CHINESE INSTITUTE OF ENGINEERS 中國工程師學會

Practical Example for a Consolidated Localization To Technique for Rolling Stock Manufacturing, Using Monorail Solution As An Example

(列車製造技術本土化一以單軌系統列車為例)

5th October 2018

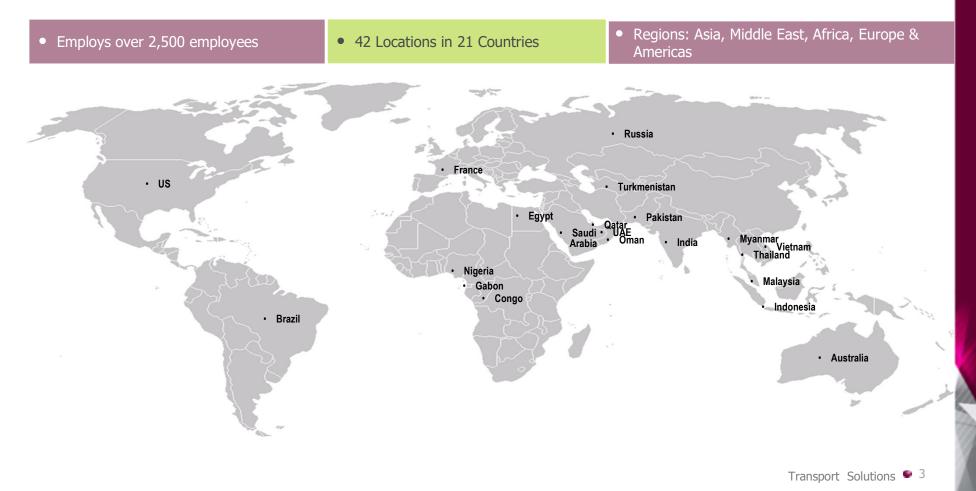


Presentation Highlights

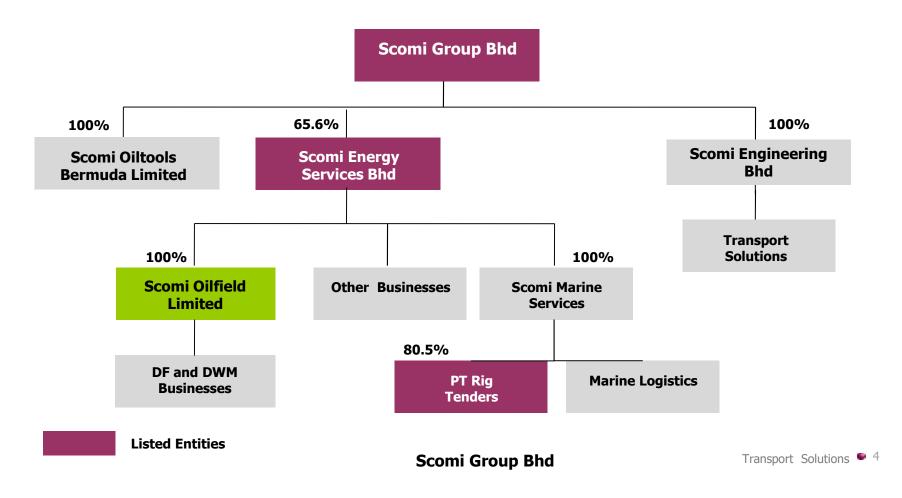
- 1. Scomi Introduction (簡介SCOMI)
- 2. Monorail Product and Engineering Capability (單軌設備及工程能力)
- 3. Monorail Rolling stock Manufacturing Capability (單軌系統列車之 製造能力)
- 4. Project Experience (交付實績)
- 5. Manufacturing Experience (生產實績)
- 6. Design Experience on Guideway Beam (導引梁之設計實績)
- 7. Conclusion (總結)



• Scomi Global Presence (SCOMI 全球佈處)



• Legal Structure (SCOMI 集團組織架構)



• Achievements (單軌系統相關成功案例)

Monorail Tenders

	Wir
2014	Sco

2008

	Winner	Project	Country
	Scomi	Sao Paulo Line 18 (巴西聖保羅市 捷運18號線)	Brazil
	Scomi	Manaus (巴西瑪瑙斯市 捷運)	Brazil
	Scomi	Sao Paulo Line 17 (巴西聖保羅市 捷運17號線)	Brazil
	Scomi	KL Monorail Fleet Expansion (馬來西亞 單軌系統 列車擴增)	Malaysia
	Hitachi	Daegu (韓國大邱單軌系統)	South Korea
	Bombardier	Sao Paulo Line 2 (巴西聖保羅市 捷運2號線)	Brazil
)	Hitachi/CSR	Chongqing (中國大陸 重慶市 單軌系統)	China
_	Scomi	Mumbai Monorail (印度 孟買市 單軌捷運系統)	India







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• Scomi Monorail Evolution (SCOMI 單軌系統之世代)









System (系統名稱)	KL Monorail (Gen 1)	Mumbai Monorail (Mumbai Gen 2)	KL Expansion (Gen 2.1)	Sao Paulo & Manaus (Brazil Gen 2.1)
First Train (該世代 2002 第一列服務列車)		2010	2013	2014
Rolling Stock (車 厢規範)	2-car train 3200 PPHPD	4-car train 7000 PPHPD	4-car train 6400 PPHPD	5 & 6-car train 36000 PPHPD
	107 pax/car Max 55 km/hr	140 pax/car Max 80 km/hr	122 pax/car Max 55 km/hr	150 pax/car (6 pax/sqm) Max 80 km/hr
	Steel+Composite 10 tonnes per axle bogie 100kW Air-cooled Drum & Electric Single split-type HVAC 1.2m Single-leaf PNE Fluorescent light Fire extinguisher	Aluminium+Composite 13 tonnes per axle bogie 170 kW Water-cooled Disc & Electric Single combined-type 1.5m Dual leaf electric door Fluorescent light Fire extinguisher	Aluminium+Composite 14 tonnes per axle bogie 170 kW Water-cooled Disc & Electric Dual combined-type 1.5m Dual leaf electric door LED saloon light Fire extinguisher	Aluminium+Composite 14 tonnes per axle bogie 240 kW Water-cooled Disc & Electric Dual combined-type 1.5m Dual leaf electric door LED saloon light Water-mist system
E&M System(核心 機電系統)	Driver system 4-min headway Fix-block system ATP 750VDC system Analog radio comm	Driver system 3.5-min headway Fix-block system ATP 750VDC system Digital radio comm	Driver system 4-min headway Fix-block system ATP (ETCS L2) 750VDC system Digital radio comm	Driverless system 1.5-min headway Moving-block system Inductive loop 750VDC system Digital radio comm

