Optimizing Singapore's university courses…

Project Team Name: Fantastic 5

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Agenda

1. Context and landscape
2. Project Objectives
3. Project setup– Disciplined Agile
4. Project vision
5. Project considerations and limitations
6. Data understanding, preparation and evaluation
7. Project findings and recommendations
   - Finding 1 : Identifying “unproductive” courses
   - Finding 2 : Identifying “misaligned” courses
   - Finding 3 : Identify sectors to re-allocate resources
8. Data governance
9. Risks and challenges encountered
10. Conclusion

Context and Landscape

Okun's Law:

- Postulated by Yale professor and economist Arthur Okun in the early 1960s.
- Looks at the statistical relationship between a country's unemployment and economic growth rates.
- States that a country's gross domestic product (GDP) must grow at about a 4% rate for one year to achieve a 1% reduction in the rate of unemployment.

CNA Commentary:

- Higher learning institutes need to change strategies to groom IT talent.

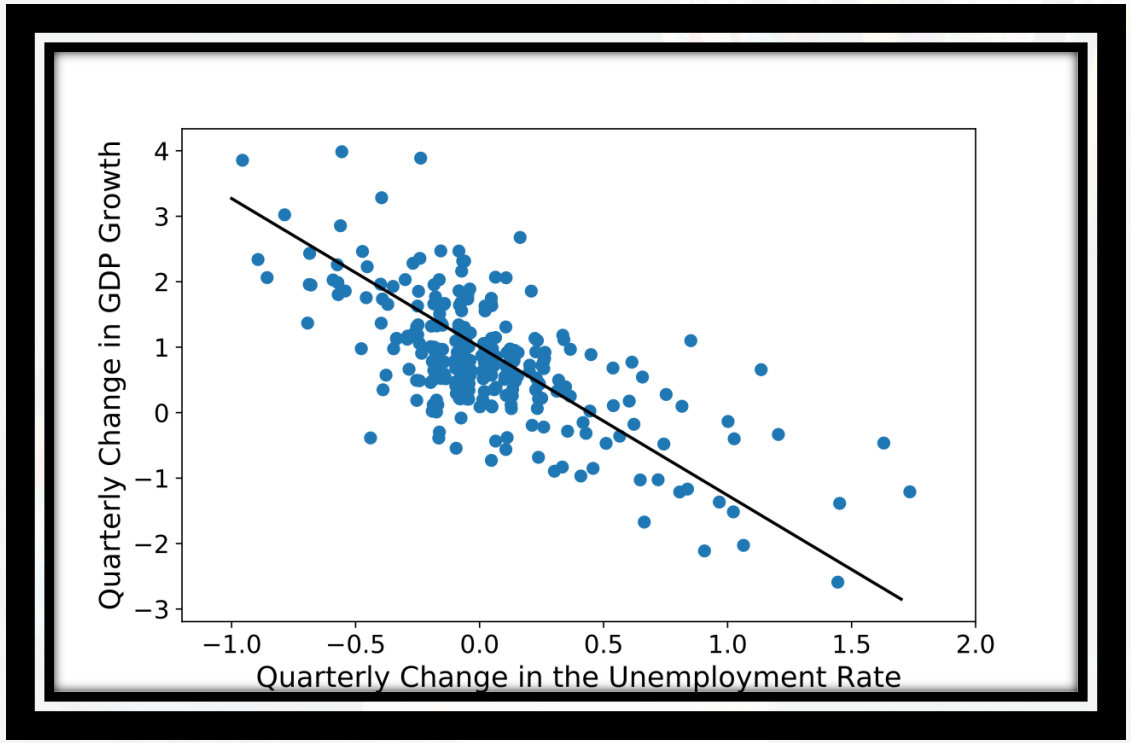
Landscape:

Past and present:

Singapore's education system traditionally prepares students with necessary skills for the economy

Future:

The rate of technological changes in today's landscape necessitates the deliberation of what skills the future workforce requires



Okun's Law regression

Project Objectives

Project objectives:

- Is the **current education system** meeting the **demands of the economy**?
- How can the system **meet the demands** of the **future economy**?

Target audience:

- MOE Policy Making Department – Higher Education Policy Education

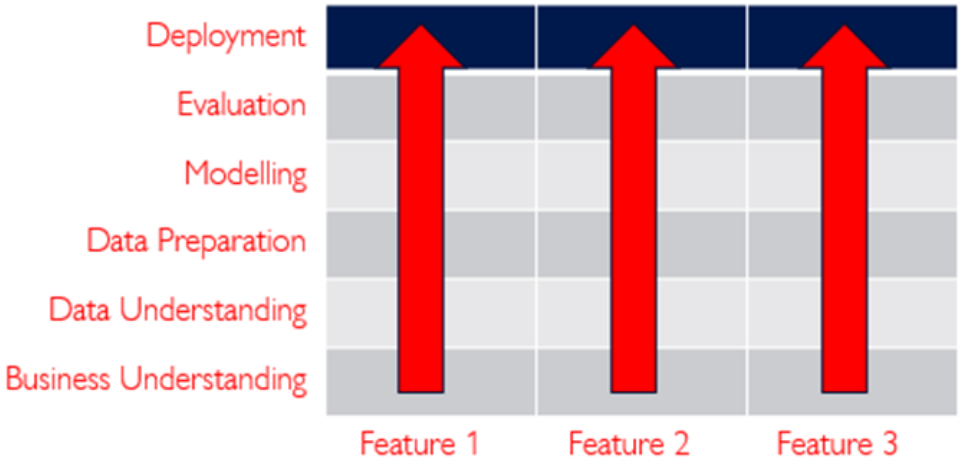
Project setup

Disciplined Agile Approach :

Disciplined agile approach was used as features were developed in iterations and the project has a fixed timeframe.

Building features in iterations allow the team to be goal-oriented, experiment and fail fast if it does not work out.

Discipline Agile was incorporated into the CRISP-DM framework, starting with the project inception phase where we came up with the project's vision along with the business and technical objectives, identified project risks, project design and some initial iterations to establish the foundation.



Project Vision

- Explore if current local universities undergraduate education curriculum prepares and equips our workforce with the necessary skills to meet future economic demands.

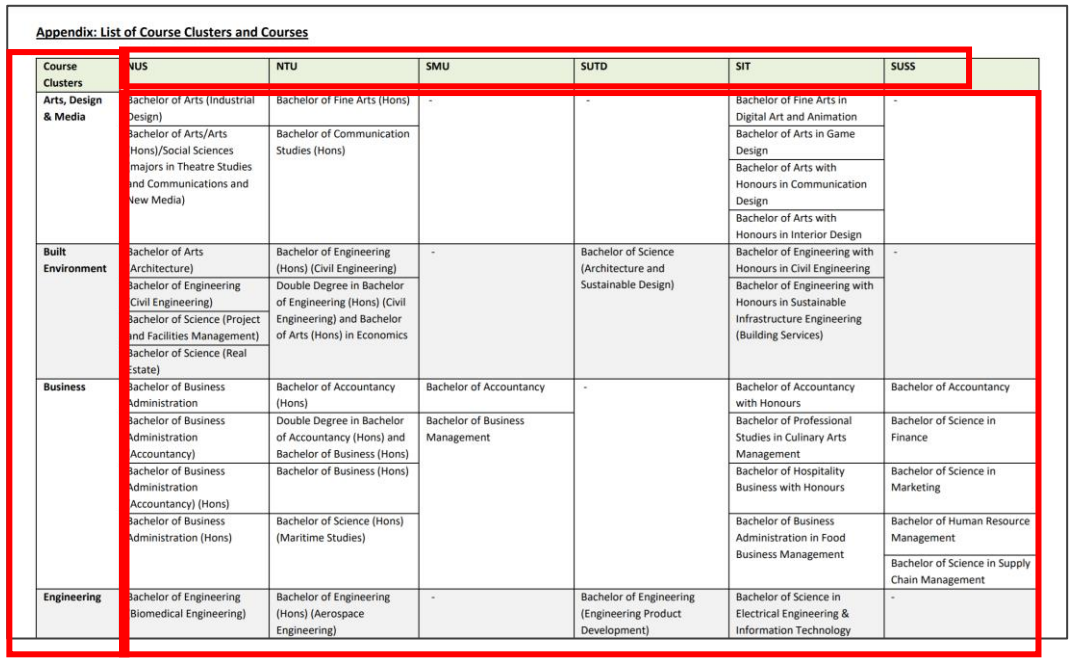
- Identify insights and recommendations to improve our local university offerings to better support Singapore's future economic growth.

Project considerations & limitations

- The scope of our study **only covers graduates from local universities**
- Assumed graduates will select employment in sectors related to course of study
- Data is not available for certain courses or years (due to the small number of graduates and/or low response rate)
- This project only analyzes the graduates from the 6 local autonomous universities in Singapore (NUS, NTU, SMU, SUTD, SIT, SUSS)
- Figures from the following universities only started in the year:
  - SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN (FROM 2013)
  - SINGAPORE UNIVERSITY OF SOCIAL SCIENCES (FROM 2017)
  - SINGAPORE INSTITUTE OF TECHNOLOGY (FROM 2017)
- Deliberately excluded 2020 data

