CONSTRUCTION INDUSTRY COUNCIL
建造業議會

Report of CIC Manpower Forecasting Model 2014 (Site Supervisory Personnel, Technicians & Professional)

October 2014

Disclaimer

Whilst reasonable efforts have been made to ensure the accuracy of the information contained in this document, the data adopted may be subject to change and readers should not rely on this document for taking any actions. Prior approval and advice seeking from CIC are requested for using or applying any figures in this report.

Preamble

- The study was carefully conducted but inevitably based on a web of assumptions and incomplete basic data, such as insufficient data of RMAA works and primary data of private projects.
- Therefore, the figures of the report are only ballpark figures and provide an indication of general trends of manpower situation. Further development of the forecast model is necessary to enhance its accuracy.
- The figures must not be taken at face value and must be considered with all assumptions taken, the inherent limitations and the need for enhancements.
- The projections in this report are based on the Construction Expenditure Forecast data from the Focus Group on Projected Construction Expenditure (Focus Group) of CIC latest update in 2014.

Content

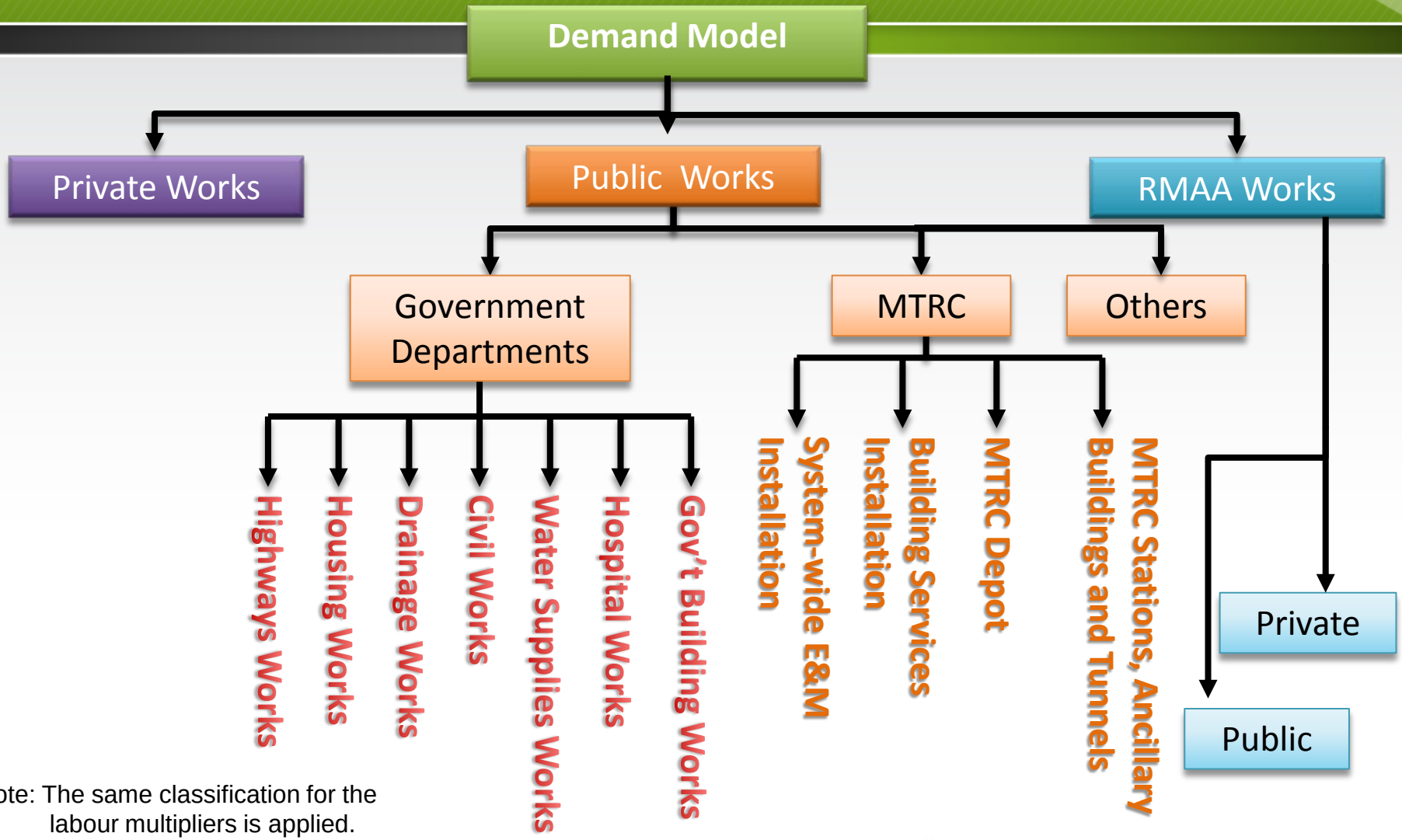
Aims for this Report

- Site Supervisory Personnel (SSP), Technicians & Professional
  - Develop manpower models for different types of personnel in the construction industry
  - Obtain an overview on the manpower situation of each type of personnel
  - Identify the types of personnel of which the manpower situation should be paid attention to
  - Make recommendations on the model enhancement in future

Objectives

- The Construction Industry Council Manpower Forecasting (CICMF) Model introduces Site Supervisory Personnel (SSP), Technicians and Professional for the 1st time in the CICMF model, based on the Construction Expenditure Forecast (latest update in 2014 by Focus Group).

The Construction Output Covered by Focus Group in Demand Model



Note: The same classification for the labour multipliers is applied.

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Site Supervision Personnel and Technicians

Classification of Site Supervisory Personnel (SSP)

1. **Construction Manager**
2. **Engineer***
3. **Technical Officer**
4. **Supervisor**
5. **Clerk of work**
6. **Inspector**
7. **Agent**
8. **Foreman**
9. **Coordinator**
10. **Safety Officer**
11. **Assistant Safety Officer/ Safety Supervisor**

Note: Some SSP (e.g. Construction Manager and Engineer) are also Professionals. The demand and supply for the SSP are part of those in construction professionals in later sections.

Remarks: Unless otherwise specified, definitions and scope of SSP mainly based on consultancy study of AIM Group Ltd in 2012

** Except E&M Engineer*

Definition of SSP

- Construction Manager
  - Plans, directs and assumes responsibilities for all aspects of construction on site in accordance with the agreed method, procedures, budget and specification; coordinates work of main contractor, sub-contractors, specialist contractors, and suppliers; liaises with architects, engineers, surveyors, specialist consultants, contractors, and government departments; reviews, inspects, evaluates, and reports on the quality, progress and cost of works and adjusts schedule as necessary.
  - *Remarks: construction managers, contracts managers, project managers and site managers are included in this category)*
  - *Note: Most of construction managers are professionals, including Architects, Civil Engineers, Structural Engineers, Building Services Engineers, Building Surveyors and Quantity Surveyors*

- Engineer*
  - Plans, designs and supervises the construction and maintenance of all engineering works on site required for the health, welfare, safety, employment and benefit of mankind, and for development of natural resources and environmental control. Investigates and reports on engineering problems on site, devises solutions and manages their implementation including development, manufacture, construction, installation, testing, operation, maintenance and repair.
  - Note: Engineers are part of those in the relevant professional disciplines covered in the section of Professional.

