The Future S&T Human Resource Requirements in the Philippines: A Labor Market Analysis

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Outline

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2. **Empirical Findings**
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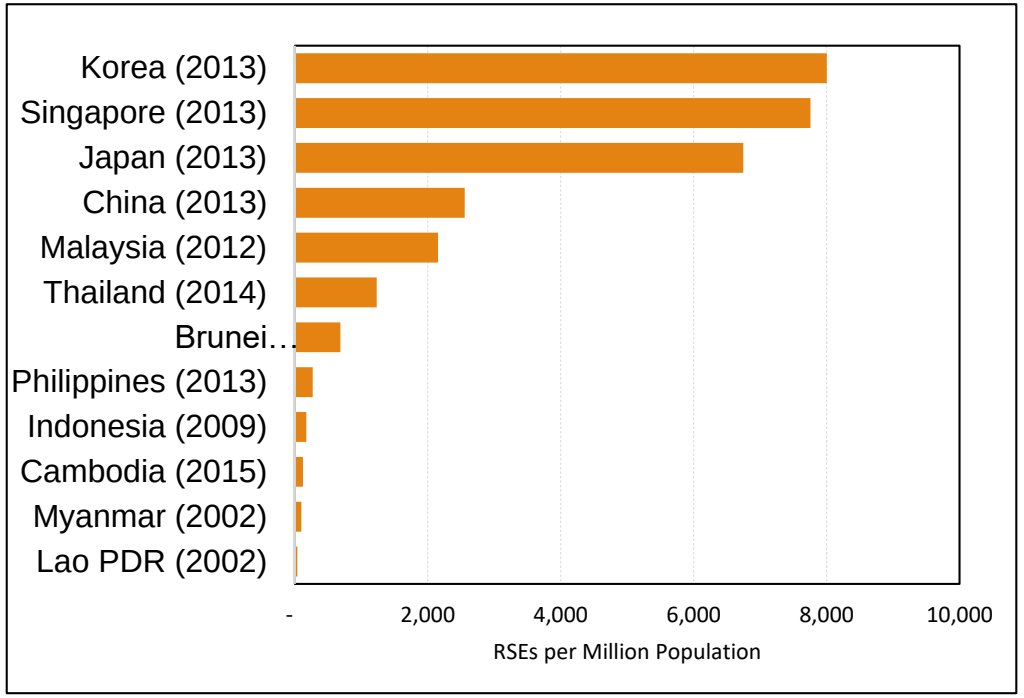
"The Future is not fully knowable, but it is also inevitable"
- Prof. Richard Edwin Baldwin

1. Introduction

- Despite importance of Science and Technology (S&T), our S&T Human Resources have been limited in the country.
- Important to examine state of S&T personnel in the country
- Need to anticipate S&T competencies & skills required especially given the emerging disruptions in the labor market brought about by Fourth Industrial Revolution (FIRe)

Number of RSEs per million population across Selected Countries



PH has 270 RSEs per million population compared to over 2000 in MY, CN, SG, and KR.

1.1 Brief Description of the Study

- Various reports by int'l orgs, e.g. WEF (2016), ADB (2018) and World Bank (2019), suggest that disruptive changes brought about by use of emerging technologies of FIRe are reshaping business models and demanding new skills sets for the workforce in the period 2020-2025.
- The study provides a holistic picture of the country's emerging S&T HR requirements and helps identify specific policy recommendations on S&T education, especially in the administration of DOST scholarship programs, as well as help ensure the matching of capabilities of S&T professionals with the demands of the labor market.

1.2 Study Methods and Data Sources

- Literature review
  - Previous DOST publications, online materials on S&T labor market
- Secondary data analysis
  - Time Series Analysis (Exponential Smoothing) on Data from Labor Force Survey (LFS): Jan 2010 to Oct 2018 (PSA)
  - Supply Side and Demand Side Estimation Using 2010 Census of Population and Housing; 2015 Population Census; Population Projections (PSA)
    a. Supply projected with $Future\ Supply = Production + Survival$
    b. Demand Based on a standard input-output model
  - Examination of data on graduates (CHED) and licensure exam results (PRC)
  - Data analysis of government positions (DBM)
- KIIs with business leaders

1.3 Study Limitations

Note: This study has been done prior to COVID and may not be reflective of the current situation (pandemic)

1) Lack of ***good quality data*** on many S&T occupations.
   - As S&T professionals/practitioners constitute about **5%** of the country's employed population, the usual sample size of the LFS of PSA is not sufficiently large to provide good quality estimates of the number employed in S&T occupations.
   - LFS respondents need not necessarily know with certainty the detailed S&T occupations (4 digit PSOC) of all household members.
2) LFS data used is from 2010 to 2018 only (36 quarters) while time series analysis requires at least 50 observations to produce accurate and reliable estimates
3) A structural break occurs in LFS data in April 2016 due to the shift in the use of 2012 PSOC from 1992 PSOC.

