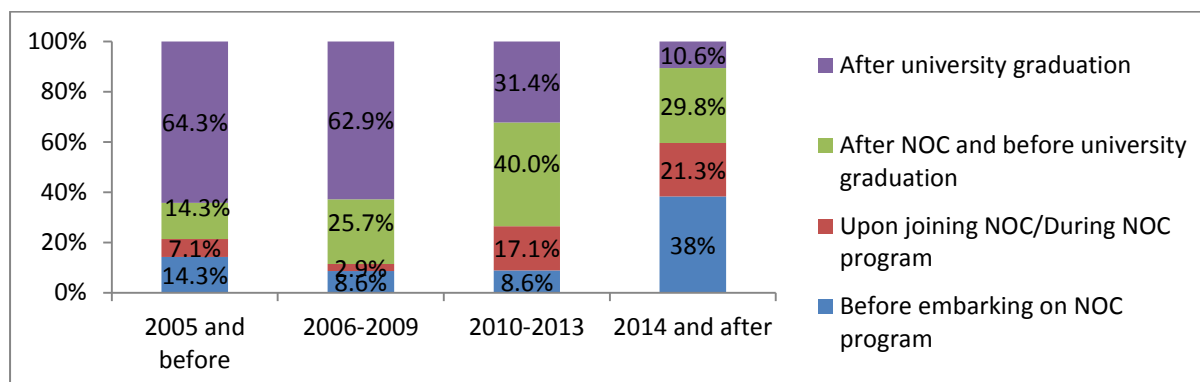


Table 5-2: Current Entrepreneurship Status by When First Startup Founded

When was first startup founded?	% still active entrepreneur	% pursuing other career
Before embarking on NOC program	33.3%	66.7%
Upon joining NOC / While on NOC program	45.5%	54.5%
After NOC and before university graduation	50.0%	50.0%
After university graduation	59.8%	40.2%

Additionally, participation in the NOC program grants alumni access to an extended community of organizations and individuals in the global startup ecosystem. Alumni entrepreneurs can call on these networks to find necessary resources for their startups. The survey asked entrepreneurs to indicate the categories of people that were involved in their first startup in the following capacities: investors, cofounders, initial employees, initial customers, board/ advisors, and suppliers. **Table 5-3** highlights three categories of relationships that NOC entrepreneurs named – NOC Alumni, contacts from NOC internship and NUS (non-NOC) alumni. Across all cohorts, 43% of entrepreneurs called on fellow NOC alumni to be involved in their first startup. We observe that this propensity is higher among more recent intake cohorts. Similarly, the propensity to utilize contacts from NOC internship is also higher for entrepreneurs from newer cohorts.

Table 5-3: NOC and NUS Connections involved in First Startup, by Intake Year

% of entrepreneurs who had NOC/NUS Connections involved in their first startup	NOC Alumni	Contact from NOC Internship	NUS Alumni
All NOC Graduated Entrepreneurs	42.9%	28.5%	32.8%
2005 and before	33.0%	20.8%	26.0%
2006-2009	41.5%	24.6%	35.9%
2010-2013	46.0%	31.6%	33.0%
2014 and after	45.7%	32.7%	32.9%

The likelihood of entrepreneurs relying on their NOC and NUS connections varies across the NOC program locations (**Table 5-4**). Entrepreneurs from Silicon Valley (56.1%), Israel (50.2%) and Shanghai (46.4%) had the higher propensity to call on other NOC alumni when setting up their first business. On the other end of the scale, only 15.9% of founders from NOC Beijing did so. In terms of utilizing contacts made during the NOC internship, founders from Silicon Valley lead the pack again (37%), followed by founders from Stockholm (29.6%). Locations where there was low reliance on internship contacts are New York (0%), Israel (8.4%) and India (9%).

Table 5-4: NOC and NUS Connections involved in First Startup, by NOC Location

% of entrepreneurs who had NOC/NUS Connections involved in their first startup	NOC Alumni	Contact from NOC Internship	NUS Alumni
All NOC Graduated Entrepreneurs	42.9%	28.5%	32.8%
Beijing	15.9%	26.8%	7.9%
Bio Valley	30.5%	24.6%	25.1%
India	27.2%	9.0%	27.2%
Israel	50.2%	8.4%	24.9%
New York	29.1%	0.0%	29.1%
Shanghai	46.4%	25.8%	31.8%
Silicon Valley	56.1%	37.0%	41.6%
Singapore	29.9%	24.0%	29.9%
Stockholm	32.1%	29.6%	27.6%

Entrepreneurs who graduated from the School of Design & Environment and Faculty of Arts & Social Science had the highest likelihood of relying on fellow NOC alumni when founding their first startup, at 57.8% and 53.2% respectively (**Table 5-5**). Relatively lower reliance on NOC alumni is observed for Science and Business graduates. In terms of relying on connections from NOC internship, founders from Arts & Social Science (37.4%) have the highest propensity, followed by Business (34.3%).

Table 5-5: NOC and NUS Connections Involved in First Startup, by Faculty

% of entrepreneurs who had NOC/NUS Connections involved in their first startup	NOC Alumni	Contact from NOC Internship	NUS Alumni
All NOC Graduated Entrepreneurs	42.9%	28.5%	32.8%
Arts & Social Science	53.2%	37.4%	26.5%
Business	37.4%	34.3%	31.6%
Computing	40.3%	26.8%	34.0%
Design & Environment	57.8%	24.7%	50.7%
Engineering	44.7%	26.4%	36.0%
Science	35.5%	17.2%	30.7%

Around half of the first startups founded by NOC alumni are still active today, or have been successfully acquired or merged (**Figure 5-4**). Survival rate is seen to be higher for startups founded by alumni from older batches. When interpreting this, the truncation effect for more recent intakes must be kept in mind. Due to the shorter post-NOC period for these cohorts, the majority of founders from recent intake are student entrepreneurs. As confirmed in **Figure 5-5**, startups by student entrepreneurs have a lower survival rate, especially startups founded before completion of the NOC program. Importantly, we find that startups founded by alumni with more working experience have higher probability of surviving.

Figure 5-4: Survival of First Startup by Founder's Intake Year

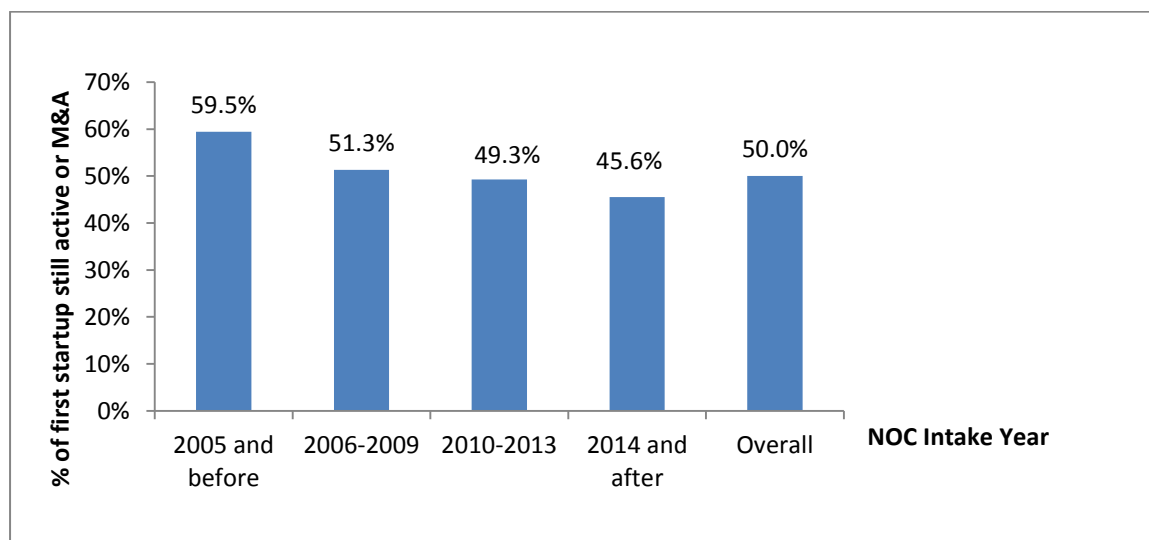
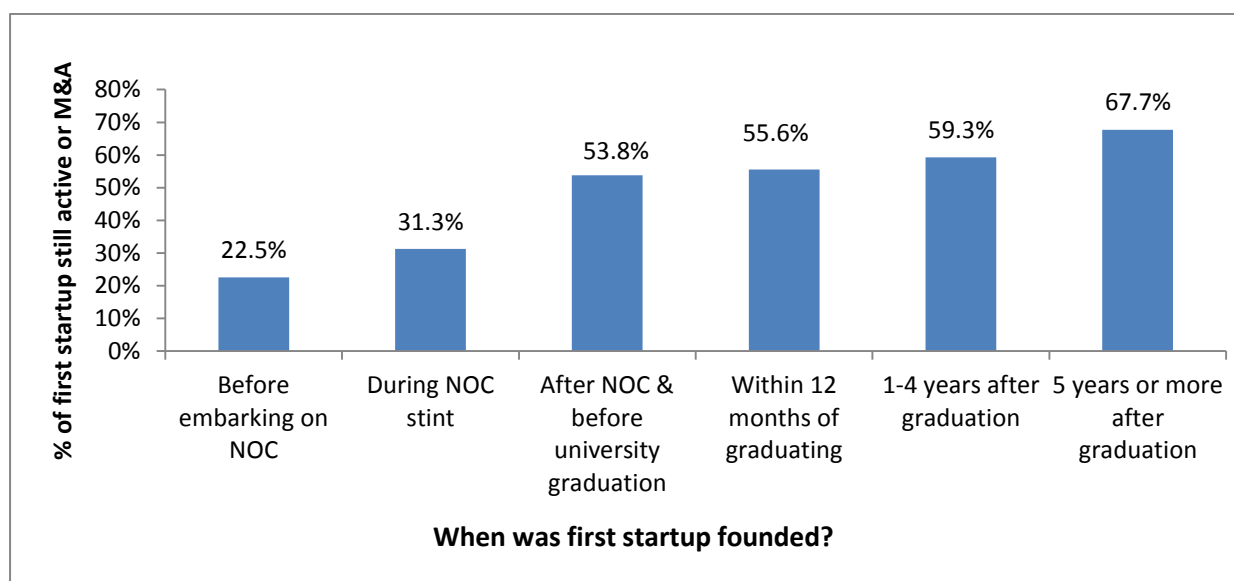


Figure 5-5: Survival of First Startup by When Founded



Current and former entrepreneurs were asked to assess the extent to which the NOC program contributed to their entrepreneurial careers overall. **Table 5-6** presents the average ratings for five areas of potential contribution, based on responses measured on a 5-point Likert scale. Scores closer to 5 indicate that the NOC program had great impact on that aspect of the founder’s career, while scores closer to 1 indicate negligible impact. An “overall NOC contribution” score was calculated by taking the mean across the five items. The overall score averages close to 4, suggesting that the NOC program on the whole has had moderate impact on founders’ careers. The most highly-rated impact of NOC is on founders’ confidence in their abilities as entrepreneurs, with scores above 4. The area with lowest perceived impact of NOC is market access, where scores are slightly higher than the midpoint of 3, indicating some impact. Comparing current and past entrepreneurs, the only area of significant difference was “practical skills & knowledge to run a startup”, which was more highly rated by current entrepreneurs.

Table 5-6: Contribution of NOC Program to Entrepreneurial Career

Impact rated on 5 point scale where 1= No Impact, 3=Some Impact, 5=Great Impact	All Alumni-Entrepreneur	Current Entrepreneur	Past Entrepreneur	Sig. (t-test)
Coming up with Business Ideas	3.87	3.87	3.86	0.916
Confidence in Abilities as Entrepreneur	4.14	4.24	4.05	0.114
Network of Useful Contacts	3.78	3.76	3.80	0.773
Practical skills & knowledge to run a startup	3.86	3.97	3.75	0.073 *
Market Access	3.07	3.04	3.11	0.642
Overall NOC Contribution (Cronbach α = 0.82)	3.74	3.78	3.71	0.541

* significant at 10%

Figure 5-6 plots the “overall NOC contribution” score by NOC program location. Variation in trends across the colleges is observed. Founders from the Silicon Valley, Stockholm, Singapore, Israel and Beijing programs gave high ratings. Relative to other locations, founders from India perceived the lowest impact. Less variation overall NOC impact was observed across faculties (**Figure 5-7**). The highest impact ratings on average were given by founders who graduated from Business and Engineering.

Figure 5-6: Overall Contribution of NOC Program to Entrepreneurial Career by NOC Location

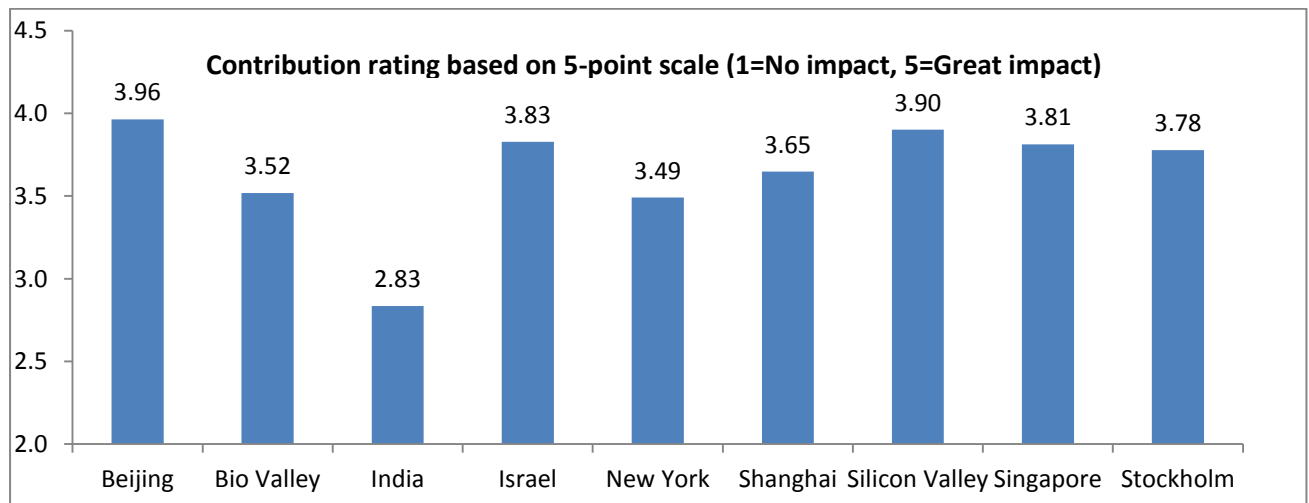
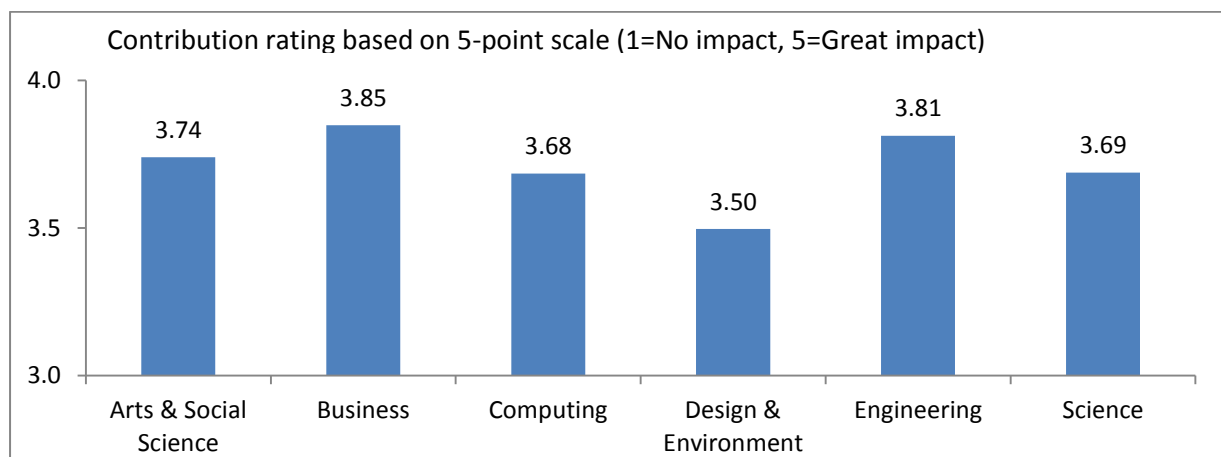


Figure 5-7: Contribution of NOC Program to Entrepreneurial Career by Faculty

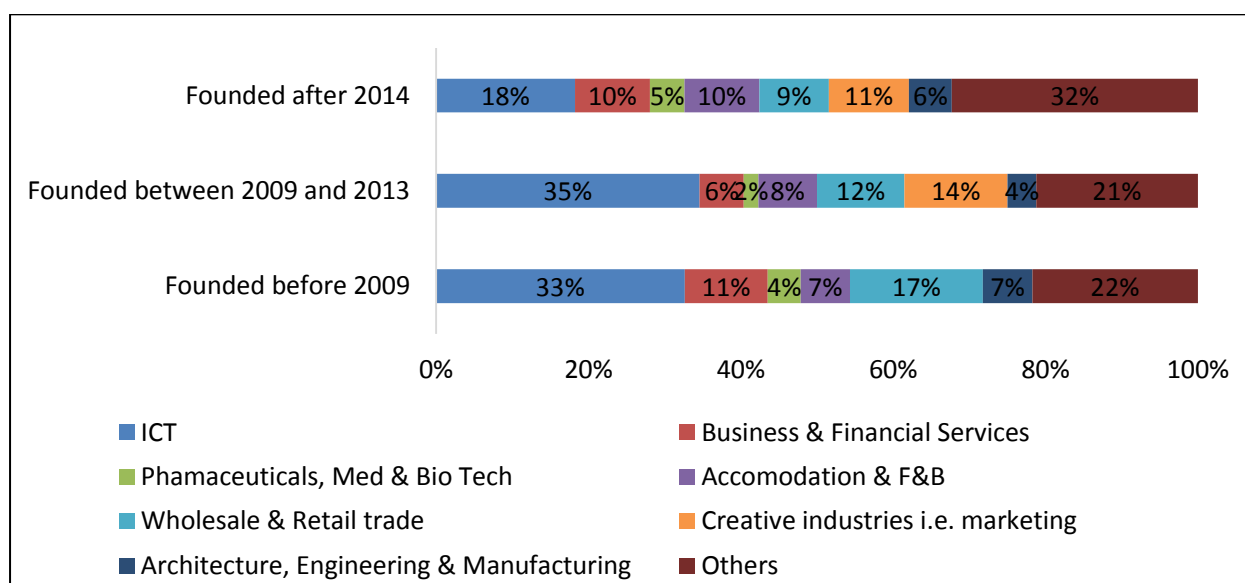


Profile of Live Startups founded by NOC Alumni

This section presents an overview of 248 startups founded by NOC alumni who responded to the survey. Only startups that are alive and active at the point of the survey are included.

From **Figure 5-8**, startups founded in earlier years tended to be concentrated in ICT, Business & Financial Services and Wholesale & Retail. In particular, the ICT sector alone accounted for one third of alumni-founded startups prior to 2009. In the last five years, NOC startups have become more diversified, with only 18% being ICT-related firms.

Figure 5-8: Main Industry of Live Alumni-Founded Startups



The majority of alumni-founded startups are still quite small with fewer than 5 employees (**Figure 5-9**). This is especially true of the younger firms founded after 2014, but a similar trend is observed among startups established more than 10 years ago. An exception to this is seen among the startups founded in the period 2009-2013. There has been notable growth in this group, with half the startups having at least 10 employees and as many as 22% with employment size above 50 people.

