

The New Foundational Skills of the Digital Economy

Results from 'New foundational skills' survey among IB students

May 2020



'The foundational human, digital, and business skills that will be needed in the digitally intensive economy of the future are already in high demand today.'

~ Burning Glass technologies

Author: Tanya Dimitrova, MSc, DigComm

Lecturer of Digital marketing at RBS

Rotterdam, The Netherlands

Table of Contents

PART I – The New Foundational Skills.....	5
The new foundational skills research	6
Blended digital professional.....	6
Methodology	9
The New Foundational Skills for the Digital Economy	10
Important findings	12
Main recommendations from the BHEF skills research.....	17
PART II - New foundational skills survey results – IB students.....	20
Introduction.....	21
The New Foundational Framework.....	21
Methodology – the survey and the interviews	22
Digital Building Blocks – Results from the survey.....	24
Data management skills.....	24
Software development & computer programming skills.....	27
Analyzing data skills	29
Digital security and privacy skills.....	32
Business Enablers	34
Business processes skills	34
Project management skills	37

Digital design skills	40
Communicating data skills	43
Human Skills.....	45
Overall conclusions of the survey	50
The New foundational skills overview.....	50
Conclusions from the expert interviews	51
Conclusion IB students – Digital building blocks.....	55
Conclusion IB students – Business enablers	56
Conclusion IB students – Human skills	58
Recommendations for IB programs	60
Appendix I – New Foundational Skills Infographic	61
Appendix II – Description and overview of the most sought skills	65
Digital security and privacy skills.....	65
The DSP skill gap.....	66
Which skillset is needed?	67
Technical hard skills (IT).....	67
Soft skills.....	69
Analyzing data & Data Management skills	72
DSA (Data Science and Analytics) Skills shortage.....	72
The job landscape today	74

Why DSA skills?.....	75
Which DSA skills are needed?	76
DSA skills frameworks for educators	78
Tools for data analysis.....	85
What should educators do?	85
Examples of a Marketing analytics courses for business students (Stukent)	88
Software development & Computer programming skills.....	90
Business and managerial aspect of programming.....	90
Why should business students learn programming	91
The effect of learning programming for business students	92
Popular software programming skills	93
TIOBE Index.....	94

PART I – The New Foundational Skills

Introduction

The research results presented in this paper presents a benchmark between the most sought skills of the digital economy and the level of these skills among IB students in national and international business schools and institutions.

To find out, the Business-Higher Education Forum (BHEF) commissioned Burning Glass Technologies to examine skills in the job market by drawing from a set of more than 150 million unique U.S. job postings, dating back to 2007. The research identified 14 skills that have become foundational in the new economy, which converge in three interrelated groups: Human Skills, Business skills, and Digital skills.

[The New Foundational Skills](#) framework tests 14 skills among these three building blocks.

The 14 New Foundational Skills are in increasingly high demand across the digital economy. Employers want these skills, and demand is rising fast. Nearly 12 million job openings in 2017 – representing 53% of all openings – sought at least one of these skills. All but two of the 14 skills had a million posted openings, and nine had over 2 million postings in 2017. Since 2012, demand for five of the skills has grown over 40% and demand for all but one skill has grown over 15%. The skill for which demand is increasing most rapidly, Communicating Data, has a growth rate of 323%. (BGT,)

Therefore the New Foundational Skills framework has been chosen to support this study and serve as a reference to all empirical data collected among RBS and IB students. After a thorough comparison of diverse digital skills methodologies and frameworks by reputable authors, this framework has been chosen as most relevant an balanced approach to examining the skills of our students across the three building blocks. The data collected and results presented by Burning Glass Technologies research, reflects the most recent outlook of global growth and development of digital skills and therefore serves as a benchmark to this study.

This study tests the current 'new foundation skills' capabilities and levels of our students and their 'readiness' for the digital economy labor market.

The main goals of the research are:

- To measure the level of digital knowledge and new foundational skills of IB students;
- To compare the results with the Burning Glass research results based on analysis of more than 150 million unique U.S. job postings, dating back to 2007 with the results of this survey;
- To understand the digital 'readiness' of our students for the digital economy job market;
- To give an understanding on which skills are in demand in more digitally intensive jobs and also in broader context;

This survey took place in from June 2019 to January 2020 and gathered results from 230 national and international business schools and IB programs.

The new foundational skills research

In 2017 the Business-Higher Education Forum (BHEF) commissioned Burning Glass Technologies to examine skills in the job market by drawing from a set of more than 150 million unique U.S. job postings, dating back to 2007.

Some of the questions that were asked were: How and when do evolving skills change the job market? Which skills are in demand in both digitally intensive jobs, and more broadly? Which skills retain their value over time? If such a set of emerging critical skills exist, how do the skills interact, and what do they mean for job seekers, employees, educators and employers?

Blended digital professional

The blended digital professional is someone who combines Human, Business Enabler, and Digital Building Block Skills with domain knowledge that is specific to a company, organization, or workforce. Competency or expertise in any of the three new foundational skill areas can be paired with domain-specific knowledge – in any sector of the economy, in a wide array of industries and

workplaces – to create the role of a “blended digital professional.” In this model, the three foundational skill areas provide the base of competency or expertise necessary to adapt to new domains, and to new jobs or opportunities, throughout one’s career.

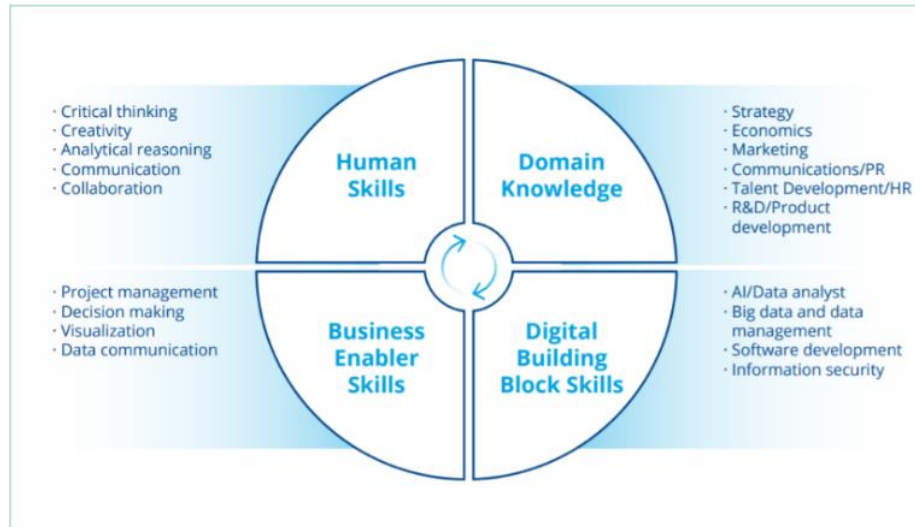


Figure 1 – The Blended digital professional

The job seekers and incumbent employees who are building a range of capacities across these groups of skills form a new cohort called blended digital professionals. Their mixed abilities give them and their employer substantial advantages, and position them to thrive in current and future markets and workplaces. Educators and employers alike will be wise to explore the most effective ways to foster the continued emergence of these much-needed professionals, who are destined to play a large role in the future of the workplace and the global economy.

In the global economy, and especially in the U.S., digitally intensive jobs are mushrooming, and they are increasingly influencing work done outside of traditionally technical industries and sectors. Not only is the economy predicated on the workforce’s acquisition of new skills, but also there is explosive demand across multiple sectors for people who can synthesize multiple skills that include a digital or technical element. (Burning Glass Technologies. “Quant Crunch: How the Demand for Data Science Skills is Disrupting the Job Market” (Boston: Burning Glass Technologies, 2017)

Fortunately, there is a growing body of evidence that skills, and their acquisition, can drive mobility, even for those most at risk of losing jobs or of having their jobs change (World Economic Forum. "Towards a Reskilling Revolution: A Future of Jobs for All" (Geneva, Switzerland: World Economic Forum, 2018).

Modern jobs integrate an array of broadly demanded skills. These are not the specialized skills of the engineer or the physicist, working with advanced mathematical models, so much as they are those of the analyzer of complex bodies of data, the software programmer, the project manager, and the critical thinker. A core benefit of foundational skills is the capacity to adapt: having a broader skill base isn't simply about meeting the needs of today's jobs. Rather, these skills equip jobseekers and incumbent employees for the future, enabling them to navigate a dynamic landscape of accelerating change: job losses, job changes, and job creation. (Bughin, Jacques. "Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation" (New York: McKinsey Global Institute, McKinsey & Co., 2017)

Raising one's level of academic attainment is the most familiar such adaptation. By securing targeted training, and by seeking out hybrid jobs – such as those that require a mix of technical and marketing skills or that combine computer science and business skills – one can command salary premiums without an advanced degree (General Assembly and Burning Glass Technologies. "Blurring Lines: How Business and Technology Skills are Merging to Create High Opportunity Hybrid Jobs" (New York: General Assembly, 2015); Restuccia, Dan, with Pang-Cheng Liu and Zoe Williams. "Rebooting Jobs: How Computer Science Skills Spread in the Job Market" (Boston: Burning Glass Technologies, 2017).

At some moment in the future, many of the high levels of skill that currently seem confined to the upper reaches of the digital economy, or to larger, more complex organizations, will become the norm among jobseekers, incumbent employees, and workplaces. This dynamic movement of skills, through time and across contexts, is an essential part of the story of the New Foundational Skills. Though highly concentrated in the digital economy, they are spreading... fast.

Multiple studies cite the development of social and emotional skills, creativity, and high-level cognitive skills as a powerful accelerator of adaptability. (Frey and Osborne; Bughin et al.)

Employers prize these skills but can have great difficulty finding them in the workplace. (Burning Glass Technologies. "The Human Factor: The Hard Time Employers have Finding Soft Skills" (Boston: Burning Glass Technologies, 2015)

Recent research suggests that rather than declining in importance, these skills are likely to become even more essential, both for jobseekers and incumbent employees and for the success of their workplaces.(Pearson and Jobs for the Future. "Demand Driven Education: Merging work and learning to develop the human skills that matter" (London: Pearson, 2018)

Further research suggests that those who can combine skills like empathy, cooperation, and negotiation with mathematical and analytic skills will thrive in an economy that increasingly relies on both. (David Deming. "The Growing Importance of Social Skills in the Labor Market" (The Quarterly Journal of Economics, vol 132(4), pages 1593-1640).

BHEF has documented the importance of soft skills in its report on 21st century workplace competencies. (Business Higher-Education Forum. "Promoting Effective Dialogue Between Business and Education Around the Need for Deeper Learning"

(Washington, D.C.: Business-Higher Education Forum, 2013)

With this research from Burning Glass Technologies, BHEF adds to its earlier analysis by investigating the Business Enabler and Digital Building Block Skills, as well as the Human Skills, required for career success.

Methodology

A team of Burning Glass Technologies analysts, working with a set of close to 56 million resumes and more than 150 million unique job postings collected by Burning Glass since 2007, analyzed Burning Glass's taxonomy of over 17,000 skills and clustered them into 14 foundational skill areas that meet the following criteria:

- **In high demand**, or in rapidly growing demand, appearing in a minimum of one million postings in 2017, or showing a minimum of 70% growth since 2012.

-
- **Common to digitally intensive roles**, with at least 20% more concentration in highly digital job families such as IT and Analysis.
 - **Already spreading to less digitally driven parts of the economy**, with at least 15% of openings outside of the IT and Analysis job families. These skills were then grouped in three groups: Digital Building Block Skills, Business Enabler Skills, and Human Skills.

The New Foundational Skills for the Digital Economy

The research identified 14 skills that have become foundational in the new economy, which converge in three interrelated groups: Human Skills, business skills, and digital skills.

Human Skills apply social, creative and critical intelligence. These skills – critical thinking, creativity, communication, analytical skills, collaboration, and relationship building – appear on many lists of sought-after “soft skills,” and are still in high demand across the digitally intensive economy.

Human skills:

- Often drive automation and technology, rather than being driven by it;
- Are more likely – not less – to be in demand in digitally intensive jobs;
- Are essential to the success of teams and enterprises;
- Are valued by employers and educators for workers at all levels;
- Are the most transferable of all New Foundational Skills;
- Can be applied across any other skill set or work context;
- Are the hardest to connect to specific career opportunities or jobs in the digital economy;
- Are useful across most jobs, but must be complemented by other skills;
- Unlike the other New Foundational Skills, are not yet treated as measurable competencies that can be taught and learned.

Digital Building Block Skills are critical to many vocations, and increasingly useful outside traditional digitally intense job families. These skills are especially useful to current or aspiring

functional analysts and data-driven decision makers. These skills include analyzing data, managing data, software development, computer programming, and digital security and privacy.

Digital building blocks skills:

- Represent essential skills for those who seek to thrive in the digital economy;
- Are great for getting one's foot in the door;
- Often have credentialing systems that signal efficiently and align with a clear progression of skills;
- Serve as a reliable means to earn more, and to advance professionally, across job families;
- Have high salary premiums: computer programming (38%) and software development;
- (34%) offer the greatest salary bumps of any New Foundational Skills;
- Enable individuals to adapt and leverage new technologies.

Business Enabler Skills play a synthesizing, integrative role in the workplace. These skills allow the other skills to be put to work in practical situations, and include project management, business process, communicating data, and digital design.

Business Enabler skills:

- Act as connective tissue between people with disparate skills and roles;
- Close technological, knowledge, and communication gaps;
- Function as a set of bridges between roles, workers, teams, and domains;
- Inform R&D with consumer, marketplace, and business insight;
- Apply the creative power of digital science to the overall business enterprise;
- Unlock, add, and communicate the value of digital technologies.

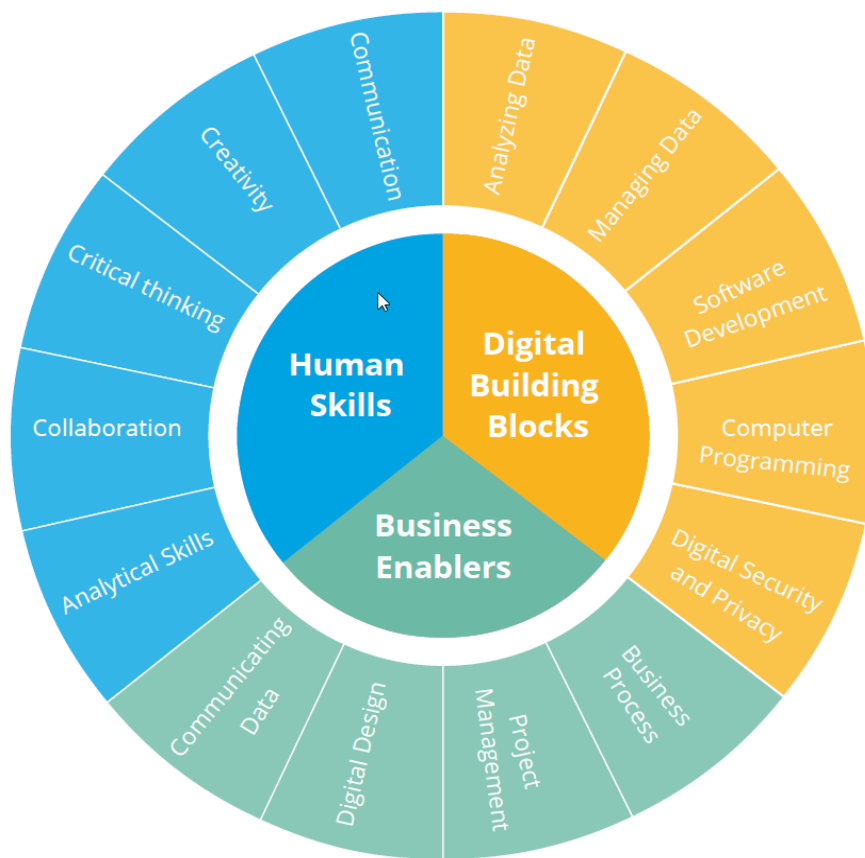


Figure 2 – The New Foundational Skills Framework

Important findings

- **The New Foundational Skills are in high demand across the economy, and jobseekers and incumbent employees with abilities in each of three skill groups have a powerful advantage.**

The 14 New Foundational Skills are in increasingly high demand across the digital economy. Employers want these skills, and demand is rising fast. Nearly 12 million job openings in 2017 – representing 53% of all openings – sought at least one of these skills. All but two of the 14 skills had a million posted openings, and nine had over 2 million postings in 2017. Since 2012, demand for five of the skills has grown over 40% and demand for all but one skill has grown over 15%. The skill for which demand is increasing most rapidly, Communicating Data, has a growth rate of 323%.

- **Those who develop the New Foundational Skills earn significantly more.**

Workers with the New Foundational Skills earn more. The average advertised salary of jobs requesting at least one of these skills was \$61,000 compared to \$53,000 for jobs requesting none of these skills – an average salary premium of \$8,000. Each of the nine skills in the Digital Building Block Skills and Business Enabler Skills groups boasts a salary premium, ranging from 7% to 38%. Software development and computer programming offer the largest salary bumps of 34% and 38%, respectively.

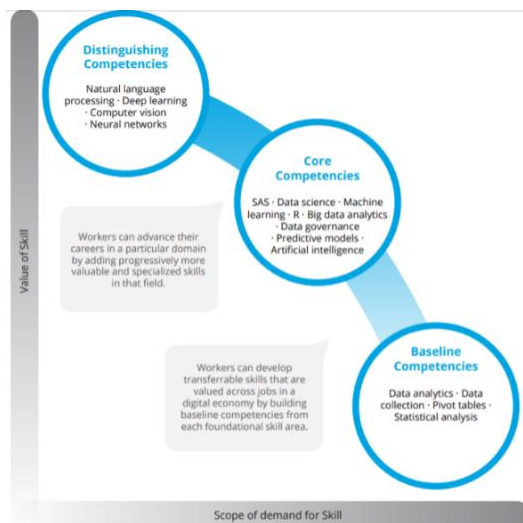


Figure 3 – Analyzing data sample drill-down on base, core and distinguished competences

- **Employers and jobseekers appear to place very different value on the New Foundational Skills**

Despite the broad-based and growing demand for these skills, jobseekers and incumbent employees frequently do not claim these skills on their resumes. An analysis of close to 56 million resumes reveals that many people are missing opportunities to add the New Foundational Skills to their portfolios – or, as applicable, to signal them to employers. Even where jobseekers and incumbent workers indicate that they possess some of these skills, they are likely to list very few of them. More than half (60%) of resumes list fewer than three of these skills, and more than a fifth (22%) list none of the New Foundational Skills at all. The two fastest growing skill areas – digital security and communicating data – are listed in only 7% and 2% of resumes, respectively. Even the three most frequently claimed skills – business process, communication, and critical thinking – are each claimed by barely a quarter of the workforce.

'There is a glaring mismatch between what employers say their workers need, and what jobseekers and incumbent workers say they have to offer.'

