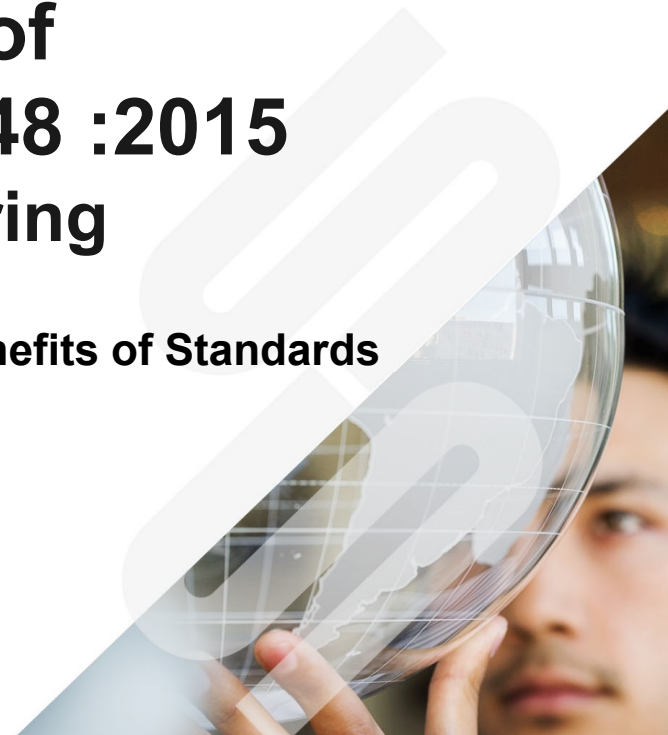


Singapore Bunkering Industry Case Study:

Economic Benefits of Technical Reference (TR) 48 :2015 Bunker mass flow metering

Based on the ISO Methodology for the Economic Benefits of Standards

30 Oct 2020



AGENDA

1. Introduction
2. ISO Methodology on Economic Benefits of Standards
3. Industry Boundaries
4. Assessment Framework
5. Evaluation
 - a) Bunker Suppliers
 - b) Ship Owners
 - c) Implementing Authority
 - d) Singapore Bunkering Ecosystem
6. Conclusions and Recommendation
7. Background
 - a) Advisory Committee
 - b) Working Committee



Singapore Standardisation Programme



- As the national standards body, Enterprise Singapore administers the Singapore Standardisation Programme through an industry-led Singapore Standards Council.
- SCIC-SDO is one of the appointed Standards Development Organisations for review and development of international and national standards.

Singapore Standards Council

Advises Enterprise Singapore on priorities, strategies, policies & procedures of the Singapore Standardisation Programme

Chemical Standards Committee

One of the 11 Standards Committees that oversee national and international standardisation within the industries

Technical Committee for Bunkering

Focus on standardisation areas within the scope of industries

Working Groups

Industry experts who contribute their expertise & experience to the development or review of specific standards

INTRODUCTION



(1) Introduction to the project

- An independent study was commissioned in 2019 by SCIC with NTU MESD and a senior ISO expert with the approval and support of Enterprise Singapore, the national standards body:
 - to validate the impacts of TR 48 based on the ISO methodology for the determination of benefits of standards.
- First bunkering industry case study on the impact of standards in Singapore
- The objective of this case study is to determine the quantitative and qualitative benefits of TR 48 in the delivery of Marine Fuel Oil :
 - ✓ To 3 key stakeholder groups
 - Bunker suppliers
 - Ship owners/operators
 - Implementing Authority and to use these outcomes
 - ✓ To assess and extrapolate to the Singapore bunkering ecosystem and its related maritime services and the port of Singapore:

Note: NTU MESD : Maritime Energy and Sustainable Development Centre of Excellence, Nanyang Technological University

INTRODUCTION



(2) Background on TR 48:

- TR 48 completed after extensive consultation during the development of the standard with various industry and government agency stakeholders which included:
 - ✓ trial initiated by the TC for Bunkering and WG for Mass Flow Metering members, that received key technical advice from both the TC and WG who provided the leadership for this trial
 - ✓ Maritime Port Authority (MPA) coordinated trials which also received inputs from the TC and WG
 - ✓ MFM verified and sealed by the Weights and Measures Office and
 - ✓ Trials' data analysed by National Metrology Centre to determine the performance of the MFM system.
- Innovations – Standards project started in Oct 2009 & achieved breakthroughs & crossed milestones, including developing new metrological and security frameworks, trial methodologies and protocols, selection and installation requirements, delivery procedures and dispute mechanisms.
- By 2015, the new standard, TR 48 on Bunker Mass Flow Metering, based on the principles of metrology and system integrity, was published.

INTRODUCTION



(3) Background on TR 48

- Led by the Technical Committee for Bunkering, the TR 48: 2015 for bunker mass flow metering was developed, which then became the first such standard in the world. It was implemented in 2017 by the Implementing Authority.
- Singapore Standard, SS 648 has been mandated since 1 May 2020. TR 48: 2015 will cease to be applied by the Implementing Authority (MPA) by 30 Nov 2020.
- There were no major changes for SS 648 so the benefits observed with TR 48 are not expected to be impacted when it replaces TR 48.