The relatively small employment size of NOC startups is echoed in revenue figures (**Figure 5-10**). The majority of firms founded after 2014 and before 2009 earned less than \$100,000 in the most recent fiscal year. Again, the exception is found among startups founded in the period 2009-2013. Here, only 18% reported revenues below \$100,000, and 42% achieved revenues in excess of \$1 million.

As many NOC startups are operating at a small scale, the majority of them have not raised external funding, as seen in **Figure 5-11**. Among the more mature startups founded prior to 2009, 13% have raised Series A and higher in their most recent funding round, with 7% having raised funding beyond Series C. The proportion of startups with Series A and higher funding is 22% in the group of startups established in 2009-2013. However, only 8% have raised beyond Series A.

Figure 5-9: Employment Size of Live Alumni-Founded Startups

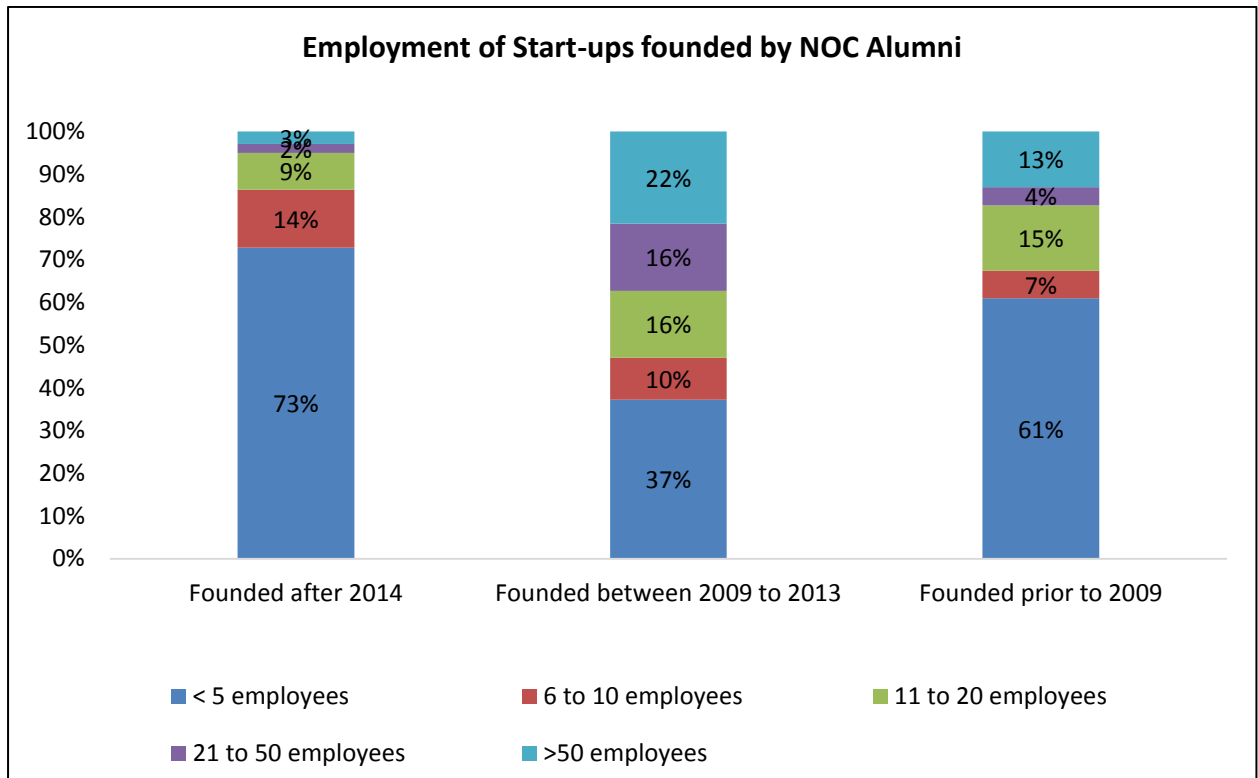


Figure 5-10: Annual Revenue (most recent fiscal year) of Live Alumni-Founded Startups

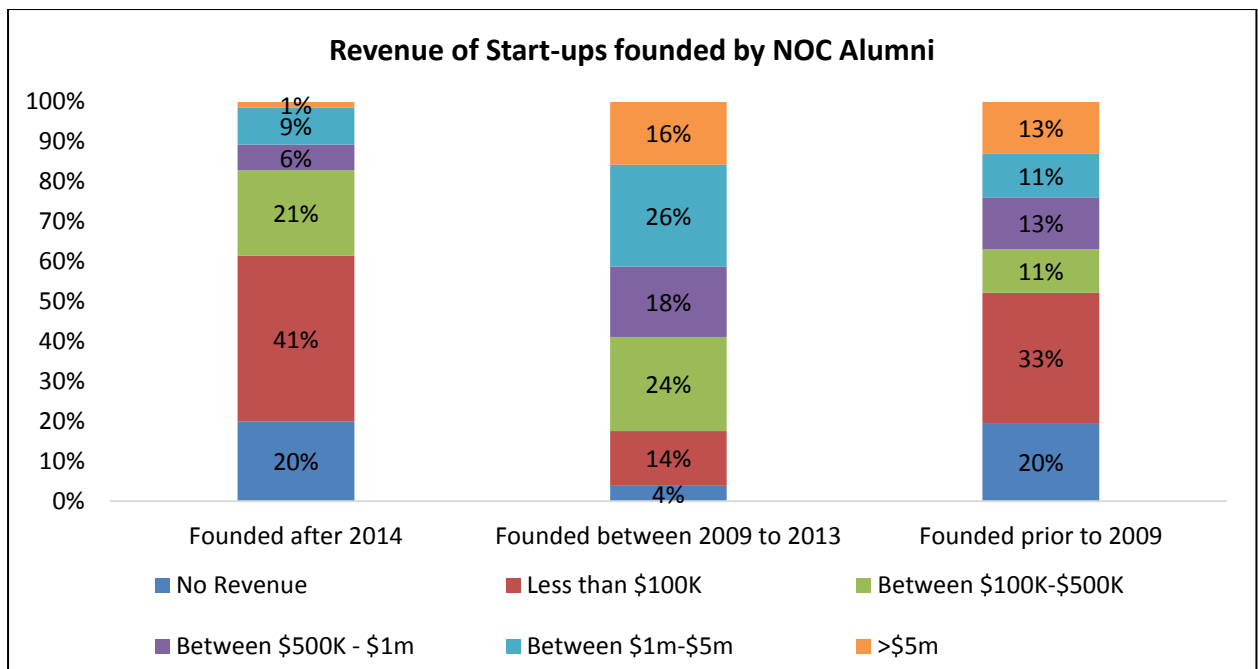
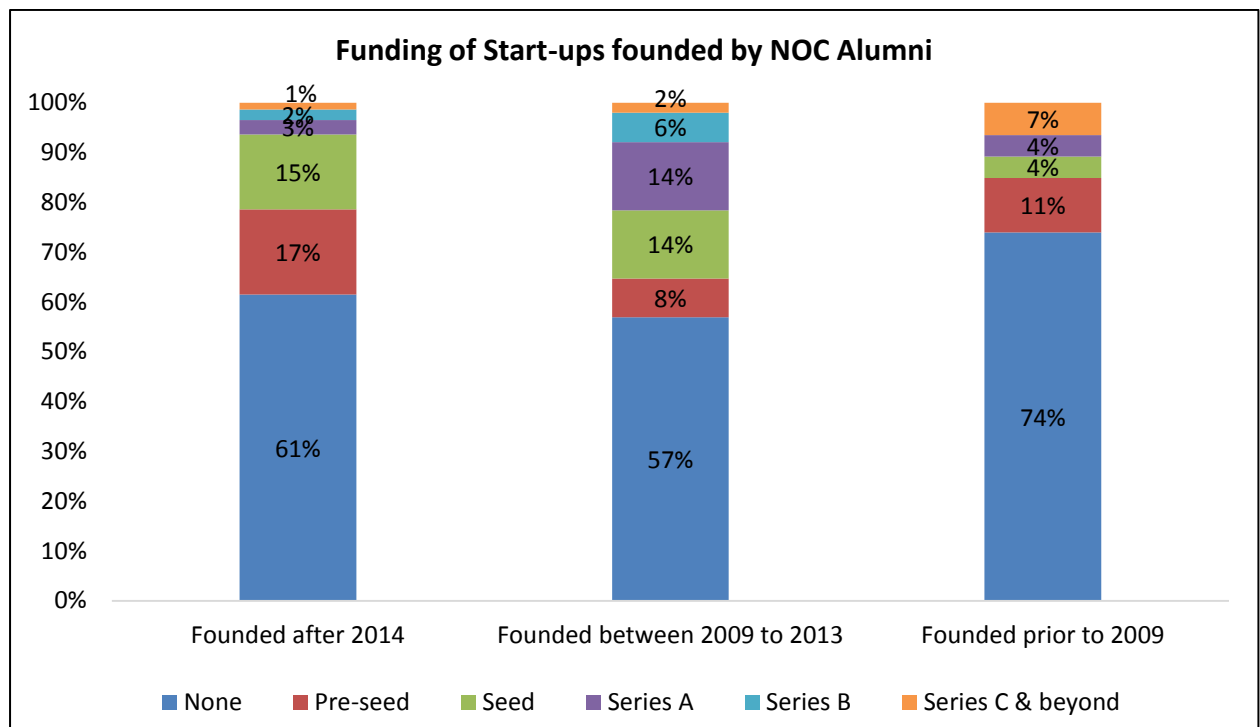
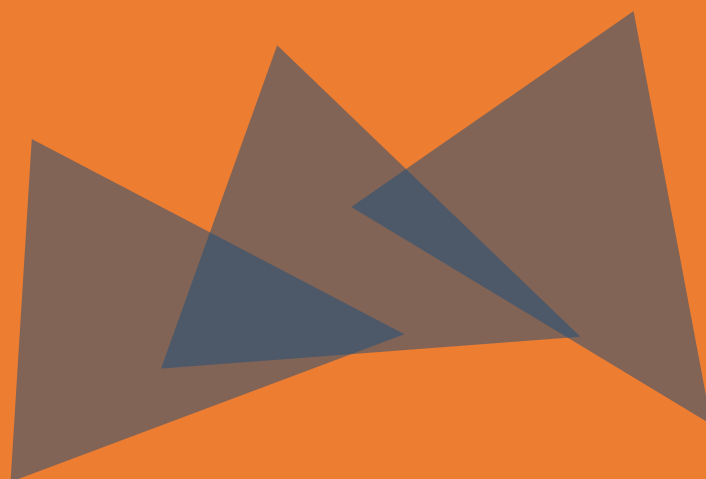


Figure 5-11: Most Recent Funding Round of Live Alumni-Founded Startups



6

INVOLVEMENT IN INNOVATION AND ENTREPRENEURSHIP (I&E) ACTIVITIES



6. INVOLVEMENT IN INNOVATION AND ENTREPRENEURSHIP (I&E) ACTIVITIES

This section presents analysis of engagement by NOC alumni in activities related to Innovation and Entrepreneurship (I&E). The impact of the NOC program should be viewed through a more expansive lens, to encompass not just venture creation but other economic activities of alumni which contribute to the I&E ecosystem in Singapore and beyond. As the analysis is concerned with post-university activities, this section solely addresses graduated NOC alumni.

Entrepreneurship Ecosystem

For the purposes of this analysis, the entrepreneurship ecosystem comprises new and young startups, and the network of actors and organizations that support, enable and facilitate the economic activities of startups. We categorize NOC alumni as being involved in the entrepreneurship ecosystem if they play at least one of these three roles: (i) Entrepreneur who runs a startup which they founded, (ii) salaried employee in a startup, (iii) salaried employee or doing any form of paid work in non-startup organisations where the work involves supporting startup-related activities.

Table 6-1 reports the extent of NOC alumni involvement in the Entrepreneurship Ecosystem and the various roles played. Almost eight in ten (79%) of graduated NOC alumni have worked in the ecosystem at some point in their career. As some of them have since left the ecosystem, the current level of ecosystem involvement is 51.3% of alumni. More than half have been employed in startups, while 44.6% have worked in other parts of the ecosystem in organizations such as incubators and VCs.

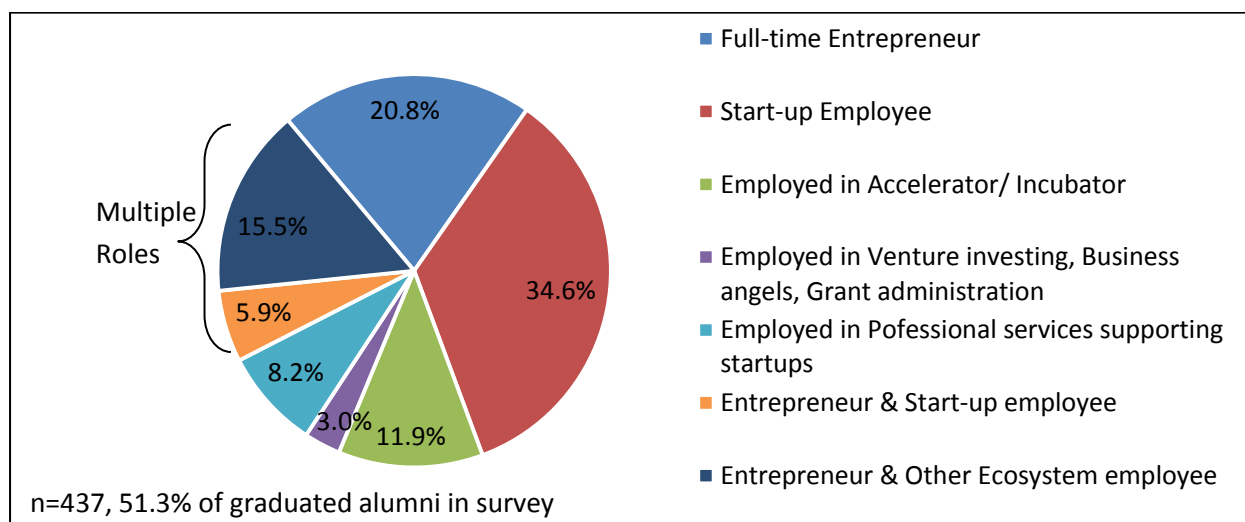
Table 6-1: Involvement of Graduated Alumni in Entrepreneurship Ecosystem

	Involvement at some point in career	Currently Involved
Involvement in Entrepreneurship Ecosystem	79.0%	51.3%
<i>Role in Ecosystem</i>		
Entrepreneur	33.6%	17.2%
Startup Employee	53.3%	23.8%
Working in other parts of Ecosystem		
Accelerator / Incubator	43.8%	12.4%
Venture investing / Business Angels / Startup grant administration	22.8%	7.9%
Training & Mentoring of startups	19.2%	7.6%
Consulting & other professional services for startups	29.6%	10.1%
Media & Publishing on startup ecosystem	15.9%	4.5%
Organizing events for the startup community	27.8%	7.7%
Developing/implementing plans or policies for startup ecosystem development	18.6%	6.9%

Note: Percentages do not sum to 100%. An alumni may be in the ecosystem in more than one capacity. For example, an entrepreneur may also be working in a VC firm at the same time.

Figure 6-1 shows the roles played by NOC alumni who are currently working in the startup ecosystem. One in five are involved as full-time entrepreneurs, while another 22% are entrepreneurs who are at the same time working in another startup (5.9%) or in other parts of the ecosystem (15.5%). Around one quarter are working full-time in organizations that support startups, with 11.9% employed by accelerators / incubators.

Figure 6-1: Roles played by Alumni Currently in Entrepreneurship Ecosystem



The extent of ecosystem involvement is consistently high across all the intake batches, as seen in **Figure 6-2**. Highest total and current participation is found among alumni in the 2006-2009 intake cohorts. Correspondingly, involvement is also consistently high regardless of when the alumni graduated from NUS (**Figure 6-3**). Interestingly, very recent graduates who left NUS in 2018 have relatively high ecosystem-attribution. While 74% of them have worked in the ecosystem since graduation, as many as 30.8% have already left the ecosystem to pursue other career options.

More variation is seen when comparing across different NOC locations (**Figure 6-4**). New York, Stockholm and Silicon Valley have produced alumni with the highest levels of ecosystem involvement, with over 80% having been in the ecosystem. In fact, over 60% of SV alumni are currently working in the ecosystem. The Asian locations have yielded comparably lower ecosystem participation. Current participation levels are notably lower among alumni of NOC Singapore, India, Beijing and Shanghai, averaging around 40% compared to the overall average of 51%. **Figure 6-5** shows that graduates from two Schools - Design & Environment and Computing – have highest propensity to be in the ecosystem.

Alumni who are based overseas have higher likelihood of currently being in the startup ecosystem (56.8% compared to 50.3% of locally-based alumni), as shown in **Figure 6-6**. There are also distinctions along gender lines. Female alumni who are overseas have the higher propensity to be in the ecosystem (59.4%) than male counterparts located either overseas (55.7%) or in Singapore (54.7%).