Further findings:

- Each of the New Foundational Skills spans a continuum of ability levels, from baseline to expert
- New Foundational Skills increase in value as careers advance
- Many of the New Foundational Skills contain opportunity for further learning
- Job seekers and incumbent employees possessing a diversity of the New Foundational Skills experience increased job mobility

Demand for the New Foundational Skills

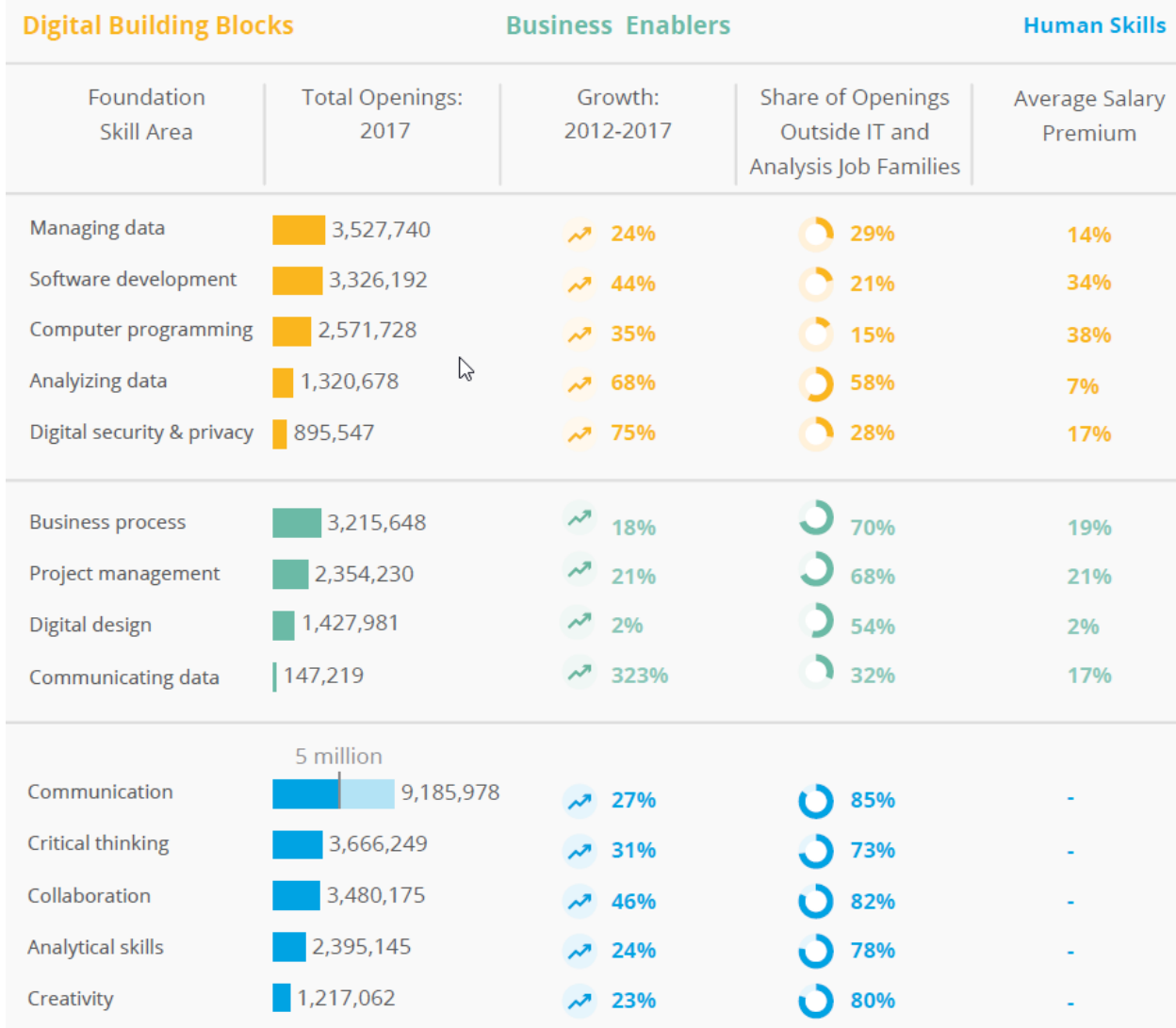


Figure 4 – Demand for the New foundational skills, Source: Burning glass, 2018

Implications

Incumbent employees and jobseekers who possess the New Foundational Skills will thrive in a digital economy – whether in digital roles like software development or in the broad array of work of the global economy, which is increasingly enabled by technology and data. These New Foundational Skills are valuable to the individual at all levels of a career and make jobseekers and

incumbent workers more adaptable to future digital disruption by giving them the skills to acquire new skills and, thereby, adapt.

Given the **supply-demand mismatch** for these New Foundational Skills, those employers with strong representation of these skills in their workforces may find themselves at a significant advantage. That is not only because these capabilities are themselves key to 21st century work, but also because they position organizations well for the future. Just as these skills make people more adaptable to future digital and sectoral disruptions, they can do the same for employers.

Educators who incorporate learning opportunities that effectively impart these skills will not only equip their students for career success but may also earn a reputation as effective partners to industry. While a number of the New Foundational Skills can be learned online, in class, and in hybrid learning systems, many will be learned in on-the-job applied learning and workplace training. Education is likely to continue to struggle to anticipate the rapidly altering needs of business: there are few tasks more challenging than to align post-secondary training with the workforce demands of a region's economy in a practical, high-impact, and sustainable way.

The New Foundational Skills also speak to the cultures and values of both the education and business sectors. The central role of Human and Business Enabler Skills reduces emphasis on what can be viewed as “vocational training” that is antithetical to the mission of the academy. At the same time, the research finds that **the value of Human Skills, which are core to the academic enterprise, is only fully actualized when combined with the more applied Digital Building Block and Business Enabler Skills** that are integral to the needs and culture of the 21st century workplace. These newly defined skills are of enduring value to jobseekers and incumbent workers. They represent a framework that bridges between the values of creativity and critical thinking that are the bedrock of higher education and the practical capabilities that individuals will need to accrue in the workplace, over the course of their careers.

Main recommendations from the BHEF skills research



Intermediary Organizations

Intermediary organizations, including regional and national business and higher education associations, should recognize the importance of the New Foundational Skills for their members' competitiveness, and take steps that illuminate and help members address current and future supply-and-demand challenges.

- Signal business' skill and talent needs by publishing market intelligence on members' talent acquisition and development challenges.
- Spotlight effective strategies for job seekers, new hires, and incumbent employees to address these challenges.
- Promote investments in market-driven partnerships and programs that build foundational skills and link learning to work.

College students

College students should recognize the importance of these skills to career growth and develop a personal plan to acquire, demonstrate, and signal these skills.

-
- Value the importance of these skills for landing jobs and advancing careers.
 - Build a mindset to become a continuous learner.
 - Seek out hands-on opportunities to acquire New Foundational Skills.
 - Signal possession of new foundational skills in one's resume.
 - Develop by pursuing volunteer, internship, or work-based opportunities.
 - Learn to identify how the foundational skills manifest in new fields.

Higher education

Higher education must recognize that the digital economy presents an opportunity to increase the value of higher education credentials by ensuring that all students possess appropriate domain, human, business, and digital skills.

- Recognize these skills as essential outcomes for 21st century learners.
- Engage faculty and administrators in building the teaching and learning of these skills into coursework and overarching curricular goals.
- Integrate skills into admissions processes and on-campus student advising.
- Provide capstone learning opportunities to build and document these skills.
- Coordinate with businesses and employers on expectations for classroom and work-based learning, internships, and job skills development.

Current Job Seekers and Incumbent Employees

Current job seekers and incumbent employees should recognize the importance of the New Foundational Skills for career adaptability and flexibility as technologies shift and job functions change. They should continuously identify strategies to acquire essential skills.

- Identify gaps in current knowledge around new foundational skill areas.
- Develop strategies, using internal training, MOOCs, boot camps, or employers' education benefits, to continuously acquire new skills.
- Learn to effectively communicate with, and learn from, digitally savvy peers.

-
- Position oneself for career growth by gaining experience with adjacent tasks and functions that require the development of new skills.
 - In resumes and other presentations, signal confirmed levels of competency, including certifications, in each of the three groups of New Foundational Skills.



PART II - New foundational skills survey results – IB students

The New Foundational Skills study among IB (HRBS, RBS) and International students

January 2020



Tanya Dimitrova, MSc, DigComm

Lecturer of Digital marketing at Rotterdam Business School

Rotterdam, The Netherlands

Introduction

The New Foundational Framework

This study is based on The New Foundational Framework discussed in the previous Part I.

In 2017 the Business-Higher Education Forum ([BHEF](#)) commissioned [Burning Glass Technologies](#) to examine skills in the job market by drawing from a set of more than 150 million unique U.S. job postings, dating back to 2007.

Some of the questions that were asked were: How and when do evolving skills change the job market? Which skills are in demand in both digitally intensive jobs, and more broadly? Which skills retain their value over time? If such a set of emerging critical skills exist, how do the skills interact, and what do they mean for job seekers, employees, educators and employers?

The Study

This study and the results shown below is based on a comparison of the results from the Burning Glass Technologies examining the level of 14 skills emerging on the digitally intensive job market and the current availability of these skills among IB students and students.

The study presents the findings per building block: Digital Building Blocks, Business Enablers and Human Skills.

Digital Building Blocks	Business Enablers	Human Skills
-------------------------	-------------------	--------------

It measures three levels of competency per skill: baseline, core and distinguishing competencies.

Baseline Competencies	Core Competencies	Distinguishing Competencies
-----------------------	-------------------	-----------------------------

The 14 specific skills are shown in the table below where you can see the three building blocks of the framework, the specific skills per building block, job openings, growth in demand per skill, share of openings outside IT sector and average salary premium.

Demand for the New Foundational Skills

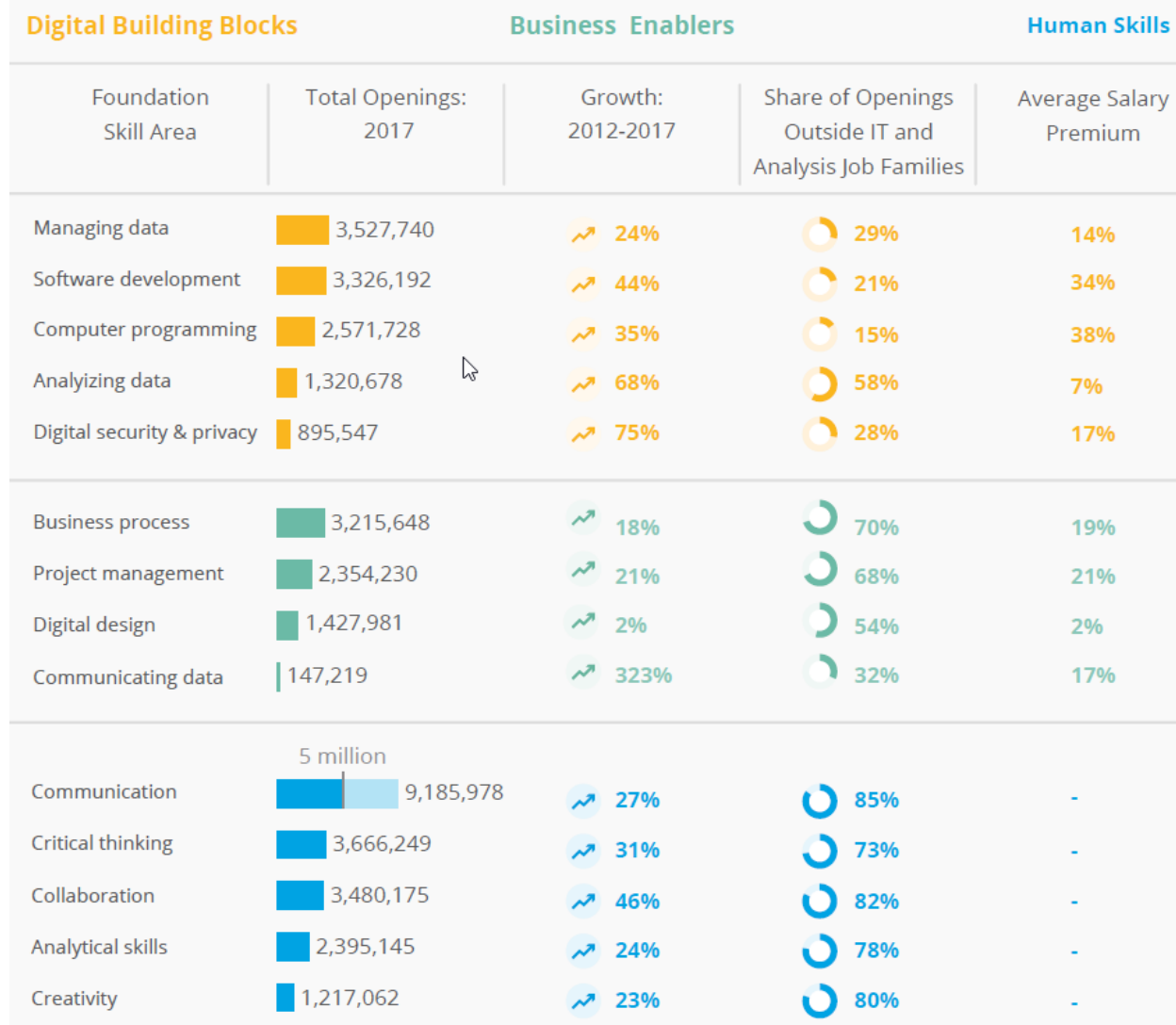


Figure 4 – Demand for the New foundational skills, Source: Burning glass, 2018

Methodology – the survey and the interviews

The results from the survey and the discussions presented are based on the study among IB students and data was gathered between **June 2019 and January 2020**.

The three building blocks of the New foundational skills -**Digital building block, Business enablers and Human skills** have served as the basis for the development of the survey and have served as a reference point for making an 'inventory' of the current foundational skills of our students. The results are further compared to the BHEF survey results to give an insight into the level of 'readiness' of IB students for the digitally enabled economy and jobs.

Sample group students – final year of bachelor study

230 respondents participated in the survey between June 2019 until January 2020. In particular 172 students from RBS, 30 students from HRBS and 28 from International schools. The responses were divided among 46% females and 54% males:

- Three international universities took part: University of Brighton, UK; University of Applied Sciences Bielefeld, Germany and TU Dublin, Ireland.
- One domestic university: Wittenborg International University
- Students from RBS and HRBS had the majority of participation in the survey.

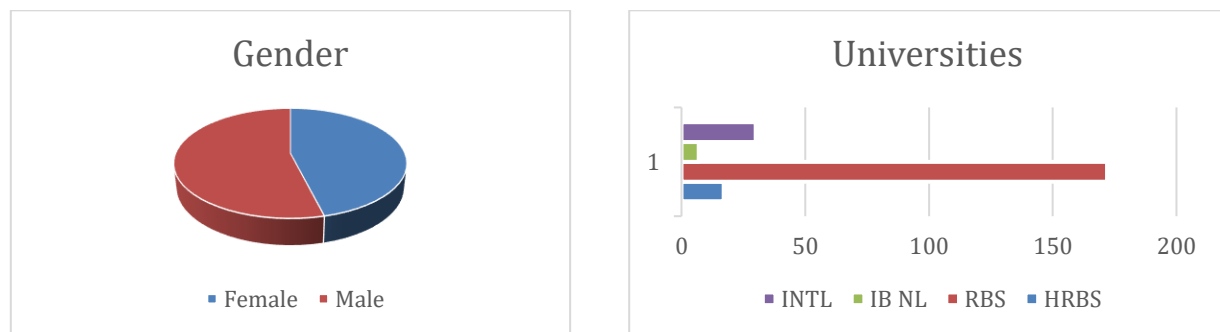


Figure 5 – Sample group students – gender & university, IB study

Sample group digital transformation experts:

8 digital transformation experts from the business field and **3 teachers** involved in the curriculum development took part in the interviews. These findings complement the findings from the survey and reflect to the credibility of the findings.

The findings and conclusions from the interviews can be found on pages 49-52!

Digital Building Blocks – Results from the survey

Data management skills

Data management skills has 24% growth rate in job openings.

Access information efficiently (time) and effectively (sources); Evaluate information critically and competently; Use information accurately and creatively for the issue or problem at hand; I understand ethical and legal issues of data usage; Manage data sets / SQL / Relational data bases / Reviewing data quality; Big data (Data warehousing, ETL, NoSQL, MySQL, Data integration, Data architecture)

Results from BHEF survey

The data managing skills have been distributed into the three competency categories. The research shows that the growth rate of managing data skills has increased with 24% in the last five years, as well as there is an increase in the salary premium for these jobs with 14%. On another side the share of resume listings from jobseekers on these skills is only 19%.

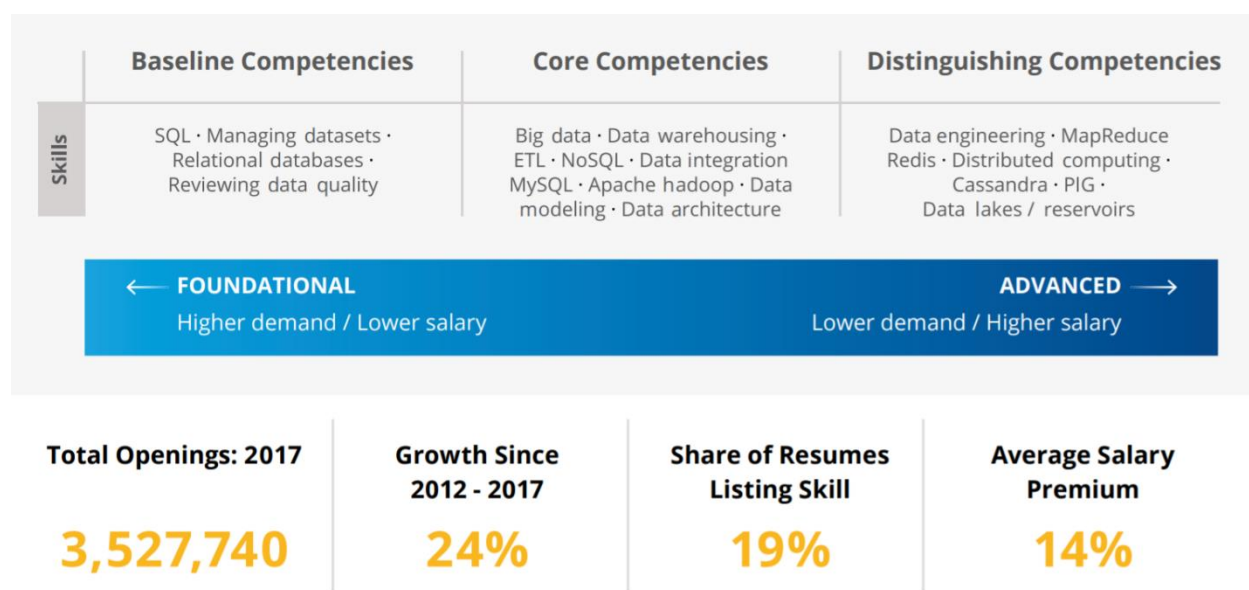
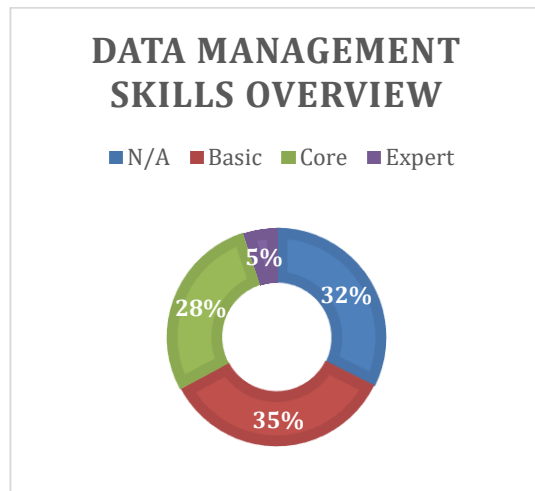


Figure 5 – Managing data competency spectrum. Source: BHEF 2018

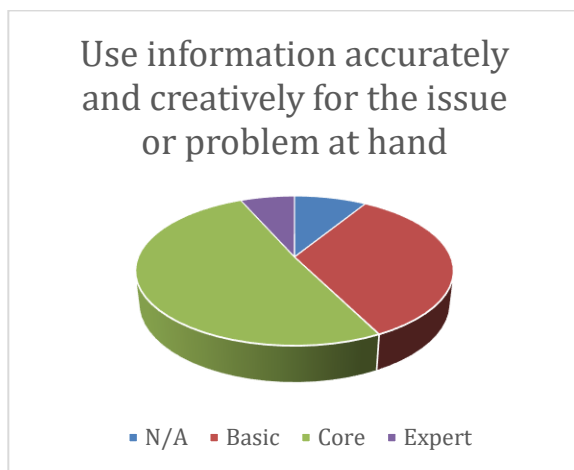
Results from IB survey – Data management skills



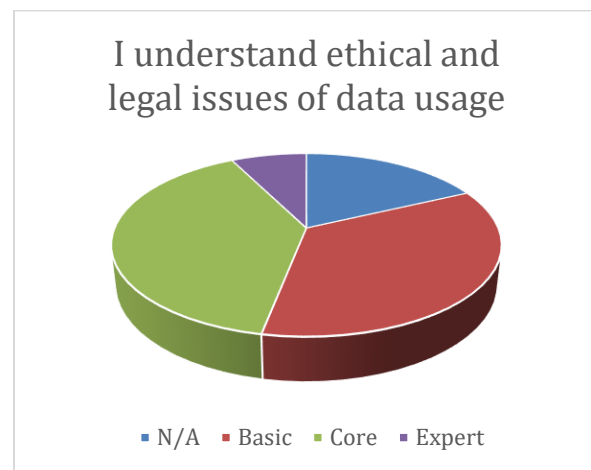
- 67% of the respondents have none or basic skills about data management skills.
- 28% state that they have understanding and use this skill proficiently and only 5% state they have expert level.

Figure 6 – Managing data survey results. Source: IB survey

The specific data management skills are presented as follows:

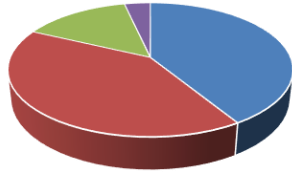


57% of the respondents have core or expert level of this skill and 43% possess this skill on a basic level or not at all.



47% of the respondents have core or expert level of this skill and 53% possess this skill on a basic level or not at all.

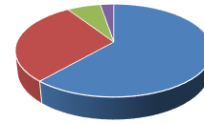
Manage data sets / SQL /
Relational data bases /
Reviewing data quality



■ N/A ■ Basic ■ Core ■ Expert

18% of the respondents have core or expert level of this skill and 82% possess this skill on a basic level or not at all.