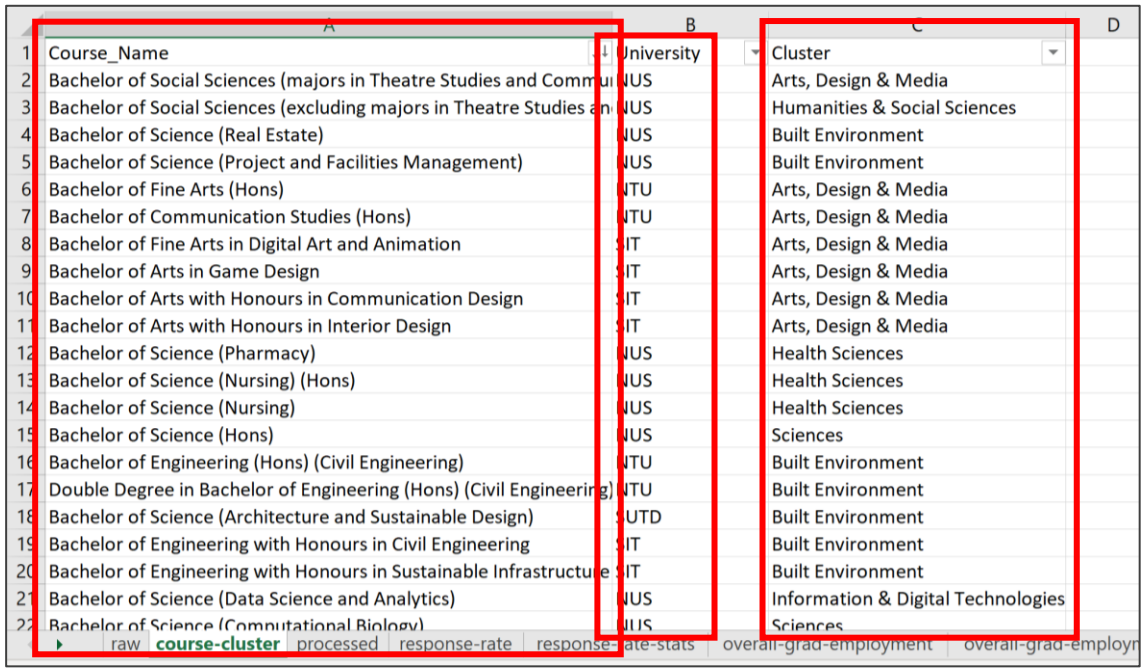
Data understanding and preparation

Data Tabulation



Appendix: List of Course Clusters and Courses

Course Clusters	NUS	NTU	SMU	SUTD	SIT	SUSS
Arts, Design & Media	Bachelor of Arts (Industrial Design)	Bachelor of Fine Arts (Hons)	-	-	Bachelor of Fine Arts in Digital Art and Animation	-
	Bachelor of Arts/Arts (Hons)/Social Sciences (majors in Theatre Studies and Communications and New Media)	Bachelor of Communication Studies (Hons)			Bachelor of Arts in Game Design	
					Bachelor of Arts with Honours in Communication Design	
					Bachelor of Arts with Honours in Interior Design	
Built Environment	Bachelor of Arts (Architecture)	Bachelor of Engineering (Hons) (Civil Engineering)	-	Bachelor of Science (Architecture and Sustainable Design)	Bachelor of Engineering with Honours in Civil Engineering	-
	Bachelor of Engineering (Civil Engineering)	Double Degree in Bachelor of Engineering (Hons) (Civil Engineering) and Bachelor of Arts (Hons) in Economics			Bachelor of Engineering with Honours in Sustainable Infrastructure Engineering (Building Services)	
	Bachelor of Science (Project and Facilities Management)					
	Bachelor of Science (Real Estate)					
Business	Bachelor of Business Administration	Bachelor of Accountancy (Hons)	Bachelor of Accountancy	-	Bachelor of Accountancy with Honours	Bachelor of Accountancy
	Bachelor of Business Administration (Accountancy)	Double Degree in Bachelor of Accountancy (Hons) and Bachelor of Business (Hons)	Bachelor of Business Management		Bachelor of Professional Studies in Culinary Arts Management	Bachelor of Science in Finance
	Bachelor of Business Administration (Accountancy) (Hons)	Bachelor of Business (Hons)			Bachelor of Hospitality Business with Honours	Bachelor of Science in Marketing
	Bachelor of Business Administration (Hons)	Bachelor of Science (Hons) (Maritime Studies)			Bachelor of Business Administration in Food Business Management	Bachelor of Human Resource Management
						Bachelor of Science in Supply Chain Management
Engineering	Bachelor of Engineering Biomedical Engineering)	Bachelor of Engineering (Hons) (Aerospace Engineering)	-	Bachelor of Engineering (Engineering Product Development)	Bachelor of Science in Electrical Engineering & Information Technology	-



	A	B	C	D
1	Course_Name	University	Cluster	
2	Bachelor of Social Sciences (majors in Theatre Studies and Commu	NUS	Arts, Design & Media	
3	Bachelor of Social Sciences (excluding majors in Theatre Studies a	NUS	Humanities & Social Sciences	
4	Bachelor of Science (Real Estate)	NUS	Built Environment	
5	Bachelor of Science (Project and Facilities Management)	NUS	Built Environment	
6	Bachelor of Fine Arts (Hons)	NTU	Arts, Design & Media	
7	Bachelor of Communication Studies (Hons)	NTU	Arts, Design & Media	
8	Bachelor of Fine Arts in Digital Art and Animation	SIT	Arts, Design & Media	
9	Bachelor of Arts in Game Design	SIT	Arts, Design & Media	
10	Bachelor of Arts with Honours in Communication Design	SIT	Arts, Design & Media	
11	Bachelor of Arts with Honours in Interior Design	SIT	Arts, Design & Media	
12	Bachelor of Science (Pharmacy)	NUS	Health Sciences	
13	Bachelor of Science (Nursing) (Hons)	NUS	Health Sciences	
14	Bachelor of Science (Nursing)	NUS	Health Sciences	
15	Bachelor of Science (Hons)	NUS	Sciences	
16	Bachelor of Engineering (Hons) (Civil Engineering)	NTU	Built Environment	
17	Double Degree in Bachelor of Engineering (Hons) (Civil Engineering)	NTU	Built Environment	
18	Bachelor of Science (Architecture and Sustainable Design)	SUTD	Built Environment	
19	Bachelor of Engineering with Honours in Civil Engineering	SIT	Built Environment	
20	Bachelor of Engineering with Honours in Sustainable Infrastructure	SIT	Built Environment	
21	Bachelor of Science (Data Science and Analytics)	NUS	Information & Digital Technologies	
22	Bachelor of Science (Computational Biology)	NUS	Sciences	

raw | course-cluster | processed | response-rate | response-rate-stats | overall-grad-employment | overall-grad-employ

Data understanding and preparation

Data Cleaning & Construction

=TRIM(RemoveSpecial(D2))

=VLOOKUP(G2,'course-cluster'!$A$2:$C$137,3, FALSE)

	D	E	F	G	H	I	J
1	degree	employme	employr	cleansed_degree name	Clustered1	Clustered2	
2	Accountancy	98.5	96	Accountancy	#N/A	Business	
3	Accountancy	98	96.6	Accountancy	#N/A	Business	
4	Accountancy	97.5	94	Accountancy	#N/A	Business	
5	Accountancy	97.3	93	Accountancy	#N/A	Business	
6	Accountancy	97.3	95.1	Accountancy	#N/A	Business	
7	Accountancy	96.4	92.3	Accountancy	#N/A	Business	
8	Bachelor of Arts in Game Design	100	86.7	Bachelor of Arts in Game Design	Arts, Design & Media	Arts, Design & Media	
9	Accountancy	96.4	93.7	Accountancy	#N/A	Business	
10	Bachelor of Arts with Honours in Interior Design	97.4	76.3	Bachelor of Arts with Honours in Interior Design	Arts, Design & Media	Arts, Design & Media	
11	Bachelor of Arts in Game Design ^	96.2	92.3	Bachelor of Arts in Game Design	Arts, Design & Media	Arts, Design & Media	
12	Accountancy	94.6	92.2	Accountancy	#N/A	Business	
13	Bachelor of Arts with Honours in Interior Design	93.9	90.9	Bachelor of Arts with Honours in Interior Design	Arts, Design & Media	Arts, Design & Media	
14	Accountancy (3-yr direct Honours Programme)	97.3	96.5	Accountancy (3-yr direct Honours Programme)	#N/A	Business	
15	Bachelor of Arts (Industrial Design)	93.3	60	Bachelor of Arts (Industrial Design)	Arts, Design & Media	Arts, Design & Media	
16	Bachelor of Arts (Hons)	92.7	68.2	Bachelor of Arts (Hons)	Arts, Design & Media	Arts, Design & Media	
17	Bachelor of Communication Studies (Hons)	92.6	62.2	Bachelor of Communication Studies (Hons)	Arts, Design & Media	Arts, Design & Media	
18	Bachelor of Arts with Honours in Interior Design	92.3	87.2	Bachelor of Arts with Honours in Interior Design	Arts, Design & Media	Arts, Design & Media	
19	Bachelor of Arts with Honours in Interior Design	92.3	76.9	Bachelor of Arts with Honours in Interior Design	Arts, Design & Media	Arts, Design & Media	
20	Bachelor of Fine Arts in Digital Art and Animation	91.2	52.9	Bachelor of Fine Arts in Digital Art and Animation	Arts, Design & Media	Arts, Design & Media	
21	Bachelor of Arts with Honours in Communication Design	91.1	58.9	Bachelor of Arts with Honours in Communication Desigr	Arts, Design & Media	Arts, Design & Media	
22	Bachelor of Arts (Hons)	90.7	74.1	Bachelor of Arts (Hons)	Arts, Design & Media	Arts, Design & Media	

raw | course-cluster | **processed** | response-rate | response-rate-stats | overall-grad-employment | overall-grad-employment rate | g ...

Data understanding and preparation

Data Integration & Transformation

E2 =INT(C2*(D2/100))

	A	B	C	D	E
1	Year	University	Total No. of Grads	Response Rate (%)	No. of Responses
2	2013	NUS, NTU, SMU	15,365	72	11062.0
3	2014	NUS, NTU, SMU, SIT	14,868	75	11151.0
4	2015	NUS	6,188	74.8	4628.0
5	2015	NTU	5,774	71.9	4151.0
6	2015	SMU	1,638	76.2	1248.0
7	2015	SIT	1363.00	78.9	1075.0
8	2015	SUTD	298.00	86.2	256.0
9	2016	NTU	5,836	77	4493.0
10	2016	NUS	6,314	80.4	5076.0
11	2016	SMU	1,803	74.1	1336.0
12	2016	SUTD	246	83.7	205.0
13	2016	SIT	1,230	84.6	1040.0
14	2017	NTU	6,042	84.3	5093.0
15	2017	NTU	30	100	30.0
16	2017	NUS	6,466	80.6	5211.0
17	2017	NUS	825	72.1	594.0
18	2017	SMU	1,779	77.6	1380.0
19	2017	SMU	114	75.4	85.0
20	2017	SUTD	228	85.4	194.0
21	2017	SIT	1,530	85.6	1309.0
22	2018	NTU	5,900	75.9	4478.0

... course-cluster | processed | response-rate | response-rate-stats | overall-grad-employment | ov

Row Labels	Sum of No. of Responses
2013	11062
2014	11151
2015	11358
2016	12150
2017	13896
2018	13783
2019	14167
Grand Total	87567

Row Labels	Average of employment_rate_overall
2013	90.66
2014	91.18
2015	91.02
2016	90.08
2017	90.32
2018	91.61
2019	91.06
Grand Total	90.85

Year	GES Respondents	Graduate Employment Rate	Employed Graduates
2013	11062	90.66	10029
2014	11151	91.18	10167
2015	11358	91.02	10337
2016	12150	90.08	10944
2017	13896	90.32	12551
2018	13783	91.61	12626
2019	14167	91.06	12900

Data understanding and preparation

Data Transformation & Aggregation

Gross Domestic Product At Current Prices, By Industry (SSIC 2015 Version 2018), Annual **		
GDP At Current Market Prices	510,737.8	469,095.9
Goods Producing Industries	123,807.6	114,447.4
Manufacturing	99,360.7	96,331.2
Construction	18,486.4	12,110.9
Utilities	5,795.1	5,853.3
Other Goods Industries *	165.4	152
Services Producing Industries	342,502	313,699.5
Wholesale & Retail Trade	86,125.5	81,783.1
Wholesale Trade	78,511.7	75,314.9
Retail Trade	7,613.8	6,468.2
Transportation & Storage	31,682.4	23,982.2
Accommodation & Food Services	10,094.2	6,301.8
Accommodation	4,309.5	1,903.5
Food & Beverage Services	5,784.7	4,398.3
Information & Communications	22,325.5	22,862.6
Finance & Insurance	68,168.3	70,297.8
Real Estate, Professional Services And Administrative & Support Services	69,644.3	59,969.4
Real Estate	16,592	13,482
Professional Services	29,084.7	26,370.5