Note: TR 48: 2015 was upgraded to SS 648: 2019 with an expansion of the scope of the standard to include distillate fuels and bunkers that meet international Maritime Organisation (IMO) regulations. The updated content included the new requirements for multi-meter installation, the enhancement of zero verification procedure and better clarity on the role of bunker surveyors in MFM bunkering regime.

INTRODUCTION



(4) Key Differences between SS 600 and TR 48

- **Bunkering operation:** Covers the delivery of bunker fuel from the bunker vessel to the receiving vessel during custody transfer of MFO.
 - ✓ **SS 600:** Based on manual tank sounding for measurement of bunker quantity delivered and was based on static mass calculation.
 - ✓ **TR 48:** Dynamic mass measurement based on application of digital technology (MFM) for real time and continuous measurement of the bunker quantity delivered and peripheral requirements e.g. dimensional and legal metrology, system security, MFM installation and MFM system approval for operation.
- Prior to TR48, SS 600 code of practice for bunkering was mandated for all bunkering operations in Singapore by the Implementing Authority. In order to progress from SS 600, the implementation of an MFM without the TR 48 would not be possible as standards go to the heart of bunkering custody transfer, i.e. 'Plug and Play' cannot apply

INTRODUCTION

(5) Project Timeline & Progress (Working in concert with Advisory Committee)

[illegible]

INTRODUCTION

(6) Scope of Work

Task 1

- Literature review & IBIA basic bunkering course.
- Interviews of Advisory Committee.

Task2

- Develop an assessment framework based on ISO Methodology with value chain and operational indicators based on initial impacts for endorsement by Advisory Committee.
- Development of questionnaires.

Task 3

- Confirm value chains and operational indicators through introductory meetings.
- Finalise after obtaining endorsement by Advisory Committee and send questionnaires to stakeholders
- Arrange interviews and follow up on answers.

Task 4

- Analyse data obtained through questionnaires and interviews from 10 respondents.
- Evaluate the impacts of TR 48 for each stakeholder and for 3 stakeholder groups.
- Extrapolate the impacts of TR 48 to Singapore bunkering ecosystem.

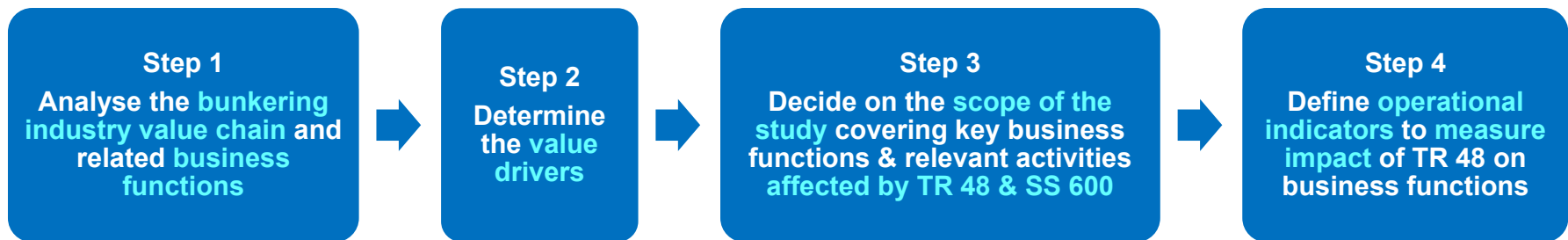
Task 5

- Complete the case study report.

ISO Methodology for Economic Benefits of Standards



(1) Key Steps based on ISO Methodology



(2) Data Collection through Questionnaires and Interviews

- Bunker suppliers: 3 respondents
- Ship owners: 6 respondents
- Implementing Authority
- Data requested in the questionnaire was over the period of 2014 to 2018 and beyond. (data from post-June 2019 was not considered).