Figure 6-2: Involvement in Entrepreneurship Ecosystem by Intake Year

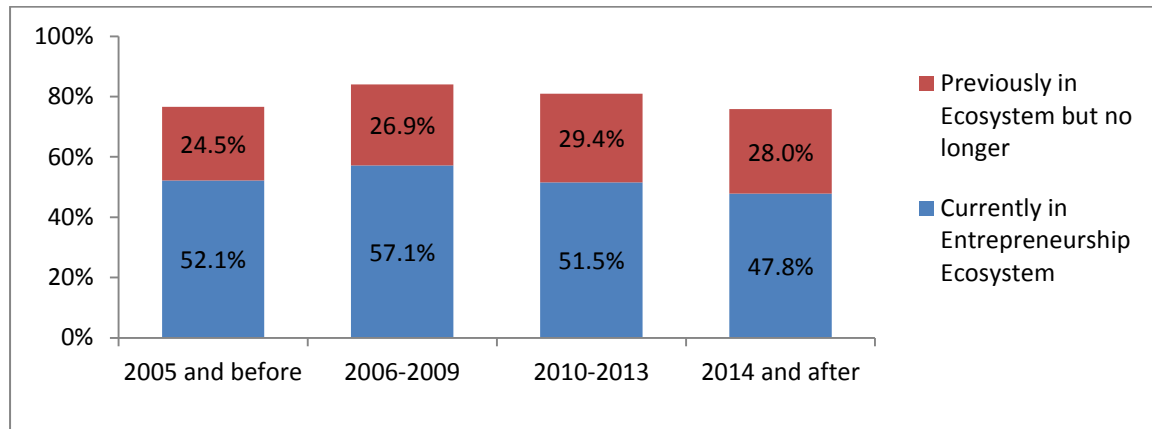


Figure 6-3: Involvement in Entrepreneurship Ecosystem by Graduation Year

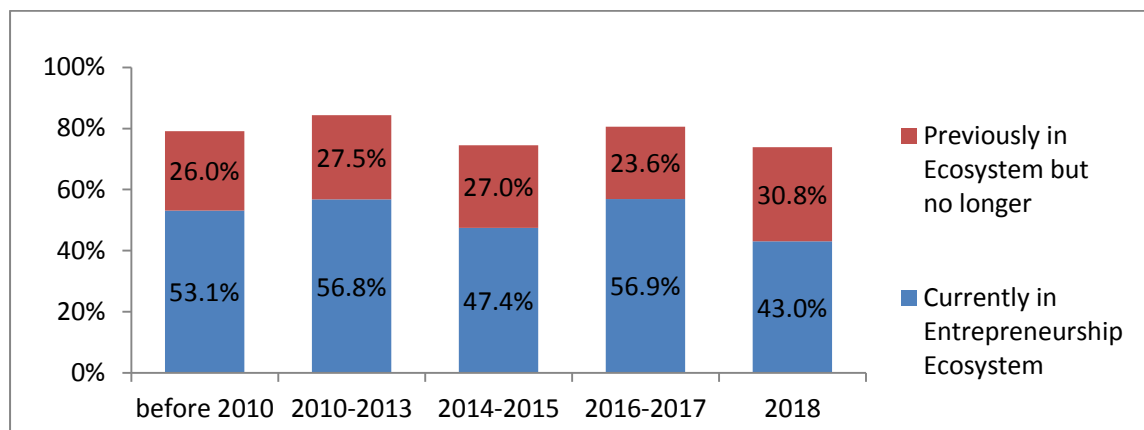


Figure 6-4: Involvement in Entrepreneurship Ecosystem by NOC Location

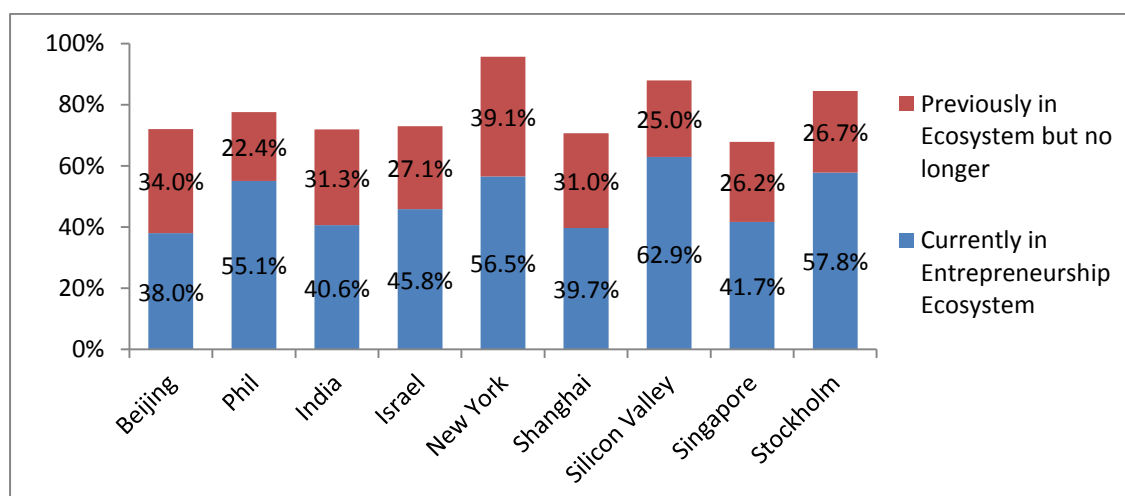


Figure 6-5: Involvement in Entrepreneurship Ecosystem by Faculty

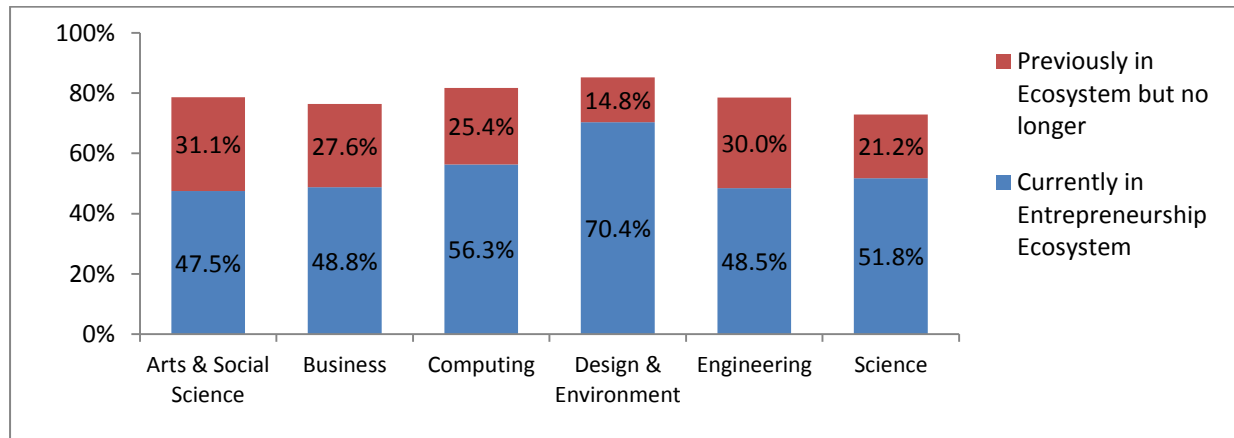
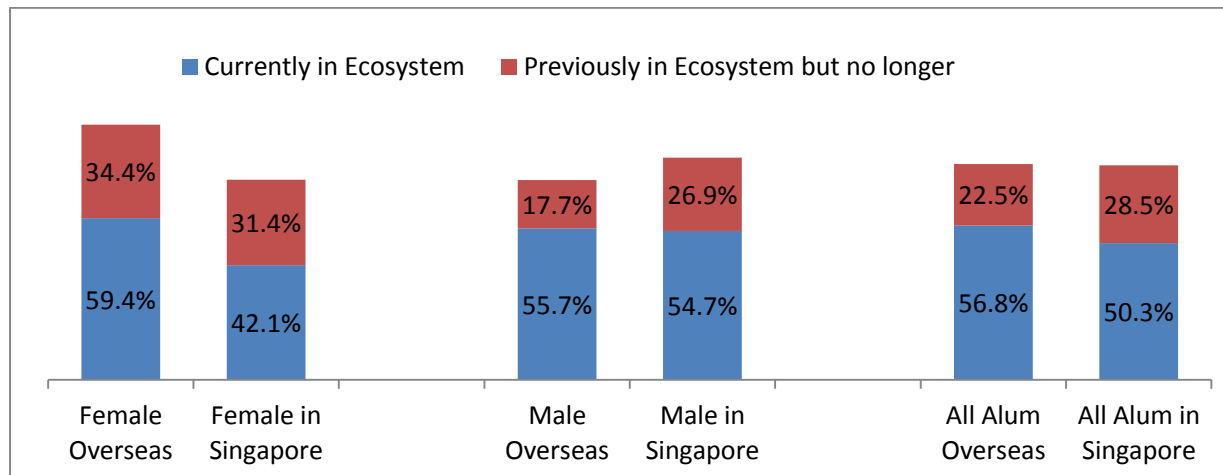


Figure 6-6: Involvement in Entrepreneurship Ecosystem by Gender and Current Location



Innovation and New Business Development

While entrepreneurs create new ventures, non-founders can be involved in starting or developing activities within existing organizational structures. Such “intrapreneurial” endeavors are vital components of the innovation-based economy and therefore of interest when assessing outcomes of the NOC program. We examine in particular the extent to which alumni are involved in innovation and new business development (NBD) roles in organizations at which they are employed or work in some paid capacity. By definition, entrepreneurs are excluded from this analysis and the sample analysed comprises graduates who have previously been or are currently salaried employees or doing other forms of paid work. For convenience, this group will be referred to as “employees” or “employed alumni”.

The questionnaire specified five activities that are related to innovation and NBD, as detailed in **Table 6-2**. The vast majority (85%) of employed alumni have conducted at least one of these activities in their jobs, with 69.6% doing so in their current jobs. The most prevalent innovation role is New Product Development (NBD), followed by business development and process innovation.

Table 6-2: Innovation & New Business Development Roles of Employed Alumni

Base is graduated alumni who have been employed or engaged in other paid work	Did at some point in career	Currently doing
Involved in Innovation & New business development roles	84.5%	69.6%
Business development & R&D feasibility studies	63.6%	42.5%
New Product Development	65.7%	46.1%
Process Innovation Projects	60.5%	45.4%
IP Management	19.3%	11.4%
Technology sourcing and licensing	33.1%	22.3%

Those who are currently employed in startups are most likely to be in innovation & NBD roles (85.9%), compared to counterparts who work elsewhere in the startup ecosystem (64.4%) and those employed outside the startup ecosystem (60.6%). From **Table 6-3**, we further observe that startup employees have much higher propensity to be in new product development (NPD) roles (69.3%) than other employees. Among alumni who are employed outside the ecosystem, process innovation (41.5%) is the most common innovation-related role, and relatively few (25.1%) are involved in business development.

Table 6-3: Innovation & New Business Development Roles by Current Ecosystem Involvement

% who are currently playing innovation & NBD roles	Startup Employee	Working in other parts of startup ecosystem	Employed in Established Organizations outside ecosystem
Currently plays Innovation & NBD role	85.9%	64.4%	60.6%
Business development & R&D feasibility studies	53.4%	75.8%	25.1%
New Product Development	69.3%	58.4%	33.2%
Process Innovation Projects	50.4%	63.9%	41.5%
IP Management	12.6%	23.1%	6.5%
Technology sourcing and licensing	23.6%	40.1%	16.3%

Those employed by the public sector and IHLs have comparably lower level of involvement in innovation and NBD (Table 6-4). Nonetheless, over half are working on process innovation projects in their jobs. Two-thirds of those working in established private sector firms have NBD-related jobs (66.4% versus 85.9% of startup employees). There is particularly healthy representation of such employees in business development (38.6%), NPD (39.4%) and process innovation (42.5%) roles.

Table 6-4: Innovation & New Business Development Roles by Organization Type of Current Employer

% who are currently playing innovation & NBD roles	Public Sector	Not-for-profit, NGOs, charity etc.	Startup	Other private sector company	IHL
Currently plays Innovation & NBD role	59.7%	75.0%	85.9%	66.4%	61.5%
Business development & R&D feasibility studies	27.4%	45.5%	53.4%	38.6%	44.7%
New Product Development	32.9%	45.5%	69.3%	39.4%	43.6%
Process Innovation Projects	53.4%	33.3%	50.4%	42.5%	52.6%
IP Management	8.2%	8.3%	12.6%	9.0%	23.1%
Technology sourcing and licensing	23.3%	33.3%	23.6%	22.1%	23.7%

Table 6-5 reports the proportion of alumni from different NOC locations involved in at least one innovation and NBD-related activity in their current job. Interestingly, alumni from NOC Singapore and NOC India who are employed in startups have lower likelihood of being in an NBD role, compared to startup employees from other locations.

Table 6-5: Current Innovation & NBD Role by Ecosystem Involvement and NOC Location

% of working alumni (excluding founders) who currently play Innovation & NBD role in their organizations	Startup Employee	Working in other parts of startup ecosystem	Employed in Established Organizations outside ecosystem
Beijing	90.0%	100.0%	70.4%
Bio Valley	88.9%	96.3%	50.0%
India	50.0%	87.5%	61.1%
Israel	87.5%	77.8%	68.4%
New York	88.9%	100.0%	100.0%
Shanghai	95.0%	81.8%	51.4%
Silicon Valley	84.3%	90.4%	65.8%
Singapore	68.8%	100.0%	67.6%
Stockholm	96.2%	84.2%	56.0%

Table 6-6 reports the proportion of alumni from different faculties involved in at least one innovation and NBD-related activity in their current job. For those employed in startups and other parts of the entrepreneurship ecosystem, involvement in innovation is uniformly high regardless of faculty. Among alumni working outside the ecosystem, alumni from Computing, Engineering and Design & Environment have higher probability of being in innovation and NBD roles. This is perhaps linked to the technical training of graduates from these faculties.

Table 6-6: Current Innovation & NBD Role by Ecosystem Involvement and Faculty

% of working alumni (excluding founders) who currently play Innovation & NBD role in their organizations	Startup Employee	Working in other parts of startup ecosystem	Employed in Established Organizations outside ecosystem
Arts & Social Science	84.0%	84.0%	53.8%
Business	88.2%	88.2%	53.1%
Computing	85.0%	85.0%	60.8%
Design & Environment	87.5%	87.5%	77.8%
Engineering	93.4%	93.4%	68.6%
Science	94.7%	94.7%	51.6%
Others	80.0%	80.0%	55.6%

The likelihood of being involved in intrapreneurship increases with experience. As shown in **Figure 6-7**, over 90% of alumni who graduated five years or more ago have worked in innovation and NBD roles, compared to less than 80% of new graduates. Intrapreneurship is also more prevalent among alumni who are overseas based (**Figure 6-8**) and male alumni (**Figure 6-9**).

Figure 6-7: Innovation & NBD Role by Year of University Graduation

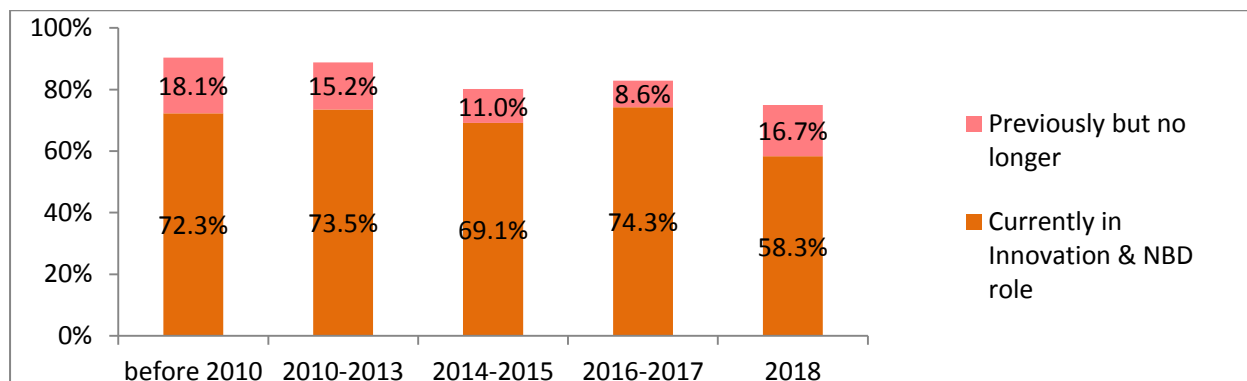


Figure 6-8: Innovation & NBD Role by Current Location of Alumni

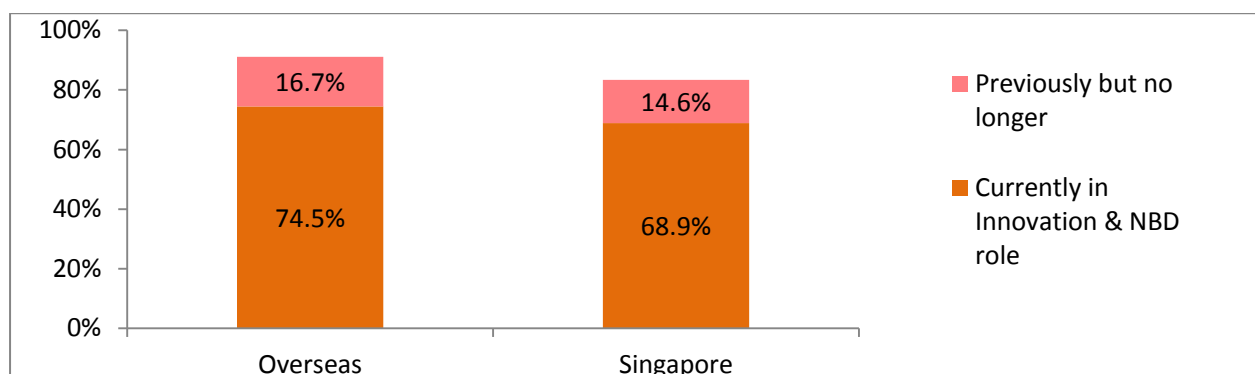


Figure 6-9: Innovation & NBD Role by Gender

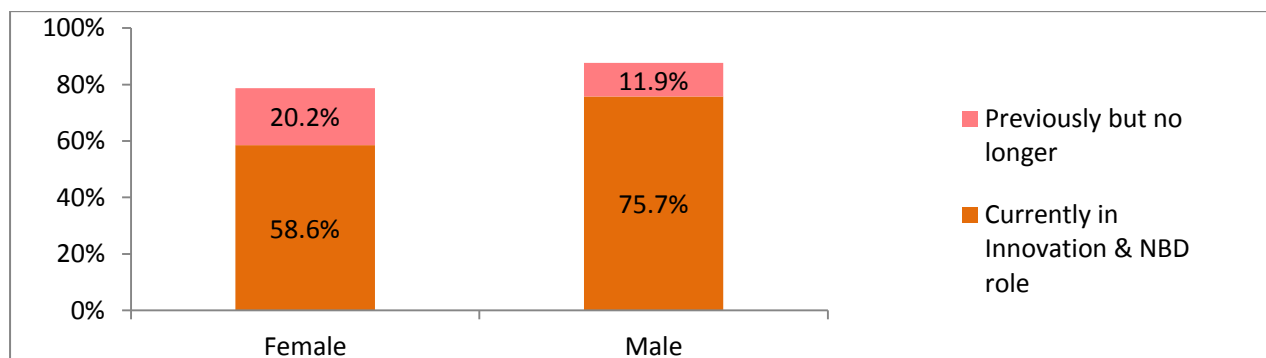


Figure 6-10 highlights several NOC alumni that play significant intrapreneurial I&NBD roles in technology-based startups and large companies. Notably, these NOC alumni have made their mark in firms with global and regional reach, and have attained positions of seniority.

Figure 6-10: NOC Alumni in Intrapreneur Roles



7

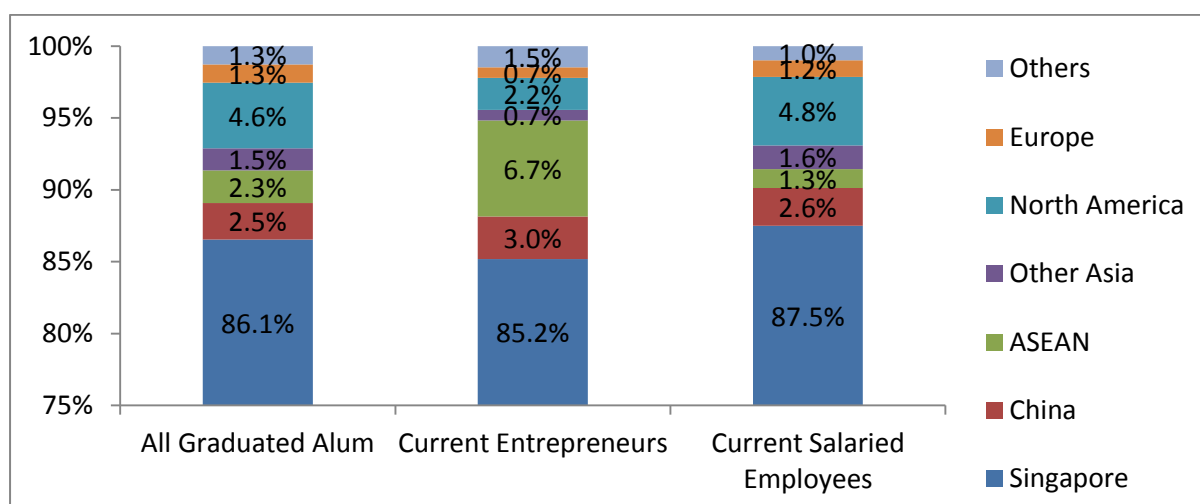
INTERNATIONAL MOBILITY OF NOC ALUMNI



7. INTERNATIONAL MOBILITY OF NOC ALUMNI

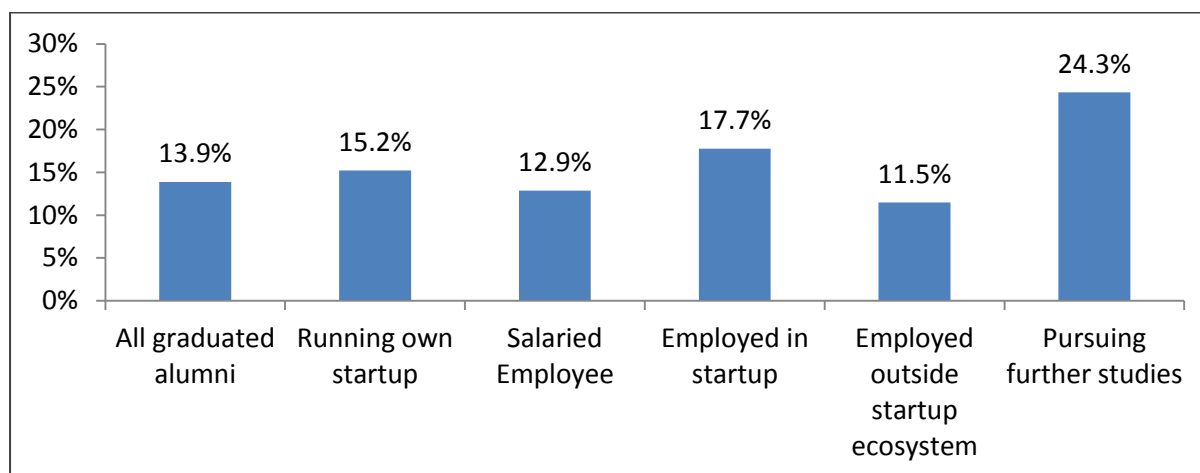
The NOC program prepares students to be global citizens, equipping them with skills and capabilities that enhance their international mobility. Being based outside of Singapore is an indication of the internationalization propensity of NOC alumni. While the majority of NOC alumni are pursuing their post-university careers in Singapore, 13.9% of them are based overseas and are located in different regions all around the world (**Figure 7-1**). This estimate of overseas-based alumni may in fact be lower than the actual proportion, as responses from outside Singapore are likely to be under-represented in the survey sample.