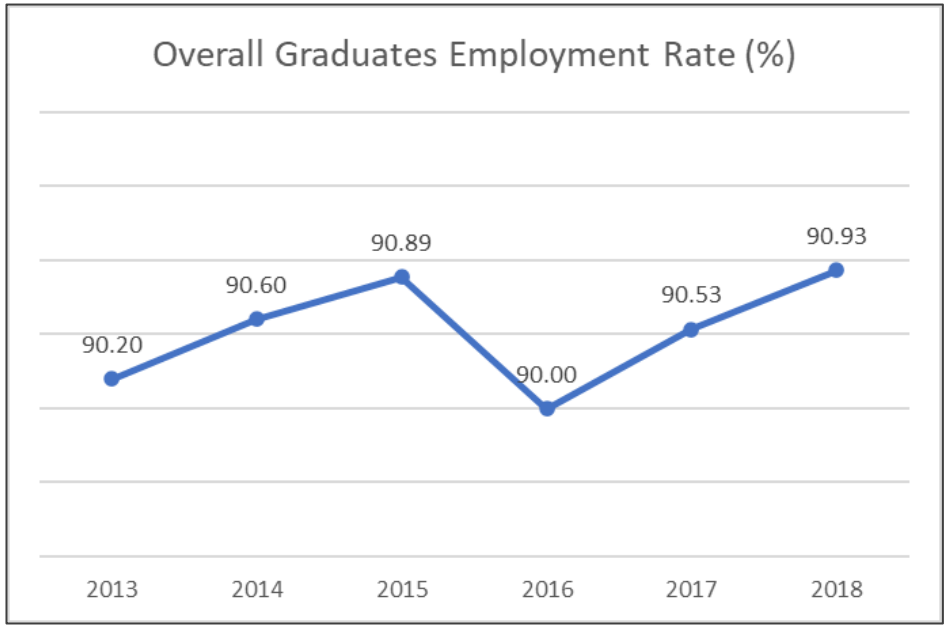
raw | GDP per sector | GDP Total

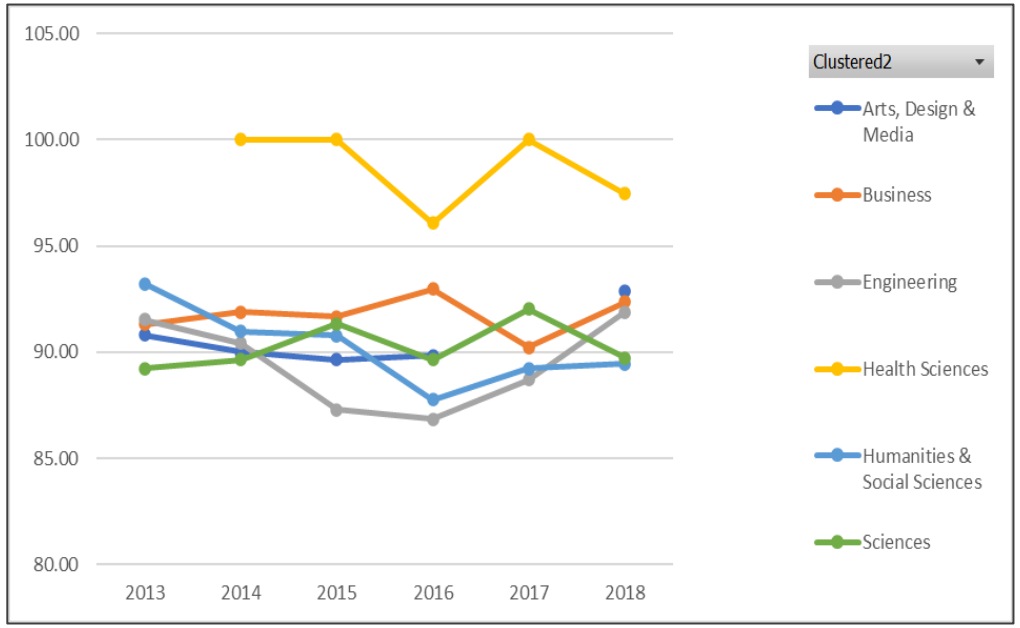
Industry	Sector	2013	2014	2015	2016	2017	2018	2019	In millions (SGD)
Manufacturing	Manufacturing	67,885	71,809.7	76,598.2	77,325.5	88,265	105,762.7	99,360.7	
Construction	Construction	17,127.3	19,183.8	20,433.8	19,673.1	17,864.3	17,827.1	18,486.4	
Utilities	Utilities	5,221.4	5,430.3	5,815.9	5,615.1	5,500.2	5,719.4	5,795.1	
Other Goods Industries *	Other Goods Industries *	132.5	138	138.1	139.2	145.9	153.2	165.4	
Wholesale & Retail Trade	Wholesale Trade	61,886.9	57,829.3	58,306.1	66,397.9	74,324.9	79,669.4	78,511.7	
Wholesale & Retail Trade	Retail Trade	6,608.4	6,895.2	7,278.4	7,604	7,781.3	7,936.5	7,613.8	
Transportation & Storage	Transportation & Storag	24,756.6	27,092.7	30,014.6	27,617.5	31,531.8	30,684.5	31,682.4	
Accommodation & Food Services	Accommodation	3,470.1	3,639.7	3,604.7	3,763.8	3,891.8	4,224.5	4,309.5	
Accommodation & Food Services	Food & Beverage Servic	4,738.8	5,025.6	5,158.3	5,470	5,525	5,643.5	5,784.7	
Information & Communications	Information & Commun	14,774.3	15,798.8	15,779.3	17,254.1	18,718.2	19,755.2	22,325.5	
Finance & Insurance	Finance & Insurance	42,892.6	45,968.7	49,874.5	51,636.5	56,853.3	62,535.7	68,168.3	
Real Estate, Professional Services And Administrative & Support Services	Real Estate	19,253.4	18,970.8	18,790.1	17,418	15,703.3	16,421.9	16,592.0	
Real Estate, Professional Services And Administrative & Support Services	Professional Services	21,673.2	22,107.2	24,218	24,895.9	25,745.7	27,039	29,085	
Real Estate, Professional Services And Administrative & Support Services	Administrative & Suppor	14,734.9	16,856.4	20,114.3	23,766.5	25,428.9	26,837.1	23,967.6	
Other Services Industries	Other Services Industrie	40,293.1	42,655.4	44,963	47,623.3	50,525.4	52,584.1	54,461.8	
Ownership Of Dwellings	Ownership Of Dwellings	17,251	17,797.2	18,100.1	17,589.4	17,436.3	17,751	18,453	
Taxes	Taxes	22,170.8	21,749.1	24,256.7	26,582.4	28,873.8	26,579.1	25,975.2	

Year	GDP At Current Market Prices [In millions (SGD)]
2013	384,870.3
2014	398,947.9
2015	423,444.1
2016	440,372.2
2017	474,115.1
2018	507,123.9
2019	510,737.80

Data evaluation

Data Exploratory Analysis

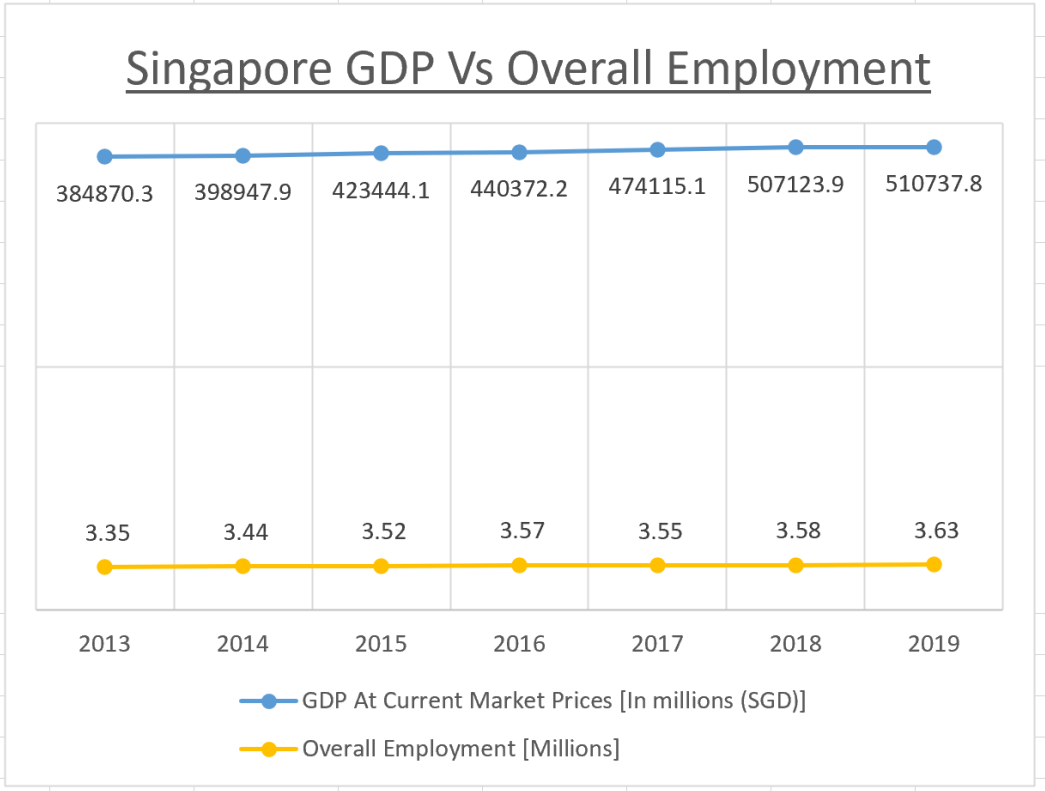




Data evaluation

Data Correlation Analysis

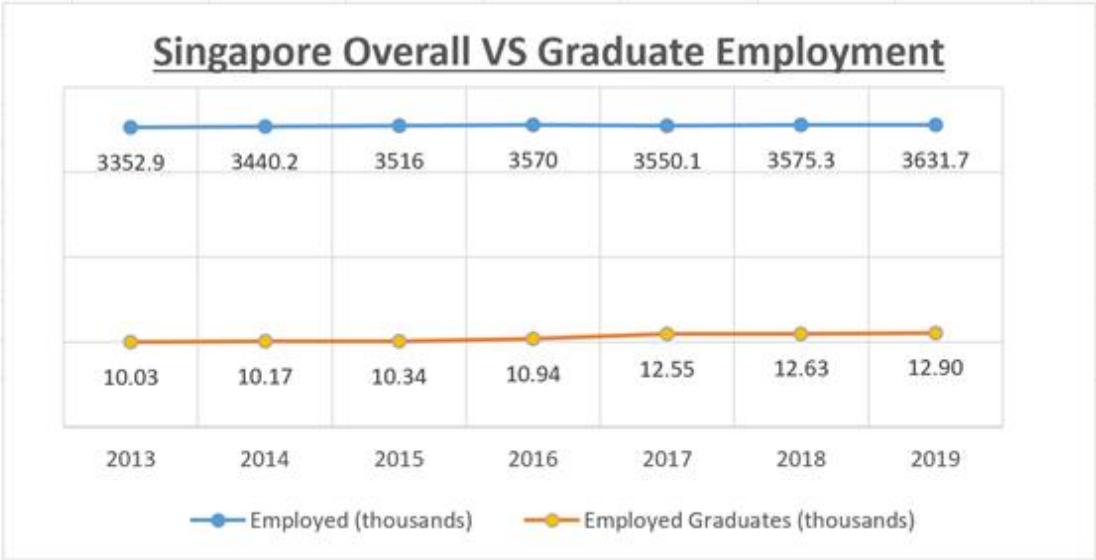
Year	GDP At Current Market Prices [In millions (SGD)]	Employed (thousands)	Overall Employment [Millions]
2013	384870.3	3352.9	3.35
2014	398947.9	3440.2	3.44
2015	423444.1	3516	3.52
2016	440372.2	3570	3.57
2017	474115.1	3550.1	3.55
2018	507123.9	3575.3	3.58
2019	510737.8	3631.7	3.63
Correlation between Singapore GDP and Employment	0.888445239	There is a very strong positive correlation between GDP and Overall Employment	