Big data (Data
warehousing, ETL, NoSQL,
MySQL, Data integration,
Data architecture)



■ N/A ■ Basic ■ Core ■ Expert

10% of the respondents have core or expert level of this skill and 90% possess this skill on a basic level or not at all.

Conclusions - Data management skills

5% of the students indicate that they have expert level and 28% have core knowledge and are proficient in the baseline competencies.

Students score higher when they use information accurately and creatively for the issue or problem at hand (57%), but when it comes to understanding ethical and legal issues of data usage they score a bit lower with 47%.

When it comes to more advanced skills as managing data sets (SQL / Relational data bases / Reviewing data quality) and working with big data (Data warehousing, ETL, NoSQL, MySQL, Data integration, Data architecture) students score much lower than the market expectations (82-90%).

Software development & computer programming skills

Software development & computer growing skills has 44% growth rate in job openings.

Develop software, Test software, Basic coding (HTML), Advanced coding (GitHub, Java, Python, SQL, Debugging, PHP, Ruby, C++ and others)

Results from BHEF survey

The 'software development & computer programming skills' are shown below. The research shows that the growth rate of these skills has increased with 44% in the last five years and as well as there is an increase in the salary premium with 34% for these jobs. On another side the share of resume listings of future employees on these skills is only 17%.

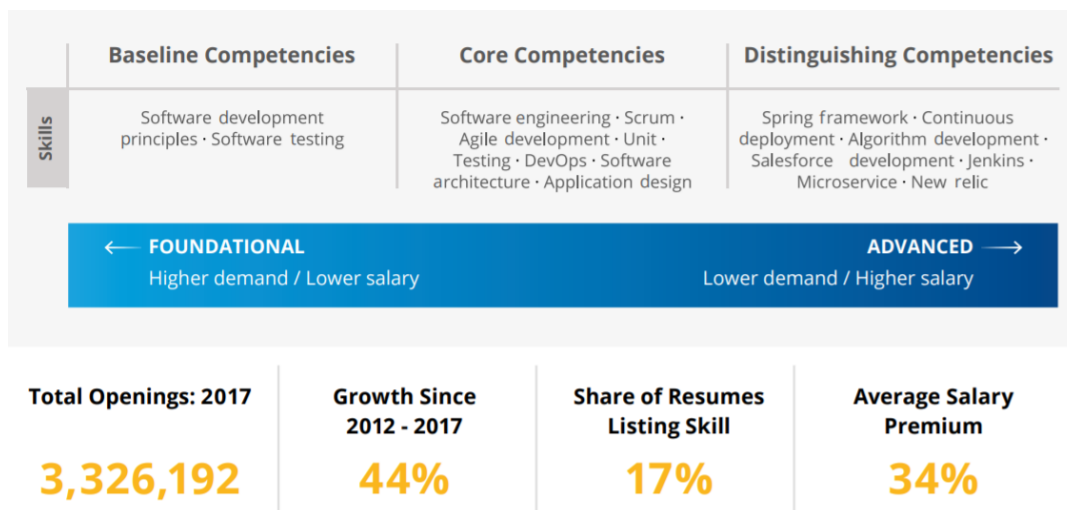
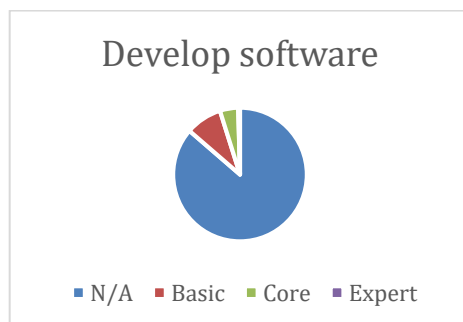


Figure 7 – Software development and computer programming skills. Source: BHEF 2018

Results from IB survey – Software development & computer programming skills

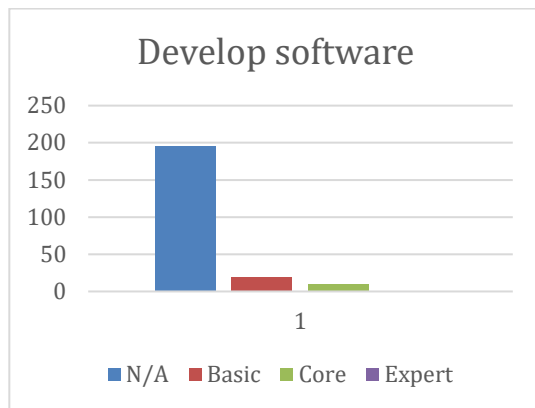


94% of the respondents do not possess any of these skills or have basic knowledge.

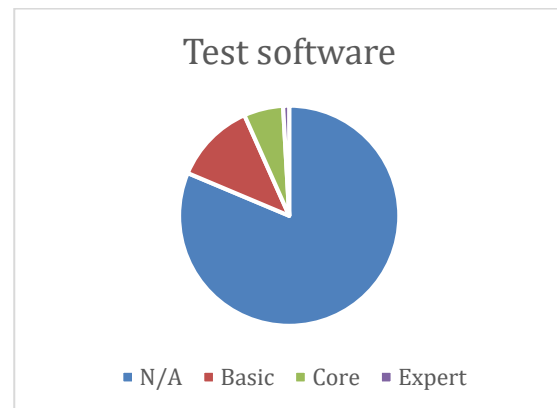
Only 5% state they are proficient on these skills and only 1 person states they are an expert.

Figure 8 – Software development and computer programming skills survey results. Source: IB survey

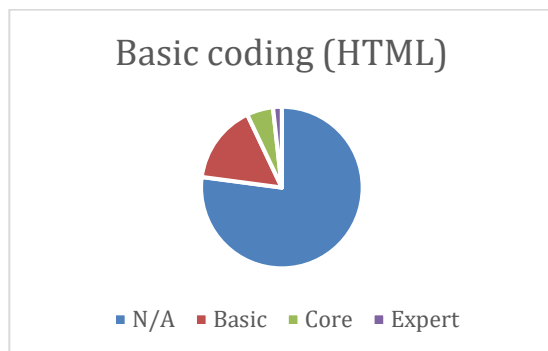
The specific software development and computer programming skills are presented as follows:



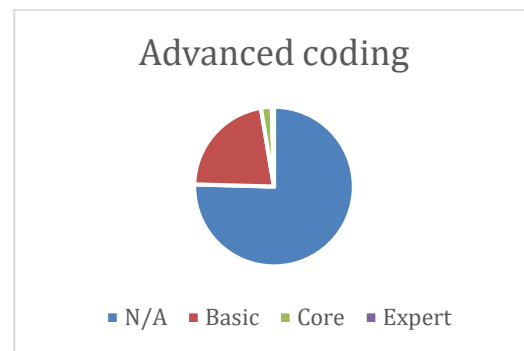
5% of the respondents have core or expert level of this skill and 94% possess this skill on a basic level or not at all.



7% of the respondents have core or expert level of this skill and 92% possess this skill on a basic level or not at all.



7% of the respondents have core or expert level of this skill and 92% possess this skill on a basic level or not at all.



3% of the respondents have core or expert level of this skill and 97% possess this skill on a basic level or not at all.

Conclusions - Software development & computer programming skills – IB students

The job opening of these skills have shown a high increase with 44% in the last five years. On another hand it is observed that IB students possess some or almost none of these skills (5%). Most proficiency occurs in basic coding (HTML), which falls under the baseline competencies.

Giving that these skills have a growth rate of 44%, but the rate of resume listings is 17%, it becomes incumbent to look into the development of such skills in education and curricula.

Analyzing data skills

Analyzing skills has 68% growth rate in job openings.

Basic data analysis; Create and work with Pivot tables; I can make basic statistical analysis; Data Science; Predictive analytics; AI, R, SAS; Big data analysis; Data governance; Predictive models.

Results from BHEF survey

The 'analyzing data' skills results show that the growth rate of these skills has increased with 68% in the last five years, however there is an increase in the salary premium with only 7% for jobs that require these skills. The share of resume listings of future employees on these skills is only 12%. Here we can observe a huge discrepancy between what is sought and what is supplied.

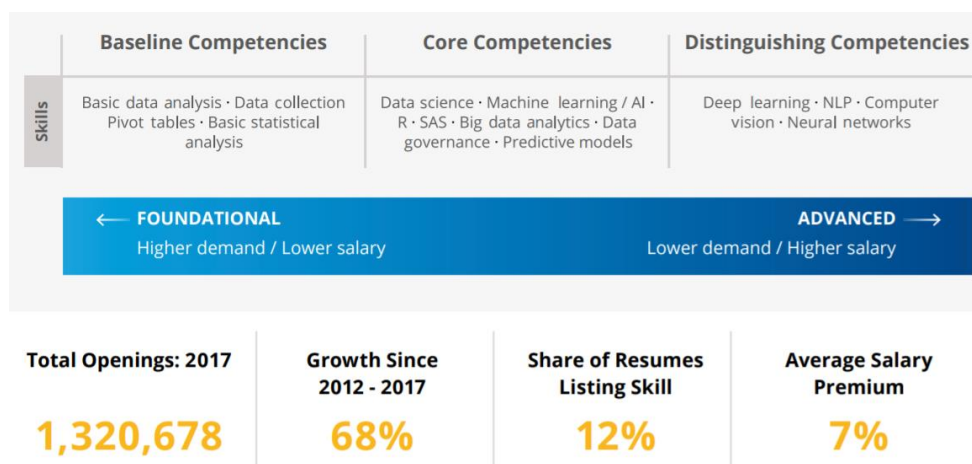
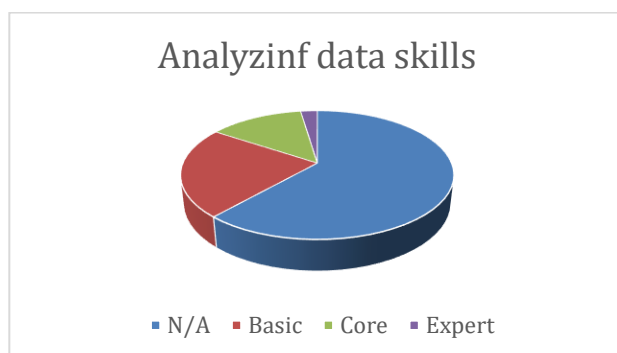


Figure 9 – Analyzing data skills. Source: BHEF 2018

Results from IB survey – Analyzing data skills

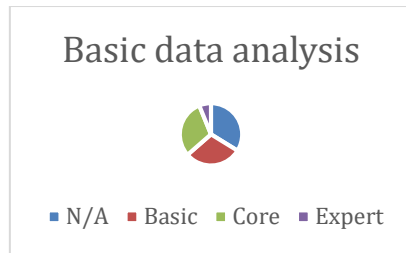


83% of the respondents do not possess any of these skills or have some basic knowledge.

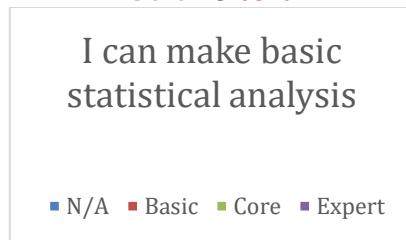
15% state they are proficient on these skills and only 2% state they are an expert.

Figure 10 – Analyzing data skills survey results. Source: IB survey

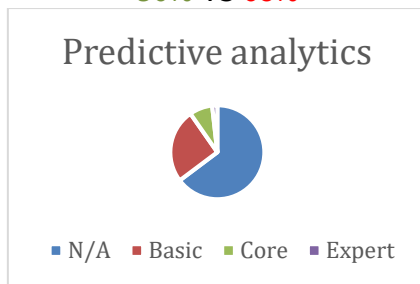
The specific analyzing data skills are presented as follows: **Green** color represents Core and Expert level (% of having these skills) & **Red** color represents N/A and Basic (still to be developed skills)



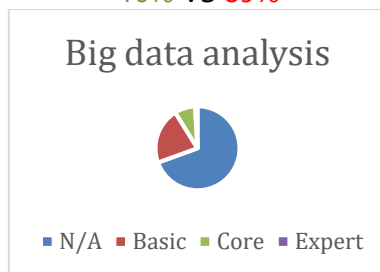
36% VS 63%



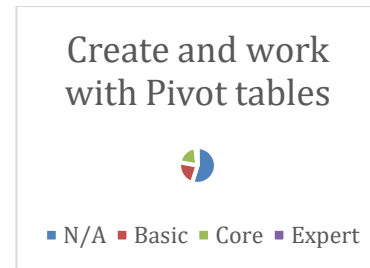
30% VS 68%



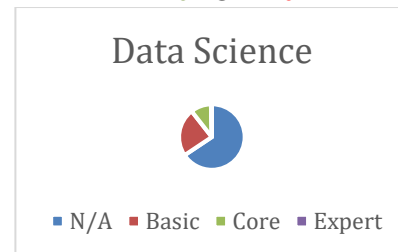
10% VS 89%



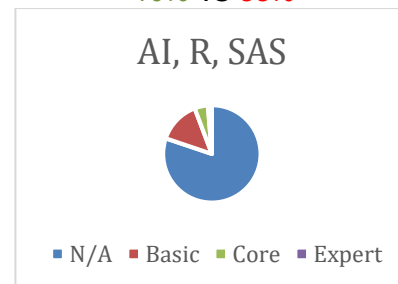
9% VS 90%



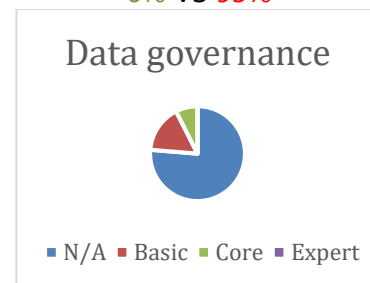
22% VS 72%



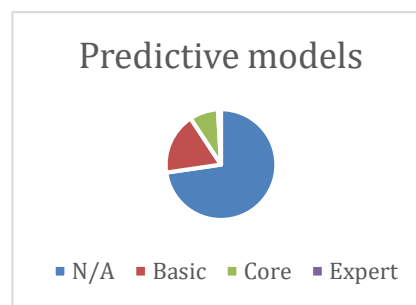
10% VS 88%



6% VS 93%



7% VS 92%



9% VS 90%

Conclusions – Analyzing data skills – IB students

15% state that they are proficient in these skills or have expert knowledge (13%-2%).

The most acquired skills are: basic data analysis, basic statistical analysis and create and work with Pivot tables.

The best expertise lie in the basic data analysis and basic statistical analysis, but not in the more advanced data analysis skills.

Most competencies lie in the baseline spectrum and most of development intention also lies there. Giving that these skills have one of the highest growth rate of 68%, but the share of the resume listings is 12%, it becomes incumbent to look into the development of such skills in education and curricula.

Digital security and privacy skills

Digital security and privacy skills has 75% growth rate in job openings.

General information security; Data privacy; Data security; Network security

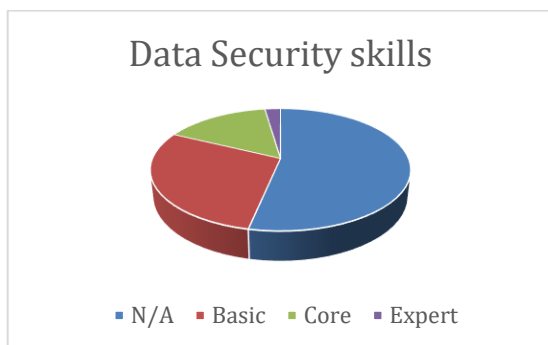
Results from BHEF survey

The digital security and privacy skills results show that the growth rate of these skills has increased with 75% in the last five years and there is an increase in the salary premium with 17% for jobs that require these skills. However the share of resume listings of future employees on these skills is only as low as 7%. Here we can also observe a huge discrepancy between what is sought and what is supplied.



Figure 11 – Digital security and privacy skills. Source: BHEF 2018

Results from IB survey – Data security skills

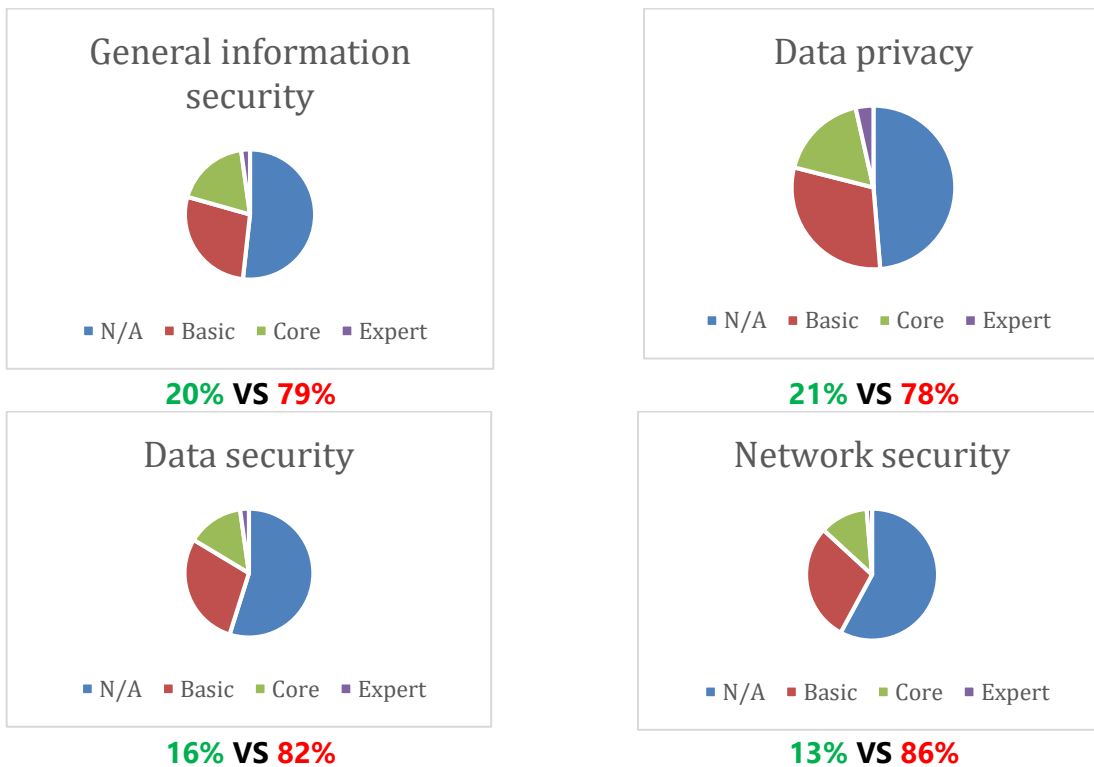


81% of the respondents do not possess any of these skills or have some basic knowledge.

18% state they are proficient on these skills and only 2% state they are an expert.

Figure 12 – Digital security and privacy skills survey results. Source: IB survey

The specific data security skills are presented as follows:



Conclusions – Data security skills

18% state that they are proficient in these skills or have expert knowledge (16%-2%).

The most acquired skills are: general information security and data privacy.

The proficiency on these skills is low, however the level of awareness is increasing and the intention to develop these skills as well.

Business Enablers

Business processes skills

Business process skills has 18% growth rate in job openings.

Business process analysis; Business planning; Strategic planning

Results from BHEF survey

The business processes skills have been distributed into the three competency categories as can be seen below. The research shows that the growth rate of business processes skills has increased with 18% in the last five years, as well as there is an increase in the salary premium for these jobs with 19%. The share of resume listings from jobseekers on these skills is 27%.

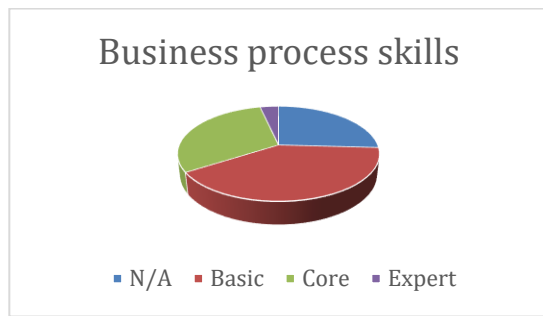


Figure 13 – Business processes skills. Source: BHEF 2018

Most of the business activities requiring these skills are IT, Sales and Business management and Operations.

70% of the job openings come from companies of digital occupation family.

Results from IB survey – Business process skills

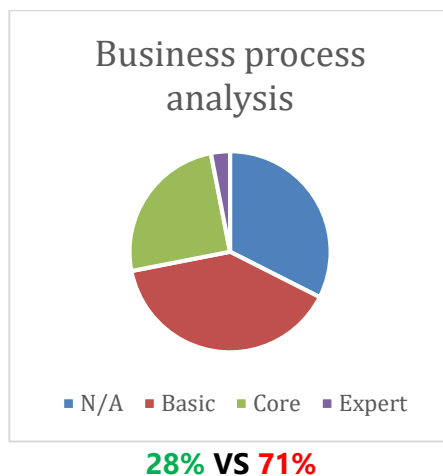


65% of the respondents have basic knowledge on these skills or do not possess any (40% vs 26%).