Product Position Rail | Scomi's Gen 2 monorail (SCOMI 二代單軌系統)





Transport Solutions

- Modern
- High Quality
- Good Value
- High Powered Drivetrain
- Superior Interior Aesthetic
- Rugged and Tropicalized
- Proven
- Innovative
- Flexible configuration

• Engineering Capability | Rolling Stock Design (車輛設計)





Engineered in Malaysia to International Standards (依國際規範在馬國設計生產)

RAMS: EN 50126 HVAC: EN 14750 UTO: EN 62267

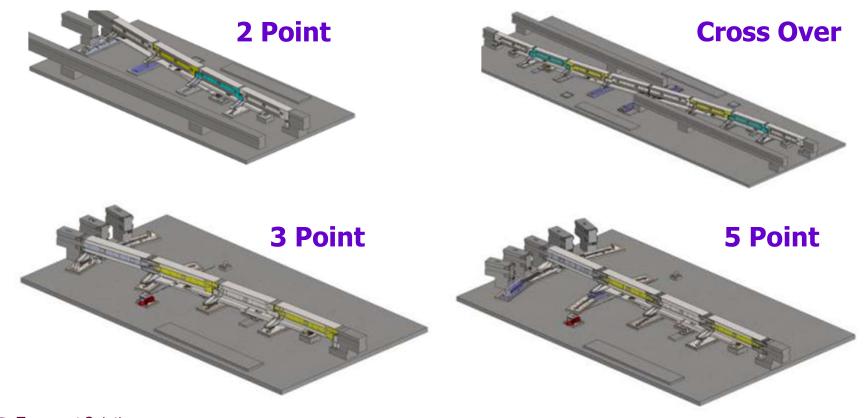
Fire: NFPA 130 or EN 45545 Doors: EN14752 Propulsion: EN 60077 & 60349

Carbody: EN 12663 Brakes: EN 13452 Electronics: EN 50155

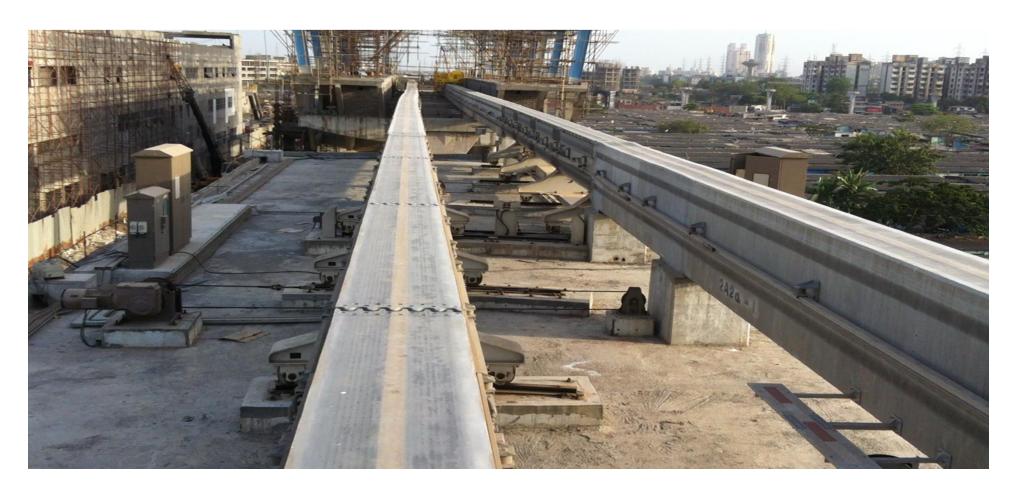
Bogie: EN 13749 Tyres: UNECE regulations Testing: EN 50215

Transport Solutions

Track Switch Variants (軌道 道岔之變化應用)







Crossover

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Scomi Manufacturing (SCOMI 全球生產據點) | Global Presence



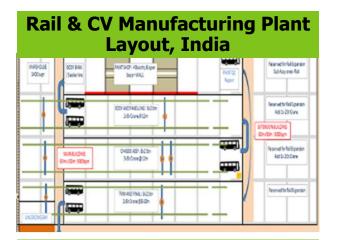
● Manufacturing Locations (生產據點)













Scomi

Manufacturing Offerings (生產製造之優勢)





■ Manufacturing Offerings | Manufacturing (Rail & CV) [生產之專業性]

Our manufacturing expertise covers a complete spectrum of production processes employed in the rail and commercial vehicles industries, from fabrication and welding to mechanical/electrical assembly activities including testing and commissioning. We incorporate best practices in all our manufacturing activities, through the cultivation of an intelligent and dedicated workforce, and through the provision and maintenance of a conducive and safe work environment.







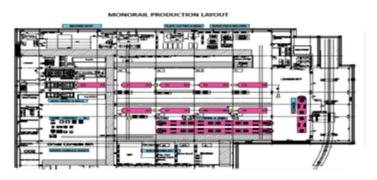




● Manufacturing Offerings | Global Manufacturing Support (生產全球支援)

With our global expansion initiatives, we have formed a team specializing in plant design and operational start-up. We can offer complete planning and execution services for manufacturing support activities or tailored requirements for the provision of technical advisory services for external and international manufacturing facilities. Our expertise covers plant design and layout, manufacturing process and routings, jig design, operation management, training and production

support.