2.1 Time Series Analysis of Data from LFS

Table 1. Projected Annual Employment Growth Rate

OCCUPATION	EXPONENTIAL SMOOTHING GROWTH RATE (%)	2016-2018 AVERAGE ANNUAL GROWTH RATE (%)
Information and Computer Technology Professionals		
Applications programmer	36.0	13.9
Computer network programmers	-18.0	27.2
Database designers and administrators	-9.7	28.3
Software developers	-4.6	-23.0
Systems administrators	29.0	63.5
Systems analysts	-15.9	-7.4
Web and multimedia developers	-14.3	52.7

2.1 Time Series Analysis of Data from LFS

Table 2. Projected Annual Employment Growth Rate

OCCUPATION	EXPONENTIAL SMOOTHING GROWTH RATE (%)	2016-2018 AVERAGE ANNUAL GROWTH RATE (%)
Engineering professionals		
Chemical engineers	54.5	-2.0
Civil engineers	14.3	15.8
Electrical engineers	-10.5	11.2
Electronics engineers	12.3	-12.0
Environmental engineers	-0.6	70.3
Industrial engineers	-0.3	46.3
Mechanical engineers	-7.7	10.6
Mining engineers, metallurgists	-2.8	26.4
Telecommunications engineers	3.5	-31.2

2.1 Time Series Analysis of Data from LFS

- The projected employment growth rates for the broad occupation groups are slightly better.

Table 3. Projected Annual Employment Growth Rate for Broad Occupation Groups

OCCUPATION GROUP	EXPONENTIAL SMOOTHING GROWTH RATE (%)	2016-2018 AVERAGE ANNUAL GROWTH RATE (%)
Information and Computer Technology Professionals	10.8	22.6
Architects, planners, surveyors and designers	-4.1	40.4
Engineering professionals	13.4	14.1
Life Scientists	2.4	3.6
Physical Scientists	1.1	0.4
Mathematical Occupations	25.1	3.8

2.1 Time Series Analysis of Data from LFS

- List of disciplines for which there are no codes in the LFS, likely due to relatively few practitioners. Note: list is not exhaustive.

1. Agricultural and biosystems engineering
2. Energy / alternative energy engineering
3. Geomatic engineering
4. Materials science and engineering
5. Robotics engineer
6. Transportation engineering
7. Computer and information research scientists
8. Information security analysts
9. Medical Scientists, Except Epidemiologists
10. Operations Research Analysts

- There are also cross-cutting occupations identified by the Jobsfit 2022 Report without separate codes in LFS but classified under a larger category.

1. Web and multimedia developers: *game developer*
2. Civil engineer : *geodetic engineer*
3. Mechanical engineer : *agricultural engineer, marine engineer*
4. Engineering professional not elsewhere classified: *sanitation engineer*
5. Biologists, botanists, zoologist and related scientists: *plant and animal taxonomist*
6. Farming, forest and fisheries advisers: *agriculturist, forester, soil scientist*
7. Chemist : *food chemist*

2.1 Time Series Analysis of Data from LFS

Recommendations

1. The sample size of the LFS should be increased in order to ensure good quality data for the purpose of projecting future S&T human resource requirements.
2. PSA should include in the LFS four digit codes for cross-cutting and emerging occupations.