Methodology



(3) ISO methodology for the Economic Benefits of Standards

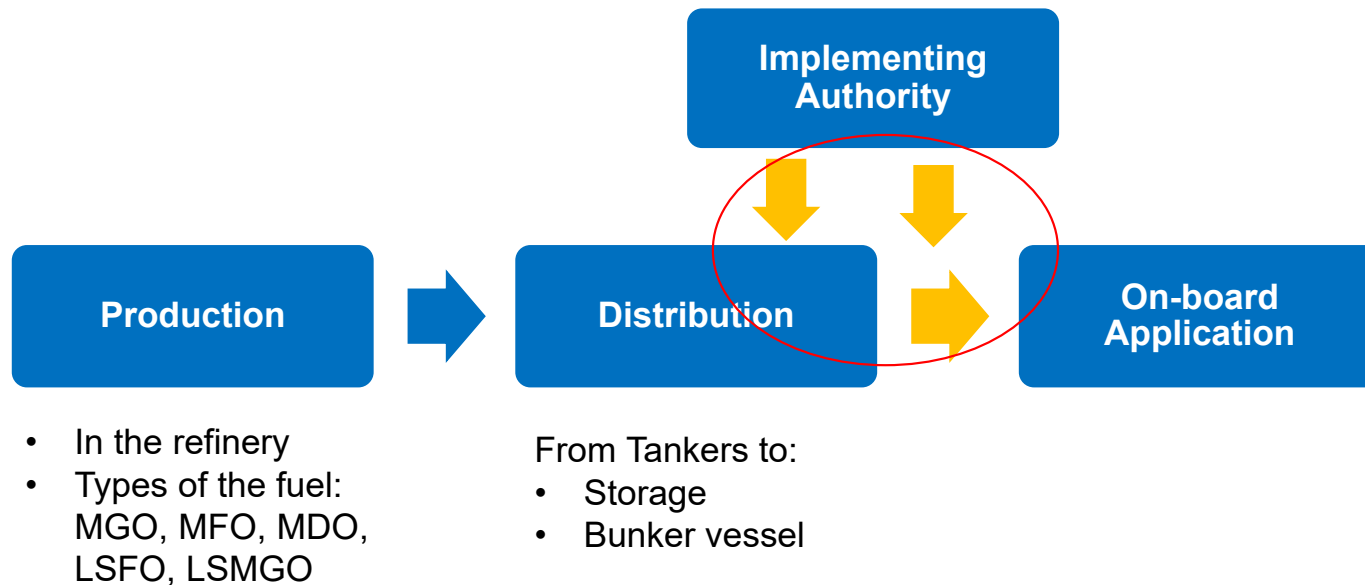
- This methodology aims to identify the impact of standards and to quantify these in financial terms & qualitative form. Revenues and costs caused by factors other than the standards are not considered. The methodology helps to focus on the impacts of standards without mixing them up with other types of impacts.

(4) Data Aggregation and Evaluation

- **Basic approach:** Comparison of impacts before and after TR 48 i.e. the impact of SS 600 relative to the impact of TR 48 for the delivery of MFO
- **Data analysis and evaluation:**
 - ✓ Analysis of data obtained through questionnaires and face-to-face interviews from the sample group of companies/organisation.
 - ✓ Evaluation of the impacts of the standard (TR 48) for the 3 stakeholder groups
 - ✓ Quantification of the cumulative impact of the standard on the sector by aggregating the data of individual company data for the different stakeholder groups and reasonably extrapolating the impacts on Singapore bunkering ecosystem.
 - For impacts that could not be quantified but identified as relevant, a qualitative assessment was given.