● Manufacturing Offerings | Machining Services (裁切、鍛造技術)

Our Machining facility is equipped with precision CNC and NC milling, turning, plasma cutting, bending, sawing, grinding and deburring capabilities. It boasts a high precision Toshiba 5-Axis Double Column Machining Center capable of taking up to 20ton work pieces. Our machinists are competently trained in the operation and maintenance of the various machines by the OEM's to ensure the highest quality machining services.









Scomi

● Manufacturing Offerings | Warranty & Product Support (保固與長期備品供應)

We offer a dedicated team to manage the product delivery through to the Client or end user, inclusive of warranty obligations for the contractual defect liability period, and continuous <u>aftersales</u> support throughout the

product life.









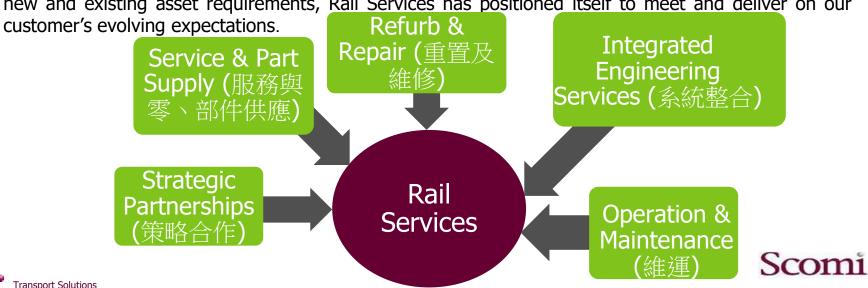


Scomi

■Manufacturing Offerings | Rail Engineering Services (RES)[全生命週期服務及供應]

As a complete strategic solutions provider for the rail industry, **RAIL ENGINEERING SERVICES** focuses on being the preferred rail services provider and partner, providing specialized technical and product support. Our main expertise includes providing comprehensive and customized solutions for our customers for all their services, spare parts and support requirements; for reliability and availability through to the integration of maintenance services. We provide full services for refurbishment, modernization, reengineering and overhaul of rolling stock and rail systems.

With the growing trend of operators and end users insisting on localized and customized solutions to new and existing asset requirements, Rail Services has positioned itself to meet and deliver on our



Manufacturing Capabilities (單軌系統生產基地)



North KL Facility (北吉隆坡設施)

Location: North KL, Malaysia

Land Area: 15 acres

Built-up Area:

Rail Building - 12,500 m² CV Building - 12,000 m²

Manufacturing Capacity (生產能力及能量):

- Purposed built facility for Monorail & Conventional Rail production
- Test track enters facility to form a covered 4 car train test area
- Flexible facility equipped for commercial vehicles production & refurbishment activities
- Capacity: 1 rail carbody per week per line
 - 250 coaches per year
 - 1,000 truck or bus chassis per year

Manufacturing Capabilities (自主生產、一站式服務)

A Comprehensive range of dedicated plant and machinery, paired with an experienced, competent and dedicated work force, tailored to the manufacture of rail and commercial vehicles.



Welding

- MIG & TIG Aluminum welding of grades 5000 & 6000 series in accordance to ISO/TR20173.20174 standards
- MIG Steel welding grades 50B in accordance to CEN ISO/TR15608.20172 standards
- Stainless steel welding grades 316 & 304 in accordance to EN ISO14343 standards



Machining

- A wide range of CNC machining capability including 3/4/5 axis milling and turning machines
- Aluminum, Stainless Steel and Carbon Steel processing, from cutting through to bending and forming



Fabrication, Finishing & Assembly

- An integrated range of capabilities including pre-production and full production of fabrications and sub assemblies in most materials including welded and bonded structures.
- In house material coating and finishing facilities to suit all material categories and coating requirements.



● Manufacturing Capabilities (一站式、一條龍服務)



Electrical & Mechanical Assembly

 With our teaming concept and flexible skill base we can efficiently integrate electrical, mechanical, pneumatic and control systems to suit all applications and integration requirements. Our assembly staff are continuously liaising with our component and system suppliers to ensure the latest advances in design and interface are installed and integrated in accordance with the suppliers requirements.



Testing & Commissioning

 Manned with a team of highly skilled T&C personnel experienced in managing rail standard FEA verification, mechanical, electrical & integration testing. Our capability also includes performing environmental testing such as EMC and Noise testing and verification. Our factory acceptance testing, on site commissioning, and system integration testing is performed in conjunction with the product designer and strictly to the product design and performance requirements.



Warranty and Product Support

• We have built up over the years a very experienced warranty and product support team. Our flexibility and ability to customize our services and support work positively towards our objective of supporting the end user and providing aftersales support throughout the product life.



● Certifications | Integrated Quality Management System (國際認可的品管履歷)



ISO 9001:2008 🗸



ISO 14001:2004 🗸



OHSAS 18001:2007 V





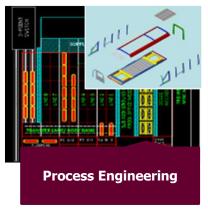








Manufacturing Process – Expertise (專業技術生產製程)

















● Manufacturing Process | Rail (軌道車輛製程介紹)



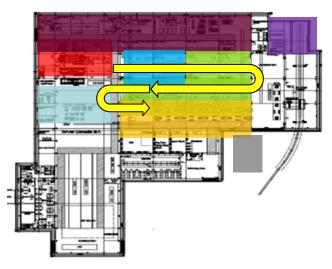
- Grinding
- WeldingCutting
- Inspection