2.2. Analysis of population census data

Share (%) of S&T Graduates by Age: 2015

Age Group	Total in the labor force	Life Sciences	Physical Sciences	Math and Statistics	Computing/IT	Engineering	All S&T
15	1,984,019	0.005	0.001	0.004	0.359	0.107	0.476
20	5,372,095	0.095	0.037	0.078	3.753	2.021	5.985
25	5,786,983	0.099	0.042	0.073	3.318	2.658	6.189
30	5,214,543	0.108	0.049	0.072	2.926	3.148	6.304
35	4,853,814	0.099	0.042	0.054	2.180	3.215	5.590
40	4,238,394	0.095	0.036	0.050	1.106	3.251	4.537
45	3,810,532	0.090	0.032	0.050	0.519	3.380	4.071
50	3,111,774	0.066	0.050	0.039	0.248	3.613	4.015
55	2,397,585	0.059	0.068	0.027	0.156	3.055	3.365
60	1,508,449	0.036	0.047	0.019	0.093	1.838	2.033
All age groups	**38,278,188**	**0.09**	**0.04**	**0.06**	**1.93**	**2.78**	**4.89**

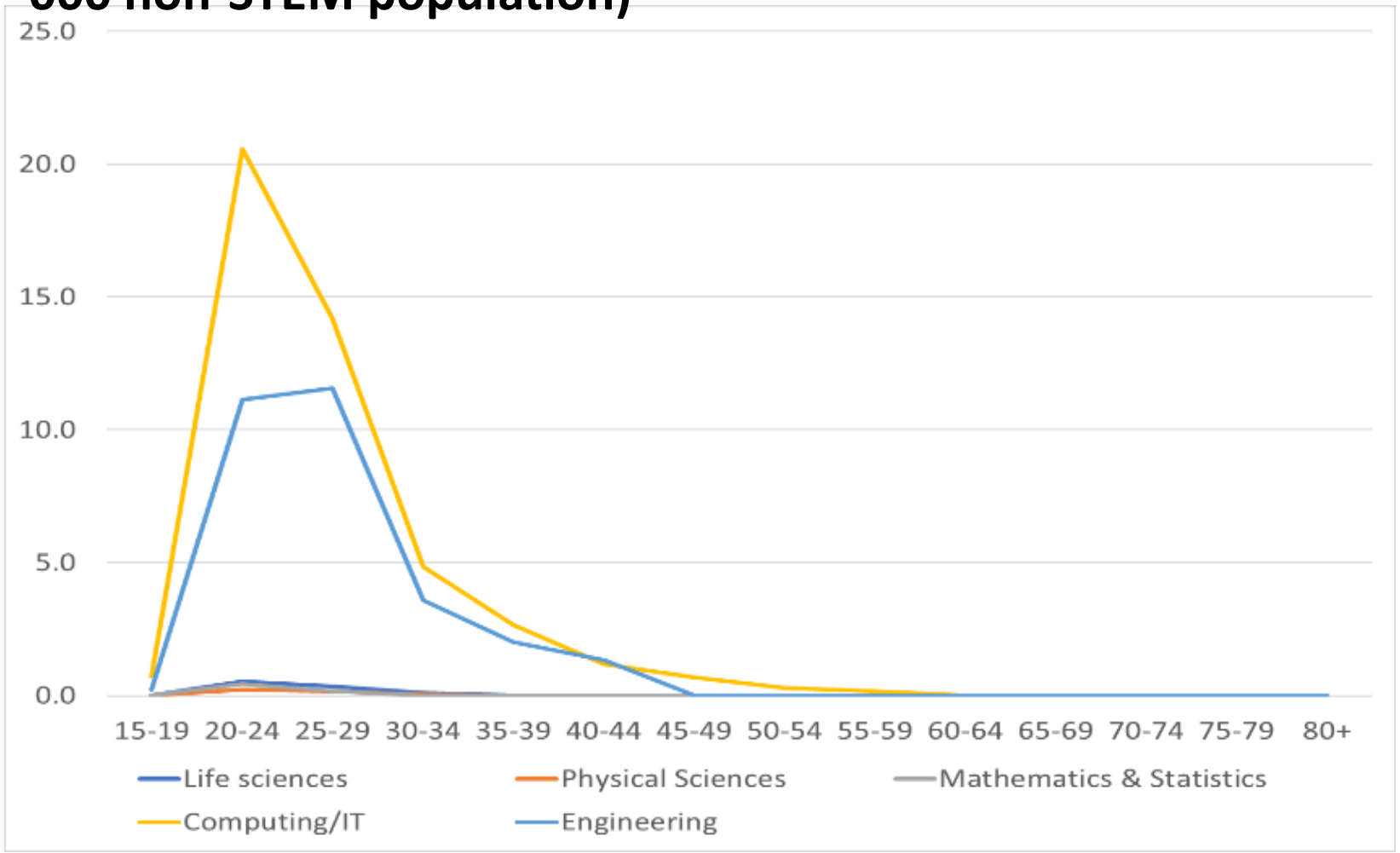
2.2. Analysis of population census data

Employment Status of S&T Graduates by Sex (in `000): 2015

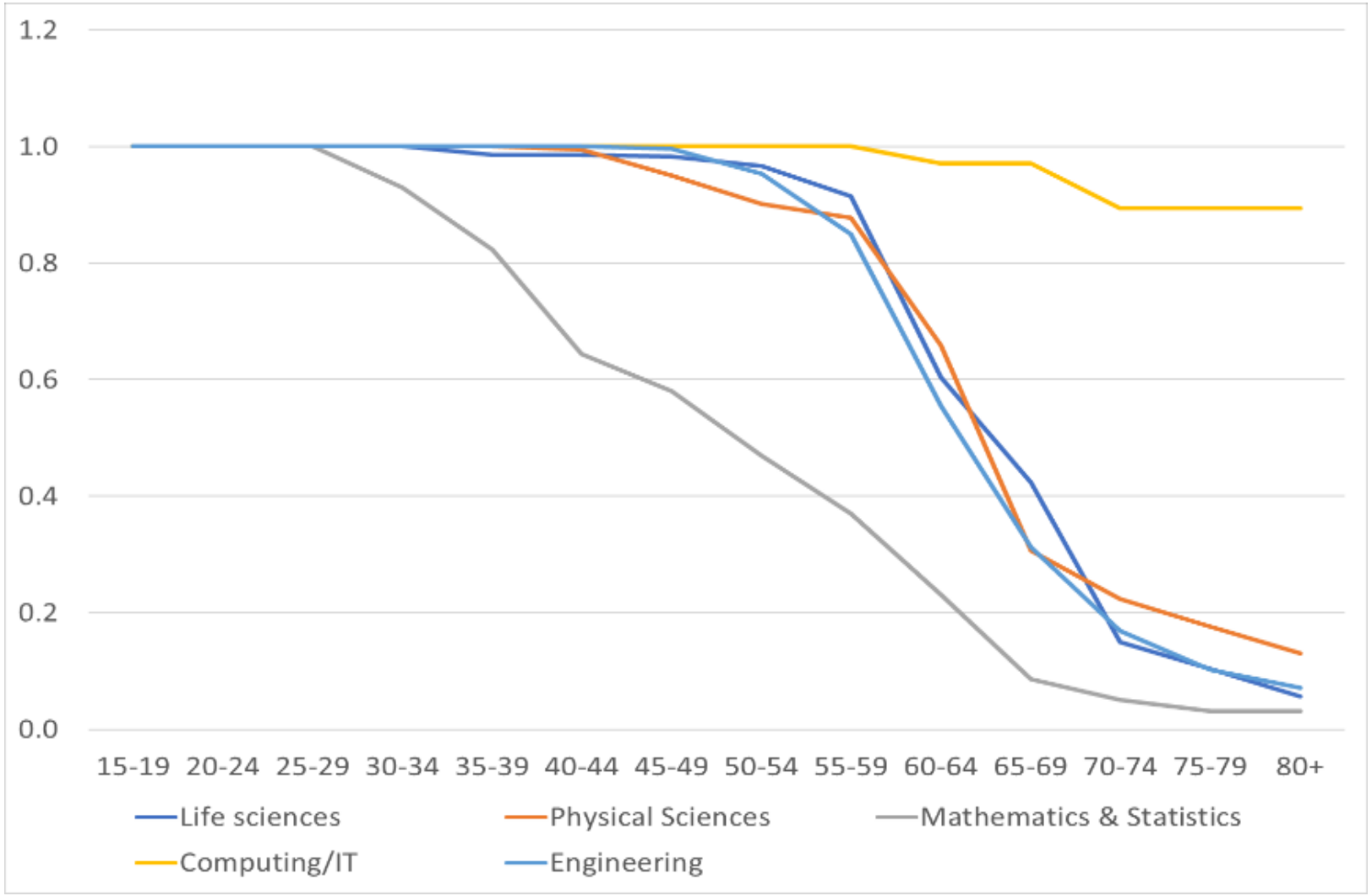