** Except E&M Engineer*

Definition of SSP

- Technical Officer
  - Supervises the work of the technician/ artisan in the daily construction, maintenance and testing work on site. Provides general assistance to professional staff in all technical aspects of civil engineering work on site. Carries out minor design work, prepares drawings, charts and schedules and maintains civil engineering records on site.

- Supervisor
  - Inspects building and civil engineering construction works (including maintenance works) to ensure conformity with contracts, drawings, specifications, workmanship standards and relevant legislation.

- Clerk of work
  - Acts as the representative of the client on site, inspects building construction works (including maintenance works) to ensure conformity with contracts, drawings, specifications, workmanship standards and relevant legislation.

- Inspector
  - Acts as the representative of the client on site, inspects civil engineering construction works (including all maintenance works) to ensure conformity with contracts, drawings, specifications, workmanship standards and relevant legislation.

Definition of SSP

- Agent
  - Plans, organizes, directs, and coordinates all activities and resources on the construction site through foremen in accordance with the agreed method, procedure, budget and specifications. Mainly hired by the contractor and is subordinate to the Manager.

- Foreman
  - Supervises, directs, and coordinates normally under the general control of the site agent, the activities of workers engaged in construction works and requisitions.

- Coordinator
  - Supervises labour and plant on site, liaises between clients, designers and subcontractors and manages interfaces between disciplines on site. Prepares programmes, monitors progress and resources, resolves problems, keeps records and provides reports on project progress.

Definition of SSP

- Safety Officer*
  - Assists the employer of a workplace or a construction site in promoting the safety and health of persons employed therein, including the inspection of workplace, plants, equipment or works processes to identify any risks and to advise on preventive measures; investigates accidents and dangerous occurrences and makes recommendations to prevent similar accidents

- Assistant safety officer/ safety supervisor*
  - Assists the employer and Safety Officer, where appropriate, in promoting safety and health of persons employed in a workplace or a construction site. Advises employee on safety standards, and supervises the observance of such standards for the promotion of safety at work.

* Definitions are made reference to the Manpower Survey Report Building and Civil Engineering Industry, Building and Civil Engineering Training Board, Vocational Training Council

Remarks: Unless otherwise specified, definitions and scope of SSP mainly based on consultancy study of AIM Group Ltd in 2012

Technicians

1. Draftsman
2. Quantity Surveying Technician
3. E&M Technician
4. Civil/Structural/Geotechnical Engineering Technician

Definition of Technicians

- Draftsman
  - Interprets the Architect's initial design concepts and sketches into a practical building solution, and translates this information into submission/contract drawings, taking due account of the constraints imposed by economic, environmental, technological and legislative requirements; coordinates information and works of other disciplines involved including statutory bodies; assists in the checking of shop drawings and prepares site sketches for projects at the construction stage; from sketch designs prepares general and detailed drawing under the supervision of architects, engineers, surveyors or contractors.

- Quantity Surveying Technician
  - Assists the quantity surveyor in preparing bills of quantities by performing taking-off, working-up and abstracting, and measuring and valuating completed works or variations.