- Sanding
- Primer
- Top coat



- Cutting
- BendingMilling
- Drilling
- Bogie Fabrication
- CuttingBending
- · Milling
- Drilling
- Bogie Assembly
 - Tire installation
 - Brake system





Endurance test Dynamic test on

track



- Drilling
- Installation
- Assembly
- Torque
- Sub assy



Water test

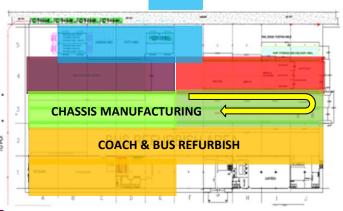


- Testing
 - Type test
 - Static test

Scomi

● Manufacturing Process | Commercial Vehicles (商用車輛製程介紹)







- Drilling
- Grinding
- Welding



Water test Inspection PDI



- Equipment assembly
- Engine installation
- Torque

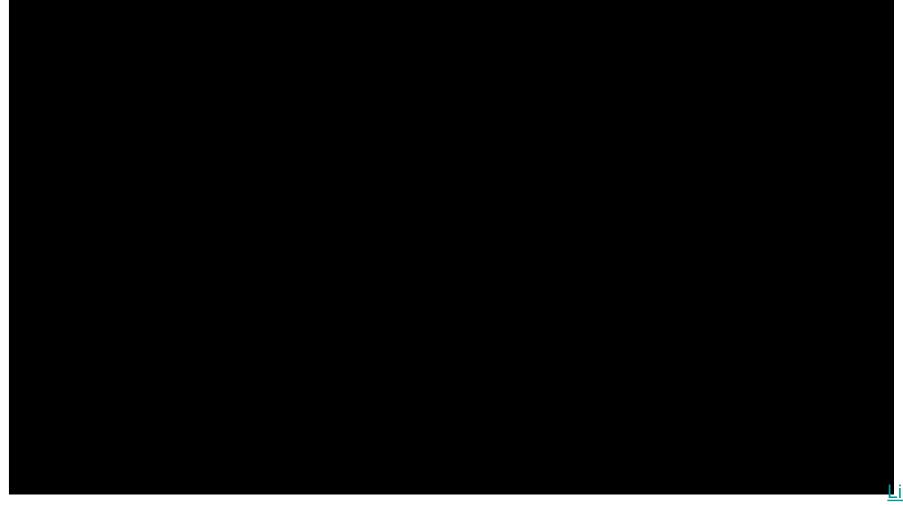


- Overhaul
- Fitting
- Trimming
- Inspection



Pre-Delivery

Inspection



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<u>Link</u>

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India Project Update (印度單軌系統)





FACTS

Phase 1 Commenced (營運日期): 2nd Feb 2014

Total Ridership (總載客量):50 million (end Apr 2018) Reliability(可靠度):99.63% Punctuality(準點率):99.58%

Phase 2 Anticipate completion: end 2018

India

Malaysia KL Monorail Project Update (吉隆坡單軌系統近況)











Delivered six 4-car train sets to Prasarana and currently five 4-car train sets are in daily operations. (交付六列 4-car列車給營運商並與現行五列 4-car列車一併混合營運)

The 4-car trains have been introduced to revenue service since 21 Dec 2014. It is the first of its kind Mixed Fleet Operations for monorail, globally. (新、舊列車—併混合營運也為全球單軌系統的成功首例)





Brazil Project Update - Line 17 & 18 (巴西單軌捷運系統17號、18號線近況)



Setting up a new manufacturing plant in Sao Paolo. Land provided by the Govt.

Requested by the Sao Paolo Metropolitan Company to step in to fast track the completion of Line 17 & Line 18

Line 17 : Additional scope of work

- Design and manufacture rolling stock (設計及製造車輛)
- Provide systems for signalling, operations control centre, track switches, power rail, power supply & distribution and fibre optics & cable trays (核心機電系統的提供)

Additional Value : RM504.6million(Original Contract Value : R\$84.1million)

Line 18: Anticipated Additional scope of work

• Design & manufacture of rolling stock(設計及製造車輛)

• 33

Anticipated Additional Value: R\$647million (Original Contract Value: R\$300million)



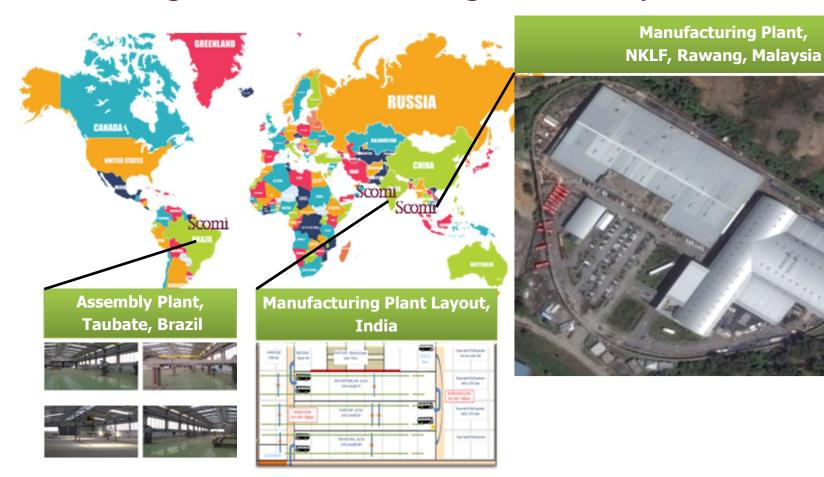


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• Rolling Stock Manufacturing Locations (列車生產基地)



Secondary Equipment Suppliers 採購本地製品 (25% of car components 達全列車零件25%)

Developed by Scomi over the past 15 years, the majority of our Secondary equipment Suppliers are local or regional, therefore logistics and product support is an advantage in completing the delivery of the Rolling Stock for challenging schedules. (採購當地製造產品作為交付列車內所使用之零件、在SCOMI各專案執行時,已有十五年經驗之久。採用當地生產之製品可絕對滿足緊湊之業主交付時程)