	Philippines	Life Sciences	Physical Sciences	Math and Statistics	Computing/IT	Engineering	All S&T
All							
Population 25 to 64 years old	44,143	36	18	20	657	1,071	1,802
In the Labor Force	31,119	28	14	17	537	965	1,560
% In the Labor Force	*70.5*	*77.0*	*78.8*	*84.7*	*81.7*	*90.0*	*86.6*
Employed	31,019	28	14	17	532	961	1,552
% Employed	*99.7*	*99.4*	*99.5*	*99.6*	*99.2*	*99.6*	*99.5*
Males							
Population 25 to 64 years old	22,278	12	7	8	329	901	1,257
In the Labor Force	20,672	11	6	8	306	834	1,165
% In the Labor Force	*92.8*	*90.0*	*89.6*	*93.3*	*93.1*	*92.6*	*92.7*
Employed	20,618	11	6	8	304	831	1,160
% Employed	*99.7*	*99.5*	*99.4*	*99.5*	*99.2*	*99.6*	*99.5*
Females							
Population 25 to 64 years old	21,866	24	11	12	328	171	545
In the Labor Force	10,448	17	8	9	230	131	395
% In the Labor Force	*47.8*	*70.4*	*71.8*	*78.5*	*70.3*	*76.6*	*72.5*
Employed	10,400	17	8	9	228	130	392
% Employed	*99.5*	*99.4*	*99.6*	*99.6*	*99.1*	*99.5*	*99.3*