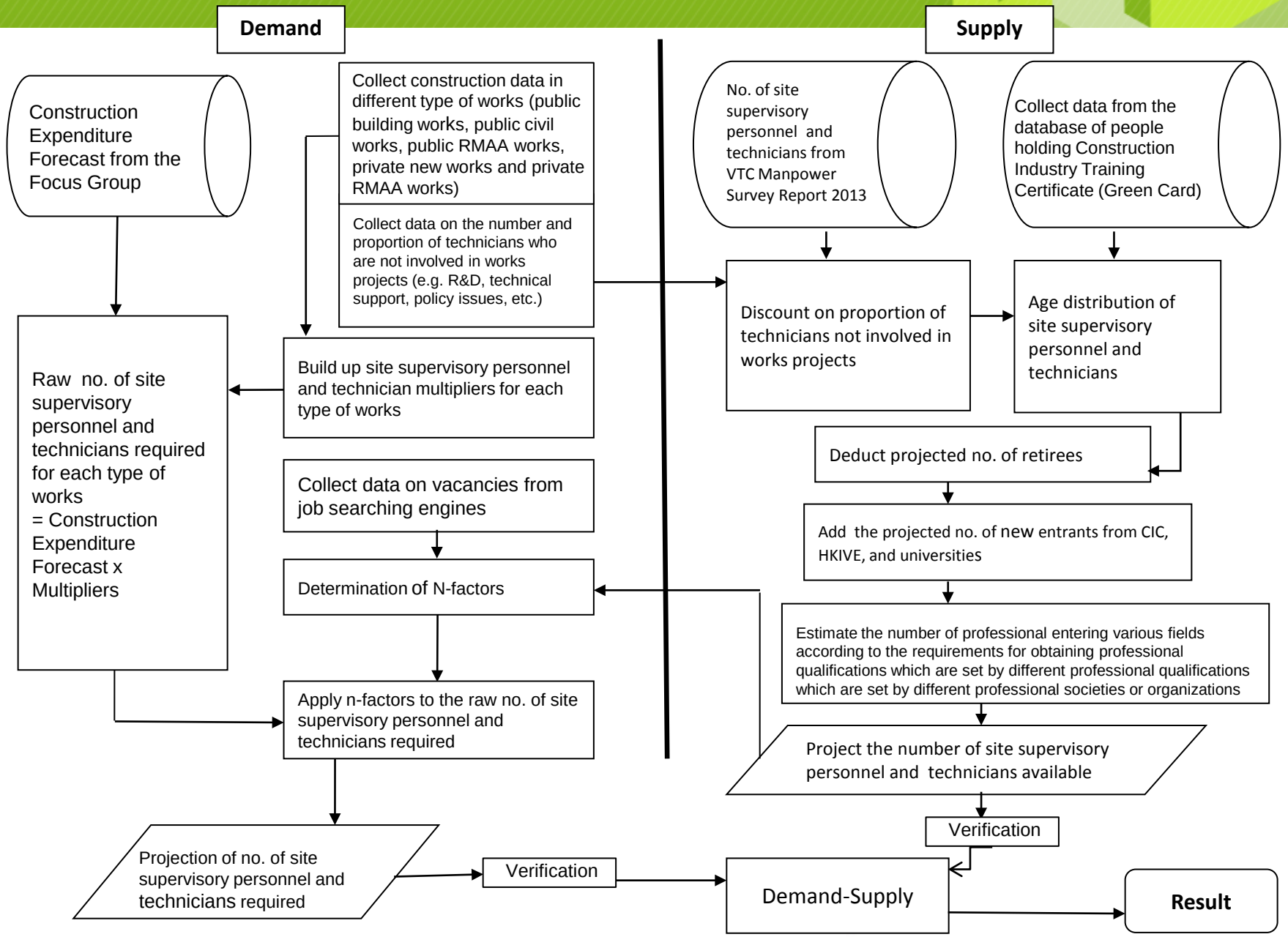
Definition of Technicians

- E&M Technician
  - Performs technical tasks, either independently or under the direction of a qualified engineer, contributory to design, installation, operation, maintenance and repair of electrical engineering, mechanical engineering or building services systems and equipment. Assists to plan, coordinate and supervise their projects.

- Civil/Structural/Geotechnical Engineering Technician
  - Carries out civil/structural/geotechnical engineering work under the supervision of a civil/structural/geotechnical engineer.

Remarks: Definitions are made reference to the Manpower Survey Report Building and Civil Engineering Industry, Building and Civil Engineering Training Board, Vocational Training Council (VTC Report)

CICMF Model for SSP and Technicians



Demand for SSP and Technicians

- A set of Multipliers were developed by the data obtained from government departments, MTRC and private companies
- Multipliers were collected by sectors involved: client, consultant and contractor
- Multipliers x Forecast Construction Expenditure from Focus Group (latest in 2014) = Manpower Requirement
- Mathematical method (N-Factors) of demand estimation by refining labour multipliers, may include but are not necessarily limited to the situations as follows:
    - An employee maybe double-counted in the process of data collection and calculation of labour multipliers as the same person (headcount) may appear in different o-charts of various projects
    - An employee may spend some of his/her time on non-Hong Kong projects
- The market structure of the combined effect of the above factors are unclear. Hence, a single coefficient with a calibration of the initial condition (forecast for the year 2014) is used to represent the combined effect

Assumptions on Multipliers (LMs) for SSP

Areas with limited construction data	Alternative construction data applying in calculating LMs
Improvement works on private residential buildings	Improvement works on private commerical building
Construction of hospitals	Consturction of public building new works
Certain types of maintenance work on public services facilities	Similar types of maintenance public services facilities

Assumptions on Multipliers (LMs) for Technicians

Areas with limited construction data	Alternative construction data applying in calculating LMs
Construction of private residential buildings (Design Stage and Feasibility Study Stage)	Consturction of commerical buildings (Design Stage and Feasibility Study Stage)
Improvement works on private residential Building	Maintenance works on Government Building
Improvement works on commerical building	Make reference to (1) Maintenance works on Government Building (2) MTRC maintenance works
Regular maintenance works in private sector	Regular maintenance works in public housing
Special types of railway works	Make reference to Civil, Drainage, Highway and Water Services works
Certain types of maintenance work on public services facilities	Similar types of maintenance public services facilities

Supply for SSP and Technicians

- Data on number of employees in the 2013 Manpower Survey Report - Building and Civil Engineering Industry, Vocational Training Council (VTC Report) is adopted as the base for the supply of the CICMF model
- A discussion group formed by members with profound experience in the industry was set up to provide comments on how to apply the VTC data in the supply for individual disciplines of CICMF model

Assumptions on SSP and Technicians - Supply

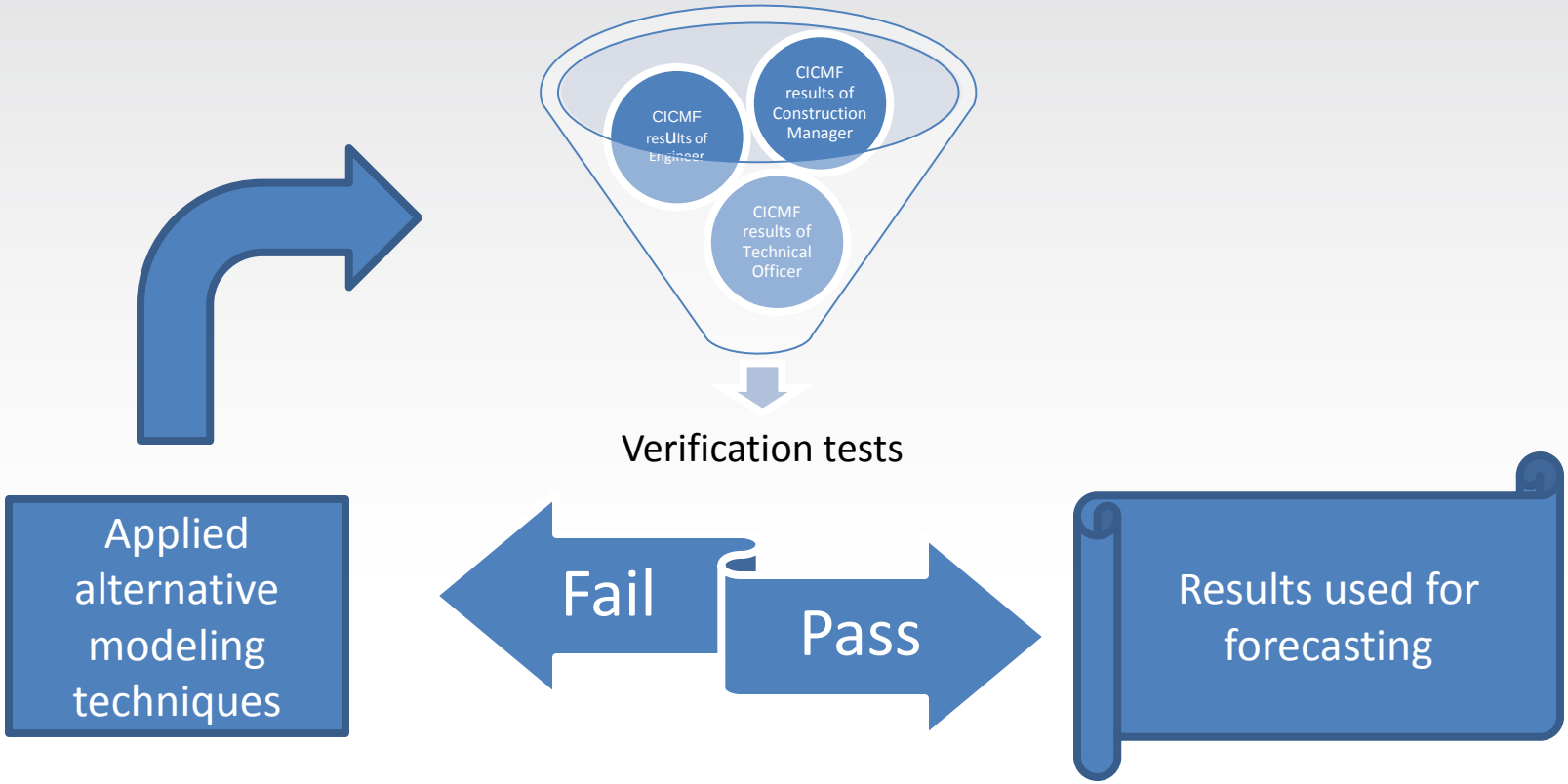
- Number of employed trainees recorded in the VTC report is also counted into the supply
- Some technicians are not involved in works projects (e.g. R&D, technical support, policy issues, etc) mainly for government departments, the percentages of employees not involved in works projects are deducted from Branch 9 of the VTC data. It is assumed that the number of this type of technicians remains constant in the study period
- Age profile of SSP and technicians is inferred and developed based on about 1,000 samples of the record of Construction Industry Training Certificates <Green Card>* registration records with job titles and age profile
- Full retirement is assumed at age 66 with yearly retirement from ages 61 to 65 for SSP and technicians with percentages taking reference to the record of green card
- *These SSP and technicians have studied and passed the test from Multi-media Self-learning package for the Mandatory Basic Safety Training Course (Construction Works) provided by CIC in order to obtain a green card.