34% state they are proficient on these skills of which 3% state they have an expert level.

Figure 14 – Business processes skills survey results. Source: IB survey

The specific business process skills are presented as follows:



Conclusions – Business processes skills – IB students

34% of the students have proficient or expert business process skills. 40% have basic skills and 26% have none.

Overall students score higher on these skills and where most in strategic planning and business planning and less in business process analysis.

Competences here lie mainly in the baseline and core competencies, however the level of awareness is increasing and the intention to develop these skills is high. Only 3% of the respondents possess expert level of competencies. These skills have a growth rate of 18% and the share of resume listings is 27%, which shows a balanced development of these skills in correlation to the job market. This also identifies that the basic and core competencies are covered in the curriculum of IB programs, however there is room for development of more advanced and distinguished skills.

Project management skills

Project management skills has 21% growth rate in job openings.

Project management principles; Plan and develop a project; Perform stakeholder analysis; Microsoft project; Scrum or Agile applications;

Results from BHEF survey

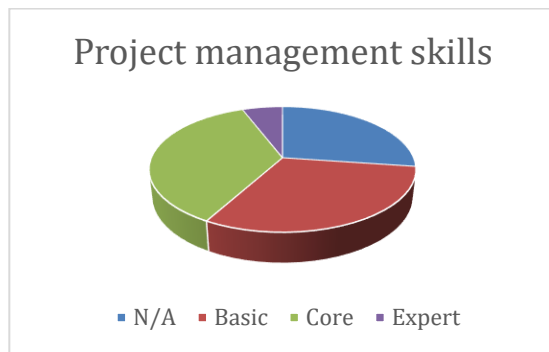
The project management skills have been distributed into the three competency categories as can be seen below. The research shows that the growth rate of project management skills has increased with 21% in the last five years, as well as there is an increase in the salary premium for these jobs with 21%. The share of resume listings from jobseekers on these skills is 23%.



Figure 15 – Project management skills. Source: BHEF 2018

Information technology and Business management and operations sectors have the most job openings for such skills and almost 70% of the demand comes from digital occupation families of companies.

Results from IB survey – Project management skills

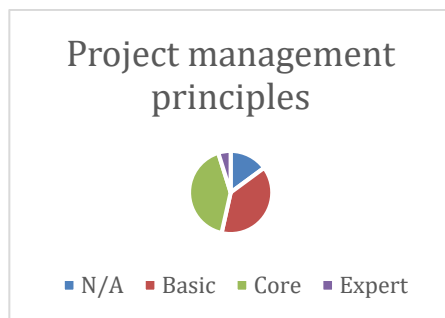


57% of the respondents have basic knowledge on these skills or do not possess any. There is equal distribution between the two groups.

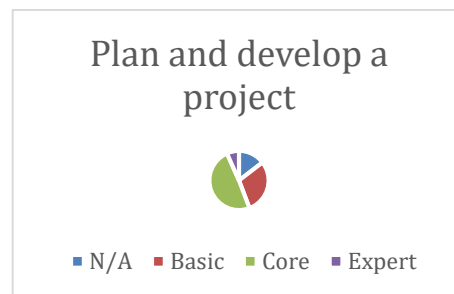
41% state they are proficient on these skills of which 6% state they have an expert level.

Figure 16 – Project management skills survey results. Source: IB survey

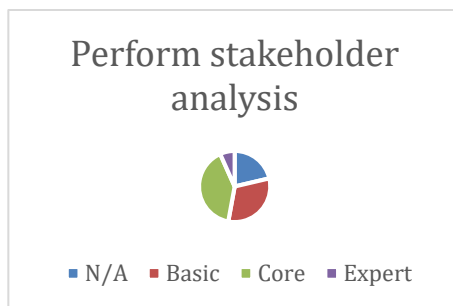
The specific project management skills are presented as follows:



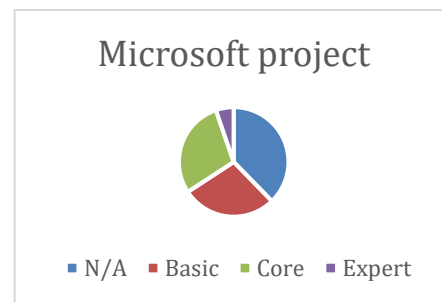
46% VS 54%



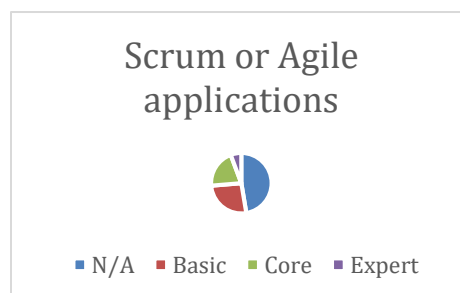
55% VS 45%



46% VS 54%



35% VS 65%



26% VS 74%

Conclusions – Project management skills

41% of the students state they are proficient on these skills of which 6% state they have an expert level. Of these skills most developed are: planning and developing of a project, project management principles and stakeholder analysis, which lie in the baseline and core competencies continuum.

There is inequal distribution when it comes to distinguished competencies such as Scrum and Agile – 74% state that they do not possess these skills or are planning to develop them. The alumni tend to have higher level of possession of the more advanced skills.

Digital design skills

Digital design skills has 2% growth rate in job openings.

Graphic design principles; Design software(s); Web design; UI / UX desing; CMS; GUI (graphical user interface); Information architecture

Results from BHEF survey

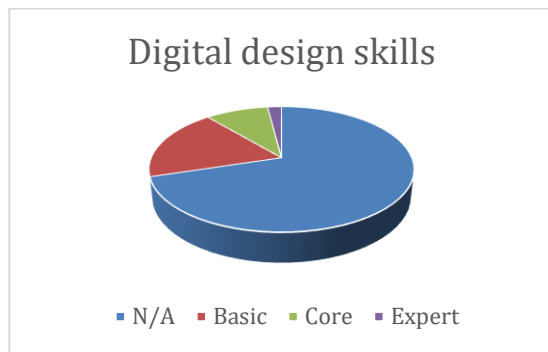
The research shows that the growth rate of digital design skills has increased with 2% only in the last five years, as well as the increase in the salary premium for these jobs is 2%. The share of resume listings from jobseekers on these skills is 20%.



Figure 17 – Digital design skills. Source: BHEF 2018

Information technology leading with 42% & Design, Media and Writing, Marketing and Public relations and Engineering (27%) sectors have the most job openings for these skills and almost equal amount of demand comes from digital and non-digital occupation families of companies.

Results from IB survey – Digital design skills

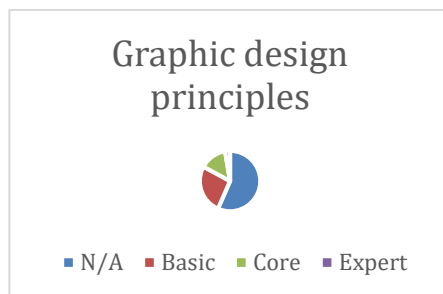


88% of the respondents have basic knowledge on these skills or do not possess any (18% vs 69%).

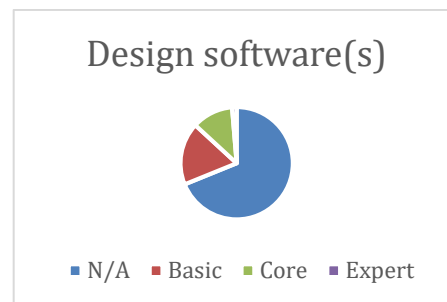
11% state they are proficient on these skills of which 2% state they have an expert level.

Figure 18 – Digital design skills survey results. Source: IB survey

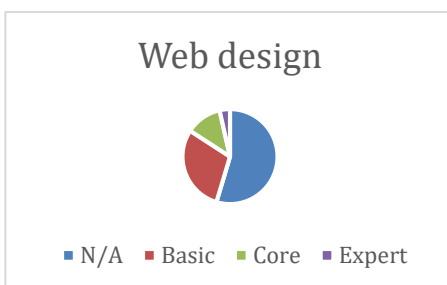
The specific digital design skills are presented as follows:



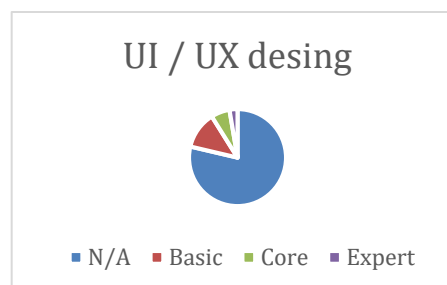
17% VS 83%



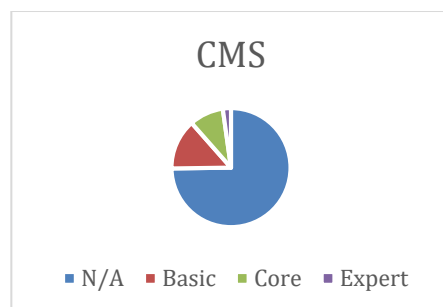
13% VS 87%



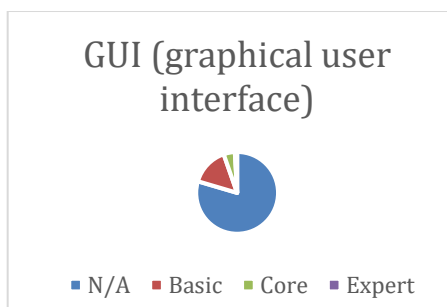
16% VS 84%



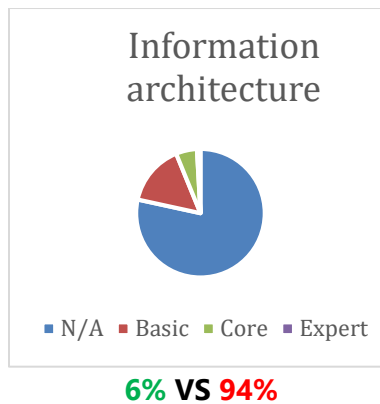
9% VS 91%



11% VS 89%



5% VS 95%



Conclusions – Digital design skills – IB students

11% state they are proficient on these skills of which 2% state they have an expert level.

Most developed are graphic design principles and web design followed by design software. Least develop skills are in the area of CMS, GUI and Information architecture skills.

These skills have a growth rate of only 2% on the job market and the share of resume listings on these skills is 2%, it shows a balanced development of these skills in correlation to the job market. The basic and core competencies about digital design are somewhat covered in the curriculum of IB, but there is not sufficient attention given to these skills. There is room for development for these skills on all three competency levels.

Communicating data skills

Communicating data skills has the highest growth rate of 323% in job openings.

Data visualization principles; Data visualisation software (Tableau, Qlikview or others)

Results from BHEF survey

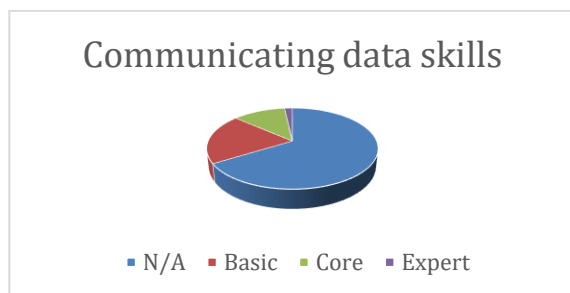
The research shows that the growth rate of communicating data skills has increased with 2% only in the last five years, as well as the increase in the salary premium for these jobs is 2%. The share of resume listings from jobseekers on these skills is 20%.



Figure 19 – Communicating data skills. Source: BHEF 2018

Information technology and Planning and Analysis sectors have the most job openings (68%) for such skills and almost 70% of the demand comes from non-digital occupation families of companies

Results from IB survey – Communicating data skills

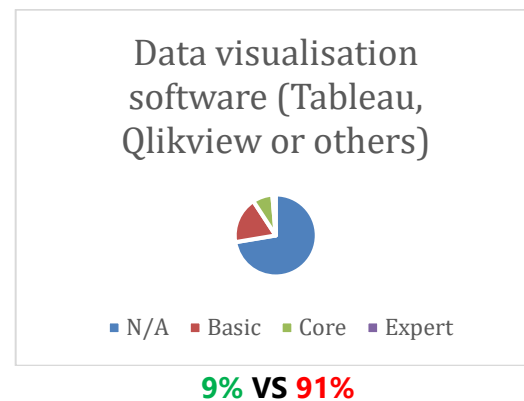
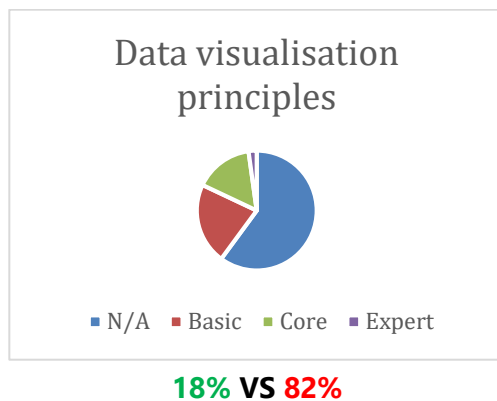


86% of the respondents have basic knowledge on these skills or do not possess any (20% vs 66%).

13% state they are proficient on these skills of which 2% state they have an expert level.

Figure 20 – Communicating data skills survey results. Source: IB survey

The specific digital design skills are presented as follows:



Conclusions – Communicating data skills – IB students

13% of the students state they are proficient on these skills of which 2% state they have an expert level. The rest of the respondents have basic knowledge on these skills or do not possess any (20% vs 66%).

There is some knowledge about data visualization principles among the students but much less on data visualization software or programs.

These skills have the highest growth rate of 323% on the job market and the share of resume listings on these skills is notably low at 2%. We observe a huge discrepancy between the job market requirements and the proficiency and availability of these skills. There is room for development for these skills on all three competency levels.

Human Skills

Communication

Communication skills has 23% growth rate in job openings.

Communication; Problem solving; Collaboration with others; Critical Thinking; Creativity; Innovation; Manage goals and time; Work independently; Flexibility and Adaptability; Digital identity (make a responsible representation of yourself online); Digital well-being (make informed and responsible choices when using digital technologies); Learning and development; Cultural and civic awareness

Results from BHEF survey

The research shows that the growth rate of **communication skills** has increased with 27% in the last five years.

The share of resume listings from jobseekers on these skills is 27%.

85% of the openings come from non-digital occupation families from sales, IT and health care sector.

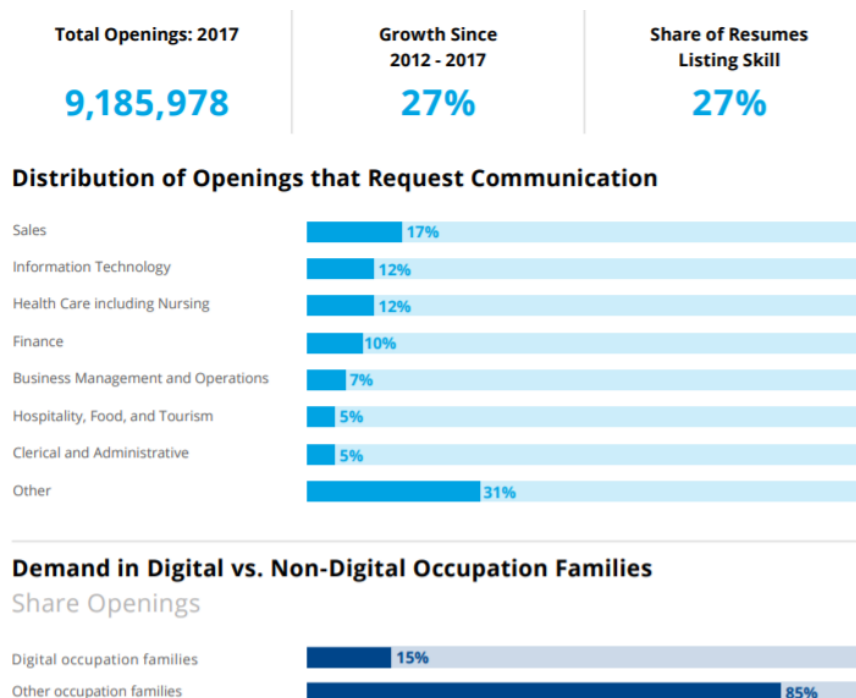
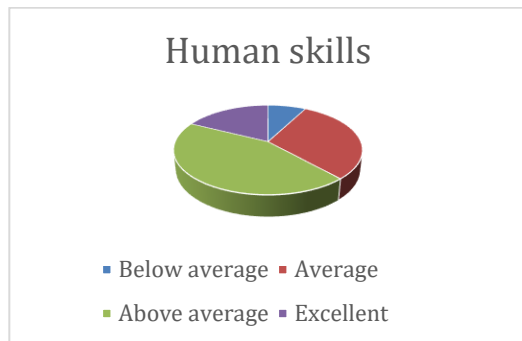


Figure 21 – Communicating data skills. Source: BHEF 2018

Critical thinking skills job openings has grown with 31% while the share of resumes is 27%. Collaboration has an increase of 46% job openings and 22% only show these skills. Analytical skills has an increase rate of 24% and share of resumes 27%. Creativity – 23% increase in job openings and 11% share of resumes.

Results from IB survey – Human skills

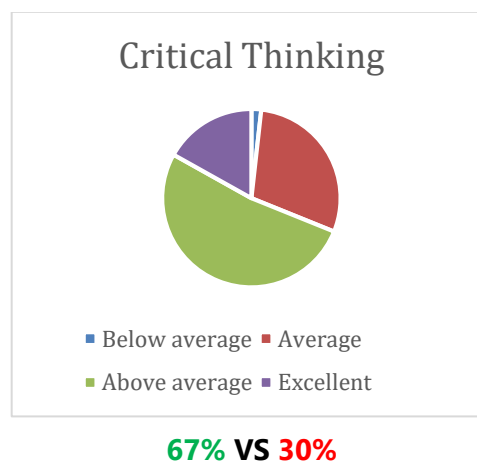
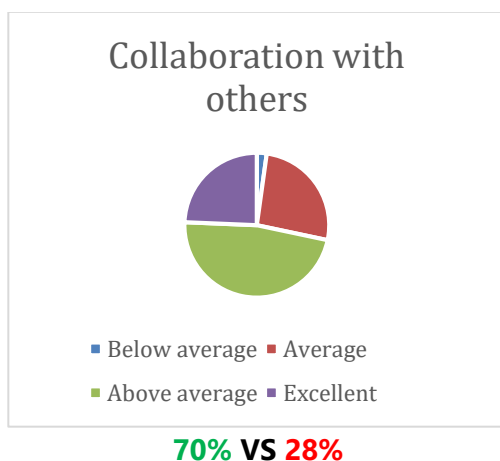
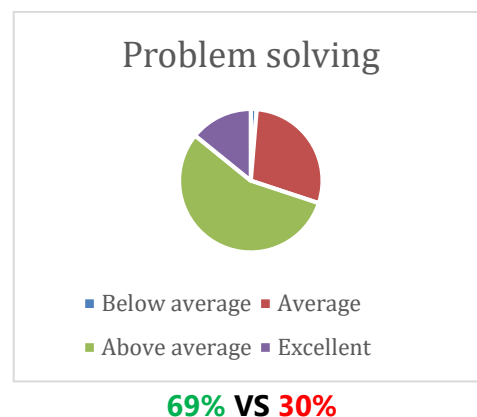
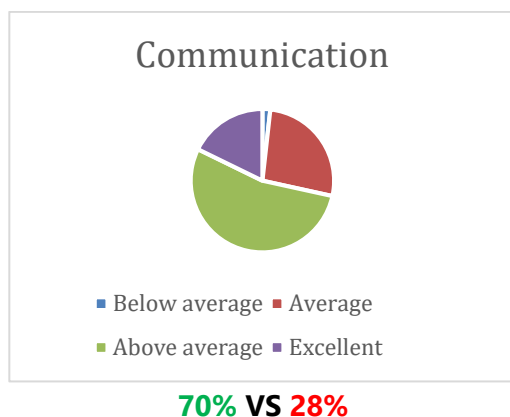


40% of the respondents have basic knowledge on these skills or do not possess any (20% vs 66%).

60% state they are proficient on these skills of which 2% state they have an expert level.