Figure 7-1: Current Geographic Location of Graduated Alumni



The extent of internationalization differs by the career status of alumni, as seen in **Figure 7-2**. As expected, those pursuing further studies have the highest likelihood to be based overseas (24.3%). Among those who are economically active, active entrepreneurs and startup employees have higher probability of locating overseas (15.2% and 17.7% respectively) compared to those who are salaried employees and employed outside the startup ecosystem.

Figure 7-2: Graduated Alumni Located Overseas, by Career Status



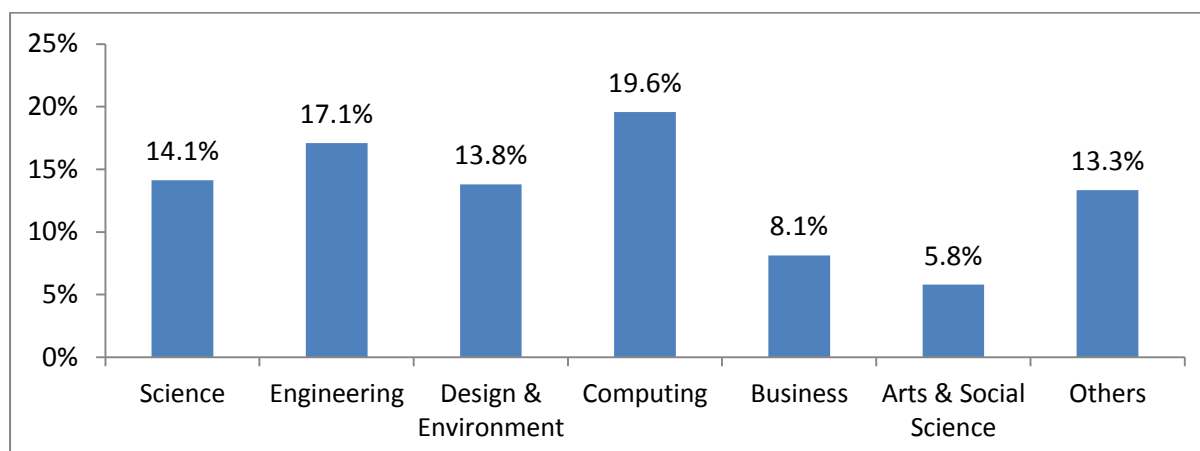
Internationalization propensity increases with experience level. Alumni who have been in the workforce longer have higher probability of locating overseas compared to more recent graduates (**Table 7-1**). Comparing across the different NOC locations, alumni from the more established programs in Silicon Valley and Stockholm have highest proportion of internally-located alumni (**Table 7-1**). This in part explained by the presence of older, more experienced alumni from these locations, compared to program locations launched after 2010.

Table 7-1: Graduated Alumni Located Overseas, by Program Location and Graduation Year

Program Location	Year of Graduation					All years
	2018	2016-2017	2014-2015	2010-2013	before 2010	
Beijing		10.5%	12.5%	13.3%		10.0%
Philadelphia			20.0%	9.4%	18.4%	14.3%
India			8.3%	17.6%		12.5%
Israel		3.7%		50.0%		4.2%
Shanghai			9.5%	16.7%	29.0%	11.9%
Silicon Valley		12.9%	7.7%	23.9%	26.3%	18.8%
Singapore		9.1%	14.8%	5.0%		8.4%
Stockholm	50.0%	4.5%	17.6%	29.2%	23.5%	19.1%
All Locations	6.4%	6.9%	7.3%	17.4%	24.3%	

Alumni who graduated with STEM-related degrees exhibit stronger internationalization tendencies than their counterparts with degrees in Business and Humanities (**Figure 7-3**).

Figure 7-3: Graduated Alumni Located Overseas, by Faculty Affiliation



Citizens of Singapore are less likely to relocate overseas than alumni who are Permanent Residents (PR) or foreigners (**Figure 7-4**). Almost one-third (32.8%) of the latter group have moved out of Singapore since graduating from NUS. Interestingly, only 10.4% returned to their countries of origin while the other 22.4% moved to other overseas locations. This testifies to the international mobility of NOC graduates.

Figure 7-4: Proportion of Graduated Alumni Located Overseas, by Citizenship Status

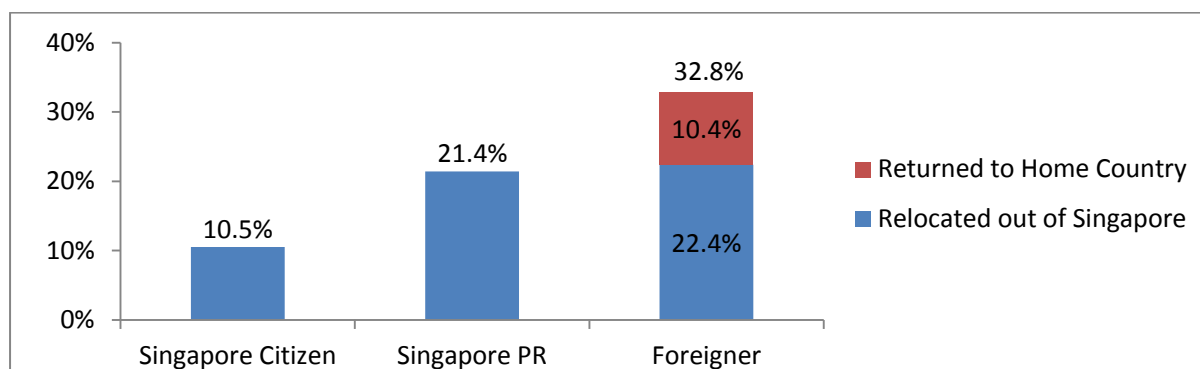
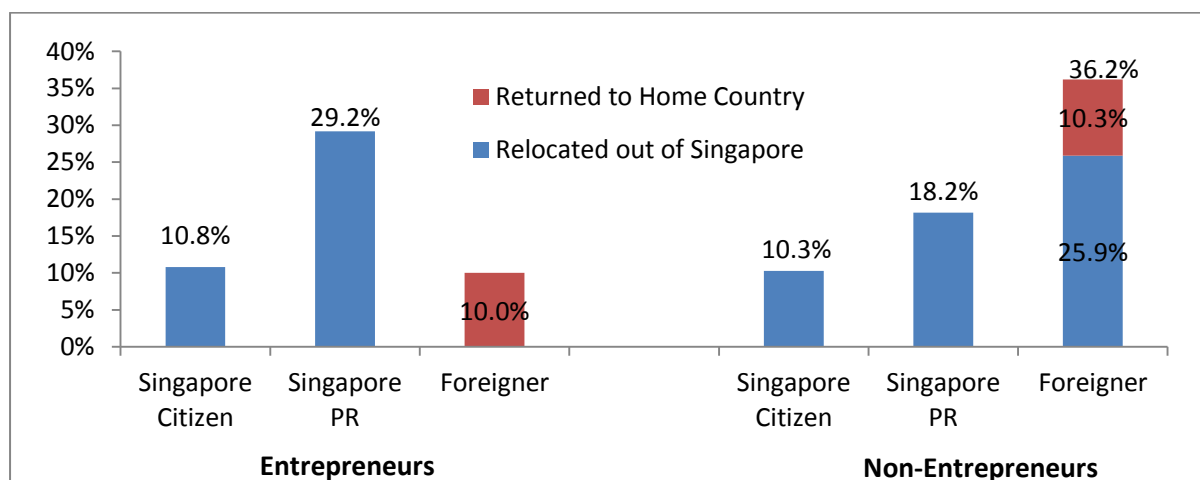


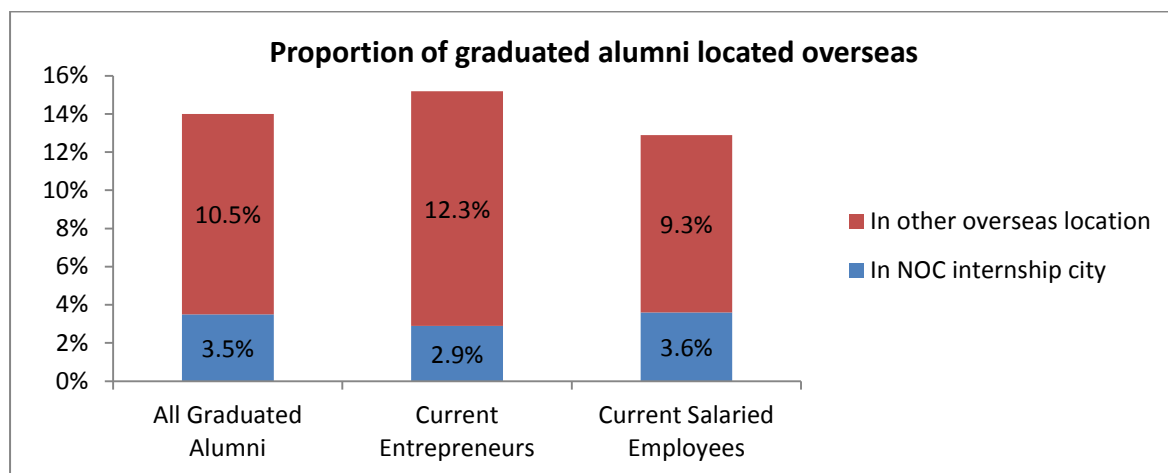
Figure 7-5 compares international propensity levels of entrepreneurs and non-entrepreneurs of different citizenship status. There is no significant difference between entrepreneurs and non-entrepreneurs who are Singapore citizens, with around 10% locating overseas. Singaporean PRs who are entrepreneurs have a higher probability of relocating internationally (29.2%) compared to PRs who are non-entrepreneurs (18.2%). Most of the foreigners who became entrepreneurs are located in Singapore, with only 10% overseas, all of whom returned to their home countries. Foreign students in the NOC program who pursued entrepreneurship after graduation have largely chosen to start-up in Singapore.

Figure 7-5: Graduated Alumni Located Overseas, by Citizenship and Entrepreneurship Status



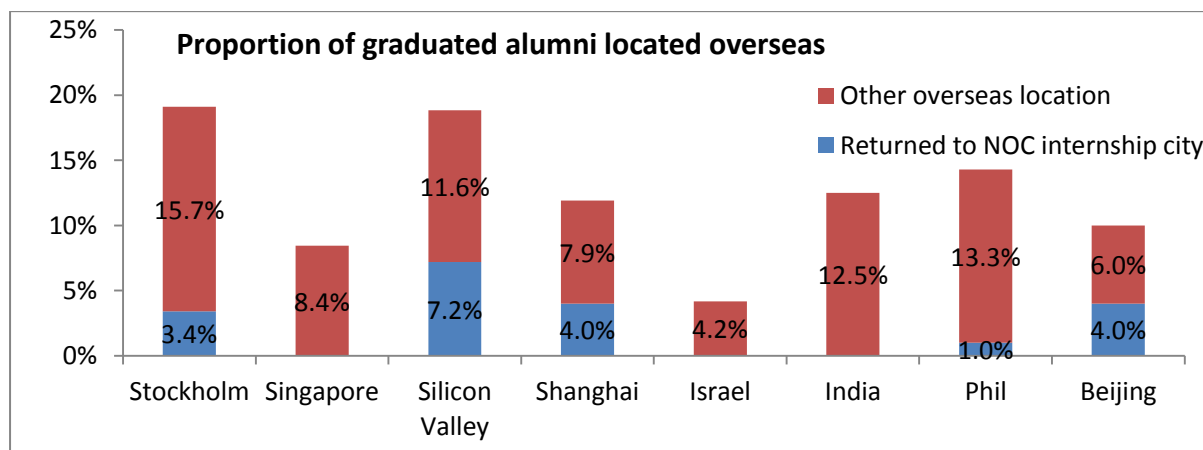
The international mobility of NOC graduates is not confined to NOC program locations. By and large, alumni based outside Singapore have moved to places other than the cities of their internship experience (**Figure 7-6**). Among the 15.2% of entrepreneurs who are based overseas, only 2.9% returned to their NOC internship city to establish their startups while the rest have ventured to other locations.

Figure 7-6: Graduate Alumni Returning to NOC Internship City



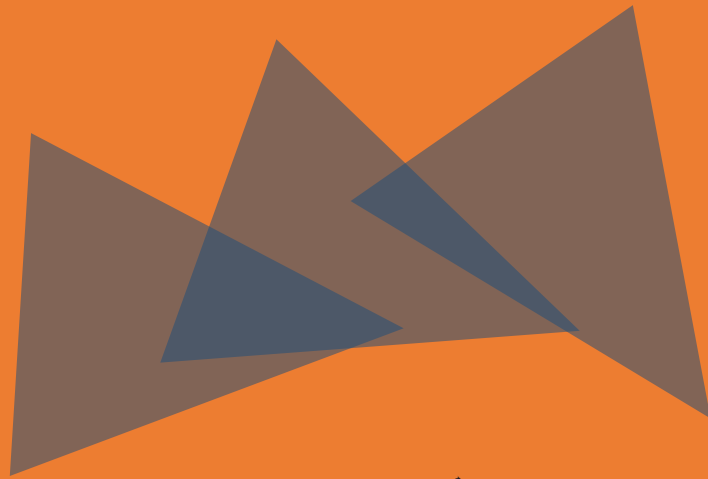
The likelihood of returning to the NOC internship city is highest among alumni from Silicon Valley (**Figure 7-7**). Of the 18.8% of SV alumni who are now based outside of Singapore, 7.2% have chosen to return to that area. We also observed relatively higher return rates among those who interned in the Chinese cities of Shanghai (4% out of 11.9% overseas-based alumni) and Beijing (4% out of 10%). Across all locations, the figures affirm that most internationally mobile NOC alumni have moved to new places beyond the NOC host cities.

Figure 7-7: Graduate Alumni Returning to NOC Internship City, by Program Location



8

NOC PROGRAM ASSESSMENT



8. NOC PROGRAM ASSESSMENT

Overall Satisfaction Rating

NOC Alumni are highly satisfied with the NOC program, as shown in **Table 8-1**. Overall, less than 2% of alumni were undecided or dissatisfied. Among graduated alumni, close to two thirds (64.9%) were “very satisfied”, while 32.5% were satisfied. Among undergraduates, more rated themselves as 4=satisfied (49.5%) than the highest rating of 5=very satisfied (43.6%). The average satisfaction score calculated on a 5-point Likert scale was 4.59 for graduates and 4.36 for undergraduates. The t-statistic supports that the difference is statistically significant.

Table 8-1: Overall satisfaction with NOC program by graduation status

	Graduates (N=797)	Undergraduates (N=187)	Total Sample (N=984)
1 Very dissatisfied	1.7%		1.4%
2 Dissatisfied		1.0%	0.2%
3 Undecided	0.9%	5.9%	1.9%
4 Satisfied	32.5%	49.5%	35.9%
5 Very satisfied	64.9%	43.6%	60.6%
	100.0%	100.0%	100.0%
Average Satisfaction Rating (5-point scale)	4.59	4.36	4.54
	t = 4.225, p = 0.000 ***		

Table 8-2 compares the average satisfaction rating of graduates and undergraduates across intake batches, NOC locations and faculties of alumni. Satisfaction level for graduates declines with intake recency, with those from the latest batches showing slightly lower level of satisfaction than those before 2010.

Comparing across NOC locations, graduated alumni from the American campuses (NY, SV and BV Philadelphia) and Stockholm expressed highest satisfaction. The Munich program was less well-rated, but it should be noted that there number of responses from this location was quite small. For the undergraduates sample, those from New York were the most satisfied and those from Stockholm the least.

The difference in satisfaction level across different faculties was minimal for the graduates subsample. Alumni who graduated from the Faculty of Arts and Social Sciences and the Faculty of Engineering were slightly more satisfied than those from other faculties. Among the undergraduates, those in the School of Design & Environment expressed highest satisfaction with NOC. There was lower satisfaction perceived by those from Computing and the category of “Other” faculties comprising joint programs, ISS and NGS.

Table 8-2: Overall Satisfaction with NOC program by Intake Year, NOC Location, Faculty

Average Satisfaction Rating (5-point scale)	Graduates (N=797)	Undergraduates (N=187)	Total Sample (N=984)
Intake year			
2005 and before	4.72		4.72
2006-2009	4.71		4.71
2010-2013	4.62		4.62
2014 and after	4.46	4.36	4.43
NOC Location			
Beijing	4.62	4.14	4.44
Bio Valley	4.64		4.64
India	4.47		4.47
Israel	4.50	4.40	4.47
Lausanne	4.56		4.56
Munich	3.33		3.33
New York	4.66	4.74	4.70
Shanghai	4.52	4.54	4.53
Silicon Valley	4.66	4.36	4.60
Singapore	4.45	4.17	4.40
Stockholm	4.63	4.10	4.53
Faculty			
Arts & Social Science	4.69	4.37	4.62
Business	4.55	4.38	4.51
Computing	4.54	4.28	4.48
Design & Environment	4.44	4.61	4.49
Engineering	4.64	4.44	4.61
Science	4.52	4.42	4.51
Others	4.40	4.01	4.28

Graduated alumni who are currently active entrepreneurs report higher satisfaction (4.7) with NOC than those who were previously entrepreneurs (4.6) and those who are non-entrepreneurs (4.55) (Table 8-3). This was also observed among undergraduates. The differences between the three groups were statistically significant at 10% for the graduates subsample, and significant at 5% for the undergraduates subsample. We did not find statistically significant difference between satisfaction levels of graduated serial entrepreneurs and single-startup founders.

Table 8-3: Overall Satisfaction with NOC program by Entrepreneurship Experience

Average Satisfaction Rating (5-point scale)	Graduates (N=797)	Undergraduates (N=187)	Total Sample (N=984)
Founding Experience			
Current Entrepreneur	4.70	4.72	4.71
Former Entrepreneur	4.60	4.31	4.57
No founding experience	4.55	4.32	4.50
One-way ANOVA significance	0.064*	0.034**	0.002***
Serial Entrepreneurship			
Founded multiple startups	4.67	5.00	4.68
Single-startup founder	4.65	4.52	4.63
t-test significance	0.799	0.001**	0.562

Perception of NOC Program Impact

Two forms of potential impact of the NOC program were measured: impact on motivation and impact on capability. As shown in **Table 8-4**, alumni were asked to indicate their level of agreement with statements pertaining to how the NOC impact has increased their motivation and desire, and their skills, ability and confidence. The statements differentiated between **entrepreneurship** (developing a new business) and **intrapreneurship** (developing new activities within existing organizations). The findings reveal that for both graduates and undergraduates, the impact of NOC was strongly felt in both areas. Overall impact across the four items was rated highly, averaging 4.31 on a 5-point scale.