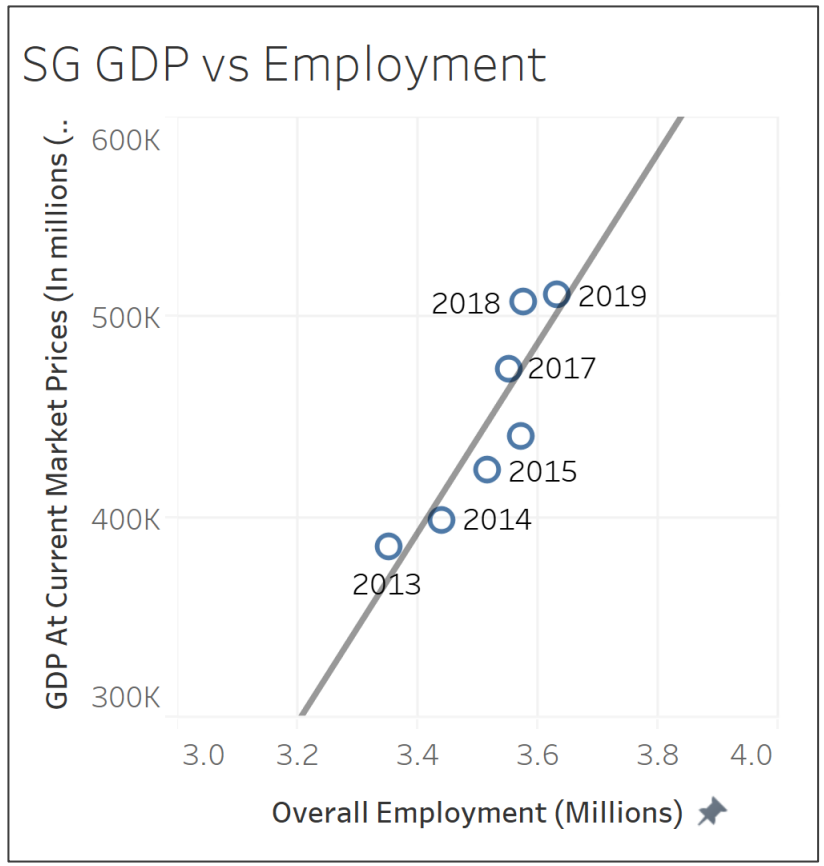
Data evaluation

Data Correlation Analysis

Year	Employed (thousands)	Employed Graduates	Employed Graduates (thousanc
2013	3352.9	10029	10.03
2014	3440.2	10167	10.17
2015	3516	10337	10.34
2016	3570	10944	10.94
2017	3550.1	12551	12.55
2018	3575.3	12626	12.63
2019	3631.7	12900	12.90
Correlation between Singapore Overall Employment and Graduate Employment	0.800971647	There is a very strong positive correlation between Overall Employment and Graduate Employment	



Project Background



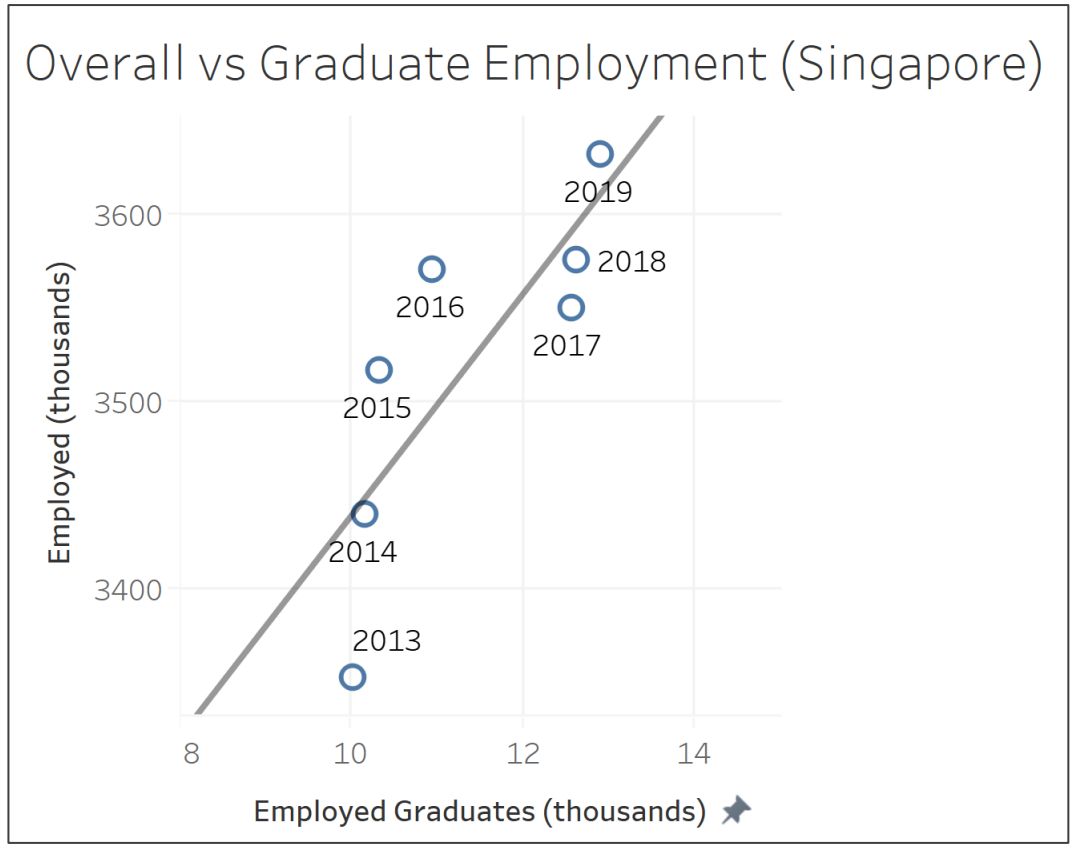
GDP and Employment have a

- **Strong positive** correlation of 0.89
- P-value of 0.007

GDP ↑ Employment ↑

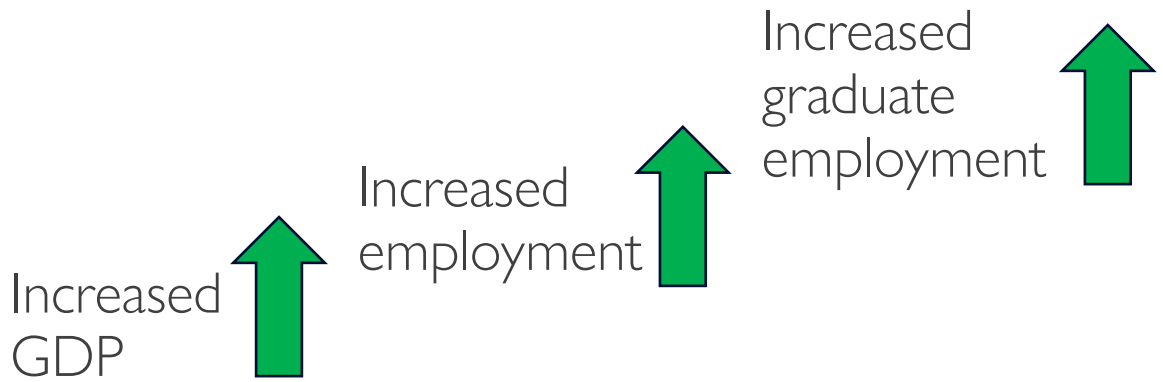
Correlation ≠ Causation

Project Background



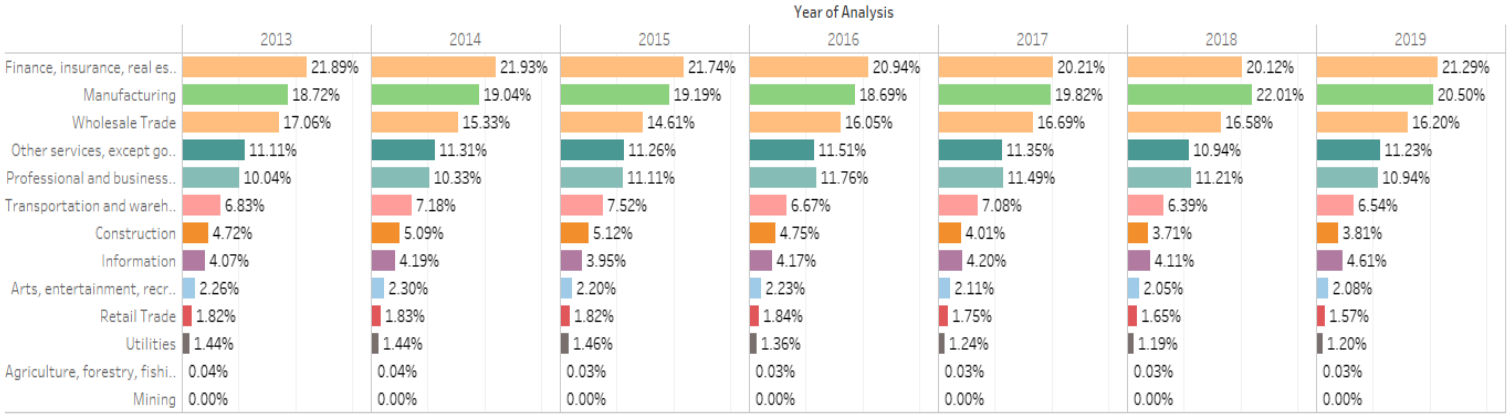
Overall Employment and Graduate Employment have a