Figure 22 – Communicating data skills survey results. Source: IB survey

The specific human skills are presented as follows: **Green** color represents Core and Expert level (% of having these skills) & **Red** color represents N/A and Basic (still to be developed skills)



Creativity



■ Below average ■ Average
■ Above average ■ Excellent

59% VS 38%

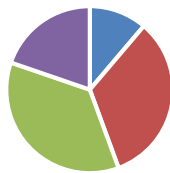
Innovation



■ Below average ■ Average
■ Above average ■ Excellent

49% VS 49%

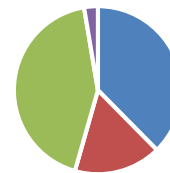
Manage goals and time



■ Below average ■ Average
■ Above average ■ Excellent

54% VS 43%

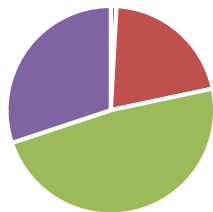
Work independantly



■ Below average ■ Average
■ Above average ■ Excellent

45% VS 53%

Flexibility and Adaptability



■ Below average ■ Average
■ Above average ■ Excellent

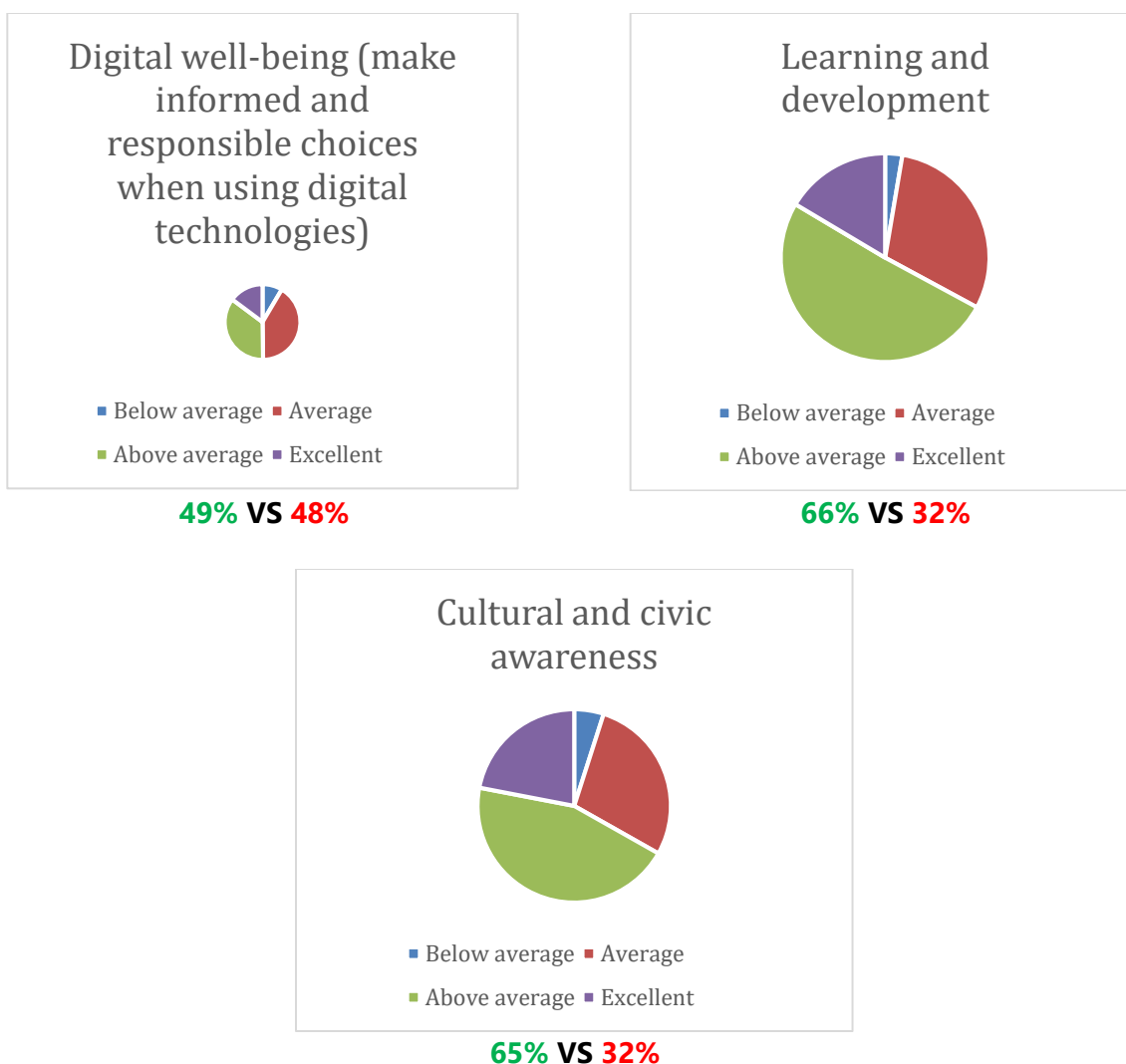
77% VS 21%

Digital identity (make a responsible representation of yourself online)



■ Below average ■ Average
■ Above average ■ Excellent

37% VS 48%



The skills in the **left** column show the higher scores among students and the ones in the **right** column show the lower developed skills.

Score High	Score Low
Flexibility and Adaptability – 77%	Creativity – 59%
Communication – 70%	Manage goals and time – 54%
Collaboration with others – 70%	Innovation – 49%
Problem solving – 69%	Digital well-being – 49%
Critical thinking – 67%	Work independently – 45%
Learning and development – 66%	Digital identity – 37%
Cultural and civic awareness – 65%	

Figure 23 – Human skills survey results. Source: IB survey

Personal reflection on human skills and mindset

I consider myself:

42 responses

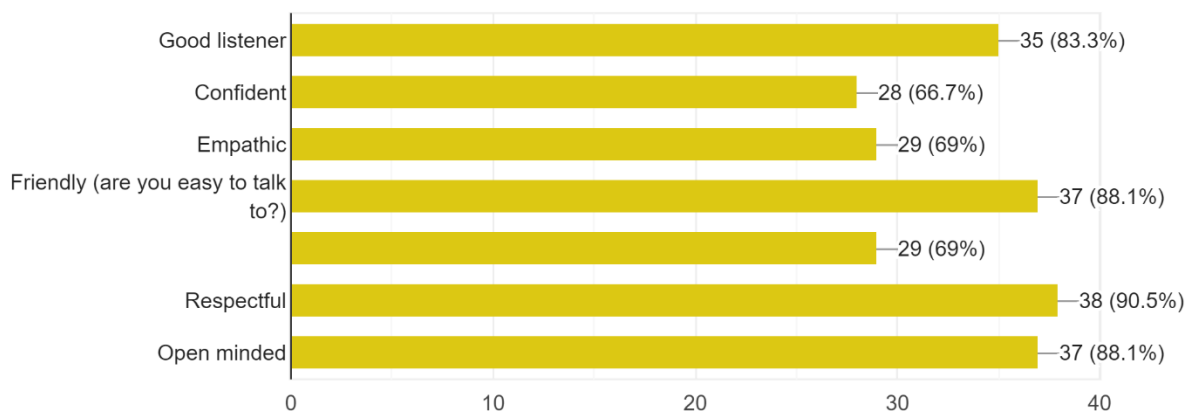


Figure 24 – Human skills survey results. Source: IB survey

Conclusions – Human skills – IB students

Majority (65-77%) of IB students state that they have above average and excellent skills in Communication, Collaboration with others, Problem solving, Critical thinking, Learning and development and Cultural and civic awareness and are **particularly good in being flexible and adaptable**. This shows that these skills are covered quite extensively in the curriculum and the students develop distinctive abilities to work independently as well as in a team and collaborate and communicate well, while demonstrating a sense of flexibility and adaptability.

On another hand students **score lower (37-59%)** on Creativity, Innovation, Managing goals and time, Learning and development and Working independantly.

More than half of the respondents state that **Digital well-being** (make informed and responsible choices when using digital technologies) and **Digital identity** (make a responsible representation of yourself online) skills are on an average level and about 18% have no or below average skills.

Overall conclusions of the survey

When looking at the distribution of the New foundation skills among job openings (demand), resume listed skills (supply) and correlate this data to the results of the survey among IB students, the following conclusions can be drawn:

The New foundational skills overview

Most sought skills:

- Communicating data (323% growth)
- Digital security and privacy (75% growth)
- Analyzing data skills (68% growth)

have the highest growth and are trending in demand.

Followed by:

- Collaboration (46%)
- Software development & computer programming skills (44%)
- Critical thinking (31%)
- Communication skills (27%)
- Data managing skills (24%)
- Analytical skills (24%)
- Creativity (23%)
- Project management (21%)
- Business processes (18%)

Discrepancy between sought and supplied skills

The largest discrepancy among supply and demand can be seen for communicating data (2% supply vs demand 323%), digital security and privacy skills (7% supply vs 75% demand), followed by analyzing data skills (12% supply vs 68% demand) and then by software development & computer programming skills (17% supply vs 44% demand).

Conclusions from the expert interviews

Twelve digital transformation experts, CEOs and teachers were interviewed to bring their insights into the topics of what is the profile of digital transformation companies, what hard and soft skills are vital for future digital transformation leaders; what is mindset to thrive in such environment and how schools curricula should address this.

What is digital transformation (DX or DT)?

Digital transformation is the cultural, organizational and operational change of an organization, industry or ecosystem through a smart integration of digital technologies, processes and competencies across all levels and functions in a staged way. Digital transformation (*also DX or DT*) leverages technologies to create value for various stakeholders (*customers in the broadest possible sense*), innovate and adapt to changing circumstances.

Digital transformation according to the experts is:



- A method to drive change
- A way to adapt to the new future
- Creating smart ecosystems
- Being able to digitalize your strategy
- Way of working with technological tools
- Encored in your top-down strategy
- Integrating digital solutions in every step
- Changing the current way of thinking and working
- Asset management in a smarter way
- Continues improvement
- Fitting the digital future
- Growing digital mindset
- Using digital enablers
- About culture and structure

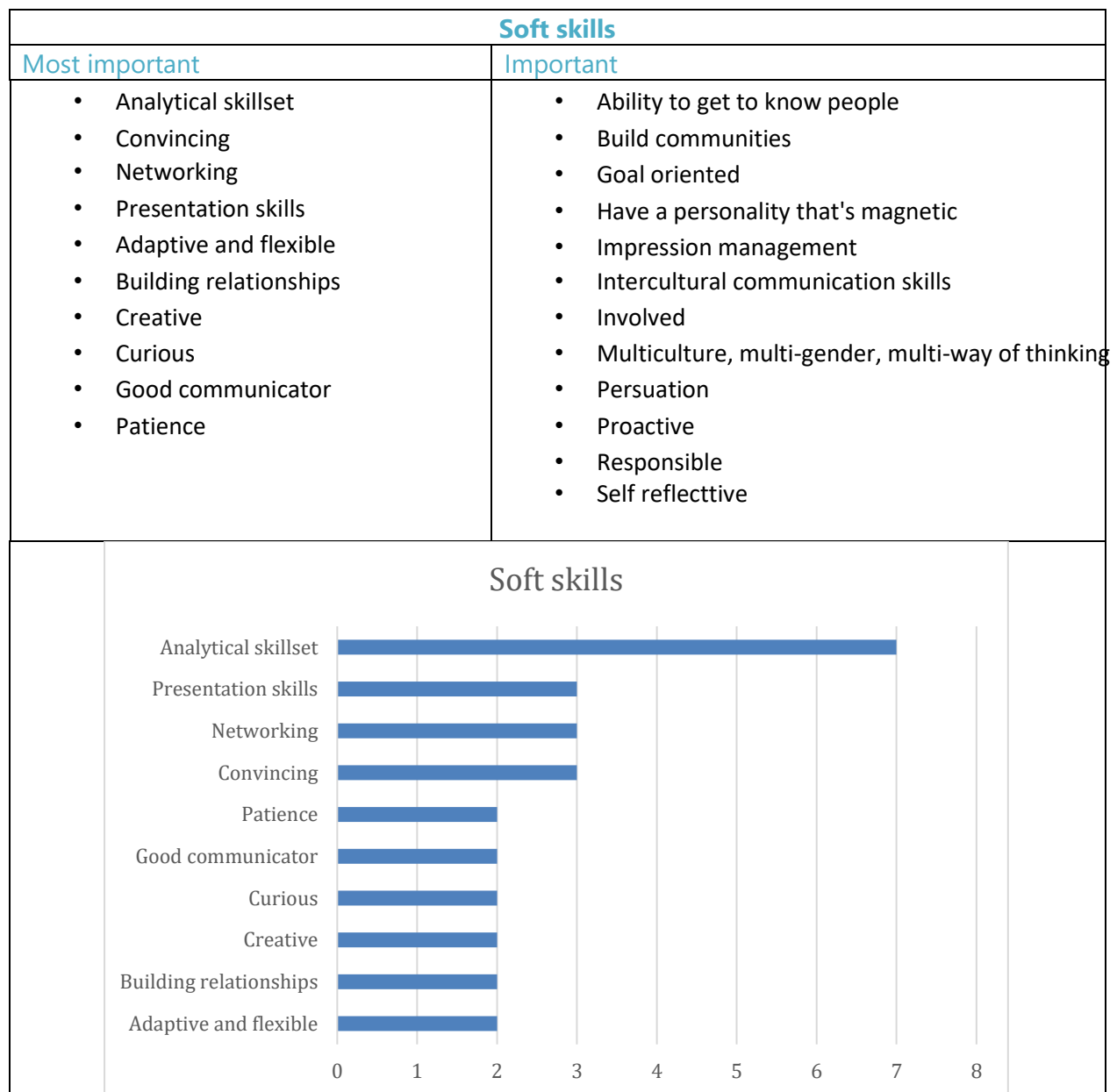
"Culture eats strategy for breakfast."

—Mark Fields, Ford CEO, who attributed the quote to Peter Drucker

There were 11 interviews and the summary form the analysis of the transcripts is shown below.

The skills described below form the necessary skillset for the future digital transformation leader who will operate successfully in a digitally intensive economy. The experts found these as the most important factors and the list also shows the prioritization of skills.

Most attention is given to the soft skills, however the hard skill, mindset and understanding the profile of the future digital transformation leader pay crucial role to build the **blended professional** of the future.



Hard skills																			
<ul style="list-style-type: none"> • Data driven decision • Basic understanding of IT • SAP, Oracle, Cloud, Analytics, AWS • SEO/SEA • Designing, prototyping and testing • Work with analysis tools • Creative people need to also understand data • Understand the limitations or opportunities in IT systems • Infrastructure of data 																			
<p style="text-align: center;">Hard skills</p> <table border="1"> <thead> <tr> <th>Hard Skill</th> <th>Value (approx.)</th> </tr> </thead> <tbody> <tr> <td>SAP, Oracle, Cloud, Analytics, AWS</td> <td>3.0</td> </tr> <tr> <td>Basic understanding of IT</td> <td>3.0</td> </tr> <tr> <td>SEO/SEA</td> <td>3.0</td> </tr> <tr> <td>Designing, prototyping and testing</td> <td>2.0</td> </tr> <tr> <td>Infrastructure of data</td> <td>2.0</td> </tr> <tr> <td>Understand the limitations or...</td> <td>2.0</td> </tr> <tr> <td>Creative people need to also understand...</td> <td>2.0</td> </tr> <tr> <td>Work with analysis tools</td> <td>2.0</td> </tr> </tbody> </table>		Hard Skill	Value (approx.)	SAP, Oracle, Cloud, Analytics, AWS	3.0	Basic understanding of IT	3.0	SEO/SEA	3.0	Designing, prototyping and testing	2.0	Infrastructure of data	2.0	Understand the limitations or...	2.0	Creative people need to also understand...	2.0	Work with analysis tools	2.0
Hard Skill	Value (approx.)																		
SAP, Oracle, Cloud, Analytics, AWS	3.0																		
Basic understanding of IT	3.0																		
SEO/SEA	3.0																		
Designing, prototyping and testing	2.0																		
Infrastructure of data	2.0																		
Understand the limitations or...	2.0																		
Creative people need to also understand...	2.0																		
Work with analysis tools	2.0																		
Mindset	Curricula																		
<ul style="list-style-type: none"> • Have vision • Digital minded • Digital transformation skills • Influencer of change in an organization • Understand systems and analysis • Understand digital natives & digital immigrants • Know enough success stories and failures • Competitive 	<ul style="list-style-type: none"> • Psychology and sociology about how do people think • Change the way working with people • Combining IT with some business knowledge • Changing your strategy in the digital age • Business models understanding • Tools and technologies • Culture and organisations • Change management • Develop digital products • Consumer behaviour • Basic understanding of the current technology trend (must) 																		

Digital transformation management skills	
Most important	Important
<ul style="list-style-type: none"> • Change management • Agile engineering culture (Agile, waterfall, sprint cycles) • Project management • Strong Stakeholder management 	<ul style="list-style-type: none"> • Manage complexity across their organization • Make smart design on high level • Business and IT alignment • Understand the use of IT in all different sort of solutions • Control the edge technology • Overview of more IT architectures • Strong customer focus • People management • Leadership • Open mindset • Build autonomous squads • DevOps is a culture • Role-model • Need to facilitate • IT skills • Connect systems • APIs and cloud

Figure 25 – Digital transformation experts interview results. Source: IB survey

The information described in the interviews and skillset the digital transformation leaders describe as important matches the 3 top most sought skills on the market as:

- Communicating data (323%)
- Digital security and privacy (75%)
- Analyzing data skills (68%)

Notably soft skills are described as most important, but blending these with specific digital skills and mindset will be the direction to developing the future blended professional.

Conclusion IB students – Digital building blocks

The table summarizes and compares the findings from the BHEF research - % job openings vs % resume listings vs % IB students.

The average salary premium is included to give further insights into the development and prospectus of the skill/job correlation.

Green gives a visual insight into the high trending skills and red into low trending skills.

It also shows the positive discrepancy and negative discrepancy.

New foundational skills (listed by priority of the highest growth)	Job openings (demand)	Resume listings (supply)	IB students (%)	Discrepancy job openings and IB students (%)	Average salary premium (% increase)
Digital building blocks					
Digital security and privacy	75%	7%	17%	58%	17%
Analyzing data skills	68%	12%	15%	53%	7%
Software development & computer programming skills	44%	17%	5%	29%	34%
Data management skills	24%	19%	33%	9%	14%

When comparing the data of supply-demand results with the responses of the IB students, we can clearly see the following:

- The most sought skills are **digital security and privacy** which are also the ones with the highest discrepancy between (17% supply vs 75% demand). IB students exhibit a downward trending in supply of this skill and lower than US results with a discrepancy of 58%;
- **Analyzing data** skills is the next highest trending skill (68%) which compared to IB students' supply (15%) gives a discrepancy of 50%;
- The third trending skills is **software development & computer programming**, where we see an increase of 44% and in comparison with the IB students' supply of 5% of we can observe a discrepancy of 29%;
- **Data management** skills are the last in line of trending with an increase of job openings of 24%. IB students score 33% supply rate with a positive discrepancy of 9%.

Implications on curriculum

Digital building blocks represent the skills that show the highest increase in demand in job openings and we can observe that majority of IB students lack **digital security and privacy and analyzing data skills**. IB students do score better on **data management skills** compare to the US average, which shows potential in developing these skills further. Also the jobs requiring these skills have the highest salary premium.

Conclusion IB students – Business enablers

New foundational skills (listed by priority of the highest growth)	Job openings (demand)	Resume listings (supply)	IB students (supply)	Discrepancy job openings and IB students supply (%)	Average salary premium (% increase)
Business enablers					
Business processes	18%	27%	34%	16%	19%
Project management	21%	23%	41%	20%	21%
Digital design	2%	20%	11%	9%	2%
Communicating data	323%	2%	13%	310%	17%

Looking at the results above we can conclude that:

- IB students have quite sufficient business processes and project management skills. It should be noted that these skills represent baseline and core competencies, but not advanced ones.
- There is a positive discrepancy between the job openings trend and the availability of these skills.
- Communicating data skills has an increase of 323%, which shows enormous progression in demand, while at the same time our students score 13% proficiency on this skill and the negative discrepancy is the largest of all skills.

-
- Digital design is not trending very much, but also the level of these skills among IB students is lower than the US average.

Implications on curriculum

- Business processes and project management skills have slower increase compare to other skills, but also IB students score quite high on these two skills. It should be noted that these skills however represent baseline and core competencies, but not advanced ones and these can be taken into consideration in the curriculum (see p.29 and 31 for the distinguishing competencies).
- Digital design and communicating data skills score low among IB students while being very important for the job market (323% increase for communicating data skills). Students should develop these skills among the entire competency spectrum.

Conclusion IB students – Human skills

According to the BHEF research human skills emerge as some of the most important and sought skills among jobseekers. However a blended digital professional will not be able to excel in their career unless they have a proper combination of all three building blocks of the new foundational skills. Their career opportunity and average salary premium will improve and they will thrive in the digital economy.