Table 8-4: NOC Program Impact by Graduation Status

Average Rating (1=Strongly Disagree, 5=Strongly Agree)	Graduates (N=797)	Undergraduates (N=187)	Total Sample (N=984)
Entrepreneurship Impact			
Increased my motivation & desire to become an entrepreneur	4.21	4.12	4.19
Increased my skills, ability & confidence to start or develop a new business	4.17	4.28	4.19
Intrapreneurship Impact			
Increased my motivation & desire to work for organizations that offer opportunities to start or develop new activities (e.g. developing or launching new goods or services, setting up a new business unit, establishment or subsidiary)	4.47	4.55	4.49
Increased my skills, ability & confidence to start or develop new activities within existing organizations	4.38	4.34	4.37
Overall Impact (Cronbach's $\alpha = 0.690$)	4.31	4.32	4.31

Graduated alumni who are startup founders rated the entrepreneurial impact of NOC more highly, on both the motivation and capability aspects. As seen in **Table 8-5**, the difference in rating for these items by entrepreneurs and non-entrepreneurs is statistically significant. On the other hand, there was no difference between entrepreneurs and non-entrepreneurs in perception of intrapreneurship impact.

Table 8-5: NOC Program Impact by Entrepreneurship Propensity (Graduated Alumni)

Average Rating (1=Strongly Disagree, 5=Strongly Agree)	Non Entrepreneur	Entrepreneur	Significance of t-test
Entrepreneurship Impact			
Increased my motivation & desire to become an entrepreneur	4.06	4.51	0.000***
Increased my skills, ability & confidence to start or develop a new business	4.04	4.42	0.000***
Intrapreneurship Impact			
Increased my motivation & desire to work for organizations that offer opportunities to start or develop new activities	4.48	4.46	0.747
Increased my skills, ability & confidence to start or develop new activities within existing organizations	4.37	4.39	0.760
Overall Impact (Cronbach's $\alpha = 0.690$)	4.24	4.44	0.000***

Alumni who have worked in the startup ecosystem expressed greater appreciation of NOC's impact on their motivations and capabilities compared to those outside of the ecosystem (**Table 8-6**). Both intrapreneurship and entrepreneurship impacts were rated significantly higher by alumni engaged in the ecosystem.

Table 8-6: NOC Program Impact by Ecosystem Involvement (Graduated Alumni)

Average Rating (1=Strongly Disagree, 5=Strongly Agree)	Never been in Ecosystem	In Ecosystem at some point	Significance of t-test
Entrepreneurship Impact			
Increased my motivation & desire to become an entrepreneur	3.94	4.28	0.000***
Increased my skills, ability & confidence to start or develop a new business	3.85	4.25	0.006***
Intrapreneurship Impact			
Increased my motivation & desire to work for organizations that offer opportunities to start or develop new activities	4.34	4.50	0.000***
Increased my skills, ability & confidence to start or develop new activities within existing organizations	4.25	4.41	0.005***
Overall Impact (Cronbach's $\alpha = 0.690$)	4.10	4.36	0.000***

Table 8-7 summarizes the overall impact rating of graduated alumni from different locations. Graduated alumni from Silicon Valley, New York and Israel rated the overall impact highest, while lowest ratings came from India and Munich.

Table 8-7: Overall Impact Rating by NOC Location (Graduated Alumni)

Overall Impact Rating (1=Strongly Disagree, 5=Strongly Agree)	
Beijing	4.30
Bio Valley	4.24
India	4.05
Israel	4.31
Lausanne	4.28
Munich	3.17
New York	4.35
Shanghai	4.19
Silicon Valley	4.47
Singapore	4.25
Stockholm	4.30
Across all Locations	4.31

Assessment of NOC Program Elements

Alumni were asked to rate various elements of the NOC program, as summarized in **Table 8-8**. For both graduates and undergraduates subsamples, the most highly-rated aspect of the NOC program is the experience of living overseas. The internship experience was also well-rated, especially by recently-returned alumni who are still NUS undergraduates.

The NOC program structure was perceived positively, averaging 4 on the 5 point scale. Majority of respondents agree that the NOC curriculum complemented their internship experience and that it was helpful in enhancing their understanding of what it takes to start a business.

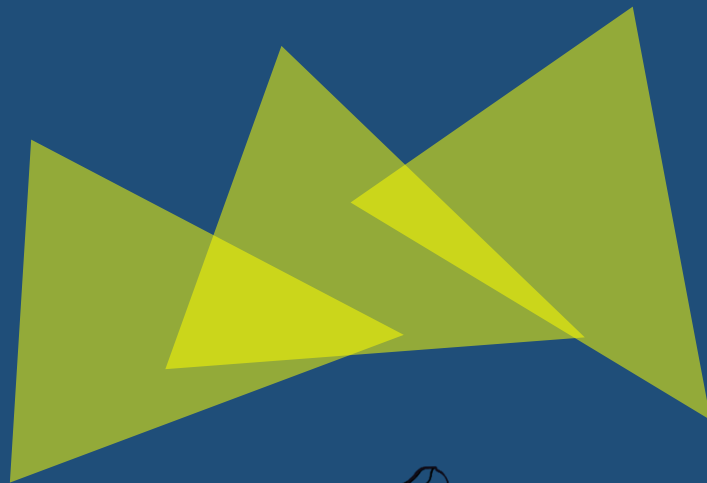
While the ratings for certain individual items point towards possible areas for improvement, it is worth emphasizing that the overall scores are still positive.

Table 8-8: NOC Program Elements by Graduation Status

Average Rating (1=Strongly Disagree, 5=Strongly Agree)	Graduates (N=797)	Under-graduates (N=187)	Total Sample (N=984)
Program Structure	4.06	3.79	4.00
The NOC curriculum was useful in helping me understand what it takes to start a business	4.06	3.91	4.03
The curriculum offered complemented my internship experience	4.05	3.67	3.97
Partner University	3.88	3.70	3.84
The partner university provided a positive learning experience	4.27	4.06	4.23
There was a favourable climate for pursuing new opportunities and innovative ideas at the partner university.	3.95	3.85	3.93
I developed friendships with students at the partner university that continued after the program.	3.41	3.18	3.36
Internship Experience Rating	4.22	4.43	4.26
My internship taught me things that I would never have been able to learn in the classroom.	4.70	4.68	4.69
I felt that the work that I did was meaningful.	4.33	4.51	4.36
My supervisor acted as a mentor and provided constructive feedback on my work performance.	4.20	4.41	4.24
I developed friendship with my co-workers at my internship that continued after the program.	4.21	4.54	4.28
I make it a point to keep in touch with the professional contacts (e.g. investors, suppliers & customers) that I have made during my internship.	3.67	4.03	3.75
Life Overseas	4.61	4.60	4.61
Develop my ability to understand and interact with people from diverse cultural and ethnic backgrounds	4.66	4.68	4.66
Allow me to become more independent/ mature	4.76	4.78	4.77
Enabled me to tolerate ambiguity	4.59	4.57	4.59
Allow me to interact with like-minded individuals in the entrepreneurial ecosystem	4.56	4.52	4.55
Provided an in-depth perspective of startup ecosystems beyond Singapore	4.46	4.47	4.46

9

ENTREPRENEURIAL INTENTIONS



9. ENTREPRENEURIAL INTENTIONS

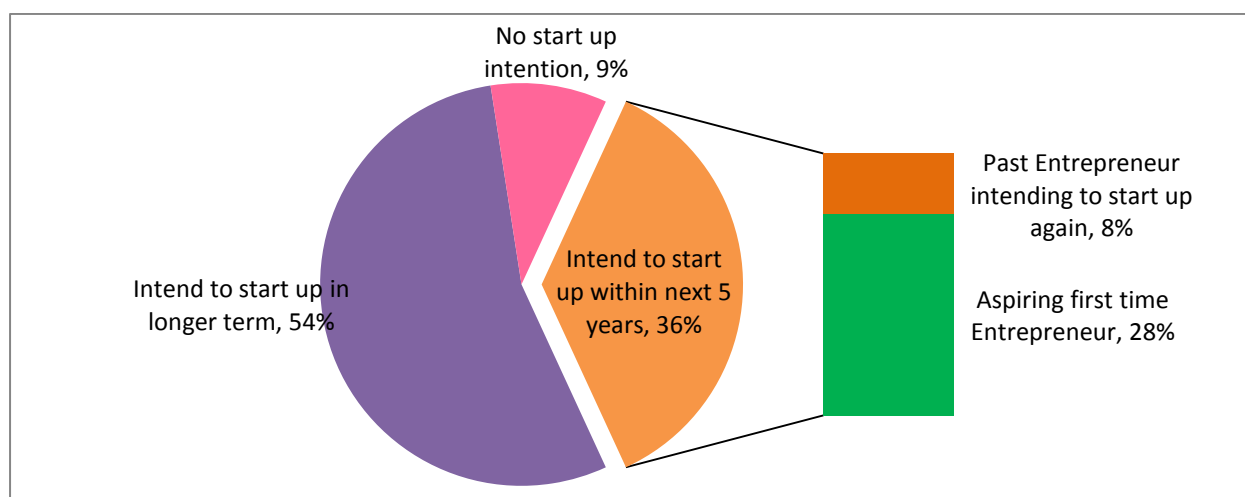
Entrepreneurial intention is defined as having given serious thought to starting a self-owned business. Intention level may range from zero interest to having concrete plans to start a business in the immediate future. In this section, we examine entrepreneurial intention of alumni at the point that the survey was administered. We focus in particular on non-entrepreneurs who express intention to start up within the next five years. By definition, current entrepreneurs are excluded from the analysis.

Fewer than 10% of NOC non-founder alumni state that they have no interest at all to start their own businesses, as shown in **Table 9-1**. The proportion of those without startup intention is higher among graduated alumni (8.2%) than undergraduates (1.7%). This may be partially due to graduated alumni being settled in their careers while undergraduates are still exploring multiple career choices. More than half of non-founder alumni claim some interest to become entrepreneurs but will not do so in the foreseeable future. The proportions are comparable for both graduate and undergraduate subsamples. Among undergraduates, 43.7% are seriously considering entrepreneurship in the short to medium term; as many as 9.8% have concrete plans in place to start up within the next year. The proportion is comparably lower for the graduates subsample (37.8% with intention, of which 5.7% have immediate plans). As shown in **Figure 9-1**, the 36% of graduated alumni with startup intention comprises 8% who are former entrepreneurs and 28% who are aspiring first-time entrepreneurs.

Table 9-1: Current Entrepreneurial Intention of Alumni by Graduation Status

	Graduates (N=797)	Undergraduates (N=187)	Total Sample (N=984)
Intend to start in short to medium term:	36.2%	43.7%	37.8%
<i>within the next year</i>	4.5%	9.8%	5.7%
<i>within next 2-5 years</i>	31.7%	33.9%	32.1%
some interest to start but not in the foreseeable future	53.9%	54.6%	54.0%
no intentions	9.9%	1.7%	8.2%
	100.0%	100.0%	100.0%

Figure 9-1: Current Entrepreneurial Intention of Graduated Alumni



The remainder of this section will focus on entrepreneurial intention of graduated alumni who are non-founders. Those from more recent batches exhibit stronger intentions than earlier graduates. As seen in **Table 9-2**, the share of those with zero intention is lowest in the batches after 2014, while the aspiring entrepreneurs group is proportionally largest among the post-2010 batches.

Table 9-2: Current Entrepreneurial Intention of Graduated Alumni by Intake Year

	2005 and before	2006-2009	2010-2013	2014 and after
Intend to start in short to medium term:	20.9%	32.4%	43.5%	37.1%
<i>within the next year</i>	5.6%	5.3%	3.7%	4.1%
<i>within next 2-5 years</i>	15.3%	27.1%	39.8%	33.1%
some interest to start but not in the foreseeable future	68.0%	52.6%	44.7%	56.4%
no intentions	11.1%	15.0%	11.8%	6.4%
	100.0%	100.0%	100.0%	100.0%

Entrepreneurial intention of graduated alumni varies considerably across the different NOC program locations. **Table 9-3** shows highest intention levels are found among graduates from New York, Israel and Beijing. The Silicon Valley has already been established to have the highest share of alumni-founders. The level of intention among non-founders is also relative high, with over a third expressing start-up intention within the next 5 years. The locations with alumni reporting relatively low intentions are India and Bio Valley (Philadelphia).

Table 9-3: Current Entrepreneurial Intention of Graduated Alumni by NOC Location

	Beijing	Philadelphia	India	Israel	New York
Intend to start in short to medium term:	39.5%	25.0%	33.3%	41.4%	54.7%
<i>within the next year</i>	4.7%	3.8%	0.0%	4.9%	4.5%
<i>within next 2-5 years</i>	34.9%	21.2%	33.3%	36.6%	50.1%
some interest to start but not in the foreseeable future	55.8%	60.0%	46.6%	51.2%	40.9%
no intentions	4.7%	15.0%	20.0%	7.4%	4.5%
	100.0%	100.0%	100.0%	100.0%	100.0%

	Shanghai	Silicon Valley	Singapore	Stockholm
Intend to start in short to medium term:	36.3%	36.9%	36.9%	30.8%
<i>within the next year</i>	2.7%	6.0%	5.5%	2.9%
<i>within next 2-5 years</i>	33.7%	30.8%	31.5%	27.9%
some interest to start but not in the foreseeable future	53.6%	53.0%	53.4%	61.8%
no intentions	10.0%	10.2%	9.6%	7.4%
	100.0%	100.0%	100.0%	100.0%

Note: Excludes locations with fewer than 20 responses.

Entrepreneurial intention is highest among graduated non-founder alumni from the School of Business, which boasts the largest proportion of aspiring entrepreneurs. As seen in **Table 9-4**, relatively high intention is also found among graduates from Engineering and Science. Two faculties are found to have relatively lower intention levels – Computing and Design & Environment. In particular graduates from the School of Computing have the second lowest share of aspiring entrepreneurs in the short to medium term, and the highest share of those with no founding intentions at all (13.6%). While the School of Design and Environment yielded the lowest proportion of aspiring founders (29.1%), very few graduates indicated zero entrepreneurial intention (4.1%).

Table 9-4: Current Entrepreneurial Intention of Graduated Alumni by Faculty

	Arts & Social Science	Business	Computing	Design & Environment	Engineering	Science
Intend to start in short to medium term:	35.0%	42.6%	30.5%	29.1%	36.6%	36.6%
<i>within the next year</i>	4.8%	5.0%	5.9%	0.0%	3.2%	7.0%
<i>within next 2-5 years</i>	30.1%	37.6%	24.6%	29.1%	33.5%	29.6%
some interest to start but not in the foreseeable future	54.4%	49.5%	55.9%	66.7%	53.4%	54.9%
no intentions	10.7%	7.9%	13.6%	4.1%	10.0%	8.5%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

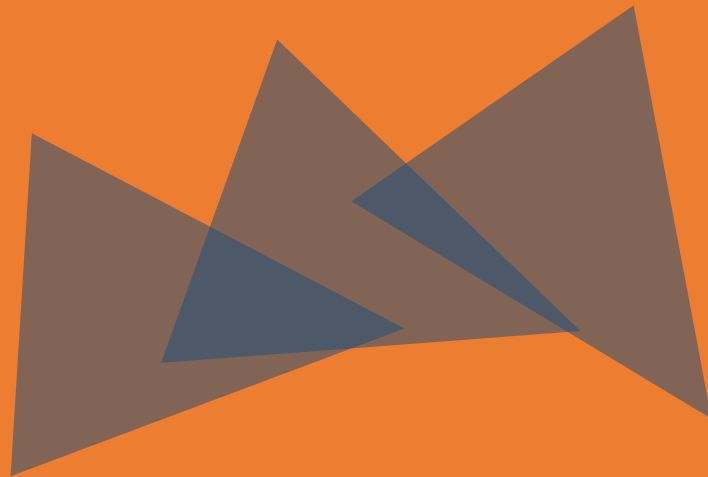
It was earlier established in Table 4-5 that current entrepreneurial propensity among male graduates (20.6%) is almost double of that among females (10.5%). This disparity along gender lines is consistent with findings on entrepreneurship activity levels in many studies. The details in **Table 9-5** reveal that the gender comparison is more nuanced once we turn our attention to intentions. The proportion of aspiring entrepreneurs in the short to medium term is only slightly higher among male non-founders (38%) compared to females (33%). In fact, the proportion of those with immediate founding plans is higher among female graduates (4.9% versus 4.5%). Notably, fewer female non-founders expressed total lack of intention (6.9%) than their male counterparts (11.6%).

Table 9-5: Current Entrepreneurial Intention of Graduated Alumni by Gender

	Female	Male
Intend to start in short to medium term:	33.0%	38.2%
<i>within the next year</i>	4.9%	4.5%
<i>within next 2-5 years</i>	28.0%	33.6%
some interest to start but not in the foreseeable future	60.1%	50.3%
no intentions	6.9%	11.6%
	100.0%	100.0%

10

NOC ALUMNI CONNECTIONS



10. NOC ALUMNI CONNECTIONS

Upon completing the NOC program, each student becomes a part of the community of NOC alumni. This community is a source of relationships and networks which alumni can call upon for social and professional support. Within the larger alumni community, those who were in the same intake batch share common experiences which bond them together.

Figure 10-1 establishes that most NOC alumni are still in contact with fellow batch mates. Understandably, almost three quarters of recently returned alumni who are still undergraduates report that they are in frequent contact with their batch mates. Comparably, only a quarter of graduated alumni maintain frequent contact with each other, and another two thirds keep in occasional contact.

Figure 10-1: Contact with NOC batch mates by Graduation Status

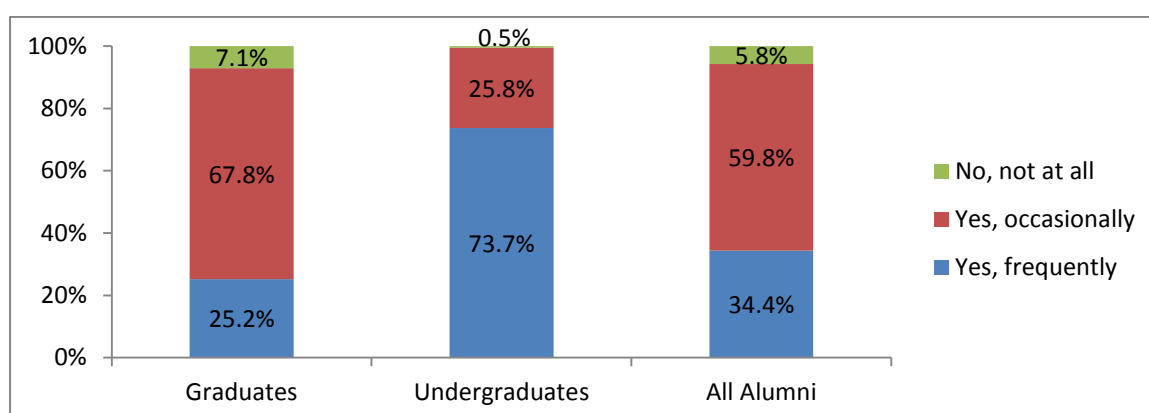


Figure 10-2 provides a more detailed look at the contact status of graduated alumni broken down by intake year. Unsurprisingly, alumni from earliest batches, especially those from before 2006, are more likely to have lost contact with their batch mates. Even so, over 80% of alumni from these early cohorts still keep in touch with each other, and as many of 19.4% are in frequent contact.