Supplier	Part	Location	Supplier	Part	Location	
CTRM	Interior	Malacca	LB Aluminium	Aluminium Extrusion	KL	
DK Composite	Cab Mask	Malacca	TSA	Aluminium Plate	KL	
Inverter	Lightings	gs Johor	Innoglass	Glass	Selangor	
Technology	3 - 3		Goldini	Fabricators	Selangor	
BDC Flooring	Flooring	KL	Total Metering	_	Electrical Supplier	KL
KVC	VMS Components	KL	Solution			
F&D Engineering	Handrail	KL	Techno Rubber	Rubber Extrusion	KL	
Linghau	VAF Sdn Bhd		VAF Sdn Bhd	Pneumatics fittings	KL	
Linatex	Castings	KL				
Top Mech	Jigs Supplier	KL	Poly Teck	Paint	KL	
Press Metal	Aluminium Extrusion	KL	Brighton	Bearings	KL	

• Brazil Assembly Model (巴西專案的生產、組裝模式)

- Land for the plant is given Free of Charge by Client (生產組裝工廠的土地由業主無償提供)
- Supply of Rolling Stock Design by Scomi (我司執行列車設計)
- Supply of Manufacturing Plan by Local Manufacturer (當地生產商執行生產計劃)
- Trainset No.1 manufactured by Scomi in Malaysia, trainset 2 onwards by Local Manufacturer (第一列車組由我司執行生產、第二列車組及其後車組由當地生產商執行)
- Local Manufacturer to provide manufacturing facility, including paint booth, cranes, bogie drop pit, test facilities etc (生產及測試設備由當地生產商提供)
- Certified welders and supervisors provided by Local Manufacturer (當地生產商執行焊接)
- Local Manufacturer to supply Track Maintenance Vehicle and Train Washing Machine (當地生產商也提供(生產)系統所需的保固車輛及洗車設備)

• Localisation of Spares & Consumables (備品、消耗品之本地化)

Supplier	Part	
SMK Engineering	Run Flat Lubricant	
Siemens	HVAC PLC Module	
ABB	HVAC Evaporator Motor	
MRF	Guide Wheel Tyres	
MRF	Load Wheel Tyres	
Adarsh Engineering	Guide Wheel Shaft	
Adarsh Engineering	Bolster Hinge Shaft	
	CV Joint Grease	
	Fire Extinguisher Glass	
	Right Angle Gear Box	
	LED in Driver Cab	
	Gangway Support Frame	
	Conical Spring Support Base	





 Product: Monorail Rolling Stock Component Categories (單軌系統列車零件類別)

Cat. 1 (一般傳統鐵路系統零部件)

Generic railway components same as conventional railway system

Cat. 2 (單軌列車所用之特別零部件)

Specific railway components customized/adapted for monorail vehicles

Cat. 3 (與我司聯合開發之單軌特殊零部件)

Monorail specific components that can be joint-developed with Scomi assistance

Cat. 4 (我司智財設計零部件)

Scomi's Proprietary Design components

Note: Cat. 1 to Cat. 3 can be localized with Licensing arrangement

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• Monorail Guideway Construction Major Risks (單軌系統導引梁之建造)

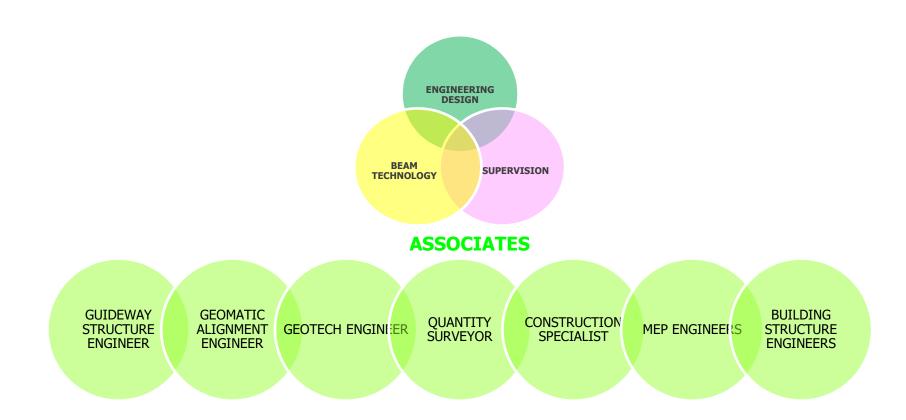








• Scope in the Application for Monorail Guideway Beam



• Scomi Civil Team International Experiences (我司土木工程團隊的國際實績)

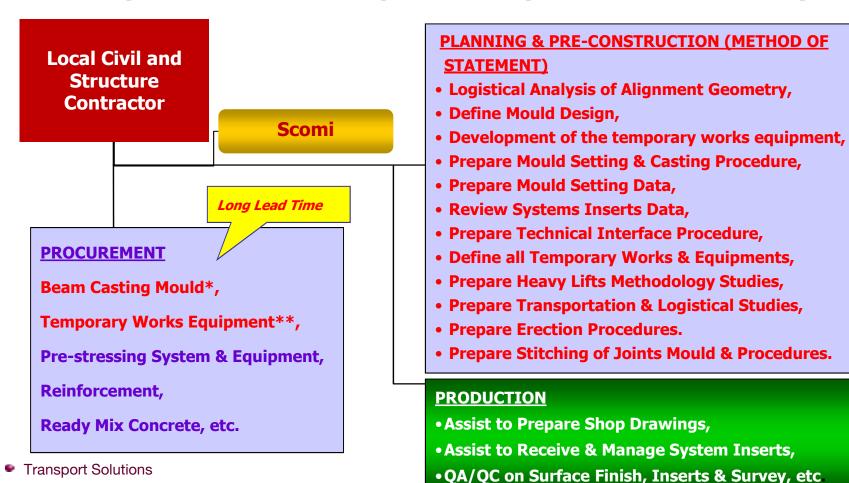
Winner	Project	Country	Civil Partners	Scomi civil involvement		
Scomi	Sao Paulo Line 18	Brazil	Primav/Cowan/ Encalso	Still in discussion		
Scomi	Sao Paulo Line 17	Brazil	CR Almeida & AG	Concept design		
Scomi	KL Monorail Expansion	Malaysia	Scomi	All design, GWB casting activity, stations extension work		
Scomi	Mumbai Monorail	India	L&T	GWB design, GWB supervision		
Marubeni	Palm Jumeirah, Dubai	UAE	Obayashi	Complete design, casting activity, GWB supervision		
Scomi	KL Monorail	Malaysia	Scomi	Complete design, casting activity, GWB supervision		