Assumptions on SSP and Technicians - Supply

- For new entrants, the predictions are based on:
  - Training places of CIC (except for safety courses by graduation records)
  - Graduation records of VTC and universities
  - Wastage ratios are applied to obtain the number of graduates entering the construction industry
- For new entrant of engineers, assumptions on the % of them who will work as SSP (calculated based on the nature of branches in the VTC report) are applied to the new entrants in projected years
- Career progression has been considered based on findings from interviews with experts

Verification –
Demand of SSP & Technicians

Verification tests are applied



Models for verification on demand

- Data source used in models for projecting figures for 2014 to 2015
  - Total Construction Expenditure Forecast from 2003 to 2013
  - Manpower figures on number employed & number of vacancies from VTC Manpower Survey Reports (Building & Civil Engineering Industry) from 2005 to 2013
- Reason for using the verification models:
  - The data of Construction Expenditure Forecast and time series are available. Hence, two multi-attributes forecast techniques (including ANN and Multiple Regression) and one trend analysis (Grey Model) can be applied.

Verification Test on Demand Figures

1. Artificial Neural Network (ANN)
2. Multiple Linear Regression
3. Grey Forecasting Models

Verification on Demand Figures of CICMF Model - SSP

SSP	Within 15% variance from 2 to 3 types of the verification models	More than 15% from 2 to 3 types of the verification models
Construction Manager	✓	
Engineer	✓	
Technical Officer	✓	
Supervisor	✓	
Clerk of Work	✓	
Inspector	✓	
Agent	✓	
Foreman	✓	
Coordinator	✓	
Safety Officer		✓
Assistant Safety Officer/ Safety Supervisor		✓

Verification on Demand Figures of CICMF Model - Technicians

Technicians	Within 15% variance from 2 to 3 types of the verification models	More than 15% from 2 to 3 types of the verification models
Draftsman	✓	
Quantity Surveying Technician	✓	
E&M Technician		✓
Civil / Structural / Geotechnical Engineering Technician	✓	

Implication on the verifications on the demand figures of the CICMF Model

- Demand of most of SSP (9 out of 11) and Technicians (3 out of 4) are within 15% variance from two to three types of verification models which are considered acceptable
- Demand of the following SSP/ Technicians vary more than 15% from two types of models or above:
  - Safety Officer
  - Assistant Safety Officer/ Safety Supervisor
  - E&M Technicians

Raw Demand on SSP (in number)

Trade Classification	2014	2015	2016	2017	2018
Construction Manager					
Engineer					
Technical Officer					
Supervisor					
Clerk of Works					
Inspector					
Agent					
Foreman					
Coodinator					
Safety Officer*	TBA	TBA	TBA	TBA	TBA
Assistant Safety Officer/Safety Supervisor*	TBA	TBA	TBA	TBA	TBA

>1,000 to ≦2,000	>2,000 to ≦3,000	>3,000 to ≦4,000	>4,000 to ≦5,000	>5,000

* Due to fail of verification tests for CICMF result, alternative models are to be studied and adopted for failed demand forecast.

Raw Demand on Technicians (in number)

Trade Classification	2014	2015	2016	2017	2018
Draftsman					
Surveying Technician (Quantity)					
E&M Engineering Technician**	N/A	N/A	N/A	N/A	N/A
Civil/Structural/ Geotechnical Engineering Technician					

>1,000 to ≦2,000	>2,000 to ≦3,000	>3,000 to ≦4,000	>4,000 to ≦5,000	>5,000

** Failed of verification tests for CICMF result. No alternative models can be found for substitution for demand forecast.

Adjustment on Raw Demand

- Considering the existing increase in average workload of construction personnel compared to that in 2011 based on the average no. of projects handled and the average no. of working hours per week
- 6% adjustment is applied on the raw demand as assumption

Demand on SSP (in number)

Trade Classification	2014	2015	2016	2017	2018
Construction Manager					
Engineer					
Technical Officer					
Supervisor					
Clerk of Works					
Inspector					
Agent					
Foreman					
Coordinator					
Safety Officer	TBA	TBA	TBA	TBA	TBA
Assistant Safety Officer/Safety Supervisor	TBA	TBA	TBA	TBA	TBA

>1,000 to ≦2,000	>2,000 to ≦3,000	>3,000 to ≦4,000	>4,000 to ≦5,000	>5,000

Attention: The CIC encourages readers to seek appropriate independent advice from their professional advisers where possible and readers should not treat or rely on this publication as a substitute for such professional advice for taking any relevant actions.

Demand on SSP (in number)

Trade Classification	2014	2015	2016	2017	2018
Draftsman					
Surveying Technician (Quantity)					
E&M Engineering Technician	N/A	N/A	N/A	N/A	N/A
Civil/Structural/ Geotechnical Engineering Technician					

>1,000 to ≦2,000	>2,000 to ≦3,000	>3,000 to ≦4,000	>4,000 to ≦5,000	>5,000

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Verification –
Supply of SSP & Technicians

Models for verification on Supply

- Data source
  - Manpower figures on number employed from VTC Manpower Survey Reports (Building & Civil Engineering Industry) from 2005 to 2013
- Trend analysis are used which includes natural logarithm equation, grey model and linear regression
- Reasons for adopting the 3 models:
  - Only time series data is available, thus trend prediction models are applied.