Figure 10-2: Contact with NOC batch mates by Intake Year (Graduated Alumni)

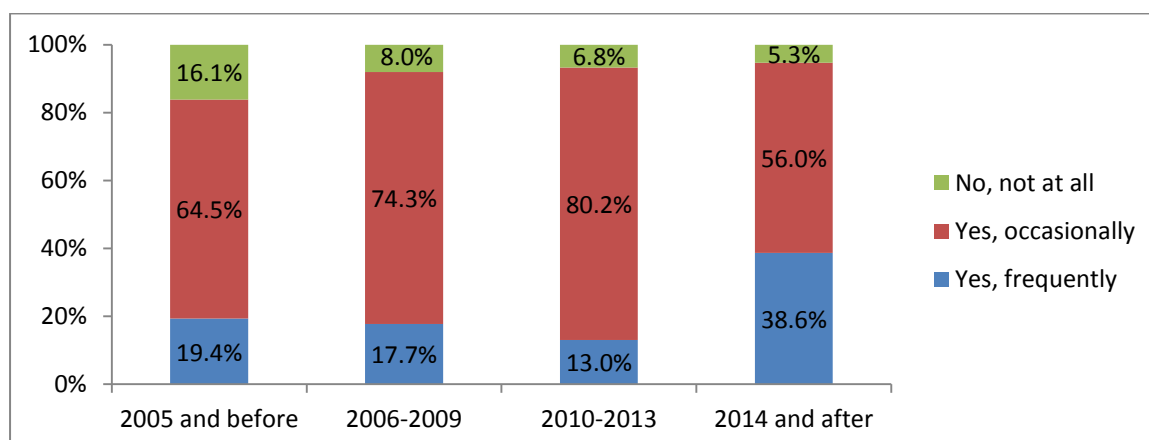
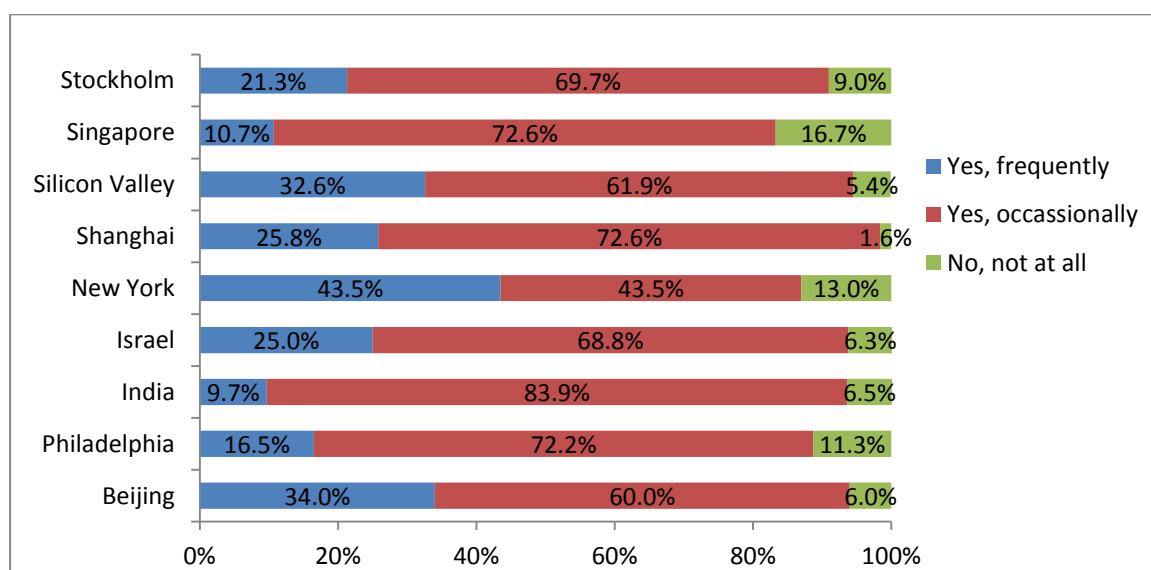


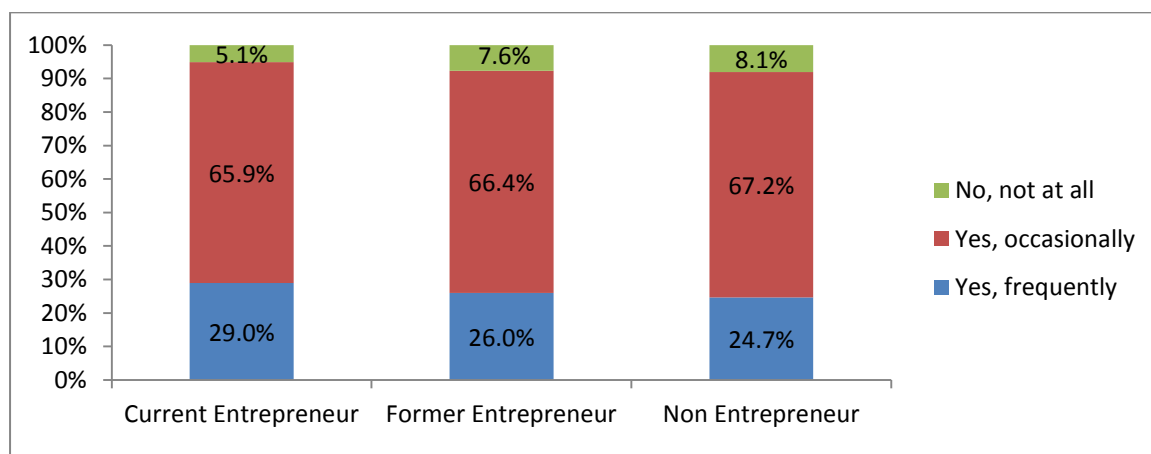
Figure 10-3 presents the tendency for alumni contact by different college locations. It should be kept in mind that these figures are aggregated across intake years and certain NOC locations are more recently established, and therefore subject to recency effects. For example, over 40% of NOC New York alumni are in frequent contact with batch mates. This is partially due to the NY program being relatively new and the alumni having returned only in the last three years. Notwithstanding the New York example, we find that many alumni from more established locations such as Silicon Valley, Stockholm, Shanghai and Beijing are still in frequent contact with each other. The locations with lower frequency of contact are Singapore (16.7% have no contact at all) and India (only 9.7% in frequent contact).

Figure 10-3: Contact with NOC batch mates by NOC Location (Graduated Alumni)



We may reasonably expect alumni-founders to have greater incentives, and therefore likelihood, of keeping in touch with their batch mates, compared to non-founders. **Figure 10-4** shows differences between current, former and non-entrepreneurs. It is seen that current entrepreneurs have the highest propensity among the three groups to be in frequent contact with batch mates, and non-entrepreneurs have the lowest propensity. However, the differences are marginal and the chi-square statistic for independence of distribution was not significant (Pearson $p=0.704$, LR $p=0.683$).

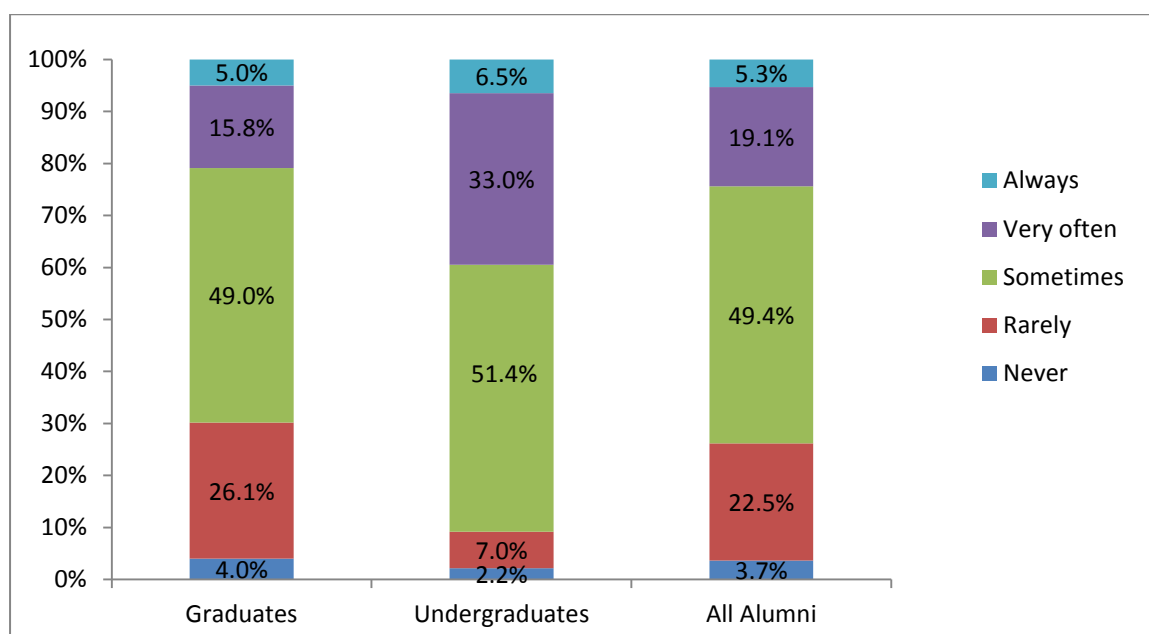
Figure 10-4: Contact with NOC batch mates by Entrepreneurship Experience (Graduated Alumni)



Alumni were next asked whether and how frequently they draw on connections made through the NOC program. This is a broader view of NOC alumni networking, as connections extend beyond fellow alumni to the larger NOC community of mentors, staff from NOC and NUS Enterprise, as well as professional and personal contacts established by alumni during their internship or while living abroad.

Around 70% of graduated alumni draw on NOC connections at least some of the time, as seen in **Figure 10-5**. In the undergraduates subsample, the proportion is much higher at 91% but this figure is subject to the caveat of recency effects. The important take away from **Figure 10-5** is that almost all NOC alumni have called on their NOC connections, and as many as 20% among those who have graduated do so very frequently or always.

Figure 10-5: Frequency of drawing on NOC connections by Graduation Status



Illustrating the recency effect, **Figure 10-6** shows that alumni from more recent batches are most likely to draw on NOC connections with great frequency. It should be noted that even among the earliest batches, more than 50% call on NOC connections at least sometimes. **Figure 10-7** shows the variation in the different NOC locations. Alumni from Beijing and Silicon Valley draw on NOC connections most frequently. Lowest frequency is observed for India, Singapore and Bio Valley Philadelphia.

We postulate that alumni-entrepreneurs would rely on NOC networks more so than non-entrepreneurs. **Figure 10-8** compares the frequency of using NOC connections for three groups of graduated alumni – current entrepreneurs, former entrepreneurs and non-entrepreneurs. Over 75% of current entrepreneurs draw on NOC connections at least sometimes, slightly higher than the proportion for former entrepreneurs (73%) which is in turn higher than the figure for non-entrepreneurs (67%). The chi-square statistics show that the differences in distribution between these three alumni groups are weakly significant (Pearson $p=0.144$, LR $p=0.088$).

Figure 10-6: Frequency of drawing on NOC connections by Intake Year (Graduated Alumni)

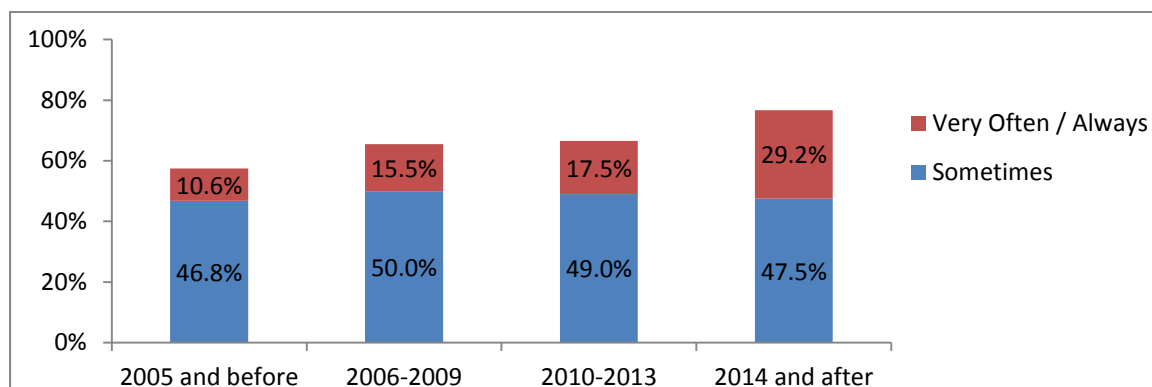


Figure 10-7: Frequency of drawing on NOC connections by NOC Location (Graduated Alumni)

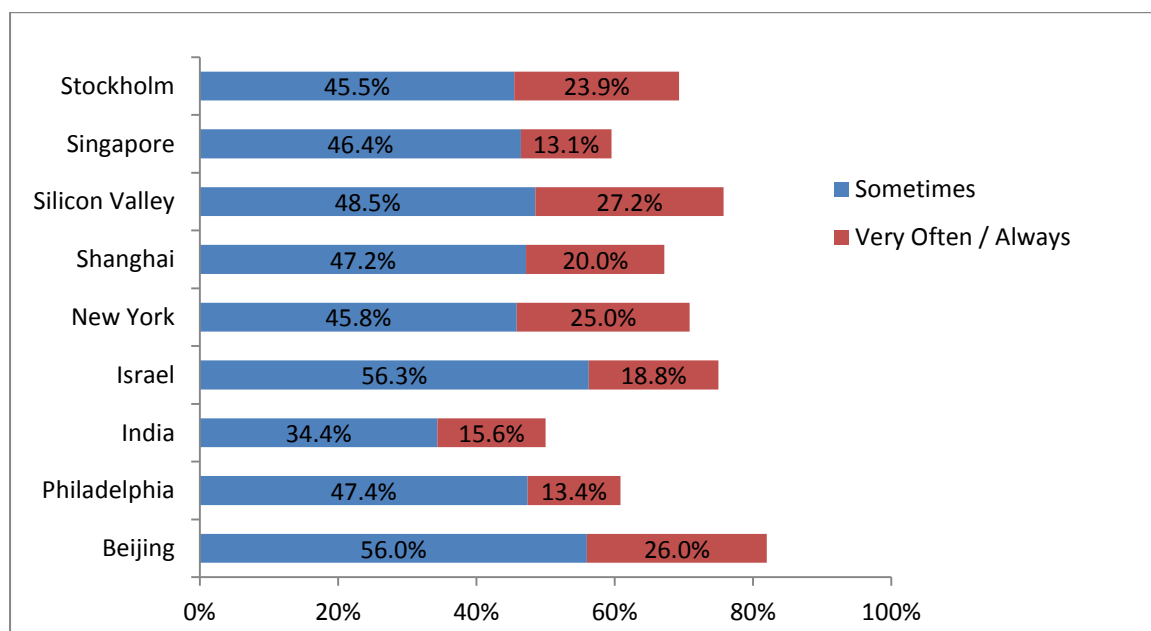
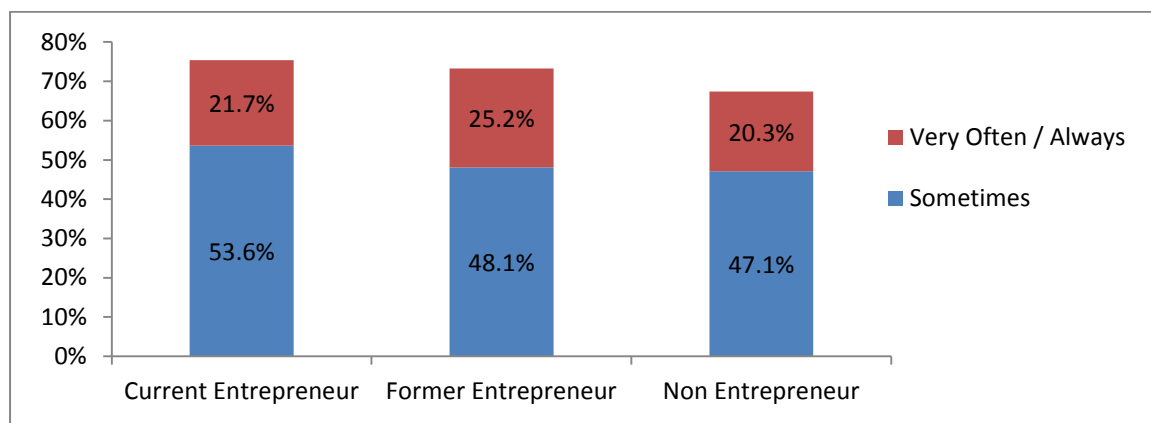
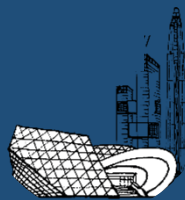
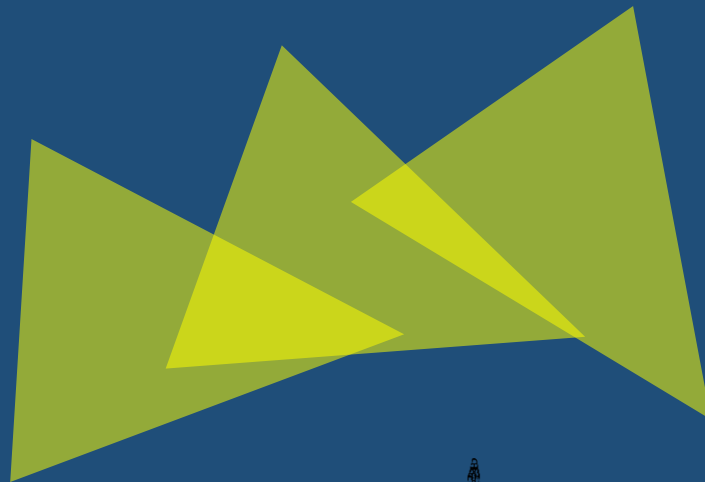


Figure 10-8: Frequency of drawing on NOC connections by Entrepreneurship Experience (Graduated Alumni)



11

DETERMINANTS OF ENTREPRENEURIAL AND INNOVATION PROPENSITIES OF GRADUATED ALUMNI



11. DETERMINANTS OF ENTREPRENEURIAL AND INNOVATION PROPENSITIES OF GRADUATED ALUMNI

What factors may explain an NOC alumnus' propensity to become an entrepreneur, or to be working in an intrapreneurship capacity in an organization? Are there aspects of the NOC program that may be correlated with these entrepreneurial and innovation propensities? To attempt to answer these questions, we conducted binary logistic regression analysis with several different dependent variables. In constructing the estimation models, we consulted the literature to ascertain measures that have been found in previous studies to influence individuals' entrepreneurial and innovation behavior. Additionally, control variables were included to account for demographic and structural differences among graduated NOC alumni.

Control variables:

Cohort Year, the year that the alumnus embarked on their NOC internship experience is assigned discrete values ranging from 1 to 17 in ascending order based on the cohort's age in 2019. The most recent cohort in 2018 takes on the value 1 and the oldest cohort in 2002, a value of 17.

Gender is a binary variable which equals 1 if the alumnus is male, and 0 if female.

Singaporean or SPR captures the citizenship status of alumni in a binary variable which equals 1 if the alumnus is a Singaporean citizen or PR at the point of the survey, and 0 if a foreigner.

Program Location is controlled using a series of dummy variables for the different NOC program locations, with Singapore as the default location.

Faculty controls for the faculty affiliation of alumni and is entered as a series of dummy variables for the different NUS schools or faculties, with the School of Science as the default.

Independent variables:

Family Business background has been found to positively influence startup propensity. It is measured here as a binary variable which takes the value 1 if the alumnus has an immediate family member, ie. a parent or sibling, who has started a business.