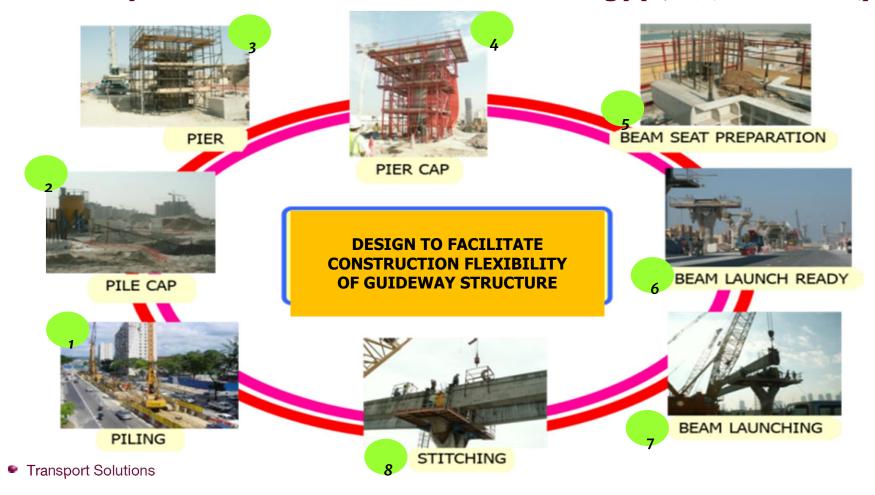




• Guideway Beam Consultancy Services (導引梁設計之顧問服務)



• Guideway Structure Construction Methodology(導引梁之建造方式)



• Guideway Technology (導引梁結構)



TYPICAL GUIDEWAY STRUCTURE

• Guideway Technology (導引梁行走面之處理原則)



WHAT ARE THE INTRICACIES OF STEPS TAKEN IN THE FABRICATION OF GUIDEWAY BEAM (GWB)?

- The GWB have to be form-finished perfectly:
 - complex-curved side-surfaces
 - Vertical & horizontal curves,
 - gradients,
 - transition curves and cant (super-elevation).
- The rider-comforts greatly depend upon the perfection of the beam surface curves.
- Beam surface finish smoothness for the rubber tyres

• Guideway Technology (導引梁製作技術)





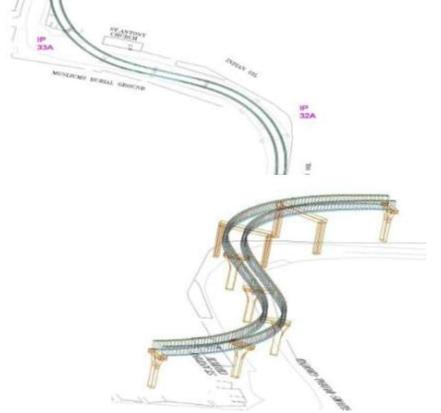
- Scomi have the know-how to convert the GWB of the designed alignment into data to be used for fabrication.
- The accurate and reliable procedures adopted in the beam fabrication works ensured that every beam is done to near perfection
- Monorail projects with tight timeline requires Beam Technology Solutions to avoid project delay.

 Design & Engineering (設計與工程): Alignment-To-Mould (扇形到塑形)

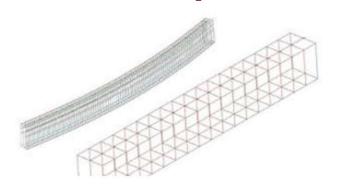


 The designed alignment is checked and optimized before beam fabrication works are executed



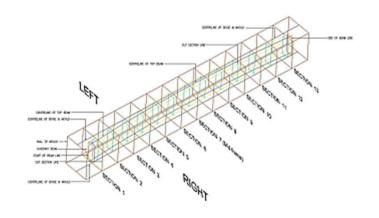


• Design & Engineering (設計與工程): Alignment-To-Mould (扇形到塑形)

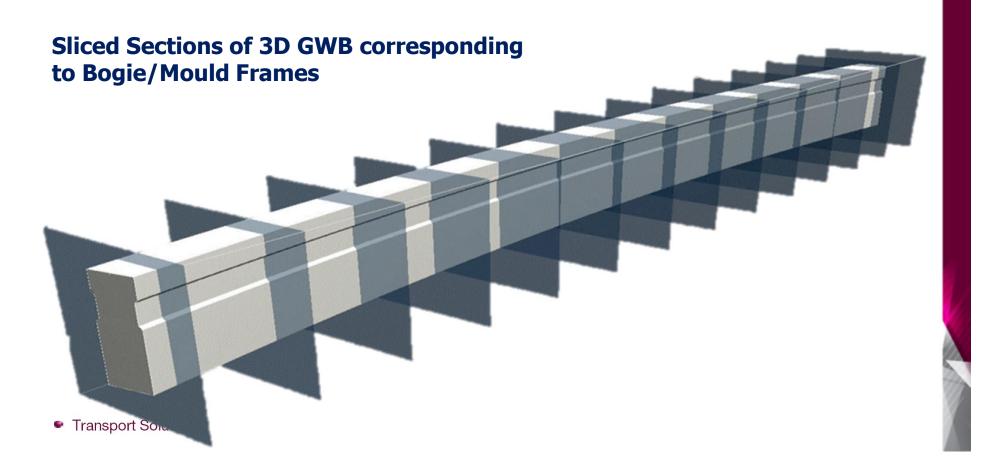


CONTINUE:

Isometric Projection of 3-D Beam derived from alignment parameters

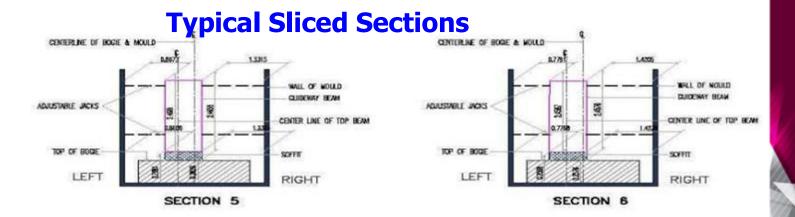


 3-D Beam rotated to Horizontal and Vertical to be 'sliced' at Bogie / Mould Frames Design & Engineering (設計與工程):
 Alignment-To-Mould (扇形到塑形)

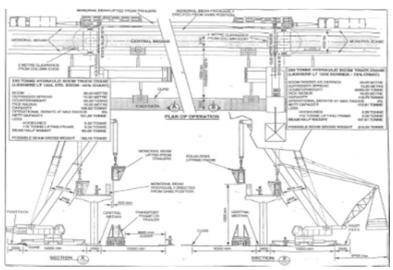


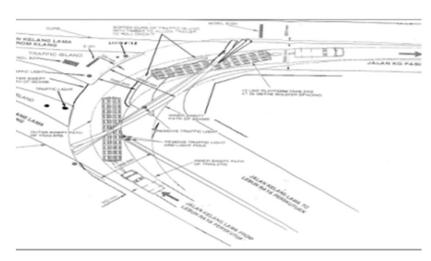
Design & Engineering (設計與工程): Alignment-To-Mould

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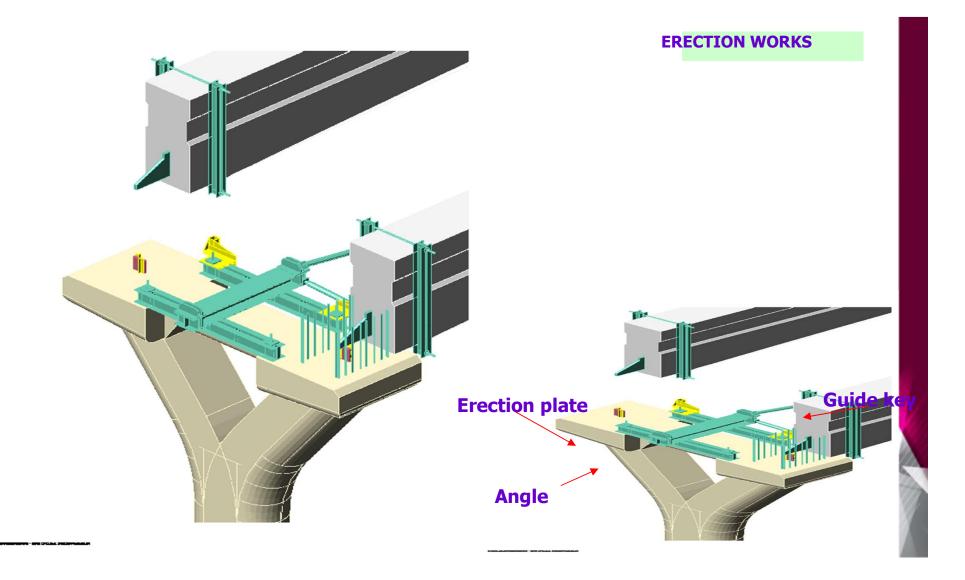
• Guideway Beam Transport (導引梁運送及吊掛)



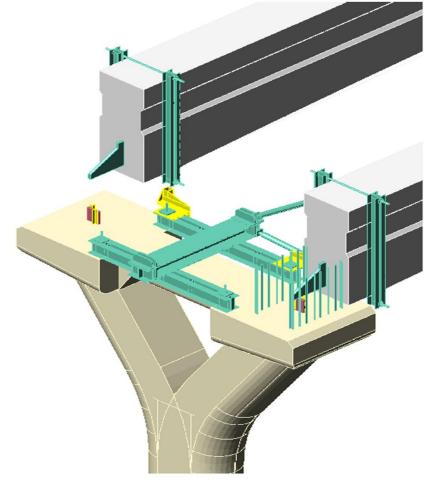


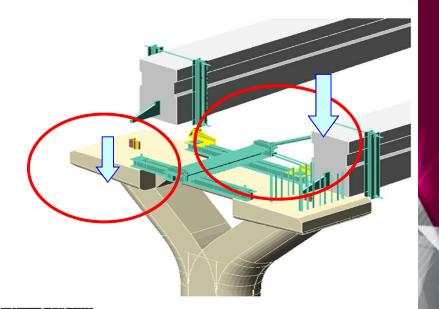




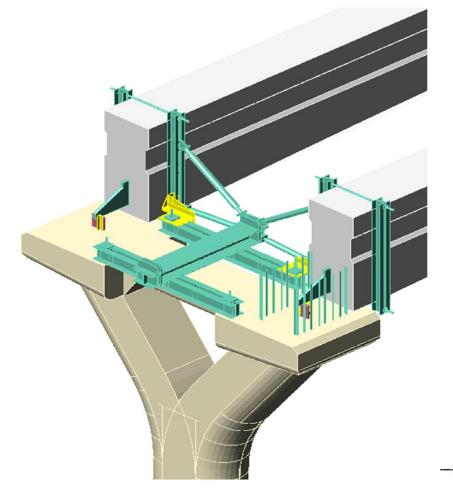


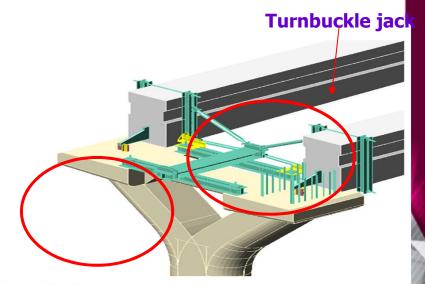
ERECTION WORKS





ERECTION WORKS





• Typical Line: Facts & Figures at a glance (導引梁預鑄實例)