2.2.1 Production Rate of New STEM Workers at Age t

(per '000 non-STEM population)



2.2.2 Survival Rate of STEM Graduates in Labor Force at Age t



2.2.3 Projected Supply, Demand, and Gap of STEM Workers

	2020	2025
Supply		
Life Sciences	41,089	48,932
Physical Sciences	18,820	21,323
Math and Statistics	24,530	27,445
Computing/IT	1,153,545	1,586,827
Engineering	1,287,053	1,485,586
Demand		
Life Sciences	45,799	62,896
Physical Sciences	22,394	31,012
Math and Statistics	29,615	40,730
Computing/IT	1,026,696	1,414,868
Engineering	1,490,765	2,055,489
Gap (Demand - Supply)		
Life Sciences	4,710	13,964
Physical Sciences	3,575	9,689
Math and Statistics	5,085	13,285
Computing/IT	-126,850	-171,960
Engineering	203,713	569,903

2.2.4 Projected Demand for S&T Workers

	2020					2025				
	Life Sciences	Physical Sciences	Math & Statistics	Computing/ IT	Engineering	Life Sciences	Physical Sciences	Math & Statistics	Computing/ IT	Engineering
Agriculture and forestry	2,115	571	703	27,217	66,198	2,596	700	863	33,405	81,247
Fishing	219	49	46	2,413	8,305	269	60	56	2,959	10,183
Mining & Quarrying	205	314	34	3,843	10,918	297	455	49	5,562	15,800
Manufacturing	2,972	5,090	1,402	95,813	180,177	4,221	7,230	1,991	136,077	255,895
Electricity, Gas and Water Supply	200	189	198	7,022	45,869	291	276	289	10,232	66,838
Construction	512	398	265	19,750	286,080	711	553	367	27,409	397,011
Trade and Repair of Motor Vehicles, Motorcycles, Personal and Household Goods	8,174	2,828	3,591	171,199	158,366	11,303	3,910	4,965	236,726	218,981
Transport, Storage & Communication	1,841	883	1,065	47,124	235,823	2,526	1,211	1,461	64,654	323,546
Financial Intermediation	1,288	306	3,017	56,678	23,046	1,763	419	4,130	77,573	31,543
Real Estate, Renting & Business Activities	276	113	235	5,396	7,010	377	154	321	7,369	9,573
Public Administration & Defense; Compulsory Social Security	6,541	2,602	4,591	112,264	174,763	8,946	3,558	6,279	153,534	239,009
Other Services	21,455	9,051	14,469	477,976	294,211	29,597	12,486	19,960	659,369	405,864
TOTAL	**45,799**	**22,394**	**29,615**	**1,026,696**	**1,490,765**	**62,896**	**31,012**	**40,730**	**1,414,868**	**2,055,489**

2.3.1 Basis of action: What do projections suggest?

- Demand and supply projections show that, by 2025, there will be an undersupply of S&T workers in Life Sciences, Physical Sciences, Mathematics and Statistics, and Engineering (consequently, a need for more graduates in these discipline groups), and an oversupply of workers in Information Technology (consequently, a need for fewer graduates in this discipline group).