Verification Test on Supply Figures

1. Natural Logarithm Equation
2. Linear Regression Model
3. Grey Forecasting Models

Verification on Supply Figures of CICMF Model - SSP

SSP	Within 15% variance from 2 to 3 types of the verification models	More than 15% from 2 to 3 types of the verification models
Construction Manager	✓	
Engineer	✓	
Technical Officer	✓	
Supervisor	✓	
Clerk of Work	✓	
Inspector	✓	
Agent	✓	
Foreman	✓	
Coordinator	✓	
Safety Officer		✓
Assistant Safety Officer/ Safety Supervisor		✓

Verification on Supply Figures of CICMF Model - Technicians

Technicians	Within 15% variance from 2 to 3 types of the verification models	More than 15% from 2 to 3 types of the verification models
Draftsman	✓	
Quantity Surveying Technician	✓	
E&M Technician		✓
Civil/ Structural/ Geotechnical Engineering Technician	✓	

Implication on the verification on the supply figures of the CICMF Model

- Supply of most of SSP (9 out of 11) and Technicians (3 out of 4) are within 15% variance from two to three types of the verification models which are considered acceptable
- Supply of the following SSP/ Technicians vary more than 15% from two types of verification models or above:
  - Safety Officer
  - Assistant Safety Officer/ Safety Supervisor
  - E&M Technicians

Trend of Manpower Situation of SSP (in number) (Demand – Supply)

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Trade Classification	2014	2015	2016	2017	2018
Construction Manager					
Engineer					
Technical Officer					
Supervisor					
Clerk of Works					
Inspector					
Agent					
Foreman					
Coordinator					
Safety Officer	TBA	TBA	TBA	TBA	TBA
Assistant Safety Officer/Safety Supervisor	TBA	TBA	TBA	TBA	TBA

≦50	>50 to ≦150	>150 to ≦250	>250 to ≦350	>350

Range refers to figures rounded to the nearest ten.

Trend of Manpower Situation of SSP (in percentage) (Demand – Supply)/ Supply

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Trade Classification	2014	2015	2016	2017	2018
Construction Manager					
Engineer					
Technical Officer					
Supervisor					
Clerk of Works					
Inspector					
Agent					
Foreman					
Coordinator					
Safety Officer	TBA	TBA	TBA	TBA	TBA
Assistant Safety Officer/Safety Supervisor	TBA	TBA	TBA	TBA	TBA

≦5%	>5% to ≦10%	>10% to ≦15%	>15% to ≦20%	>20%

Range refers to figures rounded to the nearest percent.

Trend of Manpower Situation of Technicians (in number) (Demand – Supply)

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Trade Classification	2014	2015	2016	2017	2018
Draftsman					
Surveying Technician (Quantity)					
E&M Engineering Technician	N/A	N/A	N/A	N/A	N/A
Civil/Structural/ Geotechnical Engineering Technician					

≦50	>50 to ≦150	>150 to ≦250	>250 to ≦350	>350

Range refers to figures rounded to the nearest ten.

Trend of Manpower Situation of Technicians (in percentage) (Demand – Supply)/ Supply

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Trade Classification	2014	2015	2016	2017	2018
Draftsman					
Surveying Technician (Quantity)					
E&M Engineering Technician	N/A	N/A	N/A	N/A	N/A
Civil/Structural/ Geotechnical Engineering Technician					

≦5%	>5% to ≦10%	>10% to ≦15%	>15% to ≦20%	>20%

Range refers to figures rounded to the nearest percent.

Insight from the Trend of Manpower Situation

- Supervisor, Inspector, Foreman, Coordinator and Draftsman show relatively critical in manpower situation (shortage >250) throughout all or most of the period of 2014 to 2018 considering the difference between Demand and Supply
- By considering the % shortage against supply, Technical Officer, Agent and Civil/ Structural/ Geotechnical Engineering Technician show relatively critical manpower situation (>15% to $\leqq$ 20%) in the period of 2016 to 2017

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Professional

Classification of Professional

1. Architect
2. Landscape Architect
3. Civil Engineer
4. Structural Engineer
5. Geotechnical Engineer
6. Environmental Engineer
7. Building Engineer
8. Building Services Engineer
9. Electrical Engineer
10. Mechanical Engineer
11. Building Surveyor
12. Land Surveyor
13. Quantity Surveyor
14. Town Planner

Remarks: With reference to the general definition from VTC Report, a professional is a person who applies his/ her professional skills to a wide range of technical activities and is able to use his/ her knowledge and experience to initiate practical developments. S/he should normally have received education and training equivalent to that required for a corporate membership of a professional institution.

Definition of Professional

- Architect
  - Plans, designs and supervises the erection of all types of building in compliance with building ordinance, regulations and requirements of public utilities. He is responsible for all stages and facets of a building project including advice on the brief, feasibility and sketch-planning, estimates, specifications, contract drawings and documents, tender action, contract supervision, and financial control. He also co-ordinates the work of allied disciplines engaged in building projects.

- Landscape Architect
  - Identifies and advises on construction projects requiring landscaping and other major landscaping projects; designs landscaping; organizes and supervises landscaping work; and liaises with relevant authorities and other professionals.

Remarks: Unless otherwise specified, definitions are made reference to VTC Report

Definition of Professional

- Civil Engineer
  - Plans, designs, constructs and supervises the construction of all civil engineering works required for the health, welfare, safety, employment and pleasure of mankind, and for development of natural resources and environmental control. Usually specializes in one or more of the following: (1) structural engineering (2) geotechnical engineering (3) hydraulic engineering (4) highway engineering (5) material engineering (6) traffic and transportation engineering (7) railway engineering (8) maritime engineering (9) airport engineering (10) other civil engineering fields

- Structural Engineer
  - Engages in one or more of the following activities (This job title does not refer to a civil engineer engaged in structural engineering work):
    (1) investigates structural engineering problems,
    (2) designs and advises on structures of industrial, commercial, public and residential buildings,
    (3) plans and supervises their erection, maintenance and repair

Remarks: Unless otherwise specified, definitions are made reference to VTC Report

Definition of Professional

- Geotechnical Engineer
  - Plans, designs and supervises the construction and maintenance of slopes and geotechnical aspects of site formation, tunnel and foundation works, and the development of natural resources for the construction industry. *(Remarks: Engineering Geologist is included in this category)*

- Environmental Engineer
  - Conceives, designs, appraises, directs, manages and supervises the construction of engineering works for the protection and promotion of public health and for the improvement of human's environments; investigates, improves and rectifies engineering works and other projects that are capable of injuring public health by being faulty in conception, design, direction or management.