Based in Singapore is a measure of international mobility and global outlook of individuals. It is posited that those who have ventured overseas may have higher propensity to start-up or to play innovation roles. This binary variable equals 1 if the alumni is currently based in Singapore, and 0 if currently in an overseas location.

The literature has suggested that prior startup experience may influence the likelihood of starting up again in the future. Prior experience confers self-efficacy due to accumulated knowledge of the entrepreneurship experience, as well as networks and social capital that may not be as readily accessible to first-time founders. We include two different measures of prior startup experience in our analysis:

Number of prior startups measures the extent of serial entrepreneurship in an individual's career. It is the count of the number of previous startups founded, excluding the current startup of an active entrepreneur.

Previously been an entrepreneur is a binary variable that equals 1 if the alumnus has previously founded a startup and 0 otherwise.

Related to the concept of prior startup experience are three measures we introduce to account for the resources that alumni may gain from being involved in the startup ecosystem in some way, and from having played innovation roles in the careers.

Previously employed in Startup is a binary variable that equals 1 if the alumnus has, prior to their current job, worked as a salaried employee in a startup.

Previously employed in other parts of entrepreneurial ecosystem is a binary variable that equals 1 if the alumnus has been, prior to their current job, a salaried employee in the non-startup part of the entrepreneurship ecosystem, in organizations such as VCs or incubators; and 0 otherwise.

Previously employed in Innovation or NBD role is a binary variable that equals 1 if the alumnus has previously been involved in at least one Innovation or NBD role while working in an organization, and 0 otherwise.

Involved in Startup Ecosystem during career is a binary variable that takes on the value of 1 if the alumnus is currently or has been involved in the startup ecosystem in any capacity, and 0 otherwise.

Employed in Innovation or NBD role during career is a binary variable that takes on the value of 1 if the alumnus is currently or has previously involved in at least one Innovation and NBD

Several NOC program assessment variables are included to proxy the impact of the NOC program as perceived by alumni. These are entered into the regression equations as 5-point Likert scale ratings.

NOC increased motivation to be entrepreneur and **NOC increased skills, ability and confidence to be entrepreneur** measure the extent to which NOC has affected alumni's perception of their self-efficacy and interest to become founders.

NOC increased motivation to be intrapreneur and **NOC increased skills, ability and confidence to be intrapreneur** measure the extent to which NOC has affected alumni's perception of their self-efficacy and interest to undertake creative and innovative activities within existing organizations.

I keep in touch with professional contacts from NOC internship measures the extent to which alumni leverage on entrepreneurship network resources that are available to NOC students during their internship experience.

Entrepreneurial Propensity

Regression results for Overall Entrepreneurial Propensity are shown in **Table 11-1**. The dependent variable equals 1 if alumni have founded a startup at any point, regardless of they are currently active entrepreneurs, and equals 0 if alumni have never founded a startup.

The results for the control variables confirm the observations made earlier, namely that entrepreneurial propensity is significantly higher among male alumni, and those from earlier cohorts. Having a background in family business is also a significant predictor of startup propensity. However, there is no difference in propensity between alumni who are based in Singapore and those who have relocated overseas.

Apart from influential factors that relate to the background and demographic characteristics of alumni, an area of particular interest is the role, if any, of the NOC program. The estimated coefficients on the variables pertaining to NOC impact on entrepreneurship motivation and skills are both positive and significant at the 1% level. While we do not necessarily conclude a causality relationship, there is undoubtedly a strong and positive association between NOC's entrepreneurship impact as assessed by alumni and their likelihood of becoming founders.

Table 11-1: Binary Logistic Regression for Overall (Current + Past) Entrepreneurial Propensity

Variable	Est Coeff	SE	Sig
Constant	-7.29	0.846	0.000***
Cohort Year	0.149	0.027	0.000***
Cohort Year (Squared)	-0.012	0.006	0.031**
Gender = Male	0.726	0.202	0.000***
Singaporean or SPR	0.171	0.323	0.596
Program Location (default is Singapore, only significant dummies reported)			
Philadelphia	-0.749	0.372	0.044**
Faculty (default is Science, only significant dummies reported)			
Business	0.647	0.350	0.065*
Design & Environment	1.379	0.512	0.007***
Family Business	0.847	0.171	0.000***
Based in Singapore	-0.084	0.244	0.730
NOC increased motivation to be entrepreneur	0.717	0.148	0.000***
NOC increased skills, ability and confidence to be entrepreneur	0.418	0.140	0.003***
Nagelkerke R Sq	0.292		
Chi-sq	191.848		
N = 792 graduated alumni			

Table 11-2 focuses on current entrepreneurial propensity. The dependent variable in this case takes on the value of 1 if the alumnus is currently (at the point of the survey) an active entrepreneur, and

equals 0 otherwise. As the dependent variable addresses current propensity, we include prior career activities as predictors.

Similar to findings for overall propensity, we confirm that current propensity is significantly higher among alumni who are male, from earlier cohorts and have family business backgrounds. Again, international mobility was insignificant as a predictor. Prior experience with founding multiple startups significantly increases the likelihood of being a current entrepreneur, as does previous working experience as startup employees.

Alumni's ratings of the impact of NOC on entrepreneurial motivations and capabilities were significantly and positively correlated with their current entrepreneurial propensity.

Table 11-2: Binary Logistic Regression for Current Entrepreneurial Propensity

Variable	Est Coeff	SE	Sig
Constant	-6.814	1.094	0.00***
Cohort Year	0.082	0.031	0.008***
Gender = Male	0.567	0.254	0.025**
Singaporean or SPR	0.417	0.441	0.345
Program Location (default is Singapore, only significant dummies reported)			
India	-2.554	1.127	0.023**
Israel	-1.060	0.635	0.095*
Faculty (default is Science, only significant dummies reported)			
Design & Environment	1.238	0.599	0.039**
Family Business	0.759	0.207	0.000***
Based in Singapore	-0.206	0.288	0.475
NOC increased motivation to be entrepreneur	0.490	0.194	0.012**
NOC increased skills, ability and confidence to be entrepreneur	0.379	0.180	0.036**
Number of prior startups (Serial Entrepreneur)	0.540	0.145	0.000***
Previously employed in Startup	0.452	0.219	0.04**
Previously employed in other parts of entrep ecosystem	-0.214	0.230	0.352
Previously employed in Innovation or NBD role	0.212	0.235	0.368
Nagelkerke R Sq	0.267		
Chi-sq	137.739		
N = 731 graduated alumni			

Propensity to be Employed in Entrepreneurial Ecosystem

Table 11-3 examines the current propensity to be a salaried employee in the entrepreneurial ecosystem. The dependent variable takes on the value of 1 if the alumnus is currently (at the point of the survey) employed in a startup, accelerator or any other entrepreneurial related organizations in the ecosystem, and equals 0 otherwise. Given that the dependent variable addresses the propensity to be employed within the entrepreneurial ecosystem, both entrepreneurial and intrapreneurial impact predictors are considered. Prior career activities are also included as predictors.

In contrary to earlier results, gender and prior experience as an entrepreneur were insignificant. NOC's impact on entrepreneurial motivation had no effect on the propensity to be employed in the ecosystem. This is expected as an increased entrepreneurial motivation is more likely to be associated with the starting up of new firms instead. NOC's impact on entrepreneurial capabilities, intrapreneurial motivations and capabilities are found to be positive and significantly correlated with current propensity to be employed in the entrepreneurial ecosystem.

Table 11-3: Binary Logistic Regression for Current Propensity to be Employed in the Entrepreneurial Ecosystem

Variable	Est Coeff	SE	Sig
Constant	-5.076	0.995	0.00***
Cohort Year	-0.02	0.26	0.449
Gender = Male	0.230	0.200	0.251
Singaporean or SPR	-0.201	0.328	0.540
Program Location (default is Singapore, only significant dummies reported)			
Silicon Valley	0.632	0.342	0.065*
Faculty (default is Science, none is significant)			
Design & Environment	1.561	0.566	0.006***
Family Business	0.317	0.176	0.072*
Based in Singapore	-0.207	0.268	0.438
NOC increased motivation to be entrepreneur	0.211	0.145	0.144
NOC increased skills, ability and confidence to be entrepreneur	0.306	0.148	0.039**
NOC increased motivation to be intrapreneur	0.330	0.157	0.036**
NOC increased skills, ability and confidence to be intrapreneur	0.294	0.158	0.063*
Number of prior startups (Serial Entrepreneur)	0.150	0.154	0.329
Previously employed in Innovation or NBD role	0.271	0.995	0.125
Nagelkerke R Sq	0.184		
Chi-sq	97.167		
N = 654 graduated alumni			

Propensity to be in Innovation and New Business Development Roles (Intrapreneurship)

In **Table 11-4**, attention is turned to current *intrapreneurship* propensity of alumni who are employed in established (i.e. non-startup) organizations. The dependent variable equals 1 if alumni are currently involved in I&NBD roles in their organizations, and 0 otherwise.

From the estimated coefficients on the control variables, we conclude that alumni from earlier cohorts and hence, with more experience have significantly higher intrapreneurship propensity. Prior experience working in startups increases the propensity to be employed in I&NBD roles as well. Unlike with entrepreneurial propensity, gender and family business are insignificant factors.

Alumni's perception of NOC's impact on their capabilities to become intrapreneurs was positive and significant at 10%. However, NOC's impact on motivation to be intrapreneurs was not significant. We also included assessment of NOC's entrepreneurship impact but these variables were insignificant. These findings confirm that NOC's impact on intrapreneurship is distinct from its impact on entrepreneurship. Only the former is associated with the propensity to be employed in I&NBD roles in established organizations.

Table 11-4: Binary Logistic Regression for Current Propensity to be Employed in Innovation and New Business Development Role

Variable	Est Coeff	SE	Sig
Constant	-2.224	0.813	0.006***
Cohort Year	0.064	0.024	0.007***
Gender = Male	0.144	0.187	0.440
Singaporean or SPR	-0.016	0.317	0.960
Program Location (default is Singapore, only significant dummies reported)			
Silicon Valley	-0.643	0.309	0.049**
Stockholm	-0.715	0.364	0.049**
Faculty (default is Science, only significant dummies reported)			
Engineering	0.556	0.293	0.058*
Family Business	0.186	0.165	0.259
Based in Singapore	0.434	0.236	0.078*
NOC increased motivation to be intrapreneur	-0.092	0.135	0.495
NOC increased skills, ability and confidence to be intrapreneur	0.254	0.135	0.06*
Previously an entrepreneur	0.330	0.209	0.114
Previously employed in Startup	0.837	0.172	0.00***
Previously employed in other parts of entrep ecosystem	-0.243	0.168	0.149
Nagelkerke R Sq	0.125		
Chi-sq	70.934		
N = 560 graduated alumni currently employed in non-startup organisations			

Current Entrepreneurial Intention

Table 11-5 examines factors that relate to current intention to start a new business in the short to medium term. The dependent variable, Current Entrepreneurial Intention, takes the value 1 if alumni plan to start their own businesses within the next 5 years, and 0 otherwise. This analysis is based on the subsample of alumni who are not currently active entrepreneurs.

There are no gender or cohort effects observed. Alumni who are foreigners and who are based outside of Singapore have significantly higher probability of having founding intentions. Family business background is also a significant predictor. There is no significant difference in intention levels of former entrepreneurs and those who have never been founders. However, exposure to the startup ecosystem during their working career does improve the chances of alumni intending to start their own businesses.

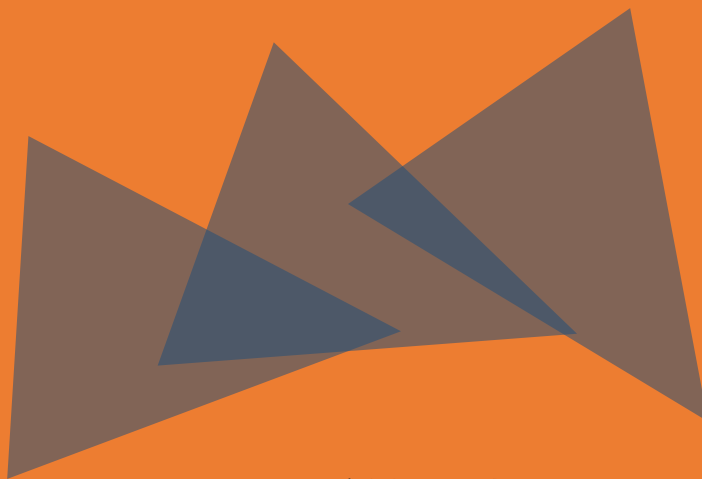
In terms of NOC program assessment, the impact of NOC on entrepreneurship motivation is positive and significant, but impact on entrepreneurship capabilities is insignificant. Another aspect of the program which correlates positively with intention is the network of professional contacts established by NOC students during their internship. Alumni who leverage on these contacts are significantly more likely to have entrepreneurial intentions.

Table 11-5: Binary Logistic Regression for Current Intention to Start up within 5 years

Variable	Est Coeff	SE	Sig
Constant	-3.684	0.876	0.00***
Cohort Year	-0.049	0.030	0.104
Gender = Male	0.120	0.221	0.588
Singaporean or SPR	-0.758	0.344	0.028**
Program Location dummies – all not significant			
Faculty (default is Science, only significant dummies reported)			
Computing	-0.860	0.406	0.034**
Family Business	0.683	0.196	0.000***
Based in Singapore	-0.584	0.284	0.039**
NOC increased motivation to be entrepreneur	0.606	0.164	0.00***
NOC increased skills, ability and confidence to be entrepreneur	0.183	0.153	0.233
I keep in touch with professional contacts from NOC internship	0.184	0.077	0.017**
Previously an entrepreneur	-0.097	0.239	0.675
Employed in Startup Ecosystem during career	0.517	0.252	0.040**
Employed in Innovation or NBD role during career	0.166	0.278	0.551
Nagelkerke R Sq	0.220		
Chi-sq	104.385		
N = 578 graduated alumni who are not currently entrepreneurs			

12

CONTRIBUTION OF NOC TO INNOVATION AND ENTREPRENEURSHIP LANDSCAPE

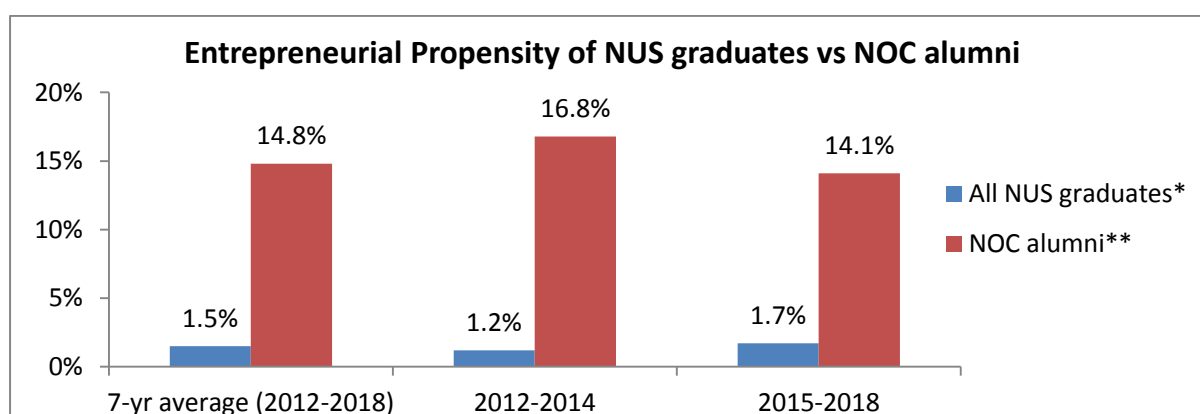


12. CONTRIBUTION OF NOC TO INNOVATION AND ENTREPRENEURSHIP LANDSCAPE

Benchmarking Entrepreneurial Propensity of NOC Alumni

Although there are no directly comparable figures available, we can conclude based on extant information that entrepreneurial propensity is much higher for NOC alumni compared to other NUS graduates. From the annual Graduate Employment Survey (GES) conducted in the last 6 years 2012-2018, it is estimated that on average 1.5% of all NUS graduates from each graduating cohort were working in a self-owned business, freelancing and self-employed six months after taking their final exams. This is taken to be the equivalent of entrepreneurial propensity for the overall NUS population of graduates. For NOC, the approximate benchmark is the proportion of alumni in each cohort who had founded a business in the period between starting NOC and before graduating from NUS. Comparing the two measures in **Figure 12-1**, it is apparent that NOC alumni are almost ten times more likely to become entrepreneurs within 6 months of graduating than other NUS graduates.

Figure 12-1: Entrepreneurial Propensity of NUS graduates vs NOC alumni



* Data for All NUS graduates from Graduate Employment Surveys 2012-2018. Measure is based on status 6 months after final exams. Includes freelancers and self-employed graduates in propensity measure.

** Measure for NOC alumni is proportion of alumni who have started their own businesses before graduating from NUS, excluding those who started up before NOC

Number of Identified Alumni-Entrepreneurs and Alumni-founded Startups

The survey estimates that around 33% of NOC alumni have founded their own businesses, with 17% currently active as entrepreneurs. These proportion estimates are subject to margins of error of approximately $\pm 3\%$ for a 95% confidence interval. The Annex explains how the error bounds are derived and computes error bounds for selected proportion and mean estimates from the survey.

Based on the universe of NUS alumni at the point of survey (2,746), the estimated entrepreneurship propensity of 33% would translate to an estimated 900 startup founders. We are however not able to identify all these founders, as many would be from the non-response group of 1,610 alumni who did not participate in the survey. **Table 12-1** shows the number of founders that we able to identify and count through a combination of different methods. Firstly, there were 332 alumni who had been identified pre-survey to be startup founders, through self-reporting of these alumni and monitoring by NOC officers. Secondly, through the survey, we identified a further 161 founders who self-reported in the survey that they had started their own businesses. Lastly, we embarked on a thorough search of LinkedIn profiles of alumni. This process is ongoing and as at time of writing, we had counted a further 63 founders. In total, we have identified 556 NOC alumni-founders.

The same process was applied for counting and identifying alumni-founded startups. As shown in **Table 12-1**, there were initially 360 known startups pre-survey. Through the survey, a further 219 startups were discovered, while online searching yielded another 86 startups. Of the total 665 startups identified, half are currently live (335, 50.4% of total alumni-founded startups) and most of these live startups are based in Singapore (287, 85.7% of live startups).

Table 12-1: Counting number of identified NOC alumni-founders and startups

	Number of Identified Founders	Number of Identified Startups **
Pre-survey (self-reporting and monitoring by NOC officers)	332	360
Identified from NOC alumni survey ¹	161	219
Identified from searching online profiles *	63	86
TOTAL	556	665
No. of live startups		335 (50.4%)
Of which number based in Singapore		287 (85.7%)

* Note: online searching is an ongoing process, count is as at May 2019

** Verification of incorporation status of startups is ongoing

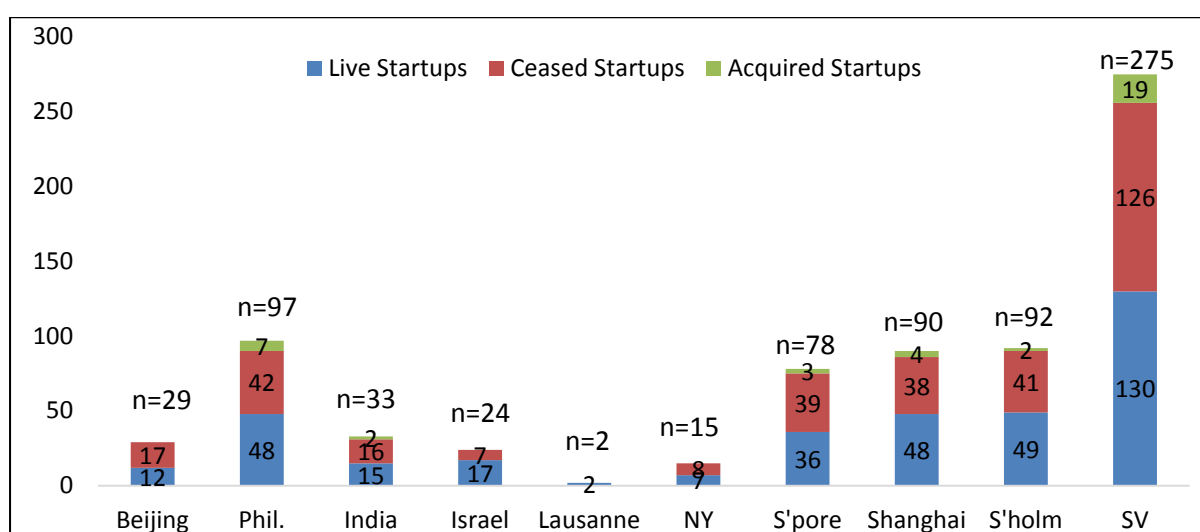
¹ All alumni who self-declared to have founded startups are counted. Startups are counted if named by alumni and able to be verified. If alumni declined to name their startups or provided insufficient information, the startups are not counted.