2.3.2 Elements of Strategy: What can be done?

- To prepare for increased demand for S&T graduates, steps should be taken to **increase enrollment and graduates**, and ensure **quality of education**.
- Increasing S&T enrollment and graduates requires **increasing interest in S&T among the young** and **improving their S&T capabilities**, as well as the **reduction in** the number of **S&T students failing to graduate on time**.
- Ensuring the quality of S&T education means working for **improvements in teaching quality and school facilities**, and **ensuring sufficient qualified faculty, relevant courses** and **degree programs**.

2.3.3 Policy Implications

1. **Increasing Enrollment and Producing Graduates**
   - *How effective is the K-12 curriculum in providing students with S&T knowledge and skills?*
   - *How effective are science sections and science schools in producing S&T students? Are there enough science sections and science schools in the country?*
   - *How effective are the following in reducing percentage of S&T students who do not graduate on time: entrance and IQ exams; scholarships and financial assistance; and counselling and healthcare for students.*
   - *What methods are used to match students with degree programs and how effective are they in reducing the percentage of students who fail to graduate on time?*

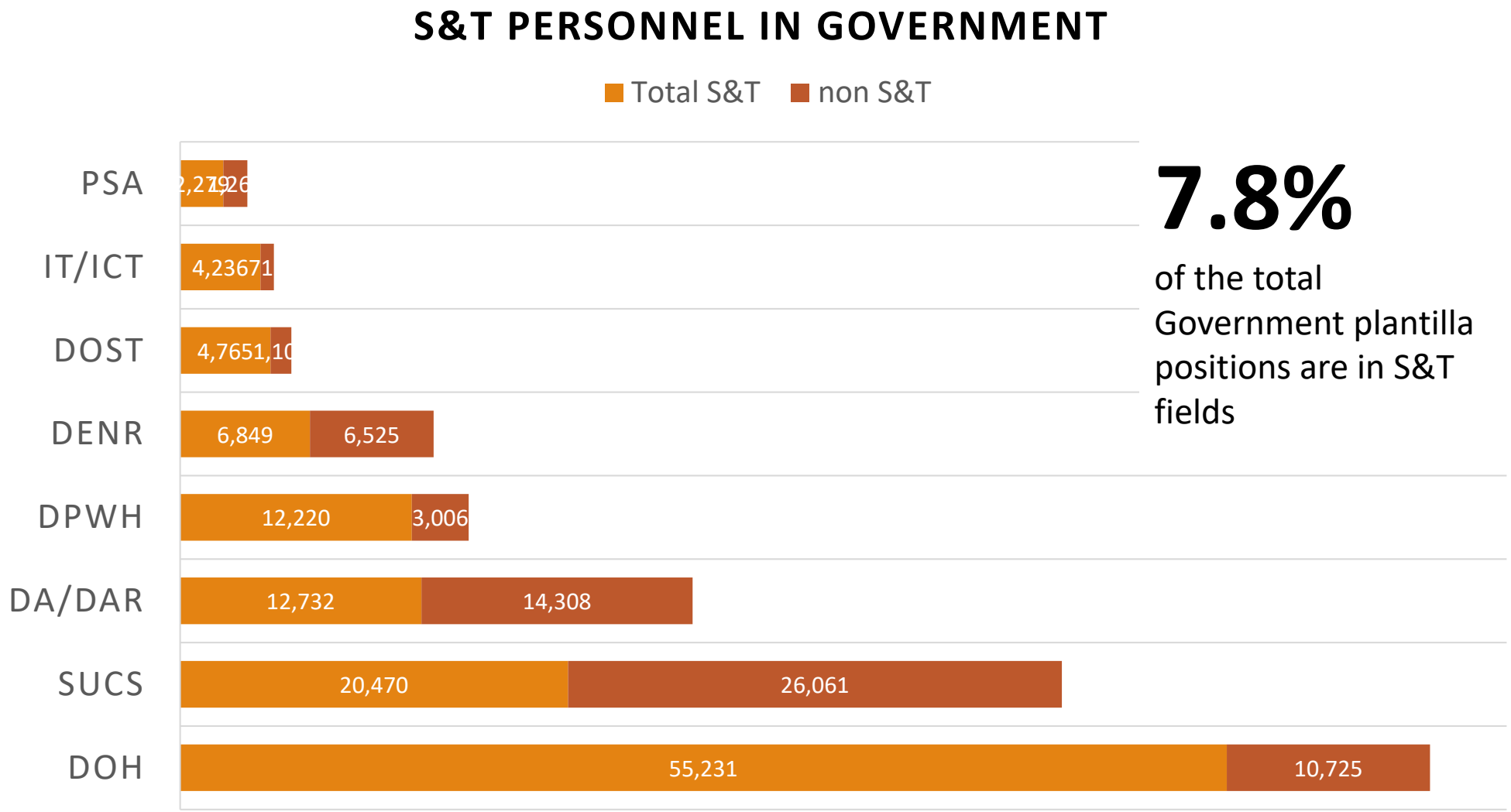
2.3.3 Policy Implications (cont'd)