Remarks: Unless otherwise specified, definitions are made reference to the VTC Report

Definition of Professional

- Building Engineer
  - Designs, constructs, appraises and/or maintains buildings whose work includes technical, financial and management processes by which buildings are designed, constructed, maintained and renewed.
  - *Please also refer to the definition of Builder/Construction Manager: Directs and assumes responsibilities for all aspects of building engineering works in accordance with the agreed method, procedures, budget and specification; co-ordinates work of main contractor, sub-contractors, specialist contractors and suppliers; liaises with architects, engineers, surveyors, specialist consultants, contractors, and government departments; reviews, inspects, evaluates and reports on the quality, progress and cost of works and adjusts schedule as necessary.

- Building Services Engineer*
  - Designs and advises on building services facilities in buildings. Plans, supervises and coordinates their installation, testing, maintenance and repair. *(Remarks: Fire Engineer is included in this category)*

*Taken comments from practitioners in the construction industry, it is difficult to have a clear cut on the duties of Building Services, Electrical and Mechanical Engineers in actual work situation. The 3 types of Professionals are grouped into 1 category for calculation in the Model.

Remarks: Unless otherwise specified, definitions are made reference to the VTC Report

Definition of Professional

- Electrical Engineer*
  - Researches into electrical engineering problems; designs and advises on electrical systems and equipment; and plans and supervises their development, construction, manufacture, installation, operation, maintenance and repair.

- Mechanical Engineer*
  - Researches into mechanical engineering problems; designs and advises on mechanical plant and equipment; plans and supervises their development, manufacture, construction, installation, operation, maintenance and repair. *(Remarks: Lift/ Escalator Engineer is included in this category)*

- Building Surveyor
  - Deals with the planning, administration and co-ordination of all types of works (including maintenance) to buildings and land with particular cognizance of requirements, by relevant public health, planning and building regulations.

*Taken comments from practitioners in the construction industry, it is difficult to have a clear cut on the duties of Building Services, Electrical and Mechanical Engineers in actual work situation. The 3 types of Professionals are grouped into 1 category for calculation in the Model.

Remarks: Unless otherwise specified, definitions are made reference to the VTC Report

Definition of Professional

- Land Surveyor
  - Undertakes the physical measurement of land and collates data for the preparation of plans and maps including cadastral surveying for land registration, topographical surveying, geodetic surveying and hydrographic surveying.

- Quantity Surveyor
  - Deals with the following aspects of building and civil engineering design and construction administration:
    (1) design cost and cost planning,
    (2) pre-contract documentation including bills of quantities and/or contract specifications,
    (3) tendering procedures, contractual agreements and advice on selection of tenders,
    (4) post-contract services including measurement of work, preparation of interim and final payment certificates and settlement of other contractual claims.

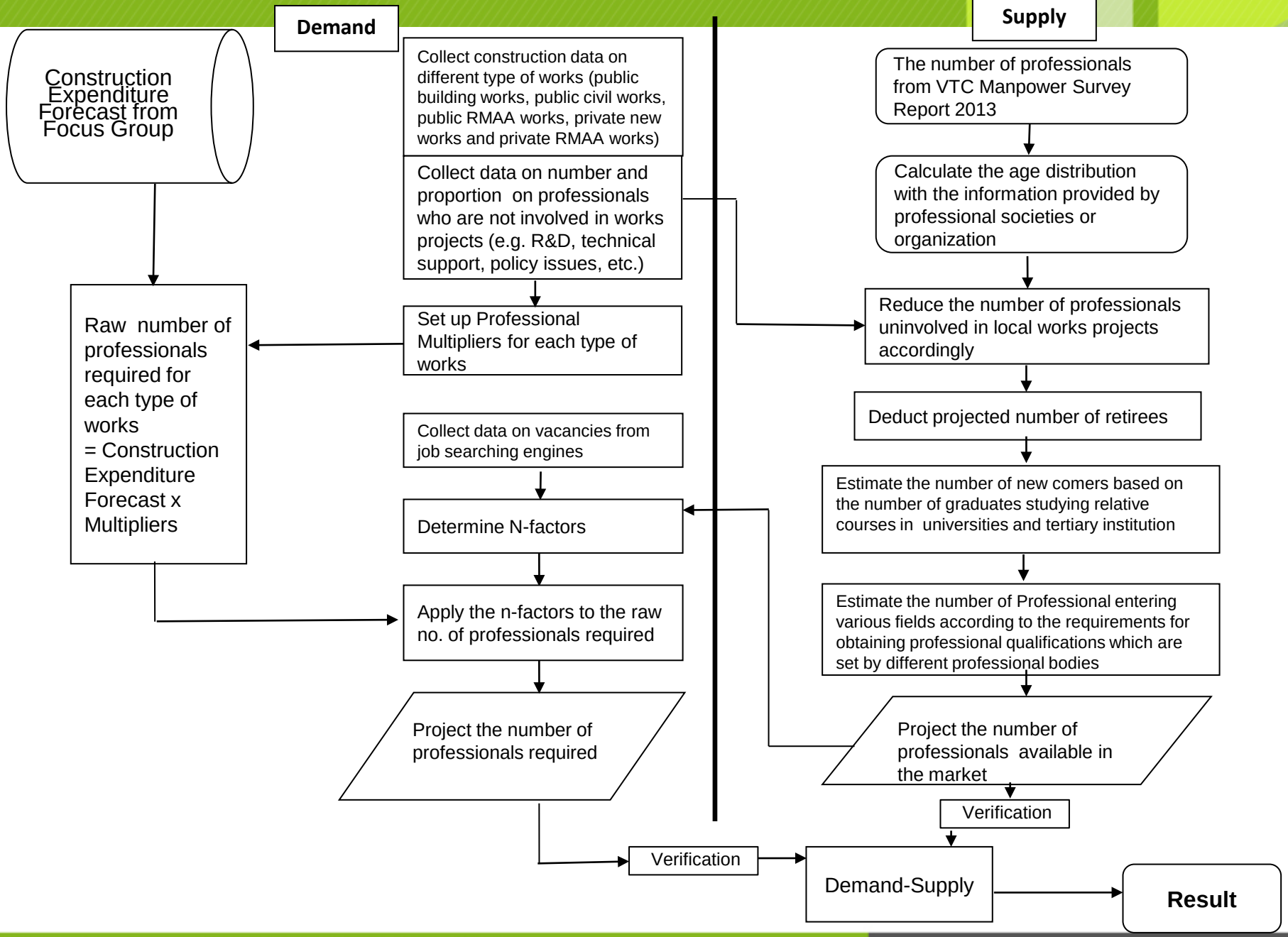
Remarks: Unless otherwise specified, definitions are made reference to the VTC Report

Definition of Professional

- Town Planner
  - Prepares and implements town plans at various levels, in the form of maps and planning reports; and undertakes planning studies, for the provision of a satisfactory physical environment in the urban and rural areas with a view to promoting the health, safety, convenience and general welfare of the community.