- **Strong positive** correlation of 0.80
- P-value of 0.03

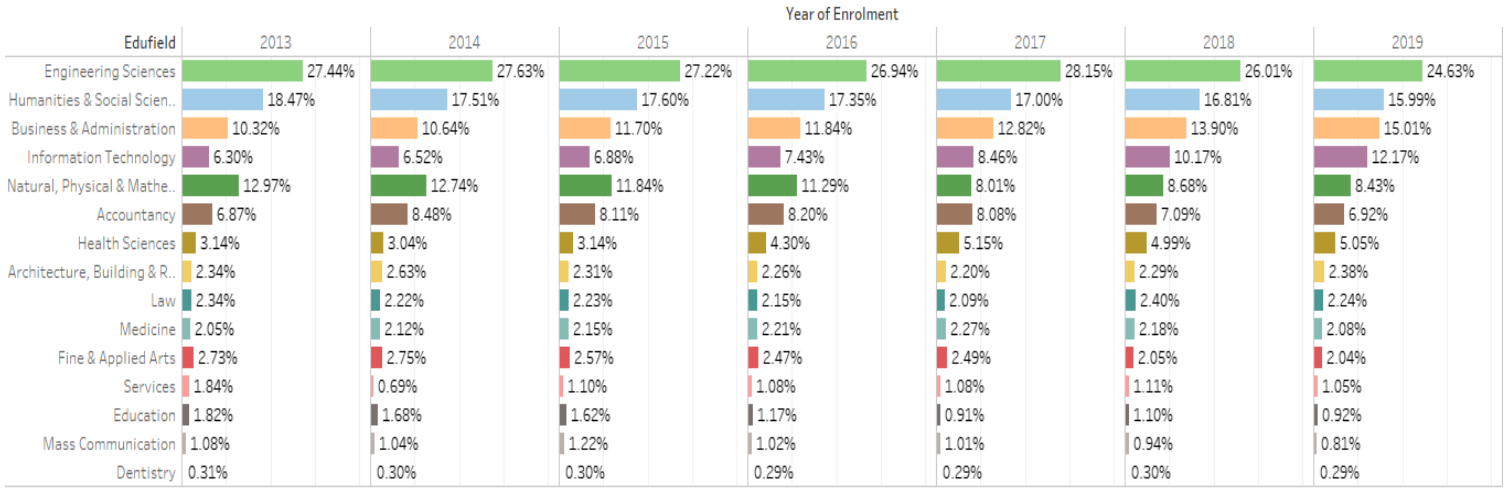


Project Findings I - Identifying "Unproductive" Courses

Sector GDP by year



Education course enrolment by year



Top 5 sectors contributing to SG's economy:

- Finance and insurance
- Manufacturing
- Wholesale trade
- Other services
- Professional and business services

Top 5 enrolment for education courses:

- Engineering sciences
- Humanities and social sciences
- Business administration
- Information technology (2017-2019)
- Natural, physical & mathematics
- Accountancy (2013-2016)

Project Recommendation 1

"Unproductive" Courses Identified

- The top 5 education courses (in terms of enrolment) were mapped to industry sectors based on the core competency of each industry sector:

Course Rank	Course	Industry Sector	Sector Rank (GDP)
1	Engineering sciences	Manufacturing	2
2	Humanities and social sciences	?	
3	Business administration	Finance and insurance Wholesale trade	1 3
4	Information technology	Information	8
5	Natural, physical & mathematics	?	

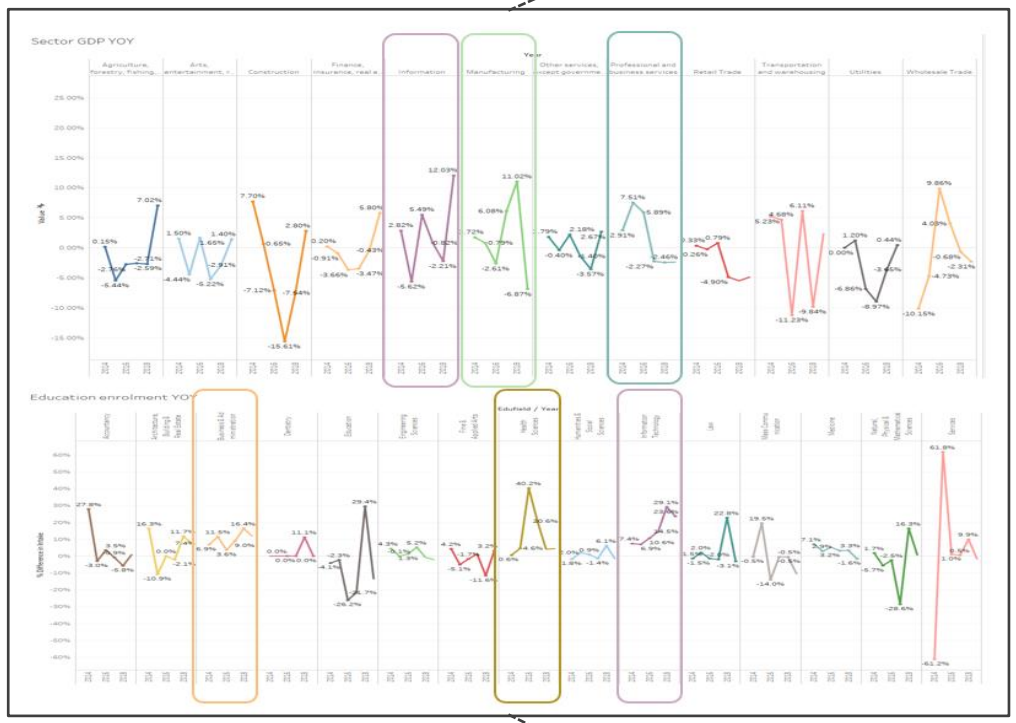
2 education sectors, while having a significant enrolment size, do not seem to have a clear contribution to GDP

- Humanities & Social Sciences – 15.99% (2019)
- Natural, Physical & Mathematics – 8.43% (2019)

Augment these faculties & courses to incorporate skillsets required for growing industries

- NUS is already doing so to their humanities school by merging the faculty of FASS with Science with a focus on new competencies and skills for a digital world
- Other local universities should likewise adopt this

Project Findings 2 - Identifying Misaligned Courses



Top 3 economic growth sectors:

- Information Technology
- Professional services
- Manufacturing

Course	Industry Sector
Information Technology	Information Technology
Business Administration	Professional services
Health Sciences	Manufacturing

Top 3 enrolment growth for education courses

- Information Technology
- Health Sciences
- Business Administration

Project Recommendation 2

Our methods of gathering and classifying GDP and graduation data are outdated!

- The top 3 education courses (in terms of YoY enrolment increase) were mapped to industry sectors based on the core competency of each industry sector:

Course	Industry Sector
Information Technology	Information Technology
Business Administration	Professional services
Health Sciences	Manufacturing

All mapped sectors are top 3 in terms of YoY economic growth (Past 3 years average)

- Information Technology→3.54%
- Manufacturing→3.41%
- Wholesale Trade→0.35%

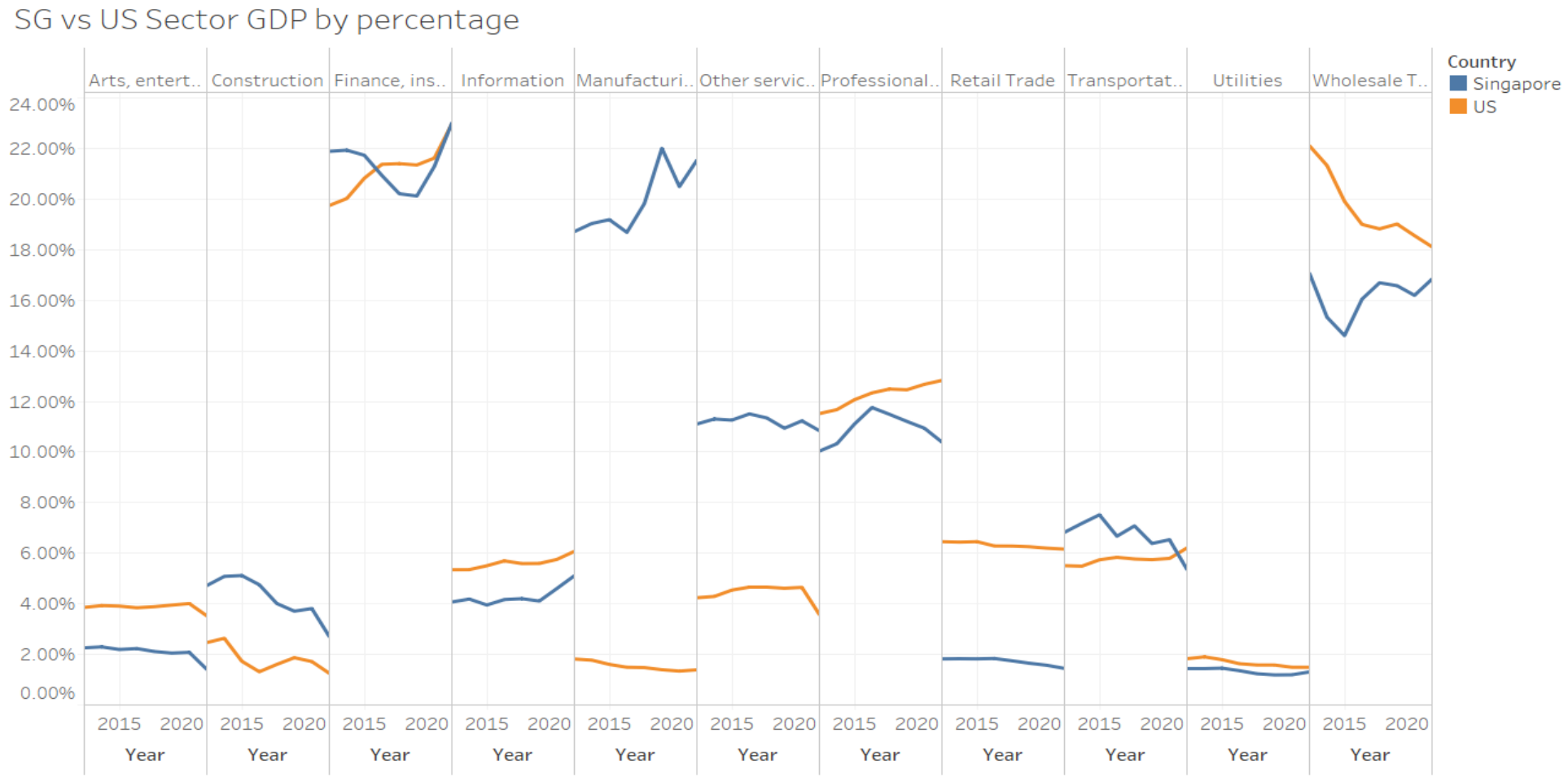
Our university enrolment numbers appear to be aligned to our economic sectors growth

- The courses with the greatest increase in enrolment corresponds with the sectors with greatest GDP growth

We need more data points!

- In 2019, IT's GDP grew by 12.03% while enrolment grew by 23.6%
- Does this hint that we are over-supplying IT graduates? – NO, because IT is required across industry sectors
- Graduate survey should include data points like current employed sector and current nature of work (e.g. IT)
- Explore measuring GDP not just by sectors but by nature of work

Project Findings 3 – Identify sectors to re-allocate resources



The trends of Arts, entertainment, recreation, accommodation, and food services, Construction, Finance, insurance, real estate, rental, and leasing, Information, Manufacturing, Other services, except government, Professional and business services, Retail Trade, Transportation and warehousing, Utilities and Wholesale Trade for Year. Color shows details about Country.