Industry Boundaries

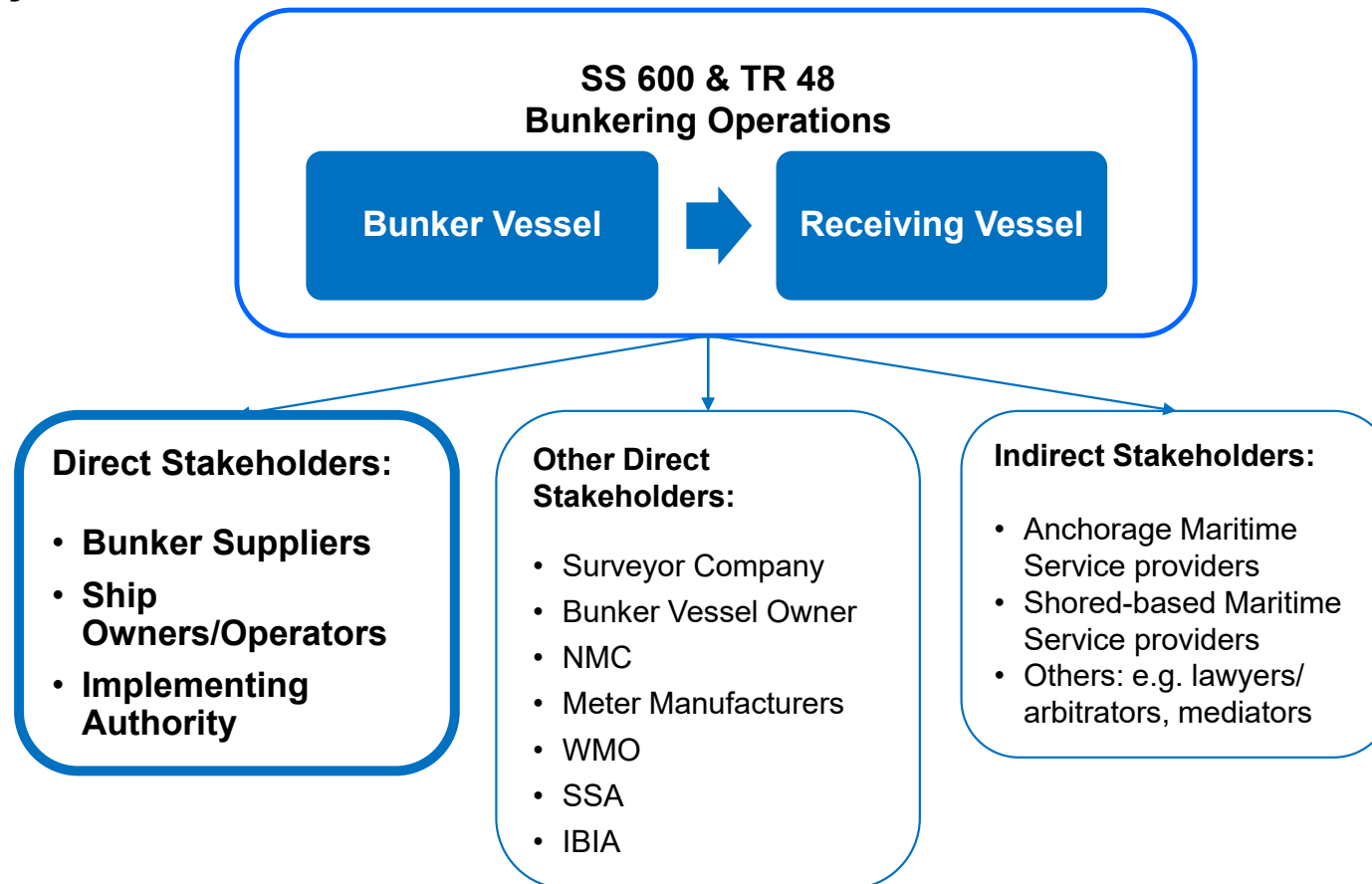
(1) Marine Fuel Supply Chain



Note: Only MFO bunker considered in case study

Industry Boundaries

(2) Industry Stakeholders



Industry Boundaries



(3) Direct Stakeholders and 10 Respondents

- **Bunker suppliers:**

- ✓ 3 respondents, covering local and international companies.

- **Ship owners:**

- ✓ 6 respondents, consisting of 2 dry bulk carrier ship owners, 2 crude oil / petroleum product tanker ship owners and 2 container ship owners. This also covered local and international companies.
- ✓ Container ships, dry bulk carriers and oil tankers constitute the type of vessels that lift approximately 90% of bunker sales volume in Singapore #.

- **Implementing Authority**

- ✓ 1 organisation

Note: # Source: Implementing Authority

Assessment Framework based on ISO Methodology (TR48 versus SS 600)



(1) Bunkering Industry Value Chain and Value Drivers

A. Support business functions			
A1. Regulatory supervision, monitoring, assurance & management			
A2. Research & Development (incl. standardization)			
A3. Engineering (installation, calibration, verification, maintenance)			
A4. Procurement			
B. Primary business functions			
B1. Inbound logistics	B2. Bunker sales	B3. Operations (Pre-delivery, delivery and post-delivery)	B4. Follow-up e.g. Dispute resolution (optional)

Note:

- MFM Installation not included in assessment as both standards are on bunkering operations
- Calibration already done for all MFM before delivery, before period of assessment so not included in assessment

Value Drivers

Assessment Framework based on ISO Methodology (TR48 versus SS 600)



(2) Scope of the Study

Bunkering Industry Value Chain		Suppliers	Ship Owners	Implementing Authority
Support Business Functions	Regulatory supervision, monitoring, assurance & management			
	Research & Development			
	Engineering			
	Procurement			
Primary Business Functions	Inbound logistics			
	Bunker sales			
	Operations			
	Follow-up (e.g. disputes)			

Scope of the study

Assessment Framework based on ISO Methodology (TR48 versus SS 600)



(3) Operational Indicators

Stakeholders	No.	Business Functions	Operational Indicators
Bunker Suppliers	S01	Operations	Time needed for bunkering operation process (pre-delivery, during-delivery and post-delivery)
	S02	Operations	Personnel costs for the crew due to the changes in crew numbers
	S03	Operations	Costs to handle HSE incidents
	S04	Dispute resolution	Costs to settle disputes due to disagreement of the mass delivered
	S05	Operations	Costs for inventory management
	S06	Bunker sales	Bunker sales and revenue
	S07	Engineering	Cost for MFM verification and other equipment maintenance activities
Ship Owners	B01	Bunker Sales (in the value chain)	Costs for procurement
	B02	Operations	Time needed for bunkering operation process (pre-delivery, during-delivery and post-delivery)
	B03	Operations	Costs to capture the bunkering data
	B04	Operations	Costs for inventory management
	B05	Dispute resolution	Costs to settle disputes due to disagreement of the mass delivered
	B06	Operations	Personnel costs for the crew
	B07	Operations	Personnel costs for surveyors
	B08	Operations	Costs to handle HSE incidents
Implementing Authority	P01	Engineering	Time and cost for use of personnel required to clear the approval of MFM test and other equipment maintenance activities
	P02	Engineering	Time and cost for meter annual verification
	P03	Regulatory supervision, etc.	Changes in handling of malpractices
	P04	Regulatory supervision, etc.	Time needed in handling bunkering data
	P05	Dispute resolution	Time and cost to oversee bunker quantity disputes

Evaluation - Overview

(1) Data collection, analysis and evaluation (Apr 2019 to Feb 2020)

Obtain initial impacts of TR 48 and confirm value chain and operational indicators through [introductory meetings](#).

After confirming with Advisory Committee on value chain & operational indicators and questionnaires, [send questionnaires](#) & arrange [interviews](#).