However the New Foundational Skills are not confined to the digital economy or technical professions. They are already sought in the majority of jobs across the economy, regardless of their relation to the digital economy. (BHEF 2018)

Major findings from BHEF research also show that human skills:

- Often drive automation and technology, rather than being driven by it
- Are more likely – not less – to be in demand in digitally intensive jobs
- Are essential to the success of teams and enterprises
- Are valued by employers and educators for workers at all levels
- Are the most transferable of all New Foundational Skills
- Can be applied across any other skill set or work context
- Are the hardest to connect to specific career opportunities or jobs in the digital economy
- Are useful across most jobs, but must be complemented by other skills
- Unlike the other New Foundational Skills, are not yet treated as measurable
- competencies that can be taught and learned

New foundational skills (listed by priority of the highest growth)	Job openings (demand)	Resume listings (supply)	IB students (supply)	Discrepancy job openings and IB students supply (%)	Average salary premium (% increase)
Human skills					
Communication skills	27%	27%	70%	57%	
Critical thinking	31%	27%	67%	36%	

Collaboration	46%	22%	70%	24%	
Analytical skills	24%	27%	70% critical thinking	46%	
Creativity	23%	11%	59%	36%	

Majority (59-70%) of IB students state that they have above average Communication, Problem solving, Collaborating with others, Critical thinking, Working independently skills and are **particularly good in being flexible and adaptable**. This shows that these skills are covered quite extensively in the curriculum and the students develop distinctive abilities to work independently as well as in a team and collaborate and communicate well, while demonstrating a sense of flexibility and adaptability.

On another hand students **score lower (32-49%)** on managing goals and time, learning and development, working independently, innovation, digital well-being and digital identity.

Jobseekers and incumbent employees need skills from each of the three buckets to be prepared for the digital economy, but few currently claim this mix of skills on their resumes. Not every person will need every skill, but jobseekers and incumbent employees can mix and match skills to become the blended digital professionals required in a broader economy that is increasingly becoming the digital economy. A key point is that these three groups of skills interface and relate with one another. While they are all valuable, it is the combinations drawn from all three groups that make them uniquely valuable, and that support the ongoing learning of individuals and the adaptability of workplaces.

Recommendations for IB programs

- Focus on creating blended professional based curriculum;
- Focus on the top three skills and create best practices in learning;
- Recognize these skills as essential learning outcomes for 21st century and of core importance of the success of students and students;
- Make an inventory and assessment of the learning tracks that embed these skills and integrate these skills in the learning program goals;
- Integrate these skills into the admissions processes and on-campus student advising;
- Work closely with external stakeholders (business, program advisory committee, intermediary advisory and training organizations) and employers to coordinate goals and expectations for classroom learning, internships, job skills development, and work-based learning.
- Communicate the role of these skills and skill clusters to students, prospective students, and the general public.

Disclaimer: the recommendations are based only on empirical data and can further be supported with relevant literature study. The top four most sought skills are described and supported with literature in Appendix II.

These recommendation and the literature review can further serve as a basis for development of an implementation plan and build upon the IB curriculum.

May 2020, T. Dimitrova

Appendix I – New Foundational Skills Infographic

The New Foundational Skills Study Results

How fit are our students for the jobs in the digital world

Three Building Blocks



Digital Skills



Business Skills



Human Skills

230 PARTICIPANTS
HRBS, RBS and International
schools

June 2019 – January 2020

150 mil job postings
on LinkedIn

2007 – 2017

Three Competence Levels



Baseline
Competencies



Core
Competencies



Distinguishing
Competencies

Digital Skills



Managing
data



Software
development



Computer
programming



Analyzing
data



Digital
security &
privacy

Managing data skills

Students results



Access information efficiently (time) and effectively (sources); Evaluate information critically and competently; Use information accurately and creatively for the issue or problem at hand; I understand ethical and legal issues of data usage; Manage data sets / SQL / Relational data bases / Reviewing data quality; Big data (Data warehousing, ETL, NoSQL, MySQL, Data integration, Data architecture)

Skill market growth

24%

● N/A ● Basic ● Core ● Expert

Software development skills

Students results



Develop software, Test software, Basic coding (HTML), Advanced coding (GitHub, Java, Python, SQL, Debugging, PHP, Ruby, C++ and others)

Skill market growth

44%

● N/A ● Basic ● Core ● Expert

Digital Skills

Computer programming skills

Students results



Basic coding (HTML), Advanced coding (GitHub, Java, Python, SQL, Debuggind, PHP, Ruby, C++ and others)

Skill market growth

35%

Analyzing data skills

Students results



Basic data analysis; Create and work with Pivot tables; Basic statistical analysis; Data Science; Predictive analytics; AI, R, SAS; Big data analysis; Data governance; Predictive models

Skill market growth

68%

Data security & privacy skills

Students results



General information security; Data privacy; Data security; Network security

Skill market growth

75%

Business Enablers

Business process

Project management

Digital design

Communicating data

Business process skills

Students results



Business process analysis
Business planning
Strategic planning

Skill market growth

24%

Project management skills

Students results



Project management principles
Plan and develop a project
Perform stakeholder analysis
Microsoft project
Scrum or Agile applications

Skill market growth

21%

Business Enablers

Business process

Project management

Digital design

Communicating data

Digital design skills

Students results



● N/A ● Basic ● Core ● Expert

Graphic design principles
Design software(s)
Web design; UI / UX desing; CMS
GUI (graphical user interface)
Information architecture

Skill market growth

2%

Communicating data skills

Students results



● N/A ● Basic ● Core ● Expert

Data visualization principles
Data visualisation software
(Tableau, Qlikview or others)

Skill market growth

323%

Human Skills

Communication

Project management

Digital design

Communicating data

Digital security & privacy

Communication skills

Students results



● Below average ● Average
● Above average ● Excellent

Communication; Problem solving; Collaboration with others;
Critical Thinking; Creativity; Innovation; Manage goals and time;
Work independently; Flexibility and Adaptability; Digital identity (make a responsible representation of yourself online);
Digital well-being (make informed and responsible choices when using digital technologies); Learning and development;
Cultural and civic awareness

Skill market growth

27%

Other human skills

Students results



● Below average ● Average
● Above average ● Excellent



● Below average ● Average
● Above average ● Excellent

Skill market growth

	5 million	
Communication	9,185,978	27%
Critical thinking	3,666,249	31%
Collaboration	3,480,175	46%
Analytical skills	2,395,145	24%
Creativity	1,217,062	23%

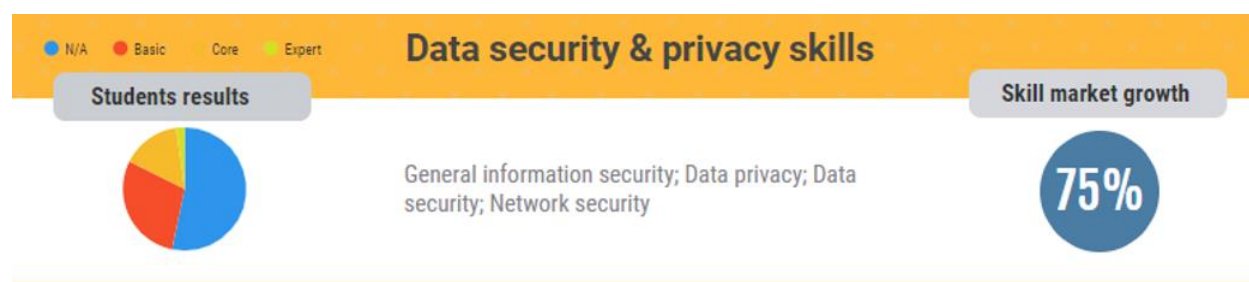
Collaboration & Critical Thinking

Creativity & Innovation

Appendix II – Description and overview of the most sought skills

Digital security and privacy skills

*The most sought skills are **digital security and privacy** which are also the ones with the highest discrepancy between (7% supply vs 75% demand). RBS graduates exhibit a downward trending in supply of this skill (6%) and lower than US results with a discrepancy of 69%.*



According to the Committee on Digital Economy Policy report Increasing connectivity and data-intensive economic activities – in particular, those that rely on large streams of data (“big data”), and the emerging Internet of Things – have the potential to foster innovation in products, processes, services and markets and help address social and global challenges. These developments have been accompanied by a change in the scale and scope of digital security and privacy risk with potential significant impacts on social and economic activities. These developments underscore the need for an evolution in policies and practices to build and maintain trust. (OECD report, 2016)

The results of the seventh (ISC)² Global Information Security Workforce Study (GISWS) conducted by Frost & Sullivan for the (ISC)² Foundation with the support of Booz Allen Hamilton, Cyber 360 Solutions and NRI Secure Technologies reveal that the security of businesses is being threatened by reports of understaffed teams dealing with the complexity of multiple security technologies and the threats posed by our increasingly connected world.

The DSP skill gap

The analysts from Frost & Sullivan forecast a shortfall of 1.5 million by 2020. This number is compounded by 45 percent of hiring managers reporting that they are struggling to support additional hiring needs and 62 percent of respondents reporting that their organizations have too few information security professionals.

According to a blog from Harvard Business Review, IBM is addressing the talent shortage by creating “[new collar](#)” jobs, particularly in cybersecurity. These roles prioritize skills, knowledge, and willingness to learn over degrees and the [career fields](#) that gave people their initial work experience. Some characteristics of a successful cybersecurity professional simply can’t be taught in a classroom: unbridled curiosity, passion for problem solving, strong ethics, and an understanding of risks. People with these traits can quickly pick up the technical skills through on-the-job training, industry certifications, community college courses, and modern vocational and skills education programs.

To further expand on the IBM example, the company says that they are looking for people with a number of in-demand skills, particularly as we grow and expand innovative career opportunities in cloud computing, AI and cybersecurity. These are the kinds of skills education institutions — high schools to community colleges and universities — should be increasingly focused on to prepare their students for 21st century opportunities:

- Cloud engineering and network development
- Data science & analytics
- Cyber threat detection
- Design for digital experiences

(IBM, 2018)

As security threats to businesses and government agencies increase, the information security analyst role is becoming increasingly important. Generally, this is not an entry-level position. A bachelor’s degree in computer science, programming, or engineering is a minimal requirement,

and many companies further require a master's degree and many years' network experience. (Occupational Outlook Handbook, 2020)

According to the [Bureau of Labor Statistics](#), 112,300 people were employed as information security analysts in 2018.

Their median annual wage in 2018 was \$98,350. The lowest 10% earned less than \$56,750, and the highest 10% earned more than \$156,580.

Career opportunities in this field are anticipated to grow by 32% by 2028—much faster than in other occupations (Bureau of Labour Statistics, 2020)

Which skillset is needed?

The skillset for Digital security and privacy skills comprises of specific technical, management and soft skills. Below is a summary of some of the essential skills that are necessary to be taught at school.

Some of the top skills that fall under this category are: Information Technology Knowledge; analytical skills; communication skills; creativity; detail-oriented

Technical hard skills (IT)

These are recommended for IT professionals, but business professionals and management students should have insight and basic understanding of security protocols and implementation of such. Below you can see the soft skills and management skills described

- Security Incident Handling & Response
- SIEM Management
- Audit & Compliance
- Firewall/IDS/IPS Skills
- Intrusion Detection
- Application Security Development
- Advanced Malware Prevention
- Mobile Device Management
- Data Management Protection
- Digital Forensics
- Identity & Access Management

(Cipher, 2020)

For starters, tech pros should understand the architecture, administration, and management of operating systems (various Linux distros, Windows, etc.), networking, and virtualization software. In other words, get to know—and love—things like firewalls and network load balancers. That’s in addition to general programming/software development concepts and software analytics skills.

There’s also the need to understand the more common programming languages, including Java, C/C++, disassemblers, assembly language, and scripting languages (PHP, Python, Perl, or shell).

Many employers demand certifications as a prerequisite for employment, and it’s easy to see why. In a recent survey, the International Information System Security Certification Consortium (ISC)² noted that a degree and certifications were often a major factor in hiring. “Cybersecurity certifications are essential to showing the level of knowledge of a cybersecurity professional. However, they should never alone be the only reference,” Joseph Carson, the chief security scientist at security vendor Thycotic, told Dice in an email.

(Dice, 2020)

Here is a recommended list of top cybersecurity certifications:

GIAC Security Expert (GSE) – the most prestigious credential in the information security industry

GIAC Security Leadership Certification (GSLC) – intended for security professionals with managerial or supervisory responsibilities – intended for security professionals that want to demonstrate

Certified Information Systems Security Professional (CISSP) – regarded as another elite credential in the information security industry

CompTIA Security+ – globally recognized certification known as a benchmark for best practices in information security

CompTIA Advanced Security Practitioner (CSAP) Exam – for IT security professionals with at least five years of experience to validate advanced IT security

CompTIA CyberSecurity Analyst+ (CSA+) – for cyber security analysts that apply behavioral analytics to improve overall IT security

EC-Council Certified Ethical Hacker (CEH) – For cyber security professionals who want to understand and how to identify weaknesses and vulnerabilities in systems

Mile2 Certified Penetration Testing Engineer and Digital Forensics – a vendor-neutral certification designed to train practitioners on forensics, digital discovery, and advanced investigation techniques.

Soft skills

These are more prominent when it comes to business and management students and according to the results of the survey RBS students score quite high on these skills.

However the digital transformation implications on the current knowledge and soft skills abilities should be taken further into consideration and examine, especially how digitally 'ready' are the current assessment of skills. For example skills as: Eagerness to dig into technical questions and examine them from all sides; Enthusiasm and a high degree of adaptability; Strong analytical and diagnostic skills; A current understanding of common web vulnerabilities; Maintaining awareness and knowledge of contemporary standards, practices, procedures and methods, need to be examined and validated further in the curriculum.

Some of the essential skills as discussed in the sources above are:

- Leadership
- Passionate about learning

-
- Determined
 - Collaborative – cyber security is shared responsibility across the organisation
 - Analytical, Inquisitive and Insightful
 - Can Think Hyper Critically
 - Consultative
 - Project management
 - Excellent presentation skills clearly articulate complex concepts (both written and verbally)
 - Ability, understanding, and usage of active listening skills (especially with customers!)
 - From a cybersecurity perspective, soft skills will also allow you to identify examples of, and explain, social engineering, which is a pervasive issue within the security community.

Privacy and security should always be a top priority for any business and as future managers business students need to know how this affects the employees, the company, the users and customers. Managers should always ensure to consult a security professional who can tailor a security programme to their unique business requirements.

Main objective of management to deal with essential aspects of privacy and security in the organisation is how to help employees protect the business, through training, resources, and a strong security culture.

Keep employees up to date on the latest company policies and guidance, as well as their own individual responsibilities. Tailor training for each role so employees learn about situations they'll encounter in their specific jobs. Finally, make sure you cover how to spot a security problem, how to report it, and what to do if something goes wrong.

Management is responsible to placing clear guidelines and protocols with the help of security professionals to be able to deal with issues and protect private and company information.

Sources:

- OECD (2016). Managing Digital Security and Privacy Risk report. <https://www.oecd-ilibrary.org/docserver/5jlwt49ccklt-en.pdf?expires=1588338327&id=id&accname=guest&checksum=759F46C5A41579DB33BF343A0735F91A>
- Frost & Sullivan for the (ISC)² Foundation (2015), Cyber 360 Solutions and NRI Secure Technologies. <https://www.isc2cares.org/IndustryResearch/GISWS/>.

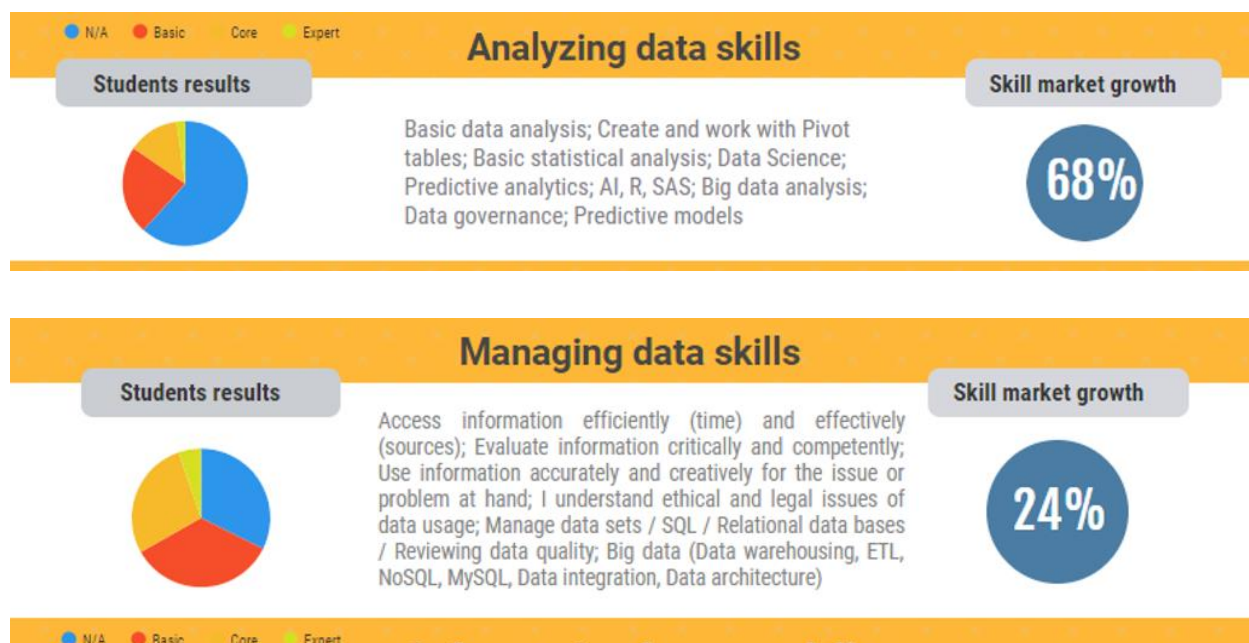
https://blog.isc2.org/isc2_blog/2015/04/isc-study-workforce-shortfall-due-to-hiring-difficulties-despite-rising-salaries-increased-budgets-a.html

- Zadenlhoff, van M. (2017 May 4). Cybersecurity Has a Serious Talent Shortage. Here's How to Fix It. Harvard Business Review. <https://hbr.org/2017/05/cybersecurity-has-a-serious-talent-shortage-heres-how-to-fix-it>
- IBM (2018 Feb 25). Four skills we should teach our students for the tech jobs of the future. New collar jobs. <https://www.ibm.com/blogs/policy/four-skills-we-should-teach-our-students-for-the-jobs-of-the-future/>
- Bureau of Labour Statistics (Accessed May 1, 2020). Occupational Outlook Handbook
- Cipher (Accessed May 1 2020). The Must-Have Skill Sets & Certifications for Cyber Security Careers. <https://cipher.com/blog/the-must-have-skill-sets-certifications-for-cyber-security-careers/>
- Dice (Accessed May 1 2020). Six Skills You Need to Succeed in Cybersecurity. <https://insights.dice.com/cybersecurity-skills/>

Analyzing data & Data Management skills

Analyzing data skills is the second highest trending skill, which compared to RBS graduates' demand (18%) show a discrepancy of 50%.

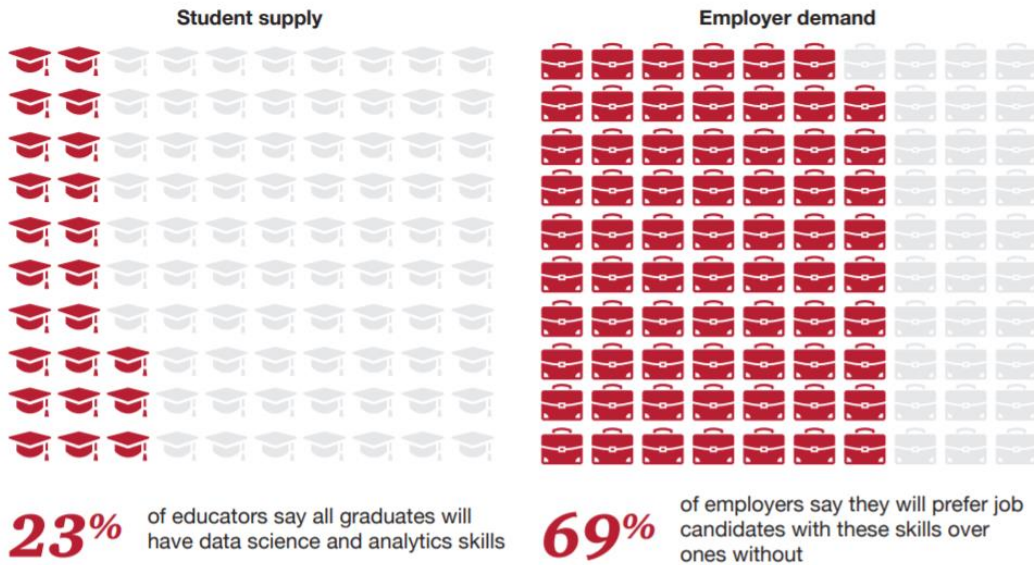
Data management skills have increase of job openings of 24%. RBS graduates score 19% supply rate with a discrepancy of 5%.