Project Findings 3 – Identify sectors to re-allocate resources

Arts, entertainment, recreation, accommodation, and food services:

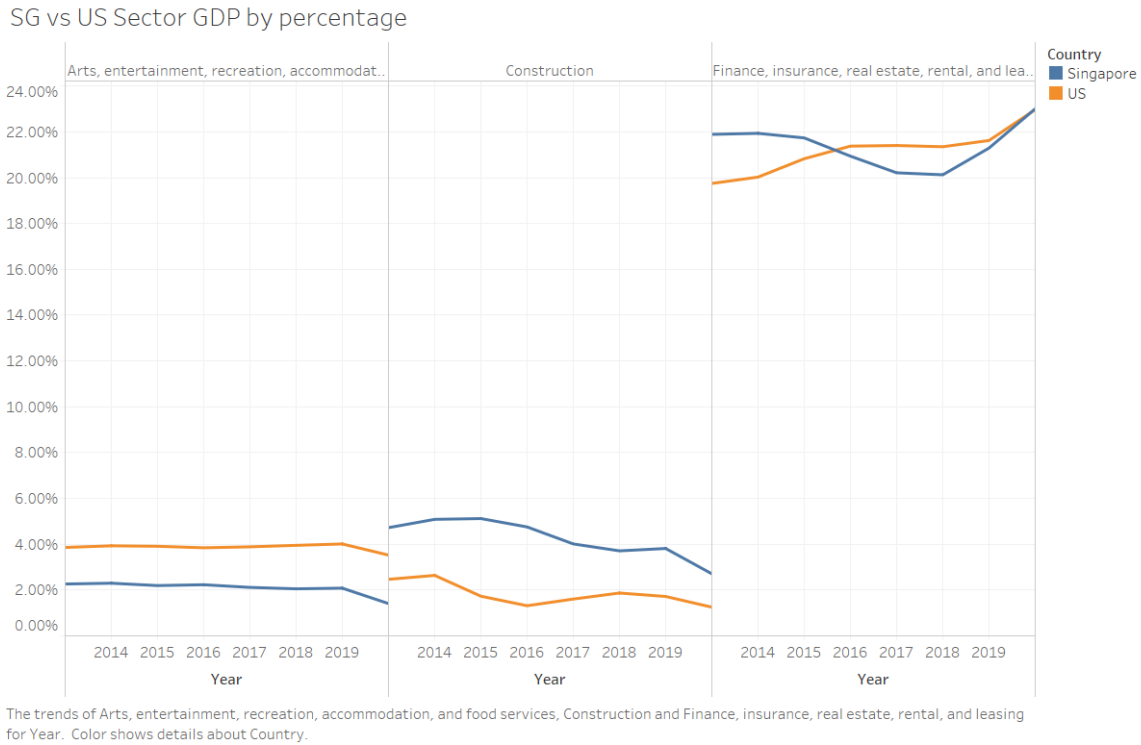
There is a drop of GDP Contribution by both countries in 2020. This might be due to pandemic.

Construction:

Contribution by this sector has been declining. We can see US's contribution is much lower, and it can be used as a good predictor for said industry in Singapore in future. Construction related education (such as architecture) can be reduced.

Finance, insurance, real estate, rental, and leasing:

Contribution by this sector is on the rise, except for Singapore in 2018. This might be due happenings in the global economy. Singapore's financial and real estate sector might be more susceptible than US' to global events. It has since bounced back and is rising. Education in this sector can be increased accordingly.



Project Findings 3 – Identify sectors to re-allocate resources

Information:

There is a steady rise in this sector for both Singapore and US. It is a larger contributor to GDP for US than Singapore and it can be used as a forecast of what will happen to the same sector here.

Manufacturing:

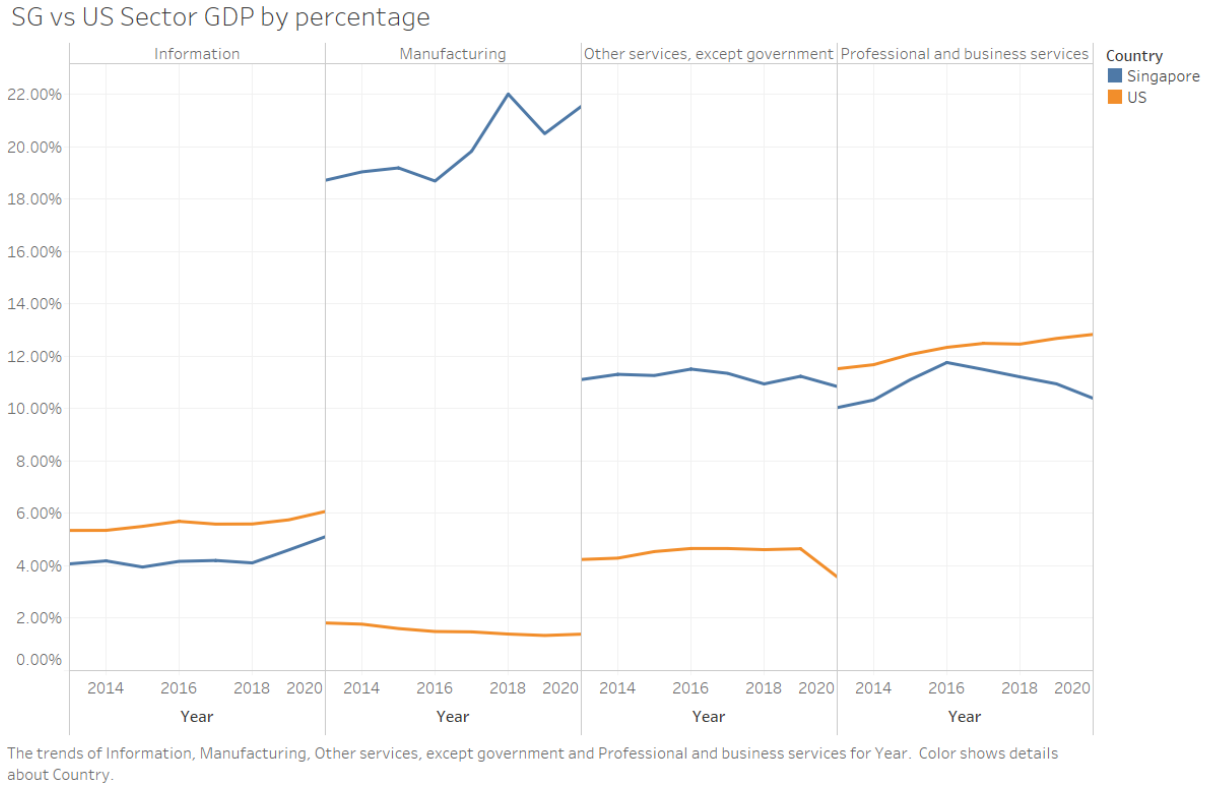
Manufacturing industry contributes to more than 20% of Singapore's GDP and our government do have plans to further grow this industry. As this is the plan by government, we are unable to advise on whether we should increase or reduce intake based on our data.

Other services, except government:

Consistent for both countries, unable to determine graduates from which sector contributes to these and we are unable to advise based on our data.

Professional and business services:

This sector has been decreasing in Singapore, however there is a steady rise for US. There might be potential for this sector in future.



Project Findings 3 – Identify sectors to re-allocate resources

Retail Trade:

This sector has seen a slow decline. Due to pandemic, technology is accelerated and there is a decrease in retail activities. Education in this sector can be decreased accordingly.

Transportation and warehousing:

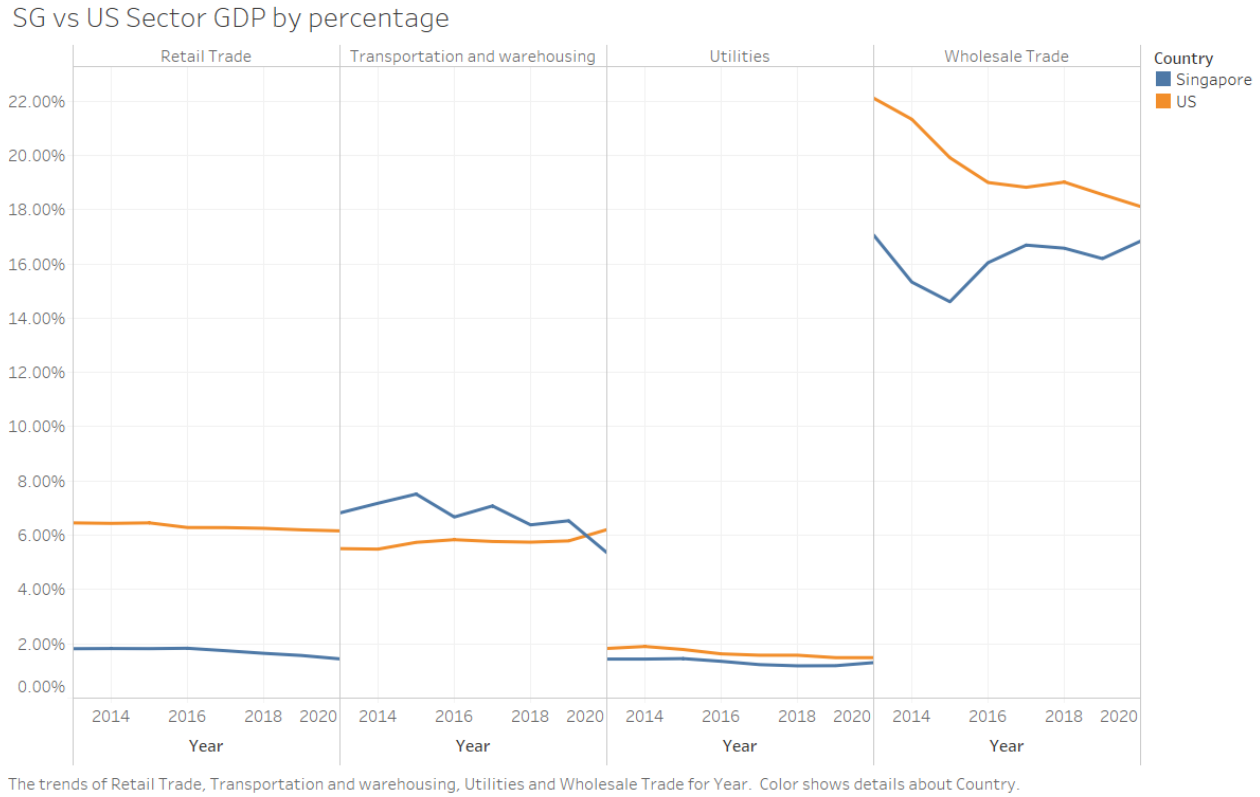
There is a decline in transportation for Singapore, compared to increase in US. We are however unable to advise as we are different geographically.

Utilities:

This sector is consistent for both countries. It should remain so as it is a staple part of the population's lives.