Analyse data obtained through questionnaires and interviews from [10 respondents](#).

Evaluate the impacts of TR 48 for [3 stakeholder groups](#) based on indicators and compare with findings from Literature Reviews.

1) Financial impacts, 2) Semi-quantitative impacts, 3) Qualitative impacts, 4) Other observations.

Extrapolate the impacts of TR 48 to [Singapore bunkering ecosystem](#).

Evaluation - Overview



(2) Bunkering Ecosystem

- The changes in operations were not uniformly applied by all stakeholders due to differences in internal practices and would account for the range in the benefits shown.
- Individual stakeholders could realise the full potential of the benefits of TR 48 in deciding to dispense with operational practices e.g. with tank sounding that would no longer be required under TR48.
- The extrapolated financial benefits for the bunkering ecosystem are based on estimates of what the potential benefit could be, if all stakeholders had similar internal practices

Evaluation – Bunker Suppliers

(1) Financial Impacts for Bunker Supplier Group

Stakeholders	No.	Business Functions	Operational Indicators
Bunker Suppliers	S01	Operations	Time needed for bunkering operation process (pre-delivery, during-delivery and post-delivery)
	S02	Operations	Personnel costs for the crew due to the changes in crew numbers
	S03	Operations	Costs to handle HSE incidents
	S04	Dispute resolution	Costs to settle disputes due to disagreement about the mass delivered
	S05	Operations	Costs for inventory management
	S06	Bunker sales	Bunker sales and revenue
	S07	Engineering	Cost for MFM verification and other equipment maintenance activities

Note: Highlighted business functions show financial impacts.

Evaluation – Bunker Suppliers

(1) Financial Impacts for Bunker Supplier Group (Extrapolated to a year)

S01 Time needed for bunkering operation process:

- Time savings of 1 to 3 hours for each bunkering transaction
- *2 to 3 additional loadings per barge per month.*

S04 Dispute Costs to settle disputes:

- 70% - 75% less quantity disputes
- Time saved per dispute about 1.5 to 3 hours
- *50% - 70% less management time annually*

S05 Costs for inventory management:

- Reduce ROB (Remain on Board) checks

S07 Cost for MFM & Zero verification:

Total potential net savings: USD 32,948,480 ~ USD 50,853,950

Note: *Observations are in italics and included for information & not used in the financial calculations*

Evaluation – Bunker Suppliers

(1) Financial Impacts for Bunker Supplier Group (Extrapolated to a year)

S01 (Operations) Time needed for bunkering operation process:

- Bunker vessel cost savings = time saving per transaction * Bunker vessel time charter equivalent cost per hour* No. of annual MFO bunker calls

S04 (Dispute resolution) Dispute Costs to settle disputes:

- a) Direct bunker cost saving per dispute incurred by bunker supplier = Average amount of bunker quantity in dispute * settlement arrangement * MFO price per MT
- b) Bunker vessel cost saving = Bunker vessel cost per hour * Average additional hours for bunker vessel being held back under SS 600
- c) Cost saving to settle each dispute on delivered bunker quantity = direct bunker cost saving per dispute incurred by bunker supplier + Bunker vessel cost saving
- d) Cost saving to settle dispute for bunker supplier group = Cost saving to settle each dispute on the delivered bunker quantity * Number of dispute reduction per year on delivered MFO bunker

Evaluation – Bunker Suppliers

(1) Financial Impacts for Bunker Supplier Group (Extrapolated to a year)

S05 (Operations) Costs for inventory management:

- a) Bunker vessel cost due to ROB checks under SS 600 = No. of ROB checks per operation * time for each check * No. of MFO bunker calls * bunker vessel time charter equivalent cost per hour
- b) Bunker vessel cost due to ROB checks under TR 48 = No. of ROB checks per month per bunker vessel * time for each check * No. of MFO bunker vessels * 12 months* bunker vessel time charter equivalent cost per hour
- c) Bunker vessel cost saving = Bunker vessel cost due to ROB checks under SS 600 - Bunker vessel cost due to ROB checks under TR 48

S07 (Engineering) Cost for MFM verification:

- a) Cost of zero verification for supplier group = cost of zero verification per test * No. of zero verification per bunker vessel per year * No. of MFO bunker vessels
- b) Cost of meter annual verification for supplier group = cost of meter verification per test * No. of meter verification per bunker vessel per year * No. of MFO bunker vessels
- c) Total cost of zero verification and meter verification = Cost of zero verification for supplier group + Cost of meter annual verification for supplier group

Evaluation – Bunker Suppliers

(2) Semi-Quantitative Impacts for Bunker Supplier Group

Stakeholders	No.	Business Functions	Operational Indicators
Bunker Suppliers	S01	Operations	Time needed for bunkering operation process (pre-delivery, during-delivery and post-delivery)
	S02	Operations	Personnel costs for the crew due to the changes in crew numbers
	S03	Operations	Costs to handle HSE incidents
	S04	Dispute resolution	Costs to settle disputes due to disagreement about the mass delivered
	S05	Operations	Costs for inventory management
	S06	Bunker sales	Bunker sales and revenue
	S07	Engineering	Cost for MFM verification and other equipment maintenance activities

Note: Highlighted business functions show semi-quantitative impacts.