DSA (Data Science and Analytics) Skills shortage

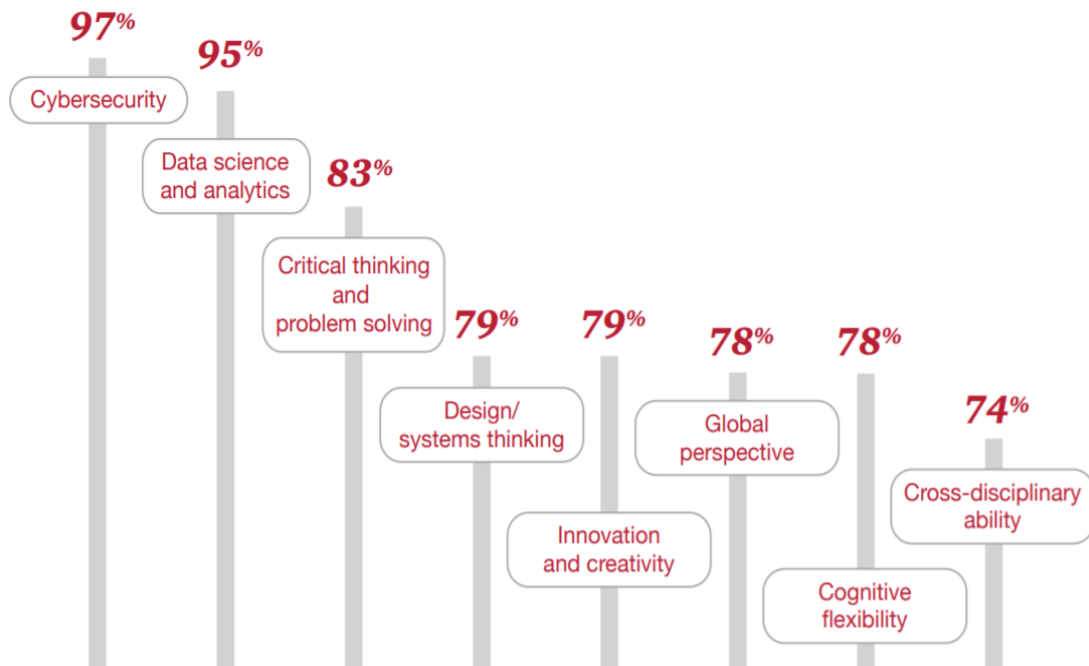
According to a The Business-Higher Education Forum (BHEF) report by 2021, 69 percent of U.S. executives say they will prefer job candidates with data skills, yet only 23 percent of educators believe their graduates will possess these skills.

"The significant skills shortage in data science and analytics has broad implications for foundational data-literacy skills needed by current and future employees. The research indicates there were 2.35 million documented data science and analytics-related job postings in 2015. This number is projected to grow to 2.72 million by 2020. Additionally, less than five percent of college students take courses in data science and analytics, much less complete a program in the field," stated BHEF CEO Brian Fitzgerald.



Base: Higher education: 127; Business: 63
 Source: Gallup and BHEF, *Data Science and Analytics Higher Education Survey* (December 2016).

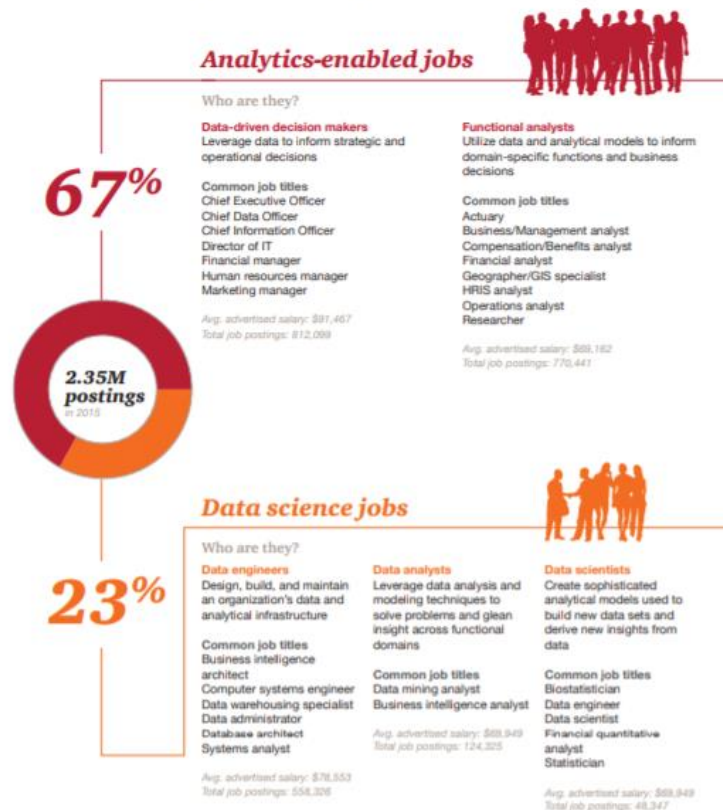
Percent of employers who say these skills are problematic to find



Source: Business Roundtable (2017).

The job landscape today

What does the jobs landscape look like today?



Note: 2.35 million US job postings from 2015. Actual salaries can be higher than what's advertised. We're showing just a small set of skills that get a premium.
Source: PwC analysis based on Burning Glass Technologies data, January 2017.

Skills that get a premium

Data-driven decision makers

Business intelligence • Business solutions •
Cloud solutions • Data warehousing • Java •
Product development • Product management •
Software development principles

Functional analysts

Business development • Business intelligence
• Business process analysis • Data mining •
Microsoft development tools • Risk management
• Software development principles • Systems
design and implementation

Skills that get a premium

Data engineers

Big data • Cloud solutions • Data storage and protection • Data warehousing • Scripting languages • Operating systems • Optimization □ SQL and NoSQL

Data analysts

Big data • Data modeling • Data mining • Data visualization • Data warehousing • Extraction, transformation, and loading (ETL) • Operating systems • Optimization • Scripting languages • Software development principles • Statistical software

Data scientists and advanced analysts

Data modeling • Data mining • Data visualization • Extraction, transformation, and loading (ETL) • Machine learning • Mathematical modeling • Optimization • Scripting languages • Software development principles

Why DSA skills?

According to Herzing University blog, there are three reasons why business students should develop strong data analysis skills:

- 1. All businesses collect data.** Whether you own your own business or work for a large corporation, you'll need to understand the fundamentals of data collection and analysis. Data serves an important function in many parts of a business, including marketing, accounting, sales and customer service. It's important for you to understand not only how data is compiled, but also its value in helping your company meet its goals.
- 2. Businesses use data to make better decisions.** Data-driven insights can inform important business decisions, such as when to launch a new product or how to improve the bottom line. Tracking sales trends helps businesses understand their customers' buying behavior and is usually used to inform marketing strategy. Cost and revenue analysis can help you determine where your organization can improve productivity and become more profitable. No matter what type of organization you work for, developing and implementing a data strategy is often essential for business success.

3. Proficiency as an analyst can advance your career. Successful data analysis requires attention to detail and critical thinking—two skills that are highly valued by employers. In fact, data analysis is quickly becoming another core competency required for many entry-level jobs. Exceptional data analysis skills are extremely important for digital marketers and business analysts and can help you advance to leadership and management roles within your organization.

From finance to marketing, data analysis is an essential practice for any type of business. By having good data analysis skills, you'll differentiate yourself from other job candidates and help bring valuable insights to your organization.

Which DSA skills are needed?

In a blog from Harvard Business Analytics, there are four types of analytics:

Diagnostic analytics - *Why is it happening?*

Diagnostic analytics look at the past performance of campaigns and processes to determine what happened and why. It isolates all confounding information to identify an accurate cause-and-effect relationship.

Predictive analytics - *What's likely to happen in the future?*

Statistical models and forecasting techniques can be used to predict likely scenarios of what might happen based on insights from big data. This form of analytics can be used to support complex forecasts.

Prescriptive analytics - *What do I need to do to succeed?*

Prescriptive analytics focuses on what actions should be taken. Where big data analytics can shed light on an area of business, prescriptive analytics gives you a much more focused answer to a specific question.

Regardless of which type of analytics you're working in, being able to offer the above hard and soft skills makes a business analytics professional an invaluable part of any business.

They further recommend the following soft and hard skills necessary to the Business analytics professional.

Business analytics focuses on data, statistical analysis and reporting to help investigate and analyse business performance, provide insights, and drive recommendations to improve performance.

They may also work with internal or external clients, but their focus is to improve the product, marketing or customer experience by using insights from data, rather than analysing processes and functions.

Hard skills	Soft skills
<p>Below are some of the top tools for business analytics professionals:</p> <p>SQL is the coding language of databases and one of the most important tools in an analytics professional's toolkit.</p> <p>Statistical languages - The two most common programming languages in analytics are R, for statistical analysis, and Python, for general programming.</p> <p>Statistical software While the ability to program is helpful for a career in analytics, being able to write code isn't necessarily required to work as an analytics professional. Apart from the above languages, statistical software such as SPSS, SAS, Sage, Mathematica, and even Excel can be used when managing and analyzing data.</p>	<p>A great business analytics professional could be described as:</p> <ul style="list-style-type: none">• A good communicator• Inquisitive• A problem solver• A critical thinker• A visualizer• Both detail-oriented and a big picture thinker

In a publication [Forbes](#) discusses that as a business professional 'understanding the data value chain helps you to put everything into context. Many systems and touchpoints are involved in the end-to-end process and it will make your life easier to understand how they are connected and who is responsible for which part.'

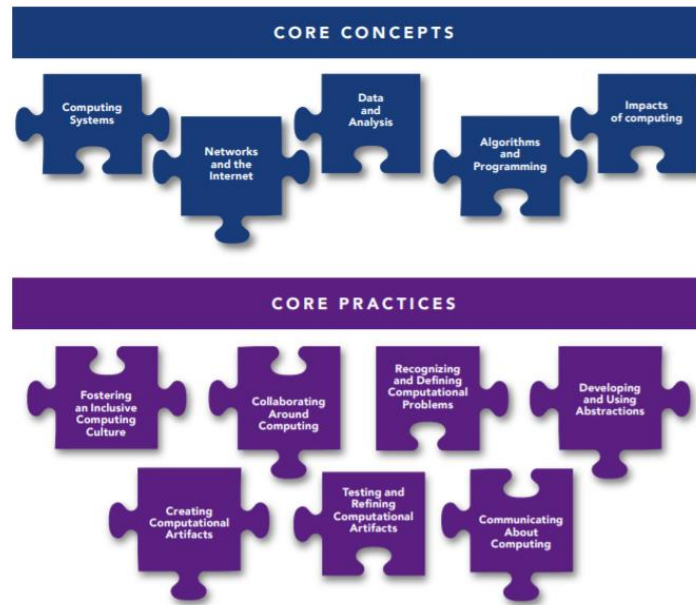
Here is set of questions to help with that:

- Where did the data come from?
- Why was it data collected, how and by whom?
- What transformation steps did it go through?
- Where is it stored?
- How can you access it and who has access to it?
- What tools do you have available for analysis?
- What questions do your stakeholders have?
- Who is the audience for your insights and what actions do they intend to take based on your findings?
- What happens with your findings once you share them?
- What impact has your analysis had? Are there visible results in decision-making?

Further communication skills, stakeholder management skills, critical thinking, presentations skills and data visualizations skills are intrinsic aspect of the DSA range of skills.

DSA skills frameworks for educators

The [K-12](#) computer science framework helps educators design K–12 education programs that include data and analytics. It's based on a multi-stakeholder view of the concepts students should know and what they should be able to do with those skills.



Source: [K-12](https://k12cs.org/) computer science framework. Accessed May17 2020. <https://k12cs.org/>

The European Union's **EDISON project** has created a framework that links skills to data science professions, where workers see the opportunities in front of them and know how their chosen educational paths can lead to their life's work. The process to get there uses continual mining of data from job postings, college-level course offerings, and insights from business leaders. In the area of data analytics and machine learning, EDISON researchers have identified skills common to data science occupations across the following broad skill groups:

1. Applied domain skills (research or business)
2. Data analytics and machine learning
3. Data management and curation
4. Data science engineering
5. Scientific or research methods
6. Personal and interpersonal communication skills.

Employers shouldn't expect to find all of the above skills in one individual. Rather, they should use these skill groups as a guide to forming teams whose members collectively have a full skill set.

The EDSF follows a competence-based approach to assist in defining the focus of educational programs, and adapt them to a specific professional profile. Different levels of proficiency are achievable for each Learning Outcome depending on the targeted professional profile.

Three proficiency levels are considered in EDSF:

- (1) general understanding of the Data Science concepts,
- (2) the ability to apply these concepts to solve concrete problems,
- (3) the ability to further assess and develop these concepts to create new knowledge.

Data Science Professional Profiles: competence groups

	Data Science Professional Profiles					
Data Science Competence groups		Managers : DSP01-DS03	Professionals: DSP04-DS09	Professionals (data handling/management: DSP10-13	Professionals (database): DSP14-DS16	Technician and associate profession: DSP17-DS19
	Data analytics					
	Data Science Engineering					
	Data Management					
	Scientific research & method					
	Business process					
	Domain Knowledge					

Legend: 1) Bars represent individual DSP profiles

2) Colours represent mastery level: familiarity–light blue; usage–blue; assessment–dark blue.

3) Red rectangle represents proficiencies needed by Data Science Profile 01 (DSP 01) for each of the 6 Data Science competence group

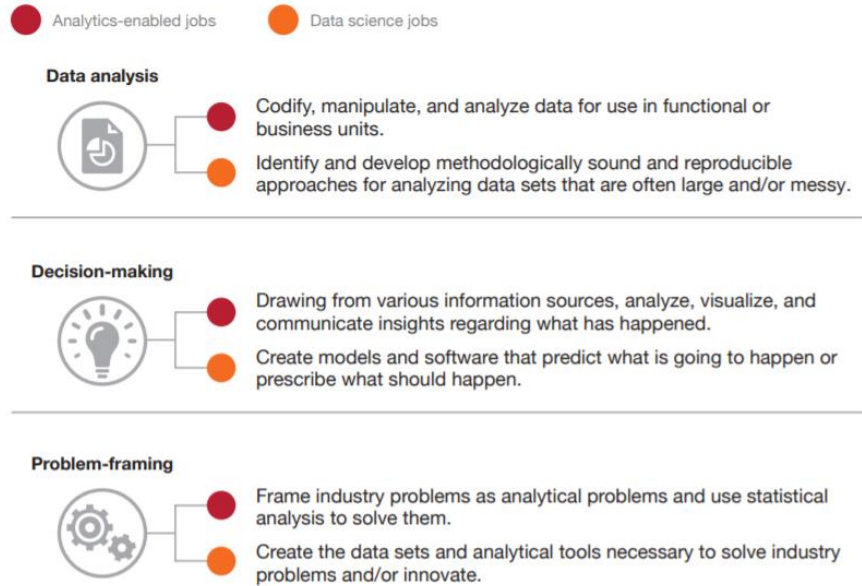
Table 1: The Proficiency Table maps the competency groups needed by each identified Data Science Profile. Rows represent the Data Science competence groups and columns represent the ESCO⁵ occupations family with the respective Data Science specific profiles.

Source: EDISON. A general introduction to [EDISON Data Science Framework](#) (EDSF) (V1.3). Accessed May 17 2020.




































Further according to **Burning Glass Technologies and PwC' research**, companies should use these skill groups as a guide to forming teams whose members collectively have a full skill set.




Figure 3: Similar skills, different job markets

Analytics-enabled jobs, such as marketing managers and functional analysts, require some of the same foundational skills as data scientists, but they apply the skills in different ways.



Source: PwC and BHEF.

Skills	Analytics-enabled jobs		Data science jobs		
	Data-driven decision makers	Functional analysts	Data analysts	Data engineers	Data scientists and advanced analysts
Domain knowledge Research or business					
Visualization The story in the data					
Data governance Including ethics and security					
Engineering Hardware, software, storage					
Management/Curation Sourcing, cleaning, manipulating					
Analytical approaches Level of precision					
Machine learning Teach computers to recognize patterns					

 Fundamental (conceptual literacy)
  Intermediate (practical application)
  Advanced (applied)

Source: PwC analysis based on Burning Glass Technologies data.

And respectively suggest the following approach to add competencies and skills:

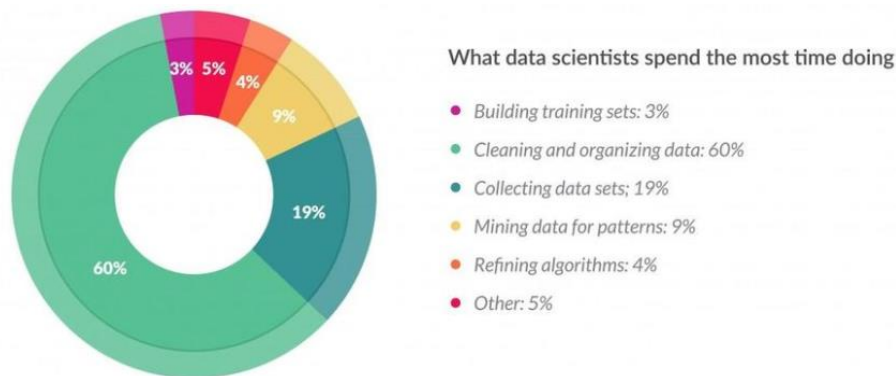
	Conceptual literacy	Practical application	Advanced data science
Degree or certificate	Certificate or a series of short courses	Major, minor, concentration, or master's degree	Graduate degree; research fellowship
MOOCs and bootcamps	A short-course series on data analytics concepts	A multicourse series or bootcamp that leads to specialization	MOOCs and bootcamps aimed at STEM professionals
Corporate development and training	Training on how to use data to drive decision-making	Training tailored to your job function	Rarely delivered by corporate trainers
Job rotation, co-op, or internship	Rarely used	Option for applying theory to a real-world problem	Option for hands-on learning

Source: PwC and BHEF.

Another **framework of DSA skills** is presented by **Dataquest**, where the focus is on *what* you'll need to do as a data analyst, not *how* you do those things.

1: Data Cleaning and Preparation

[Research shows](#) that data cleaning and preparation accounts for around 80% of the work of data professionals. This makes it perhaps *the* key skill for anyone serious about getting a job in data



Source: Cleaning big data, Forbes 2016

2: Data Analysis and Exploration

At its core, data analysis means taking a business question or need and turning it into a data question. Then, you'll need to transform and analyze data to extract an answer to that question.

Another form of data analysis is exploration. Data exploration is looking to find interesting trends or relationships in the data that could bring value to a business.

3: Statistical Knowledge

A strong foundation in probability and statistics is an important data analyst skill. This knowledge will help guide your analysis and exploration and help you understand the data that you're working with.

Additionally, understanding stats will help you make sure your analysis is valid and will help you avoid common fallacies and logical errors.

4: Creating Data Visualizations

Data visualizations make trends and patterns in data easier to understand. Humans are visual creatures, and most people aren't going to be able to get meaningful insight by looking at a giant spreadsheet of numbers. As a data analyst, you'll need to be able to create plots and charts to help communicate your data and findings visually.

This means creating clean, visually compelling charts that will help others understand the data. It also means avoiding things that are either difficult to interpret (like pie charts) or can be misleading (like manipulating axis values).

5: Creating Dashboards and/or Reports

As a data analyst, you'll need to empower others within your organization to use data to make key decisions. By building dashboards and reports, you'll be giving others access to important data by removing technical barriers.

This might take the form of a simple chart and table with date filters, all the way up to a large dashboard containing hundreds of data points that are interactive and update automatically.

6: Writing and Communication Skills

The ability to communicate in multiple formats is a key data analyst skill. Writing, speaking, explaining, listening— strong communication skills across all of these areas will help you succeed.

Communication is key in collaborating with your colleagues. For example, in a kickoff meeting with business stakeholders, careful listening skills are needed to understand the analyses they require. Similarly, during your project, you may need to be able to explain a complex topic to non-technical teammates.

Written communication is also incredibly important — you'll almost certainly need to write up your analysis and recommendations.

7: Domain Knowledge

Domain knowledge is understanding things that are specific to the particular industry and company that you work for. For example, if you're working for a company with an online store, you might need to understand the nuances of e-commerce. In contrast, if you're analyzing data about mechanical systems, you might need to understand those systems and how they work.

Domain knowledge changes from industry to industry, so you may find yourself needing to research and learn quickly. No matter where you work, if you don't understand what you're analyzing it's going to be difficult to do it effectively, making domain knowledge a key data analyst skill.

8: Problem-Solving

As a data analyst, you're going to run up against problems, bugs, and roadblocks every day. Being able to problem-solve your way out of them is a key skill.

Tools for data analysis

Towards data science gives recommendation to some of the most popular and used data analysis tools

1. Excel - With a variety of powerful features such as form creation, PivotTable, VBA, etc., Excel's system is so large that no analytics tool can surpass it, ensuring that people can analyze data according to their needs.