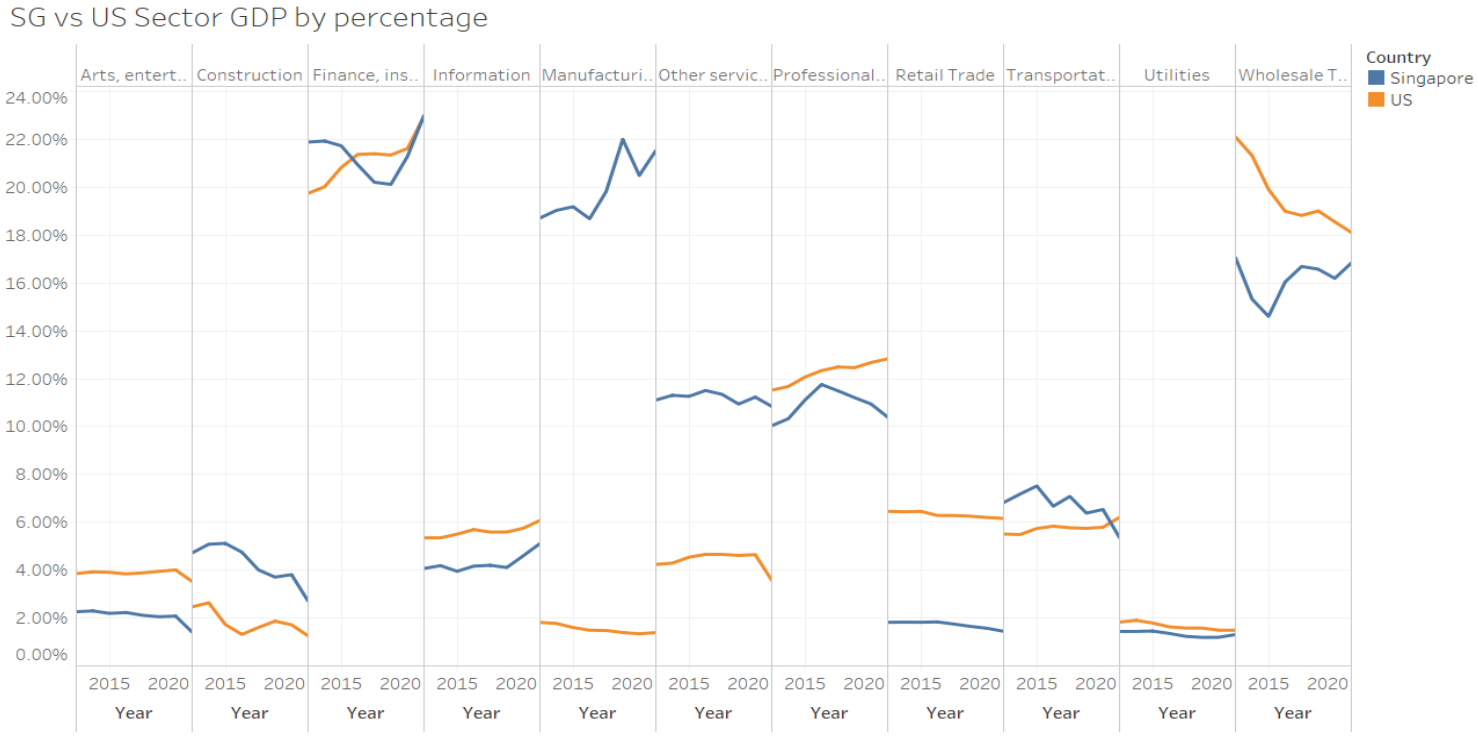
Wholesale Trade:

Wholesale Trade industry is on the rise for Singapore contrary to US' decline. As there are initiatives put in place by government to digitalise this sector, we might see further growth until Singapore has hit US stage of economy. Education in this sector can be increased accordingly.



Project Recommendation 3

We grouped the sectors into:
Unable to advise, increase resources, decrease resources, or remain unchanged
based on our findings.



Sector	Recommendations
Arts, entertainment, recreation, accommodation, and food services	Unable to advise
Construction	Decrease resources
Finance, insurance, real estate, rental, and leasing	Increase resources
Information	Increase resources
Manufacturing	Unable to advise
Other services, except government	Unable to advise
Professional and business services	Increase resources
Retail Trade	Decrease resources
Transportation and warehousing	Unable to advise
Utilities	Remain unchanged
Wholesale Trade	Increase resources

Data Governance

From the perspective of a data & analytics practice in MOE:

Data quality issues observed in published data set:

- **Completeness** – SUTD's 2018 data is missing
- **Timeliness** – Data is only available till 2018

Assumptions:

- MOE has an existing data governance structure
  - Research and Management Information Division – Provide leadership in data strategy and data governance

Recommendations:

- Structure
  - Unclear who data steward is
  - Assign data to a steward from Higher Education Planning Office

- TRIFECTA

Policies / Procedures	Measure
• Include in **data quality policy** that data should be **100% complete** & **refreshed every 6 months** • Conduct data quality audit once a year	• 0 missing data found during data quality audit • Automate checks within 1 year
• Automate this data collection such as by integrating with IRAS • **Tackles issue of none responses** (~20%) to the survey and **provides more records** • Provides **more data points as such time taken for employment** for more analysis and insights	• Complete integration within 1 year

Data Governance

From the perspective of a data & analytics practice in MOE:

Data governance considerations on our Analysis & Insights (Output):

- Assigning the "Right" Data Steward
  - Interests aligned with the value of our output
  - Policy making authority or influence
  - Has hunch on whether output "makes sense"
  - Senior person in MOE's Higher Education Planning Office

- Data Security
  - Output to be classified accordingly
  - Assuming that existing bands are Confidential, Restricted, Internal & Public. Output is minimally Internal as insights are sensitive due to it having an impact on higher education policy making

- Data Quality
  - Comply with existing data quality policies
  - Peer-reviewed by at least 2 senior MOE staff – 1 from the Higher Education Planning Office and 1 from the Research and Management Information Division

- Data Compliance
  - No personal data. All data is on an aggregated level.

Risks and challenges encountered

I	P	S
3	3	9

Missing Data Records

- Missing records in the main dataset – Graduate Employment Survey.
- After conducting a quick check, we found out that the 2018 SUTD records are missing.

Mitigation

- Thorough check by pivoting the dataset and finding any missing records.
- Supplement the missing records by finding other data sources and merging them.

I	P	S
2	3	6

Data Unavailability

- We require GDP and graduate's data from other countries such as the USA.
- Preliminary findings are that such data are hard to find for foreign countries.

Mitigation

- Web scrape of the data using R (Source: FRED economic data) is carried out to collect data which we cannot find.

I	P	S
3	2	6

Insufficient Time

- Project is on top of existing responsibilities.

Mitigation

- Commitment to block out time to collaborate on the project.
- Constant updates & communication.
- Employ use of burn down charts to track project progress carefully.

I	P	S
3	1	3

Unexplainable Findings

- Findings / Insights uncovered deviates significantly from our hypothesis.
- Unable to make sense of findings and provide actionable recommendations.

Mitigation

- Conduct background research to look for supporting evidence.
- Conduct high level analysis such as simple correlation to quickly validate hypothesis.

I	P	S
3	1	3

Unclear Objectives

- While the project team (us) were aligned on the general theme of the project.
- We struggled to define clear business objectives on our first inception iteration.

Mitigation

- Conduct 1 more inception iteration to thrash out what the business objectives should be before concluding the inception phase.

Conclusion

1

Re-design / Re-invent "Unproductive" Faculties & Courses

- Humanities & Social Sciences and Natural, Physical & Mathematics
- Prepare for the digital world

2

Re-design Graduate Employment Survey & GDP Measurement

- Capture data points like current employed sector and current **nature of work** (e.g. IT)
- Explore measuring GDP not just by sectors but by **nature of work**

3

Re-design / Re-invent Faculties & Courses of Sunset Sectors

- Re-invent construction related courses such as Civil Engineering and Architecture

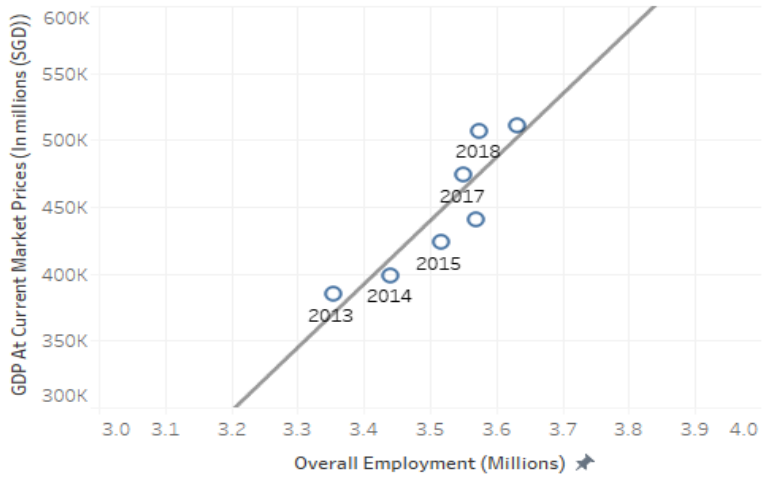
THANK YOU

Economy, Education Relationship

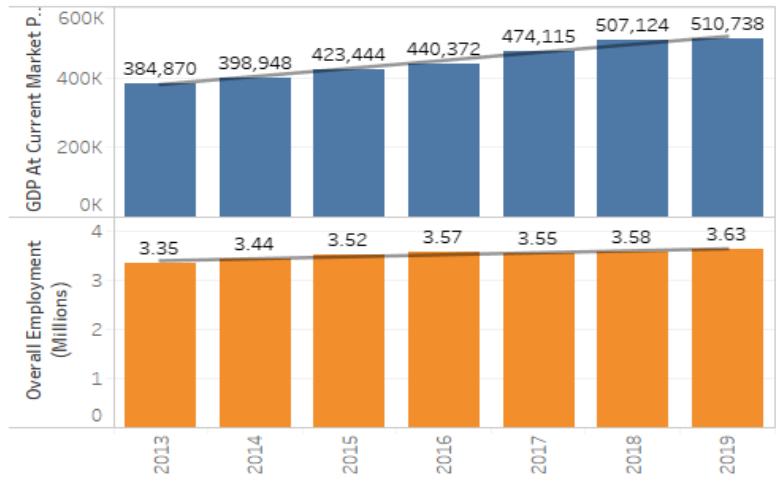
Strong postive correlation between GDP, employment(0.89)and graduate employment(0.80)

Increase in GDP--> Increase in overall employment--> increase in graduate employment

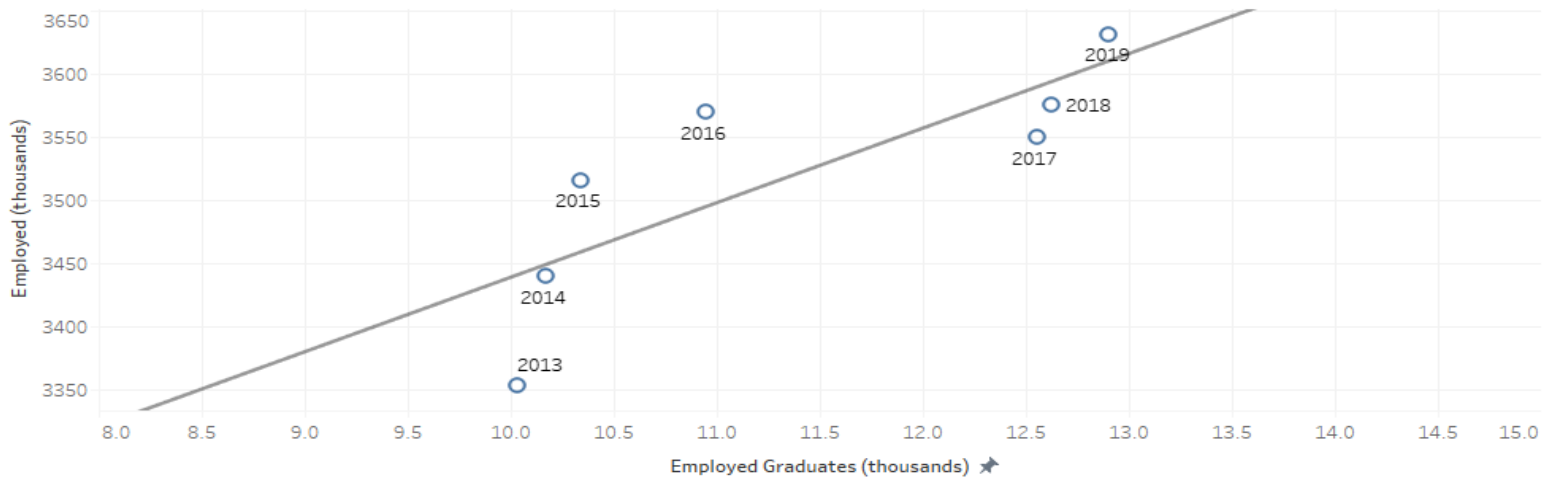
SG GDP vs Employment



SG GDP vs Overall Employment 2



SG Employment vs Graduate Employment



Analysis on economy and graduate enrolment by year

Top 5 industry sectors vs Top 5 education courses

Do all courses directly impact the GDP?