Remarks: Unless otherwise specified, definitions are made reference to the Manpower Survey Report Building and Civil Engineering Industry, Building and Civil Engineering Training Board, Vocational Training Council

CICMF Model for Professional



Assumptions on Professional - Demand

1. Mathematical method of demand estimation from the labour multiplier approach is same as for SSP and Technicians
2. The time for project inception and feasibility/ design stages are considered by averaging the offset time by different project types
3. The market patterns on each professional do not have much change in projected years
4. Similar approach of N-factors used in SSP & Technicians is applied on adjusting the demand of professionals
5. The N-factors have reflected the practice of outsourcing Hong Kong projects to non-local professionals
6. Findings from the joint surveys with professional bodies (to be presented in the following slides) on number of projects handled and percentage of time spent on Hong Kong projects were considered to calibrate the N-factors
7. The market structure of the combined effect of the factors in point 6 are unclear. N-factors are used to represent the combined effect

Assumptions on Multipliers (LMs) for Professional

Areas with limited construction data	Alternative construction data applied in calculating LMs
Construction of private residential buildings (Design Stage and Feasibility Study Stage)	Consturction of commerical buildings (Design Stage and Feasibility Study Stage)
Improvement works on private residential Building	Maintenance works on Government Building
Improvement works on commerical building	Make reference to (1) Maintenance works on Government Building (2) MTRC maintenance works
Regular maintenance works in private sector	Regular maintenance works in public housing
Special types of railway works	Make reference to Civil, Drainage, Highway and Water Services works
Certain types of maintenance work on public services facilities	Similar types of maintenance public services facilities
Construction of private residential buildings (Design Stage and Feasibility Study Stage)	Consturction of commerical buildings (Design Stage and Feasibility Study Stage)

Joint Survey with the Hong Kong Institution of Engineers (HKIE)

1. Survey conducted in 2nd quarter of 2014
2. Questionnaires sent to members under the disciplines of Building, Building Services, Civil, Electrical, Environmental, Geotechnical, Mechanical and Structural Engineering
3. A total of 201 completed questionnaires received
4. The result of Building, Geotechnical, Mechanical and Structural disciplines may not be representative enough as the sample size is small
5. The result of Environmental discipline is not shown due to a very small sample size
6. Only respondents who claimed to be working in the construction or construction-related industry and claimed to either mainly work on site or normally be stationed in office are included in the analysis

Implications from the Joint Survey with HKIE

- E&M engineers on average take up more projects than other disciplines
- On average Building Services Engineer and Mechanical Engineer spend more time on non-local projects

Adjustment on Raw Demand

- Considering the existing increase in average workload of construction personnel compared to that in 2011 based on the average no. of projects handled and the average no. of working hours per week
- 6% adjustment is applied on the raw demand as assumption

Verification –
Demand of Professional

Verification of Demand of Professional

- Similar reasons as SSP & Technicians for using the 3 Models:
  1. ANN
  2. Multiple Linear Regression
  3. Grey Forecasting Models

Verification on Demand Figures of CICMF Model - Professional

Professional	Within 15% variance from 2 to 3 types of the verification models	More than 15% from 2 to 3 types of the verification models
Architect	✓	
Landscape Architect	✓	
Civil Engineer	✓	
Structural Engineer	✓	
Geotechnical Engineer	✓	
Environmental Engineer	✓	
Building Engineer	✓	
E&M & Building Services Engineer		✓
Building Surveyor	✓	
Land Surveyor	✓	
Quantity Surveyor	✓	
Town Planner	✓	

Implication on the verification on the demand figures of the CICMF Model

- Demand of Professional (11 out of 12) are within 15% variance from two to three types of verification models which are considered acceptable
- Demand of Professional vary more than 15% from 2 types of models or above:
  - E&M and Building Services Engineer*

*Taken comments from practitioners in the construction industry, it is difficult to have a clear cut on the duties of Building Services, Electrical and Mechanical Engineers in actual work situation. The 3 types of Professionals are grouped into 1 category for calculation in the Model.

Insight from the Age Profile of Professional provided by Professional Bodies

- Among the professionals with age profile available from the relevant professional bodies, more than 40% of the existing members are over 50 years old for Civil Engineers, Structural Engineers, Geotechnical Engineers, Environmental Engineers, Building Engineers, Building Services Engineers, Electrical Engineers, Mechanical Engineers and Land Surveyors
- Building Engineers shows the highest percentage of members over 50 years old (68%)
- Aging problem is a concern in Construction Professionals

Assumptions on Professional - Supply

1. Data on number of employees in the VTC report is adopted for the supply of the CICMF model. This relies heavily on the feedback from respondents. Membership of professional bodies has been taken as a reference only. Besides, similar to the method and assumptions for technicians, these professionals not being involved in works projects are removed from the supply
2. 95% of the employees of Builder/Construction Manager in the VTC report are professionals based on the consultancy study on Development Strategy for Professional Resources of Hong Kong's Construction Related Engineering Services Sector conducted by the University of Hong Kong in 2011
3. Age profile of professionals are based on the information obtained from relevant professional bodies
4. For the age profile of Town Planner and Landscape Architect, as no information is available, it is assumed that their age profiles are the same as Architect

Assumptions on Professional - Supply

5. Full retirement is assumed at age 66 with yearly retirement rates at ages from 61 to 65 (assumed with reference to the existing age profile)
6. To predict the number of new entrants, local universities were invited to provide graduation records and employment information of graduates for construction related programmes
7. For some programmes which may produce professionals of more than one disciplines, the distribution of graduates entering the relevant disciplines is assumed according to the distribution of members by relevant professional bodies
8. The route and years to become professionals were also studied

Assumptions on Professional - Supply

9. Based on the collected data on the proportion of local to overseas graduates employed for entry level position of relevant professions in recent two years obtained from private companies and government departments, the number of new entrants graduating from overseas is predicted
10. It is assumed that the number of overseas graduates employed yearly in point 9 will not change in the projected years
11. Career progression from SSP/Technicians to relevant Professionals has been considered

Assumptions on Professional - Supply

12. The supply of Civil Engineer, Structural Engineer, Geotechnical Engineer, Building Engineer, Building Services Engineer, Electrical Engineer and Mechanical Engineer are discounted based on the survey findings on the proportion of time they spent on HK projects