2. Improving Quality of Education

- PRC data (2012-2016): lower than 50% average passing rate in the ff. degree programs:
  i. (Engineering and Technology) Marine Engineering, Agricultural Engineering, Civil Engineering, Electronics Engineering, and Geodetic Engineering
  ii. (IT-Related Disciplines) Library Science
  iii. (Medical and Allied Disciplines) Occupational Therapy, Radiologic Technology, Midwifery, Nursing, Respiratory Therapy, and Veterinary Medicine
  iv. (Natural Science) Geology

  - *Do schools meet standards on school facilities?*
  - *What is the impact of faculty development through Ph.D. scholarships and increased pay, benefits, and incentives on faculty retention?*
  - *Are the current S&T degree programs relevant? There should be a regular assessment of relevance of existing S&T degree programs to make the country better prepared in coping with the disruptions brought by FIRe.*

2.4. Analysis of Government Positions



7.8%

of the total Government plantilla positions are in S&T fields

2.4.1 Characteristics of S&T Personnel in Government

- Median Salary Grade of SG15-SG16
- Largest specified S&T background are Nursing, MDs, Agriculture, Forestry, Civil Engineering, Statistics and Meteorologists
- Largest unfilled positions are those for Nurses, MDs, SUC professors, and Agrarian Reform Technologists
- Increasing vacancies are found in Nurses, Senior Engineers and IT positions

Department	Total Positions	Total S&T Plantilla Categories	Total S&T Personnel[1]	Median SG
DOH	65,956	132	55,231	SG15 (Nurse II)
SUCs	46,531	42	20,470[2]	SG15 (Asst Prof. I)
DA/DAR	27,040	42	12,732	SG14 (Sr. Agrarian Reform Technologist)
DPWH	15,226	19	12,220	SG16 (Engineer II)
DENR	13,374	96	6,849	SG15 (Forester II)
DOST	5,865	32	4,765	SG16 (Science Research Specialist II)
Various (IT/ICT)	4,947	24	4,236	SG16 (Information Systems Analyst II)
Various/PSA (Statisticians)	3,546	15	2,279	SG16 (Statistical Specialist II)
Total	173,992	363	112,167	

- 22,913 Nurses, 19,045 Medical Doctors
- Expansion of Government Hospitals, Supreme Court ruling for increasing Nurses' entry level salary
- Largest S&T position vacancies

- 12,732 positions for Agriculture, Agricultural Engineering and related fields
- Sixty-Two (62) SUC/HEIs offering various fields

- ~43% of teaching positions are for S&T-related fields
- Largest Colleges are those of Agriculture & Forestry, and Engineering/IT.