2. BI tools - Business intelligence is born for data analysis, and it is born at a very high starting point. The goal is to shorten the time from business data to business decisions and use data to influence decisions. BI tools are specialized in data analysis.

Take the common BI tools such as **Power BI, FineReport, and Tableau** for example. You will find that they are designed according to the data analysis process. First, data processing, data cleaning, and then data modeling, finally data visualization that uses presentation of charts to identify problems and influence decision-making.

These are the only way for data analysis, and there are some pain points of employees in this process.

3. R & Python - The programming language is very powerful and flexible. You can write code to do anything you want. For example, R and Python are the indispensable tools for data scientists. From a professional perspective, they are definitely more powerful than Excel and BI tools.

What should educators do?

The BHEF report outlines eight actions for change for educational institutions:

Responding to the supply-demand challenge:

1 Hire for skills, not only diplomas. Clarify demand with signals that motivate educators and job seekers

2 Be bold with investment. Invest in market-driven programs that link learning with work

What business needs to change:

3 Know the roles. Structure your people plan for the digital economy

4 Prioritize lifelong learning. Modernize training and development for long-term employability

What higher education needs to change:

5 Create hubs, not silos. Use data science to build multidisciplinary strength.

6 Champion data literacy for all. Enable all students to become data literate and open more routes to data science.

7 Step up professional ties. Strengthen alignment with societies that drive professional conduct.

8 Design for inclusion. Expand the pathways that lead to a diverse analytics workforce.

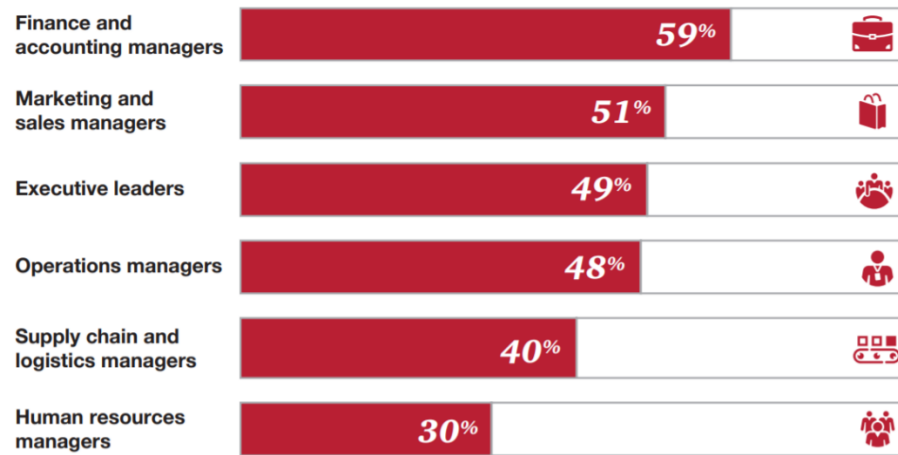
DSA (data science and analytics) can be seen as part of a broader set of trends that are challenging colleges and universities to:

- Change curriculums to meet skill needs
- Structure degrees and credentials for individual paths
- Provide a high-quality education at a reasonable cost
- Partner more frequently with employers
- Invest in their reputations for applied research

While university-branded MOOCs, bootcamps, and hackathons help universities meet some of these challenges, DSA skills can be learned outside of the university setting, so students want compelling reasons to commit to a university program.

The fastest growing job areas require both analytical and social skills. Competency in DSA includes the ability to thrive in multidisciplinary teams. The ability to apply data science and analytics in healthcare, for example, means driving outcomes that touch doctors, nurses, patients, and administrators. To achieve this, educators need to provide a program that brings industry, health

policy, computer science, and data science together through a diverse range of skills, expertise, and experience.



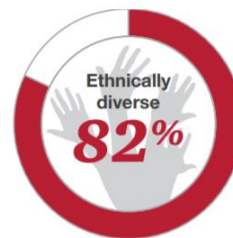
Base: 63 US business leaders
Source: BHEF and Gallup, *Data Science and Analytics Business Survey* (December 2016).

Diversity in DSA

Educators can foster greater diversity in data science and analytics in a variety of ways. Some of them are as follows:

- Training and support for faculty.
- Teaching foundational DSA skills in a broad number of degrees.
- Creating engaging introductory courses.
- Designing curriculum for practical use.

We struggle to find qualified data scientists who are...



Source: Business Roundtable (2017).

Examples of a Marketing analytics courses for business students (Stukent)

AN OVERVIEW OF MARKETING ANALYTICS
FOUNDATIONAL MARKETING ANALYTICS TOOLS
DATA TECHNOLOGIES
ACCESSING MARKETING DATA USING STRUCTURED QUERY LANGUAGE
MARKETING DATA PLATFORMS
EXTRACTING MEANING FROM DATA ON THE WEB
THE ANALYTICS OF SEGMENTATION, TARGETING AND POSITIONING
A/B TESTING
EXPERIMENTAL DESIGN IN THE DIGITAL AGE
ARTIFICIAL INTELLIGENCE
DATA VISUALIZATION
MARKETING ANALYTICS METRICS
ANALYZING THE RESULTS OF A/B TESTS AND EXPERIMENTS
MARKETING MIX MODELS
MODERATION IN MARKETING MIX MODELS

Source: Davis B., Marketing analytics textbook. [Stukent](#)

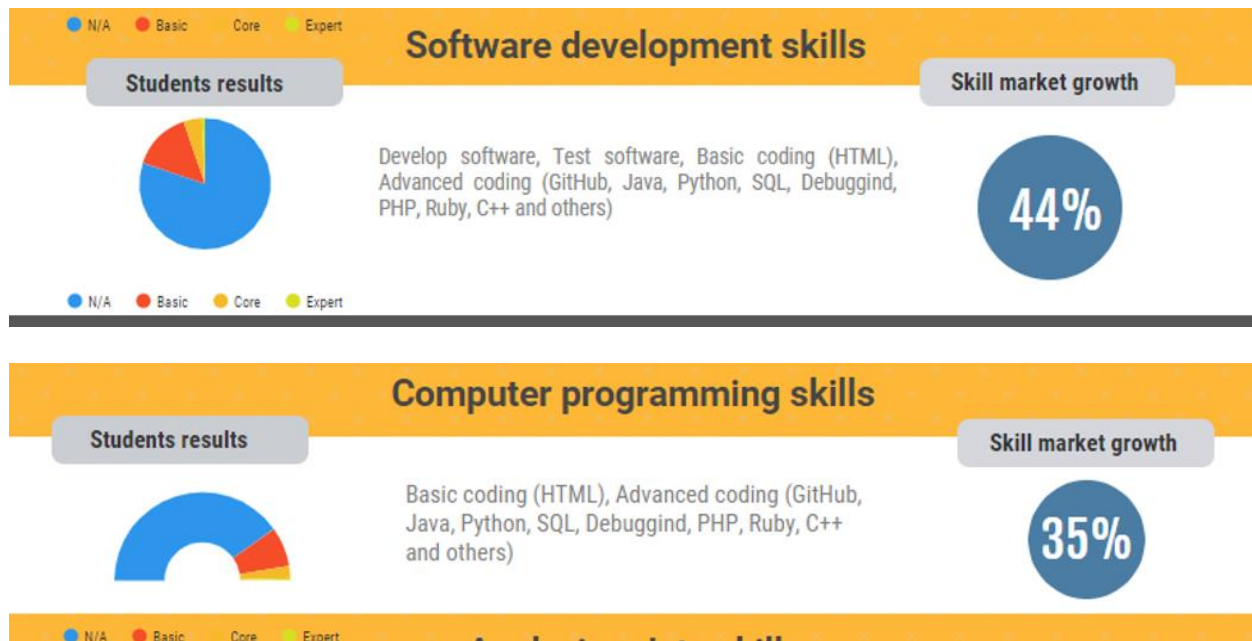
Sources:

- Business-Higher Education Forum and PwC (2017). Investing in America's data science and analytics talent. https://www.bhef.com/sites/default/files/bhef_2017_investing_in_dsa.pdf
- Herzing University blog (Accessed May 17 2020). Why Business Students Need Data Analysis Skills. <https://www.herzing.edu/blog/why-business-students-need-data-analysis-skills>
- Forbes. Top 7 Skills You Need To Have As A Data Analyst. Feb 19, 2019
- K-12 computer science framework. Accessed May17 2020. <https://k12cs.org/>
- EDISON. A general introduction to [EDISON Data Science Framework](#) (EDSF) (V1.3). Accessed May 17 2020.
- Press G., March 23 2016. Cleaning Big Data: Most Time-Consuming, Least Enjoyable Data Science Task, Survey Says. [Blog](#).
- [Harvard Business Analytics Staff](#) (August 16, 2018). 9 Skills Every Business Analytics Professional Needs. <https://analytics.hbs.edu/blog/top-business-analytics-skills/>

-
- Murray E. (Feb 19, 2019). Top 7 Skills You Need To Have As A Data Analyst. Forbes.
<https://www.forbes.com/sites/evamurray/2019/02/19/top-7-skills-you-need-to-have-as-a-data-analyst/#48606e2368f2>
 - Davis B., Marketing analytics textbook. [Stukent](#)
 - Davis B., SDS 2018. How to Teach Marketing Analytics for Student Career Readiness.
[Slideshare](#).

Software development & Computer programming skills

The third next skills is **software development & computer programming**, where we see an increase of 44% and in comparison with the RBS graduates supply 23% of we can observe a discrepancy of 21%



There is not a substantial research on the relation of the development of software and computer programming skills and their impact on business students' learning, development and work success. In the literature review below some aspects of this relation are discussed, but more empirical data needs to be regarded to understand the correlation of these two to the implication on business success.

Business and managerial aspect of programming

Programming jobs are as hot as ever and there is no end in sight. If you are looking for a secure job with the flexibility to work online from anywhere, software development is the way to go. One of the best things about the field of computer programming is that the most popular programming languages can be found with a quick Google search and can be learned online for free. Introductory programming courses are available for learning Java, Python, Perl, Ruby, C++, HTML, PHP, and pretty much everything else. In addition to free online courses, there are hosts of websites dedicated to teaching you in-demand programming languages. Basic programming knowledge can help you build a path to a multitude of career paths — web development, game development, machine learning, data science, and more. To add top programming skills to your resume, all you need is a computer, some dedicated time and the desire to learn (edX, 2019).

Today's students are prospective entrepreneurs, as well as potential employees in modern, start-up-like intrapreneurship environments within established companies. In these settings, software development projects face extreme requirements in terms of innovation and attractiveness of the end-product. They also suffer severe consequences of failure such as termination of the development effort and bankruptcy. As the abilities needed in start-ups are not among those traditionally taught in universities, new knowledge and skills are required to prepare students for the volatile environment that new market entrants face.

University courses do not often provide students with the chance to see the link between their actions and real-life outcomes, although it would be possible. Many of the important relationships and effects in software engineering are learnt best when students gain personal experience of the practical application of the methodologies. Therefore, teaching start-up-related knowledge and skills requires an environment where students can experience the consequences of their actions. This both gives meaning to students' experiences and solidifies their prior knowledge, creating a fertile ground for posing questions that motivate further learning (Fabian et al, 2018).

Why should business students learn programming

Learning to write computer program has long been recognized as challenging to students, especially to novices who are introduced to programming for the first time (Blayney, 2009; Ramalingam, LaBelle and Wiedenbeck, 2004; Robins, Rountree and Rountree, 2003). In some undergraduate business programs, programming is included as a small component in a larger Principle of Management Information Systems (PMIS) course.

In an empirical study of what IT skills are expected from non-IT major business students, based on interviews with business recruiters, programming is ranked as No. 10 in the IT skills list (He and Guo, 2011). It is understandable that programming in a narrowly speaking sense (coding) is not the top IT skills sought after from non-IT major business students. After all, the hard-core coding tasks require substantial amount of programming theory, knowledge, and skills. They should be left to professional programmers, not casual business professionals. However, nowadays IT plays a critical role in the business operation and can contribute to organization objectives by either reducing cost or enhancing competitive advantage. Non-IT business professionals need to get involved, contribute, assess, and sometimes manage IT projects (Kendall and Kendall, 2011; Kroenke, 2014). Programming is an important component of IS (Topi, et al., 2010). Therefore, having a basic understanding and working knowledge of programming will help business professionals in many important fronts in their career (Ngo-Ye T and Park S., 2014).

Having some basic understanding of computer programming will be very helpful for a business professional or student to appreciate the work of IS professionals, especially programmers. This understanding will also better prepare business students to collaborate with programmers. The late Apple CEO Steve Jobs said: "Everybody in this country should learn how to program a computer, should learn a computer language, because it teaches you how to think. It's like going to law school. I don't think anybody should be a lawyer, but going to law school can actually be

useful because it teaches you how to think in a certain way[...] I view computer science as a liberal art" (Rosoff, 2011). It seems that there is a good reason that ev (Ngo-Ye T and Park S., 2014).

According to another study, modern software practices call for the active involvement of business people in the software process (Nuseibeh & Easterbrook, 2000). Apart from the crucial role of end users in eliciting precise user requirements, business people are intimately involved in all stages of software development (Jacobson, Booch, & Rumbaugh, 1999). At present, software is commonly adapted, composed from reusable components and frameworks, and even created by business people rather than information systems (IS) developers (Shaw, 2000). Therefore, programming has become an indispensable part of the IS component of the core curriculum at business schools.

E-business applications development (a.k.a. Client-server programming, Web-based programming, or E-commerce) is the only programming course mandatory for all business students. It is the basic hands-on-experience course, where students develop Web-based E-commerce applications.

Teaching business students programming could be very difficult, and the reasons for that are multiple and complex. Business students do not routinely take courses in computer architectures, operating systems, compilers, algorithms, and theory of programming languages. They lack the notion of layers of virtual machines abstracting the programmer from the underlying hardware. Business students cannot visualize the compiler's mapping of the source code they write to raw machine instructions directing the system's underlying hardware. Grasping the notion of virtual machine is a good academic exercise in abstract thinking, but acquiring this skill, even though worthwhile, comes at a dear price. Time investment is not the only issue at stake here.

The effect of learning programming for business students

According to a Harvard Business Review and Tom Eisenmann [research](#) 83% of the students who after graduation found a job in a tech company or created a start-up said that following a CS course was very beneficial. Some of the benefits described were:

(1) Writing software – being able to write software that can save costs for the organisation; save costs for outsourcing; understand the aspects of user experience.

(2) Communicating with developers – respondents felt more confident in their ability to discuss technical issues with developers; it gave them working knowledge and confidence to be able to review code; they were able to diagnose issues and help the engineers identify why certain algorithms that calculated scores were wrong.

Jon Einkauf, a product manager for Amazon AWS, said, "I work with developers on my team every day to define and build new features. In addition, the users of my product are developers and

data scientists. Taking CS50 gave me a glimpse of what it's like to be a developer — to get excited about complex computer science problems, to get frustrated when you hit a bug. It taught me enough about software development that I don't feel lost in my current job. I can ask intelligent questions, I can push back on the developers when necessary, and I am confident that I could teach myself anything else I need to learn."

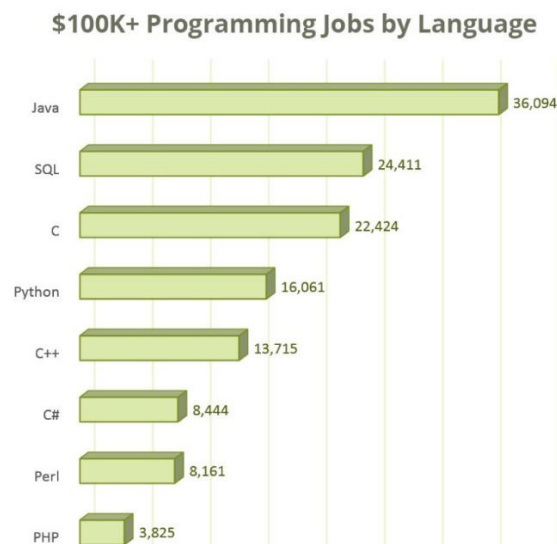
(3) **Recruiting** - Several respondents mentioned that their CS50 experience had helped persuade recruiters that they were committed to a career in technology.

Popular software programming skills

According to a edX blog the four most lucrative programming skills are:

#1 – Java

A search of the most popular programming skills on Indeed.com shows that Java is at the top in terms of outstanding jobs with salaries above \$100K. The Java programming language tops the latest [TIOBE Index](#) as the most popular programming language and is also the TIOBE Programming Language Hall of Fame Winner for 2015. Java runs on 7 billion devices and is used to develop native Android applications. A February, 2016 Indeed.com search for Java returned over 36,000 jobs paying over \$100K per year with over 60,000 [full time Java positions](#) paying over \$70K per year.



Source: Indeed.com, February 2016
The number of \$100K+ jobs appearing in the Indeed.com search results for each programming language.

#2 – SQL

SQL is the programming language for managing data. Since almost every programming application in existence interacts with data in one way or another, it's understandable that SQL would be high on the lists of requested skills and high-paying jobs. Indeed.com lists over 20,000 [jobs in SQL](#) paying over \$100K per year.

#3 – C

C was created in 1972 by Dennis Ritchie at Bell Labs and is one of the most widely used programming languages of all time. It is second only to Java on the [TIOBE Index](#) of programming language popularity, with C++ and C# falling right below in the 3rd and 4th positions. C++, also created at Bell Labs, is a flexible extension of the C language that allows programmers to create applications that will run on a wide variety of hardware platforms. C#, pronounced *C-Sharp*, is modern, object-oriented programming language developed by Microsoft.

#4 – Python

Python was created by [Guido van Rossum](#), a.k.a. Benevolent Dictator for Life, in 1989 and he gave the programming language its name based on his love of the Monty Python Flying Circus.

TIOBE Index

Below you will see the [TIOBE index](#) classification. The TIOBE Programming Community index is an indicator of the popularity of programming languages. The index is updated once a month. The ratings are based on the number of skilled engineers world-wide, courses and third party vendors. Popular search engines such as Google, Bing, Yahoo!, Wikipedia, Amazon, YouTube and Baidu are used to calculate the ratings. It is important to note that the TIOBE index is not about the *best* programming language or the language in which *most lines of code* have been written.

May 2020	May 2019	Change	Programming Language	Ratings	Change
1	2	▲	C	17.07%	+2.82%
2	1	▼	Java	16.28%	+0.28%
3	4	▲	Python	9.12%	+1.29%
4	3	▼	C++	6.13%	-1.97%
5	6	▲	C#	4.29%	+0.30%
6	5	▼	Visual Basic	4.18%	-1.01%
7	7		JavaScript	2.68%	-0.01%
8	9	▲	PHP	2.49%	-0.00%
9	8	▼	SQL	2.09%	-0.47%
10	21	▲▲	R	1.85%	+0.90%

Source: TIOBE Index for May 2020 (<https://www.tiobe.com/tiobe-index/>)

Sources:

- edX, Feb 7 2019. The 4 Most Lucrative Programming Skills You Can Learn Online. [Blog](#)
- Smith, Brien N., and James R. Necessary. "Assessing the computer literacy of undergraduate college students." *Education*, vol. 117, no. 2, 1996, p. 188+. Gale Academic OneFile, Accessed 17 May 2020.
- Rombach, D., Münch, J., Ocampo, A., Humphrey, W. S., & Burton, D. (2008). Teaching disciplined software development. *Journal of Systems and Software*, 81(5), 747-763.
- Fabian Fagerholm, Arto Hellas, Matti Luukkainen, Kati Kyllönen, Sezin Yaman, Hanna Mäenpää. Designing and implementing an environment for software start-up education: Patterns and anti-patterns, *Journal of Systems and Software*. Volume 146, 2018
- Milam W. Aiken, Jeanette S. Martin & Joseph G. P. Paolillo (1994) Requisite Skills of Business School Graduates: Perceptions of Senior Corporate Executives, *Journal of Education for Business*, 69:3, 159-162
- Ngo-Ye, Thomas & Park, Sung-Hee. (2014). Motivating Business Major Students to Learn Computer Programming – A Case Study.
- TIOBE Index for May 2020. (<https://www.tiobe.com/tiobe-index/>)
- Nuseibeh, B. A., & Easterbrook, S. M. (2000). Requirements engineering: A roadmap. 22nd International Conference on Software Engineering, Limerick, Ireland
- Jacobson, I., Booch, G., & Rumbaugh, J. (1999). The unified software development process. New York, NY: Addison-Wesley
- Shaw, M. (2000). Software engineering education: A roadmap. 22nd Int'l Conference on Software Engineering, Limerick, Ireland
- Roussev, Boris; Rousseva, Yvonna. *Decision Sciences Journal of Innovative Education*. Fall2004, Vol. 2 Issue 2, p121-152. 32p.
- HBR, Eisenmann T., Should MBAs Learn to Code?. September 02, 2013. (<https://hbr.org/2013/09/should-mbas-learn-to-code>)