Evaluation – Bunker Suppliers



(2) Semi-Quantitative Impacts reported

“Semi-Quantitative” refers to impacts which cannot be converted into financial impacts because they depend on additional measures that companies need to take. These benefits are therefore not seen for all suppliers.

S02 Personnel costs for the crew:

When the TR is followed closely, Bosun and 1 AB(Able Bodied Seaman) are no longer needed in bunkering during the delivery process and have other duties now

S06 Bunker sales and revenue:

- Increase 20% - 60% bunker sales volume reported (with an increase in bunker vessels for some suppliers) .
- Increase the operational turnarounds.
- The market being more standardized and stable.

Evaluation – Bunker Suppliers

(3) Qualitative Impacts for Bunker Supplier Group

Stakeholders	No.	Business Functions	Operational Indicators
Bunker Suppliers	S01	Operations	Time needed for bunkering operation process (pre-delivery, during-delivery and post-delivery)
	S02	Operations	Personnel costs for the crew due to the changes in crew numbers
	S03	Operations	Costs to handle HSE incidents
	S04	Dispute resolution	Costs to settle disputes due to disagreement about the mass delivered
	S05	Operations	Costs for inventory management
	S06	Bunker sales	Bunker sales and revenue
	S07	Engineering	Cost for MFM verification and other equipment maintenance activities

Note: Highlighted business functions show qualitative impacts.

Evaluation – Bunker Suppliers



(3) Qualitative Impacts reported

S03 Costs to handle HSE incidents: Less exposure of crew to the bunker fuel with less sounding.
(Each bunker vessel has approximately 8 or more bunker tanks)

Other Qualitative Impacts:

- Improved data transparency and reduced human errors.
- Better bunker schedule management.
- Increase reputation and competitiveness of the port in Singapore.

(4) Other Observations

- One-time set up cost related to MFMs for compliance to TR 48 (Pre TR 48).
- Higher market share due to less competitors and more customers.

Evaluation – Ship Owners

(1) Financial Impacts for Ship Owner Group

Stakeholders	No.	Business Functions	Operational Indicators
Ship Owners	B01	Bunker Sales (in the value chain)	Costs for procurement
	B02	Operations	Time needed for bunkering operation process (pre-delivery, during-delivery and post-delivery)
	B03	Operations	Costs to capture the bunkering data
	B04	Operations	Costs for inventory management
	B05	Dispute resolution	Costs to settle disputes due to disagreement about the mass delivered
	B06	Operations	Personnel costs for the crew
	B07	Operations	Personnel costs for surveyors
	B08	Operations	Costs to handle HSE incidents

Note: Highlighted business functions show financial impacts.

Evaluation – Ship Owners



(1) Financial Impacts for Ship Owner Group (Extrapolated to a year)

B01 Costs for procurement:

- Time saving of 15-60 min per bunkering stem;

B02 Time needed for bunkering operation process:

- Time saving of 1 to 4 hours for bunkering process.

B05 Costs for settling disputes :

- A decrease of 50% - 90% bunker quantity disputes.
- Estimated time saving for each shipboard dispute is 0.5 to 3 hours (4 respondents reported).

Total potential net savings: USD 26,370,000 ~ USD 95,760,000

Evaluation – Ship Owners



(1) Financial Impacts for Ship Owner Group (Extrapolated to a year)

B01 Costs for procurement:

- $\text{Manpower cost reduction in procurement} = \text{Time saving from Procurement processing per stem} * \text{procurement manager salary per hour} * \text{No. of annual MFO bunker calls}$

B02 Time needed for bunkering operation process:

- $\text{Vessel cost savings} = \text{time saving per call} * \text{Vessel time charter equivalent cost per hour} * \text{No. of MFO bunker calls}$

B05 Costs for settling disputes :

- a) $\text{Direct bunker cost saving per dispute incurred by ship owner} = \text{Average amount of bunker quantity in dispute} * \text{settlement arrangement} * \text{MFO price per MT}$
- b) $\text{Vessel cost saving due to dispute} = \text{vessel cost per hour} * \text{average additional hours for vessel being held back under SS 600}$
- c) $\text{Cost saving to settle each dispute on delivered bunker quantity} = \text{direct bunker cost saving per dispute incurred by ship owner} + \text{Vessel cost saving due to dispute}$
- d) $\text{Cost saving to settle disputes for ship owner group} = \text{Cost saving to settle each dispute on delivered bunker quantity} * \text{Reduction in number of disputes per year on delivered MFO bunker}$

Evaluation – Ship Owners

(2) Semi-Quantitative Impacts for Ship Owner Group

Stakeholders	No.	Business Functions	Operational Indicators
Ship Owners	B01	Bunker Sales (in the value chain)	Costs for procurement
	B02	Operations	Time needed for bunkering operation process (pre-delivery, during-delivery and post-delivery)
	B03	Operations	Costs to capture the bunkering data
	B04	Operations	Costs for inventory management
	B05	Dispute resolution	Costs to settle disputes due to disagreement about the mass delivered
	B06	Operations	Personnel costs for the crew
	B07	Operations	Personnel costs for surveyors
	B08	Operations	Costs to handle HSE incidents

Note: Highlighted business functions show semi-quantitative impacts.