Workforce training alignement with economy

Sector GDP by year

Year of Analysis

	2013	2014	2015	2016	2017	2018	2019
Finance, insurance, real es..	21.89%	21.93%	21.74%	20.94%	20.21%	20.12%	21.29%
Manufacturing	18.72%	19.04%	19.19%	18.69%	19.82%	22.01%	20.50%
Wholesale Trade	17.06%	15.33%	14.61%	16.05%	16.69%	16.58%	16.20%
Other services, except go..	11.11%	11.31%	11.26%	11.51%	11.35%	10.94%	11.23%
Professional and business..	10.04%	10.33%	11.11%	11.76%	11.49%	11.21%	10.94%
Transportation and wareh..	6.83%	7.18%	7.52%	6.67%	7.08%	6.39%	6.54%
Construction	4.72%	5.09%	5.12%	4.75%	4.01%	3.71%	3.81%
Information	4.07%	4.19%	3.95%	4.17%	4.20%	4.11%	4.61%
Arts, entertainment, recr..	2.26%	2.30%	2.20%	2.23%	2.11%	2.05%	2.08%
Retail Trade	1.82%	1.83%	1.82%	1.84%	1.75%	1.65%	1.57%
Utilities	1.44%	1.44%	1.46%	1.36%	1.24%	1.19%	1.20%
Agriculture, forestry, fishi..	0.04%	0.04%	0.03%	0.03%	0.03%	0.03%	0.03%
Mining	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Education course enrolment by year

Year of Enrolment

Edufield	2013	2014	2015	2016	2017	2018	2019
Engineering Sciences	27.44%	27.63%	27.22%	26.94%	28.15%	26.01%	24.63%
Humanities & Social Scien..	18.47%	17.51%	17.60%	17.35%	17.00%	16.81%	15.99%
Business & Administration	10.32%	10.64%	11.70%	11.84%	12.82%	13.90%	15.01%
Information Technology	6.30%	6.52%	6.88%	7.43%	8.46%	10.17%	12.17%
Natural, Physical & Mathe..	12.97%	12.74%	11.84%	11.29%	8.01%	8.68%	8.43%
Accountancy	6.87%	8.48%	8.11%	8.20%	8.08%	7.09%	6.92%
Health Sciences	3.14%	3.04%	3.14%	4.30%	5.15%	4.99%	5.05%
Architecture, Building & R..	2.34%	2.63%	2.31%	2.26%	2.20%	2.29%	2.38%
Law	2.34%	2.22%	2.23%	2.15%	2.09%	2.40%	2.24%
Medicine	2.05%	2.12%	2.15%	2.21%	2.27%	2.18%	2.08%
Fine & Applied Arts	2.73%	2.75%	2.57%	2.47%	2.49%	2.05%	2.04%
Services	1.84%	0.69%	1.10%	1.08%	1.08%	1.11%	1.05%
Education	1.82%	1.68%	1.62%	1.17%	0.91%	1.10%	0.92%
Mass Communication	1.08%	1.04%	1.22%	1.02%	1.01%	0.94%	0.81%
Dentistry	0.31%	0.30%	0.30%	0.29%	0.29%	0.30%	0.29%

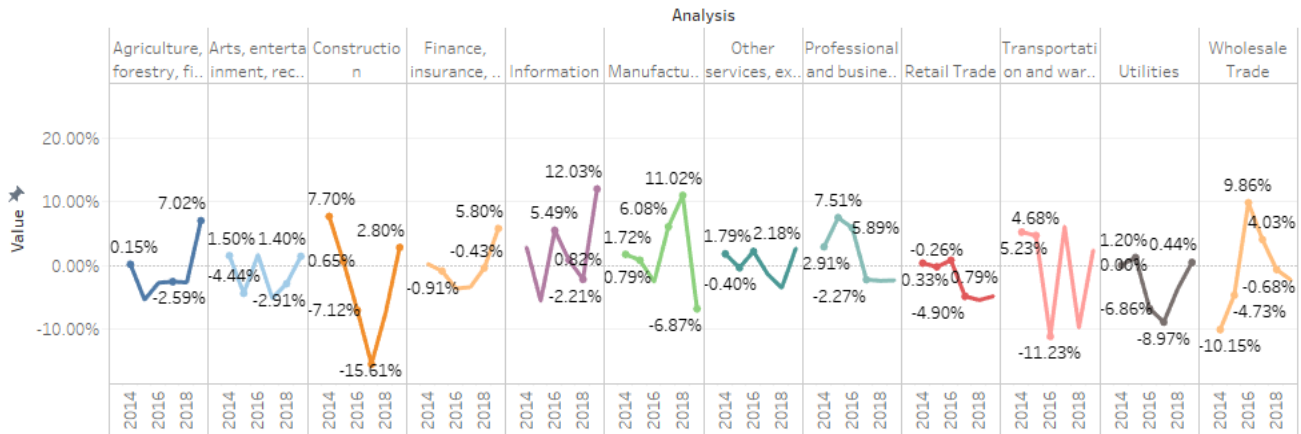
Analysis on economy and graduate employment by growth

Top growth industry sectors vs top growth education course

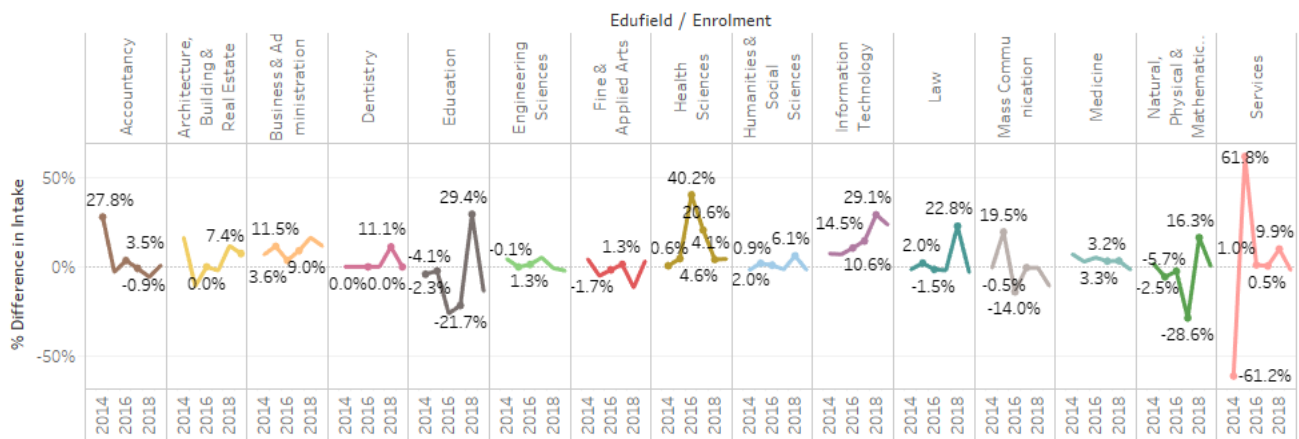
Are both industry sector and education course aligned?

YOY growth for sector and education

Sector GDP YOY



Education enrolment YOY

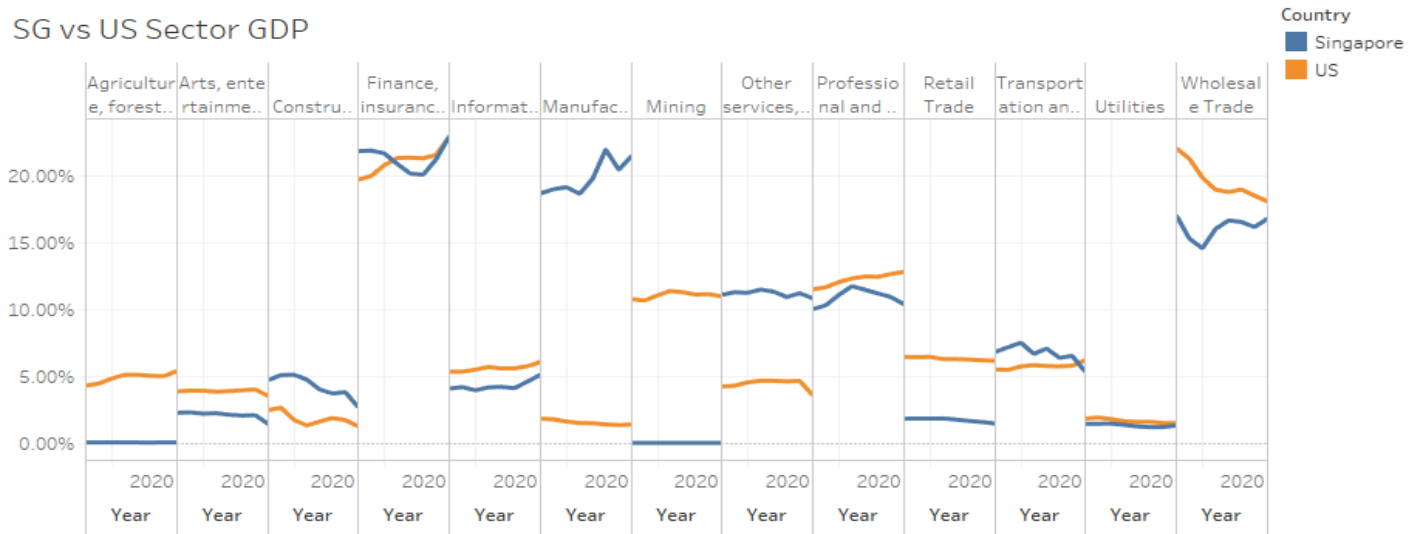


Analysis on US vs SG economy

SG GDP vs US GDP

What is the forecast for SG based on a mature economy?

SG vs US Sector GDP



SG vs USA (percentage)