Guideway beam casting cycle and number of moulds required for a 45km alignment (導引梁預鑄循環及所需模具數量-以45km扇形為例)

Facts	Figures		
Total no of span for entire alignment	924		
No of span of length = 29m	696 (>75%)		
No of span of length = 25m	141 (>15%)		
No of beams with 25m/29m span	1,674		
> Straight beams	1,490 (89%)		
> Curve beams	184 (11%)		
Based on 24 months guideway construction period, the maximum casting duration = 18 months			
No of straight moulds required assuming turn around time is 2 days	= 6.6 say 7		
No of curve moulds required assuming turn around time is 3 days	= 1.2 say 2		

Transport Solutions

Summary (小結)

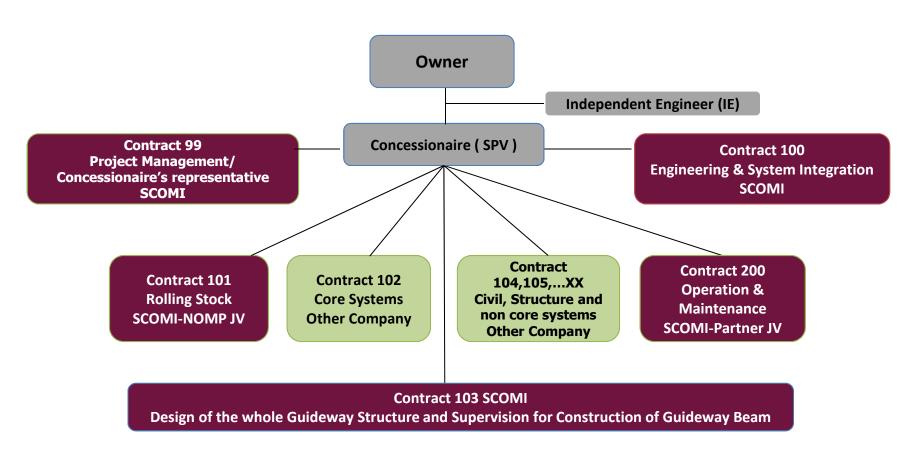
- ✓ Our beam width (800mm) with hallow beam technology is optimized for max span length
- ✓ Curve optimization technique
- ✓ Proven construction methodology and long experience lead to zero beam rejection and zero accident

Presentation Highlights

- 1. Scomi Introduction
- 2. Monorail Product and Engineering Capability
- 3. Monorail Rolling stock Manufacturing Capability
- 4. Project Experience
- 5. Manufacturing Experience
- 6. Design Experience on Guideway Beam
- 7. Conclusion (總結)



PROJECT STRUCTURE (其他可選擇性的專案架構)



PROJECT CONTRACT DEFINITION (相關專案的工作範籌)

LUMP SUM AMOUNT CONTRACT FOR DESIGN, CONSTRUCTION, MANUFACTURING, SUPPLY, TESTING AND COMMISSIONING OF THE MONORAIL SYSTEM FOR THE MONOAIL PROJECTS

CONTRACT 99	Project Management
CONTRACT 100	Preparation of DPR, SI/SA, Interface management, Integrated Testing and Commissioning
CONTRACT 101	Rolling stock, Special Jigs and Tool, Depot Equipment
CONTRACT 102	Signaling and Communication System, Traction and Power Supply System, Fare Collection System, Platform Auto Gates System
CONTRACT 103	Guideway Structure Design and Supervision of Guideway Beam Construction
CONTRACT 104-10X	Stations, Sub-Stations Including E&M works, Depot, OCC and DCC Including E&M works, Guideway Structure, Switch Decks
CONTRACT 200	Operation & Maintenance of The Monorail System for Each Year of Operation After Commissioning of The System

• Project Costing Structure (專案成本架構)

		Cost	Scomi	Local Company
CC104	Stations including MEP, sub-station and switch decks	14.0%	0.0%	100.0%
CC103	Guideway Structure + Walkway	25.0%	9.0%	91.0%
CC105	Depot Structure including MEP, OCC and Equipment	4.0%	0.0%	100.0%
CC101	Switches, Special Jigs and Tool	5.0%	30.0%	70.0%
CC102	Signaling	8.0%	0.0%	100.0%
CC102	Communication	4.0%	0.0%	100.0%
CC102	Automatic Fare Collection and Platform Screen Door	3.0%	0.0%	100.0%
CC102	Traction Power Supply System	7.0%	0.0%	100.0%
CC101	Rolling Stock + Spares + 2 years DLP	20.0%	40.0%	60.0%
CC100	System Integration	5.0%	100.0%	0.0%
CC99	Project Management	5.0%	50.0%	50.0%
	Total Cost	100.0%	19.3%	80.8%

- Advantages Of Localization (技術本土化的優勢)
- Cheaper Maintenance cost (減輕維護成本)
- Lower Production cost (降低生產成本)
- Quick response time (對所需求、反應速度快)
- Increase local employment (刺激本地就業之增加)
- Spur local Economy (提振本地經濟發展)
- Upskilling of local talent pool (提升本地技術人才)
- Import Tax Exemption (減免進口關稅)

Thank you

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