Evaluation – Ship Owners



(2) Semi-Quantitative Impacts reported

“semi-quantitative” refers to impacts which cannot be converted into financial impacts because they depend on additional measures that companies need to take. Not all respondents reported this impact.

B06 Personnel costs for the crew:

- For crew management, some respondents have reduced their spot checks of their on-board fuel inventory

Evaluation – Ship Owners

(3) Qualitative Impacts for Ship Owner Group

Stakeholders	No.	Business Functions	Operational Indicators
Ship Owners	B01	Bunker Sales (in the value chain)	Costs for procurement
	B02	Operations	Time needed for bunkering operation process (pre-delivery, during-delivery and post-delivery)
	B03	Operations	Costs to capture the bunkering data
	B04	Operations	Costs for inventory management
	B05	Dispute resolution	Costs to settle disputes due to disagreement about the mass delivered
	B06	Operations	Personnel costs for the crew
	B07	Operations	Personnel costs for surveyors
	B08	Operations	Costs to handle HSE incidents

Note: Highlighted business functions show qualitative impacts.

Evaluation – Ship Owners



(3) Qualitative Impacts reported

B03 Costs to capture the bunkering data:

- Bunker information was easily accessible in digital format.
- 4 ship owners responses ranged from yes to more specific savings of about 2.5 hours.
- Increase in transparency with TR 48 data with improved data security.

B04 Costs for inventory management:

- Half of ship owner respondents reflected they has improved inventory management with more certainty in the quantity received.

B07 Personnel costs for surveyors:

- No reported changes.

B08 Costs to handle HSE incidents:

- No reported changes.

Evaluation – Ship Owners



(4) Other Observations (Productivity)

- **Bunker fuel and fuel budget:**
 - ✓ Fuel budgeting by ship owners expected to become more accurate.
- **Incidents of known difference in ROB versus ordered quantity:**
 - ✓ A decrease in incidences of known differences in the ROB versus ordered quantity.
- **Management or planning of shipping schedules:**
 - ✓ Shorter bunker calls as turnaround times have improved with better communications
- **Reputation and Competitiveness of port in Singapore**
 - ✓ Less worries on short supply and disputes.
 - ✓ More certainty in quantity of bunker fuel received as ordered.
 - ✓ Greater transparency and stringent oversight.

Evaluation – Implementing Authority

(1) Financial impacts for Implementing Authority

Stakeholders	No.	Business Functions	Operational Indicators
Implementing Authority	P01	Engineering	Time and cost for use of personnel required to clear the approval of MFM test and other equipment maintenance activities
	P02	Engineering	Time and cost for meter annual verification
	P03	Regulatory supervision, etc.	Changes in handling of malpractices
	P04	Regulatory supervision, etc.	Time needed in handling bunkering data
	P05	Dispute resolution	Time and cost to oversee bunker quantity disputes

Note: Highlighted business functions show financial impacts.

Evaluation – Implementing Authority



(1) Financial Impacts for Implementing Authority (Extrapolated to a year)

P01 Time and cost for use of personnel required to clear the approval of MFM test:

- Witness and check 'acceptance' test: 8 hours.
- Compiling 'acceptance' test data: 1 hour.
- Approval letter issuance: 1 hour.

P02 Time and cost for meter annual verification:

- Annual check MFM system verification: 8 hours
- Compiling acceptance test data: 1 hour.
- Approval letter issuance: 1 hour.

Total net costs (exclude one-time set up cost): USD 32,500

Evaluation – Implementing Authority



(1) Financial Impacts for Implementing Authority (Extrapolated to a year)

P01 Time and cost for use of personnel required to clear the approval of MFM test:

Manpower cost required to complete the approval of MFM test, etc. = time required to clear the approval of MFM test per vessel * manpower * number of bunker vessels * salary per hour

P02 Time and cost for meter annual verification:

Manpower cost for annual verification = time required for annual check per vessel * manpower * number of bunker vessels * salary per hour

Evaluation – Implementing Authority

(2) Semi-Quantitative impacts for Implementing Authority

Stakeholders	No.	Business Functions	Operational Indicators
Implementing Authority	P01	Engineering	Time and cost for use of personnel required to clear the approval of MFM test and other equipment maintenance activities
	P02	Engineering	Time and cost for meter annual verification
	P03	Regulatory supervision, etc.	Changes in handling of malpractices
	P04	Regulatory supervision, etc.	Time needed in handling bunkering data
	P05	Dispute resolution	Time and cost to oversee bunker quantity disputes

Note: Highlighted business functions show semi-quantitative impacts.

Evaluation – Implementing Authority



(2) Semi-Quantitative Impacts reported

“semi-quantitative” refers to impacts which cannot be converted into financial impacts because they depend on additional measures that companies need to take.

P04 Time needed in handling bunkering data:

- Significant reduction in time of up to 90% as compared to the past.