Verification –
Supply of Professional

Verification on Supply Figures of CICMF Model - Professional

Professional	Within 15% variance from 2 to 3 types of the verification models	More than 15% from 2 to 3 types of the verification models
Architect	✓	
Landscape Architect	✓	
Civil Engineer	✓	
Structural Engineer	✓	
Geotechnical Engineer	✓	
Environmental Engineer	✓	
Building Engineer	✓	
E&M & Building Services Engineer	✓	
Building Surveyor	✓	
Land Surveyor	✓	
Quantity Surveyor	✓	
Town Planner	✓	

No. of Employees from the 2013 Manpower Survey Report Building and Civil Engineering Industry, Vocational Training Council

Job Title	No. of Employees (incl. Branch 1-9)
Architect	2,859
Landscape Architect	444
Civil Engineer	4,414
Structural Engineer	2,416
Geotechnical Engineer (incl. Engineering Geologist)	1,139
Environmental Engineer	493
Builder/Construction Manager	1,512
Building Services Engineer	1,040
Electrical Engineer	386
Mechanical Engineer	312
Building/Maintenance Surveyor	693
Land Surveyor	958
Quantity Surveyor	2,069
Town Planner	441

No. of Employees from the 2013 Manpower Survey Report Electrical and Mechanical Services Industry, Vocational Training Council

Job Titles	No. of Employees under the Electrical & Mechanical Engineering Sector (incl. Branch 1-4)
Building Services Engineer	9,32
Electrical Engineer	2,455
Refrigeration/ Air-conditioning/ Ventilation Engineer	1,190
Mechanical Engineer	664
Fire Services Engineer	477
Lift/Escalator Engineer	324

Remarks: The above figures are for reference only and they have not been considered into the calculation in the CICMF Model due to the unclear proportion of employees working in the construction industry.

Trend of Manpower Situation of Professionals (in percentage) (Demand – Supply)/ Supply

Attention: The CIC encourages readers to seek appropriate independent advice from their professional advisers where possible and readers should not treat or rely on this publication as a substitute for such professional advice for taking any relevant actions.

Trade Classification	2014	2015	2016	2017	2018
Architect					
Landscape Architect					
Civil Engineer					
Structural Engineer					
Geotechnical Engineer					
Environmental Engineer					
Building Engineer					
E&M and Building Services Engineer**	N/A	N/A	N/A	N/A	N/A
Building Surveyor					
Land Surveyor					
Quantity Surveyor					
Town Planner					

** Failed of verification tests for CICMF result. No alternative models can be found for substitution for demand or supply forecast.

Remarks: Data on number of employees in the VTC report is adopted for the supply of the CICMF model. This relies heavily on the feedback from respondents. Membership of professional bodies has been taken as a reference only

≦5%	>5% to ≦10%	>10% to ≦15%	>15% to ≦20%	>20%

Range refers to figures rounded to the nearest percent.

Trend of Manpower Situation of Professionals (in number) (Demand – Supply)

Attention: The CIC encourages readers to seek appropriate independent advice from their professional advisers where possible and readers should not treat or rely on this publication as a substitute for such professional advice for taking any relevant actions.

Trade Classification	2014	2015	2016	2017	2018
Architect					
Landscape Architect					
Civil Engineer					
Structural Engineer					
Geotechnical Engineer					
Environmental Engineer					
Building Engineer					
E&M and Building Services Engineer**	N/A	N/A	N/A	N/A	N/A
Building Surveyor					
Land Surveyor					
Quantity Surveyor					
Town Planner					

** Failed of verification tests for CICMF result. No alternative models can be found for substitution for demand or supply forecast.

Remarks: Data on number of employees in the VTC report is adopted for the supply of the CICMF model. This relies heavily on the feedback from respondents. Membership of professional bodies has been taken as a reference only

Number of Enrolments (Full-time Locally-accredited Self-financing Post-secondary Programmes)

Area of study: **Architecture, Construction & Town Planning**

	Total	No. change compared to the previous year	% change
2013/14	421	78	+19%
2012/13	343	86	+25%
2011/12	257	96	+37%
2010/11	161	-	

Source: http://www.cspe.edu.hk/content/Stat-Student-Enrolments

Number of Enrolments (Full-time Locally-accredited Self-financing Post-secondary Programmes)

Area of study: **Engineering & Technology**

	Total	No. change compared to the previous year	% change
2013/14	2325	521	+22%
2012/13	1804	586	+32%
2011/12	1218	96	+8%
2010/11	1122	-	

Source: http://www.cspe.edu.hk/content/Stat-Student-Enrolments

Concluding Remarks

- The CICMF study shows that the professionals, site supervision personnel and technicians are generally facing the challenge of additional manpower requirements

- SSP and Technicians
  - Foreman, Supervisor, Coordinator, Inspector, Clerk of Works and Draftsman require additional workforce when considering numbers.
  - Agent, Technical Officer and Civil/ Structural/ Geotechnical Engineering Technician require additional workforce when considering percentages.

Concluding Remarks – Con't

- Professional
  - If considering the difference between Demand and Supply, Civil Engineer, Structural Engineer and Quantity Surveyor show critical manpower situation throughout all or most of the period from 2014-2018.
  - By considering shortage %, Landscape Architect and Quantity Surveyor appear to have a high level of shortage in for all or most of the period from 2014-2018.
  - Aging is a concern among most of the professionals
- The raise in the number of self-financing places in construction-related studies in recent years may provide an indirect source of supply to fill the gap between supply and demand of the construction personnel.

Ways Forward

- Field research may help understand the market intelligence relevant to the types of SSP, Technicians and professional in which the projected figures required further exploration.
- Alternative modeling may be explored to tackle the problematic areas.
- More effort and resources should be put to investigate and understand the market structure of E&M technicians, Safety Officers, Assistant Safety Officers/ Safety Supervisors, E&M and Building Services Engineers and Building Surveyors.

Future Enhancement

- Constantly update the age profile (if available) and relevant information from the professional bodies
- To facilitate the data providers to provide more construction data related to the private works
- The number of working hours performed by construction personnel should be monitored periodically and considered as a factor in the Model
- The average maximum number of projects managed by different types of construction personnel in a fixed period of time should be collected from surveys with professional bodies and considered as a factor in the Model

Future Enhancement – Con't

- The effect of manpower outsourcing in the construction industry should be further studied
- The vacancies of the relevant construction personnel in the market should be closely monitored
- The allocation of data from the VTC Report into different types of construction personnel in the Model should be constantly reviewed

Enquiries

Enquiry on this report maybe made to the CIC Secretariat at:

Construction Industry Council Headquarters
15/F, Allied Kajima Building
138 Gloucester Road, Wanchai
Hong Kong

Tel. no.: (852) 2100 9000
Fax no.: (852) 2100 9090
E-mail: enquiry@hkcic.org
Website: www.hkcic.org

Thank you