The counts of identified alumni-founders and alumni-founded startups in **Table 12-2** are subject to several important caveats. Firstly, as already mentioned, we are not able to fully account for the founding status of alumni in the non-response group. The count of 556 is likely undercounting the actual number alumni-founders. To partially mitigate against non-response, we attempt to identify potential founders in this group by searching online profiles on LinkedIn. This leads to the second caveat, which is that LinkedIn profiles are subject to their own drawbacks as a data source. A number of alumni do not have LinkedIn presence and their founder status cannot be determined. We have also observed that some profiles are outdated. Additionally, not all founders include their startups in their online CVs. The third caveat pertains to self-reporting as the means to identify startups. Although the survey defined startups as incorporated businesses, alumni may have

included non-incorporated entities such as projects or websites when reporting their self-owned businesses. We have attempted to verify incorporation status of Singapore-based entities where possible. However, we are not able to do so for foreign entities. In some cases, the names of the startups as provided by the alumni are not the same as the officially registered names. The difficulty of ascertaining registration status is compounded for startups which have ceased operations.

Alumni from the Silicon Valley account for 275 of the identified startups, the largest number for any program location by some distance (**Figure 12-2**). This is followed by Philadelphia with 97 startups and Stockholm with 92 startups. It should be noted that the Silicon Valley program has produced a higher number of startups not just because of higher propensity level, but also because it has the highest number of NOC alumni.

Figure 12-2: Identified startups founded by NOC alumni by Program Location



*Note: Startups with founders from different programme location are counted once in each location

Figure 12-3 highlights an interesting characteristic of the identified NOC startups. The majority of the startups involve a single NOC alumni-founder (it should be noted that these startups may have been co-founded with entrepreneurs who are not NOC alumni) while 14% were co-founded by teams of several NOC alumni. The detailed breakdown reinforces the strength of network ties within the NOC alumni community. As expected, around half the founding teams comprise alumni who were in the same batch and program location. However, we also observe cross-program teams from the same intake year, as well as cross-batch teams from the same program location. Significantly, a number of startups were founded by teams with alumni from different batches and program locations.

In **Figure 12-4**, we trace the establishment of startups by alumni from cohorts in the years up to 2010. By focusing on earlier intakes, we avoid truncation issues and are able to observe trends over a longer period. We observe that the startup formation by NOC alumni ranges over a relatively long time horizon. Many of the identified alumni-entrepreneurs were student entrepreneurs, with 10% establishing their first startups even before embarking on NOC and 23% doing so during or shortly after their internship stint. Another 15% founded their first startups one year after returning from NOC. Excluding those who were founders prior to NOC, the time taken to start up appears to approximate a U-shape. While there is a large group that started up almost immediately, almost a

third of the alumni-founders waited at least 4 years after returning from NOC to found their first ventures. This latter group has opted to gain working experience and build up capital before starting their entrepreneurial careers. We observe that there is particularly high propensity to start up in the period between 4 and 6 years after returning from NOC.

Figure 12-3: Composition of Alumni Founding Teams

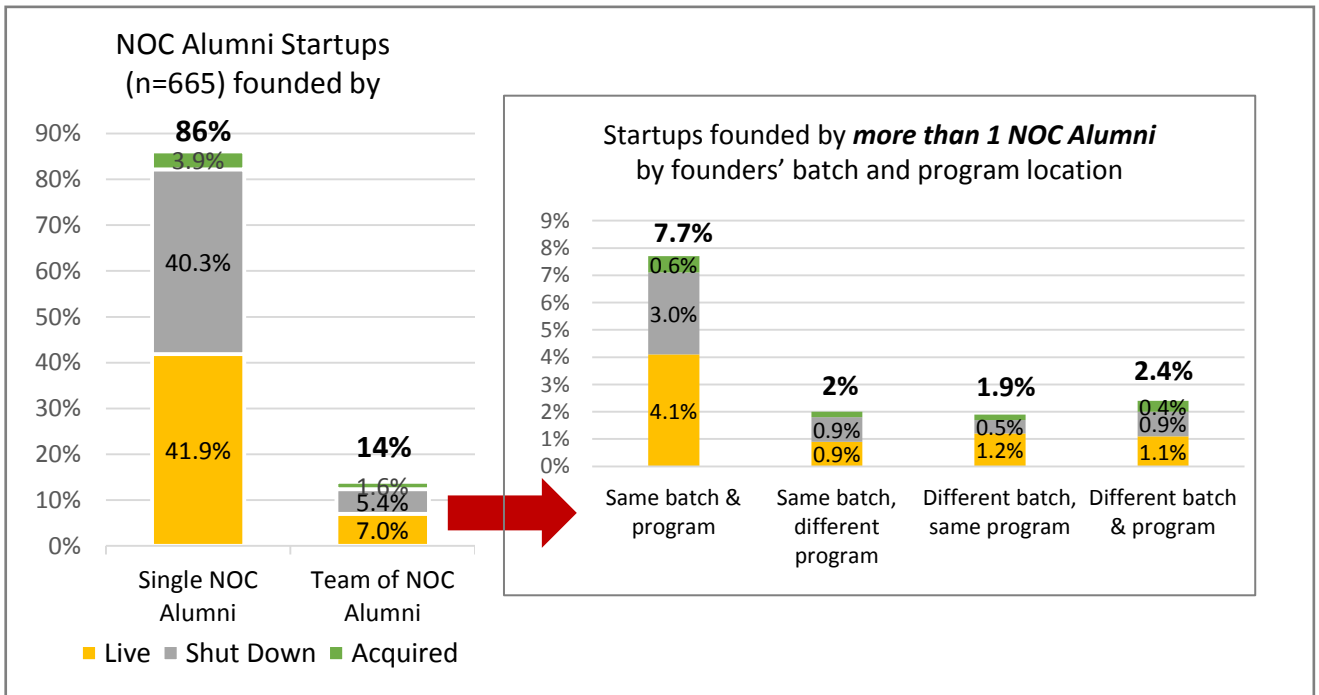
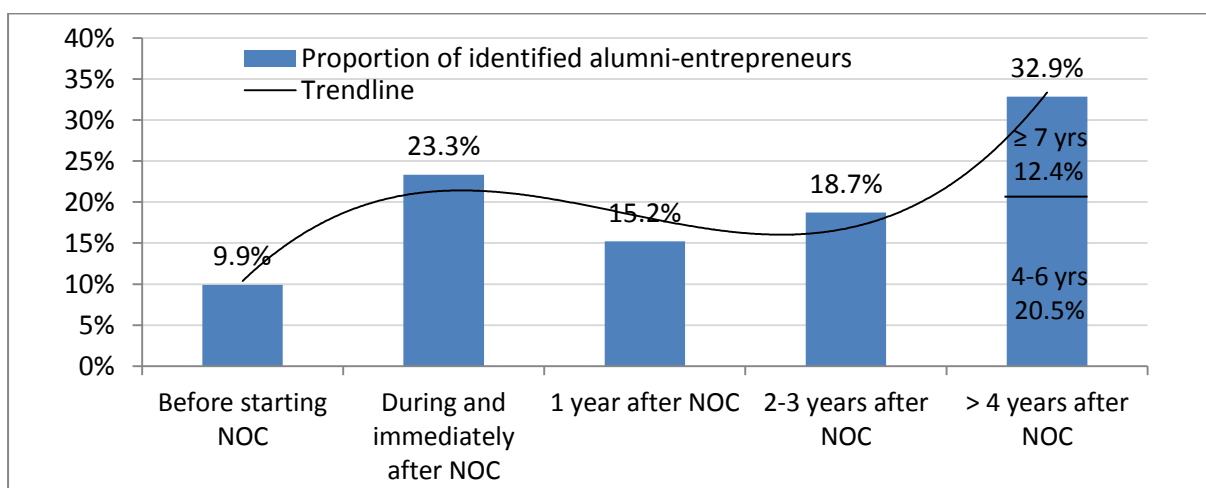


Figure 12-4: When did NOC alumni-entrepreneurs found their first startups?



Note: This analysis is confined to founders from cohorts in the period up to 2010. This is to control for truncation effects as founder from more recent intakes have less waiting time compared to graduates from older batches.

NOC Alumni-founded Startups in Singapore’s startup ecosystem

The NOC program contributes a miniscule share of total graduates from the institutes of higher learning (IHLs). From **Table 12-2**, NOC alumni constitute only 0.5% of fresh graduates from local IHLs in the period 2013-2017. If we include Singaporean students returning from overseas studies as well as foreign graduates who come to Singapore seeking opportunities, NOC contributes an even smaller share of the tertiary-educated population joining the Singapore workforce every year.

Compared against this small share, the startups founded by NOC alumni contribute disproportionately to Singapore’s startup ecosystem. It is estimated that over 4% of live technology-based startups operating in Singapore were founded by NOC alumni. Of Singapore startups that have raised external funding, 8.5% are NOC startups. We also observe prominent representation of NOC alumni-founded startups in the exclusive list of Singapore “Scale-ups” which have raised in excess of USD 10 million in external funding (4.7%). In total, the startups by NOC alumni have raised USD 670 million, which accounts for 3.2% of all funding raised by Singapore-based startups. If funding raised by a number of foreigner-founded startups that raised very large amount (Grab, Lazada etc) are excluded, the figure increased to over 10%.

Table 12-2: Contribution of NOC to Singapore Startup Ecosystem

	NOC	Singapore	NOC Share (%)
Graduates from Singapore universities & polytechnics (2013-2017)	993	200,244 ¹	0.5%
Live Singapore-based tech startups	383 (287) ³	~6,500 ²	5.9% (4.4%) ³
Number of startups that have raised external funding	94 ⁴	1,104 ⁵	8.5%
Singapore-HQ startups with >USD 10 million funding (“Scale-Ups”) ⁶	9 ⁶	192	4.7%
Total Funding raised by startups	USD 670 mil ⁴	USD 21 bil ⁷ (excl. foreigner-founded: USD 6.7 b) ⁸	3.2% (10.5%) ⁸

¹ Source: Singapore Education Statistics 2018; figures for autonomous universities and polytechnics in Singapore, excludes private institutions.

² Internal estimate from TechASEAN database.

³ Extrapolated from NOC Alumni survey and internal records. Figure in brackets refer to actual number of identified startups reported by survey respondents and sourced from online tracking.

⁴ From internal NUS databases

⁵ Source: Crunchbase.

⁶ Excludes Zopim, which was acquired by Zendesk for USD30 mil and went IPO after M&A

⁷ Source: Crunchbase. Includes funding to firms founded by foreigners, such as Grab, Lazada

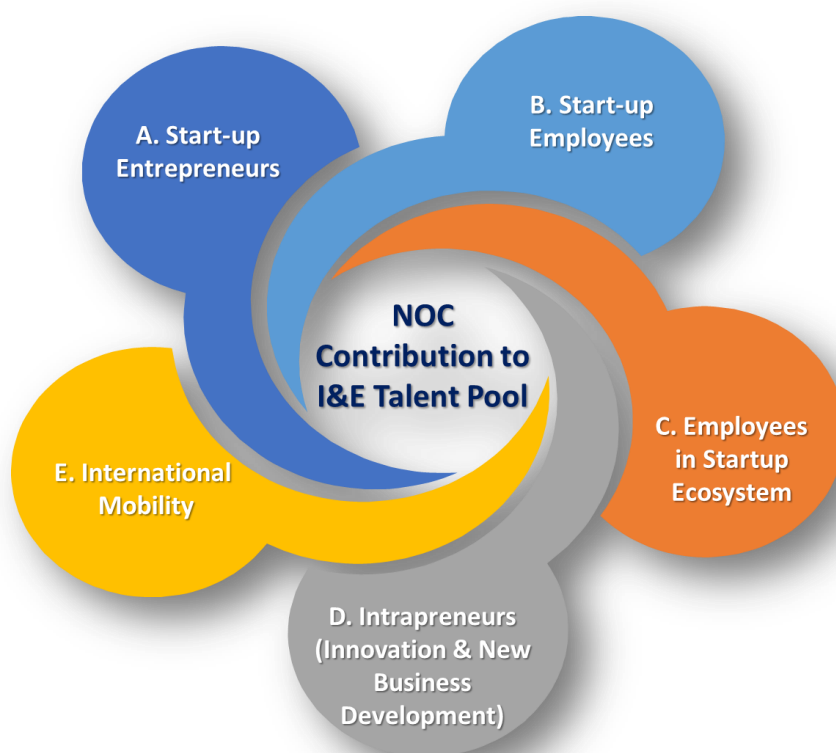
⁸ Figure excludes funding to firms founded by foreigners.

Contribution of NOC to the Innovation & Enterprise Ecosystem

The preceding analysis has clearly confirmed the significant contribution of the NOC program to the creation of founders, tech startups and scale-ups in Singapore. The impact of the NOC program should however be viewed in terms of its broader contribution to the development of the larger pool of entrepreneurial talent for Singapore's I&E ecosystem. As depicted in **Figure 12-5**, this is not restricted to producing alumni who become startup entrepreneurs. The contribution of NOC is more holistic and is rooted in the philosophy that an entrepreneurial mindset is about the spirit of risk-taking, innovation and embracing of new challenges. The act of venture creation is an outcome but not the end-game.

The NOC program was found to have made significant impact on its alumni in terms of enhancing their motivations and skills for both entrepreneurship and intrapreneurship. NOC does not merely develop startup founders, but also the talents who will eschew more "stable" employment for the excitement of working in startups and who understand and are passionate about the needs of startups. Besides the high proportion of alumni (one-third) who went on to start businesses, an even larger proportion had opted to work as employees in startups and other ecosystem supporting organizations such as venture investment firms and incubators. NOC also generates a significant pipeline of intrapreneurial talents for established organizations looking for individuals with motivations and capabilities in playing innovation and new business development role. Finally, NOC alumni are also found to be internationally mobile and able to thrive in an increasingly globalized and connected world.

Figure 12-5: How NOC Contributes to Innovation and Enterprise Talent Pool



TECHNICAL ANNEX 1 – STATISTICAL WEIGHTING

A total of 984 NOC alumni participated in the online survey, of which 181 came from a pre-identified sample of start-up founders (n=332) in our sampling frame. The high response rate (53.9%) among the pre-identified start-up founders suggests a potential bias towards entrepreneurs in the results if left uncorrected. To adjust for the over representation of entrepreneurs in our sample, statistical weights are applied when conducting analysis. The weights are calculated separately for the graduate and undergraduate subsamples. Examples of weighted and unweighted estimates for both subsamples are shown in **Table A-1**.

To calculate the statistical weights, we compute the following:

$$W_i = N_i/N = \text{weightage of strata } i \text{ in total population}$$

Where strata is defined by:

- (1) Proportion of identified entrepreneurs in the sampling frame and the response sample
- (2) Distribution of program location in the sampling frame and the response sample

Table A-1: Weighted and non-weighted estimates of survey results

	Weighted Estimate	Unweighted Estimate
GRADUATE SAMPLE		
Proportion of entrepreneurs (current & former)	33.7%	40.8%
Mean satisfaction with NOC (5-point Likert scale)	4.58	4.59
UNDERGRADUATE SAMPLE		
Proportion of entrepreneurs (current & former)	16.0%	16.0%
Mean satisfaction with NOC (5-point Likert scale)	4.33	4.34

TECHNICAL ANNEX 2 – ERROR BOUNDS ESTIMATION

Error bounds are calculated separately for the graduate and undergraduate subsamples to give an indication of the true values of our data. In the calculations, strata is defined according to the criteria used for statistical weighting: (1) pre-survey founder status identification (2) program location.

To calculate a 95% confidence interval for the *strata proportion* estimates, the following formula was used:

$$p_i \pm \left[t \sqrt{(1-f_i)} \sqrt{\frac{p_i(1-p_i)}{(n_i-1)} + \frac{1}{2n_i}} \right]$$

To calculate a 95% confidence interval for the *overall proportion* estimates, the following formula was used:

$$p \pm \left[t \sqrt{\sum_{i=1}^k W_i^2 \frac{p_i(1-p_i)}{(1-\frac{1}{N_i})(n_i-1)} + \frac{1}{2n}} \right]$$

Where:

pi = estimated proportion for strata i

ni = number of respondents from strata i

n = total number of respondents

fi = ni/Ni = sampling rate for strata i

Wi = Ni/N = weightage of strata i in total population

t = 1.96 for 95% confidence interval

Using these formulae, we estimate with a 95% confidence level that the 'true' value of the proportion of graduate entrepreneurs is 33.7% ± 3.4% while the proportion of undergraduate entrepreneurs is 16% ± 5.9%. The estimated error bounds at a 95% confidence level for the proportion of entrepreneurs (current and former) are shown in **Table A-2** below.

Table A-2: Standard Error Bound Estimates for the Proportion of Entrepreneurs in the survey

	Estimated Value (weighted)	95% confidence bounds	
		Lower	Upper
Proportion of Graduate entrepreneurs (current & former)	33.7%	30.3%	37.1%
Proportion of Undergraduate entrepreneurs (current & former)	16.0%	10.1%	21.9%

To calculate a 95% confidence interval for the *strata mean* estimates, the following formula was used:

$$\hat{Y}_i \pm t \sqrt{1 - f_i} \frac{S_i}{\sqrt{n_i}}$$

To calculate a 95% confidence interval for the *overall mean* estimates, the following formula was used:

$$\sum_{i=1}^k W_i \hat{Y}_i \pm t \sqrt{\sum_{i=1}^k (W_i^2 (1 - f_i) \frac{S_i^2}{n_i})}$$

Where:

\hat{Y}_i = estimated proportion for strata i

n = total number of respondents

$f_i = n_i/N_i$ = sampling rate for strata i

$W_i = N_i/N$ = weightage of strata i in total population

n_i = number of respondents from strata i

N_i = population of strata i

S_i^2 = estimated variance of \hat{Y}_i

t = 1.96 for 95% confidence interval

Using these formulae, the 'true' value of the mean satisfaction with NOC (measured based on a 5-point Likert scale in the survey) is estimated. At a 95% confidence level, the mean satisfaction with NOC is 4.58 ± 0.04 among graduates and 4.33 ± 0.07 among undergraduates. **Table A-3** provides the estimated mean error bounds.

Table A-3: Standard Error Bound Estimates of the Mean Satisfaction with NOC Program (measured on a 5-point Likert scale)

	Estimated Value (weighted)	95% confidence bounds	
		Lower	Upper
Mean satisfaction with NOC among Graduates (5-point Likert Scale)	4.58	4.54	4.62
Mean satisfaction with NOC among Undergraduates (5-point Likert Scale)	4.33	4.26	4.41