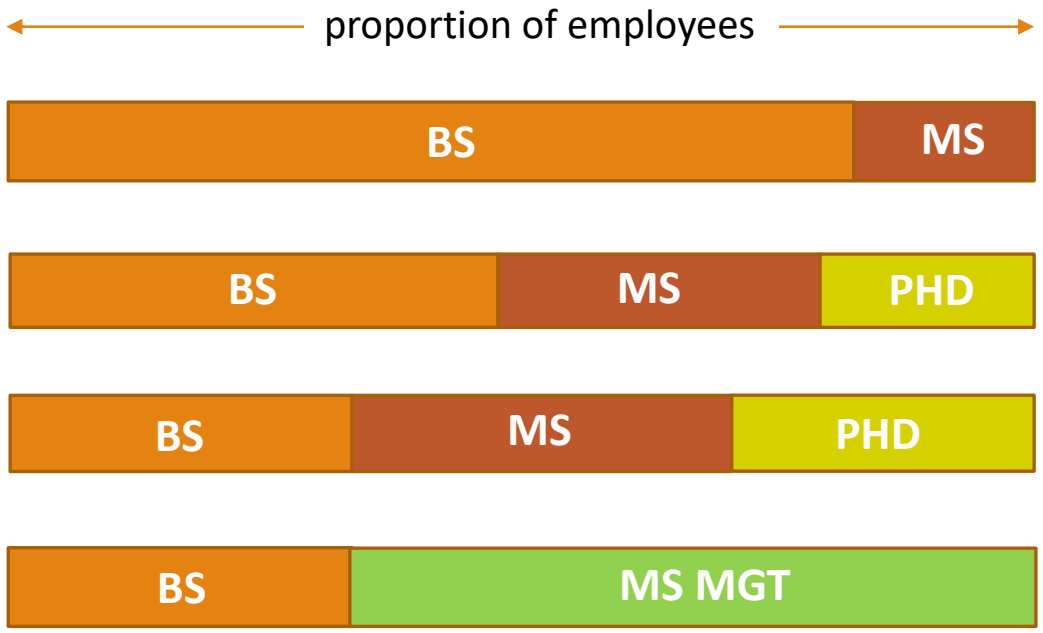
- 12,220 positions for Civil, Electrical, Mechanical Engineering and Dredging operations
- Total number of contractual/project positions outnumber plantilla posts by 3:1

- 1,248 Foresters, 2,250 Environment/Ecosystems Managers
- Sixty-Two (62) SUC/HEIs offering various fields

- 4,116 SRS positions (non-field specific)
- 594 Meteorologists in DOST-PAGASA

- 2,279 Statisticians
- Potential increase in demand due to the National ID program

2.4.2 Ideal Education Requirement



Service/Lab Personnel
DPWH, DOH, DA, DENR, DOST labs, NSA

Research
DOST RDIs

Teaching
SUCs

Research Management
DOST Councils, DOST ROs

*manpower requirements are satisfied by replacing education requirements with year of experience

2.5. Rethinking RDIs @ DOST

Restructuring R&D Institutes to enhance productivity

DOST R&D Institutes (RDIs) are a special type of government agency engaged in basic and applied research. While all RDIs also provide some form of service to the general public, its core function remains to be similar to SUCs engaged in research than an R&D management or service agency in DOST. In fact, its deliverables are more analogous to the research outputs of SUCs which includes publications, patents, and trainings. **It is in making this comparison that the structure of RDIs must be more similar to SUCs** rather than the other DOST agencies. This shift in structure is thought to result in a more productive environment and an increase in interest from S&T graduates to join RDIs.

Flatter Bureaucracy

Promotion-based Performance

Tenure for Productivity

Term-limited management positions

3. Summary and Ways Forward

- ***S&T workers are essential*** in supporting a country's economic growth
- Total S&T workforce constitutes only a small portion of the country's workforce—need for ***government support*** of most of S&T disciplines
  - ***Prioritize disciplines*** that have declining employment levels, but are extremely needed to improve productivity in some sector or industry(i.e. agriculture, biology, chemistry and possibly even chemical engineering)
  - Government's massive boost in support for current and future S&T workers should be a ***joint undertaking*** with private sector and academic institutions

3. Summary and Ways Forward (cont'd)

- ***Encourage young population (and their parents)*** to go into S&T fields
  - Aside from providing financial assistance/scholarships, ***aggressive media campaigns supporting S&T*** for instance, especially through social media, could be used to disseminate info on S&T careers and opportunities, and surveys on young about "dream jobs" (as in Korea)
- ***Understand other factors*** that affect the supply of S&T workers in order to obtain behavioral insights and craft necessary policies to incentivize (e.g. look into disparities in labor force by sex and/or by discipline)
- ***Timing of scholarships*** is crucial. Highest propensity to join S&T fields is around tertiary level—financial support to be concentrated in this stage

3. Summary and Ways Forward (cont'd)

- ***Strengthen role of academe and research institutions*** to produce knowledge through research and to develop talents and innate capabilities of young; these institutions must be responsive in meeting evolving manpower needs and requirements
  - Need for an evaluation of skills taught to Engineering and Technology and in IT-Related Disciplines to **identify** any **mismatches between skills** currently **taught and skills required** in the future--there may be scope to improve not only technical but also soft skills of our learners
  - **Regular review and revise *curricula*** of colleges and universities needed—abolish old degrees and develop new ones
  - ***Research agenda*** of academic institutions are to be reviewed and revised
  - Rethink RDIs of DOST: reshape their structures into those of academe

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