P05 Time and cost to oversee bunker quantity disputes

- Save 3 hours for each quantity dispute investigation.

Evaluation – Implementing Authority

(3) Qualitative impacts for Implementing Authority

Stakeholders	No.	Business Functions	Operational Indicators
Implementing Authority	P01	Engineering	Time and cost for use of personnel required to clear the approval of MFM test and other equipment maintenance activities
	P02	Engineering	Time and cost for meter annual verification
	P03	Regulatory supervision, etc.	Changes in handling of malpractices
	P04	Regulatory supervision, etc.	Time needed in handling bunkering data
	P05	Dispute resolution	Time and cost to oversee bunker quantity disputes

Note: Highlighted business functions show qualitative impacts.

Evaluation – Implementing Authority



(3) Qualitative Impacts reported

P03 Changes in handling of malpractices:

- Reduced opportunities for malpractices

(4) Other Observations

- Faster turnaround in port stay reported by ship owner to Implementing Authority.

Evaluation – Singapore Bunkering Ecosystem



(1) Financial Impacts by Business Functions (Extrapolated to a year)

- TR 48 has the greatest quantifiable impact on reducing the cost of operations, followed by dispute resolution.

No.	Business Functions in Value Chain	Aggregated ANNUAL financial impacts for each business function (USD)	Aggregated ANNUAL financial impacts for overall bunkering group (USD)	Percentage of impact for each business function against overall bunkering group
1	Operations	Savings between USD 39,330,000 and USD111,330,000	Total net savings: USD 59,285,980 to USD 146,581,450	66.3% - 76.0%
2	Dispute Resolution	Savings between USD 20,070,000 and USD 37,530,000		33.9% -25.6%
3	Bunker Sales	Savings between USD 270,000 and USD 1,080,000		0.5% - 0.7%
4	Engineering	Increase costs of USD 384,020 to USD 3,358,550		(0.6– 2.3)%

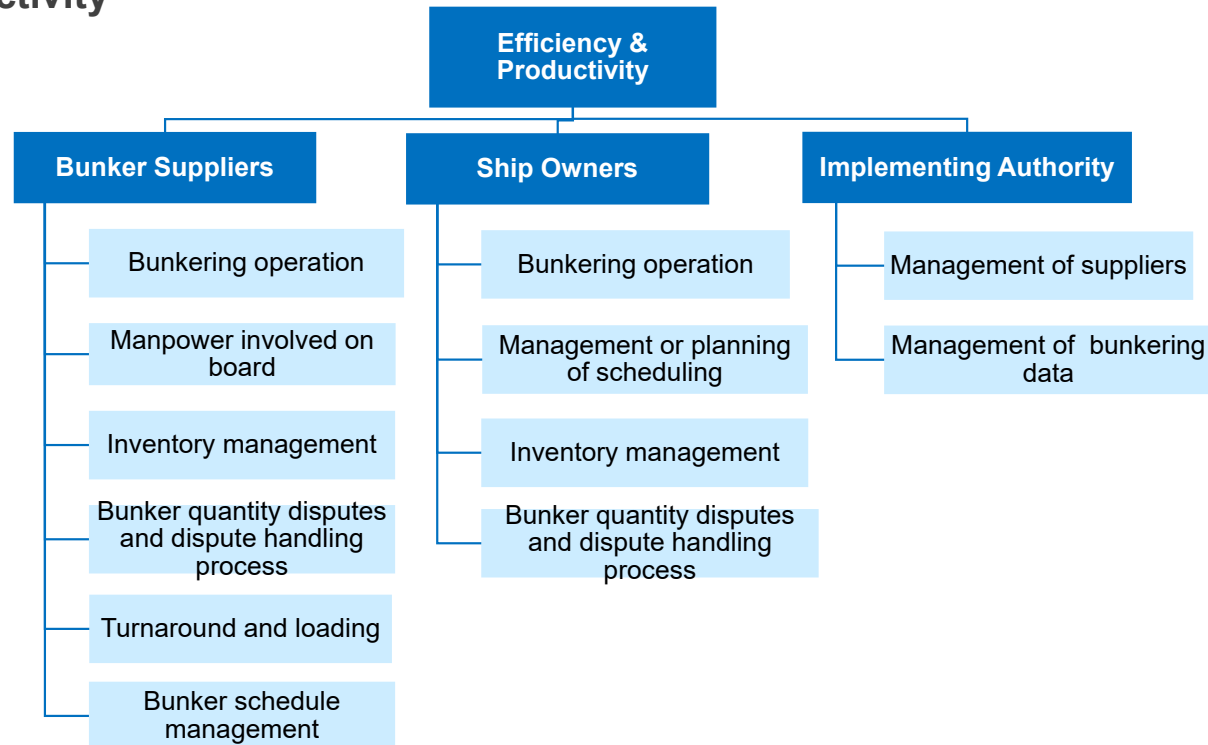
^[1] Aggregated annual financial impact of the three stakeholder group.

^[2] () denotes negative financial impact.

Evaluation – Singapore Bunkering Ecosystem

(2) Qualitative Benefits

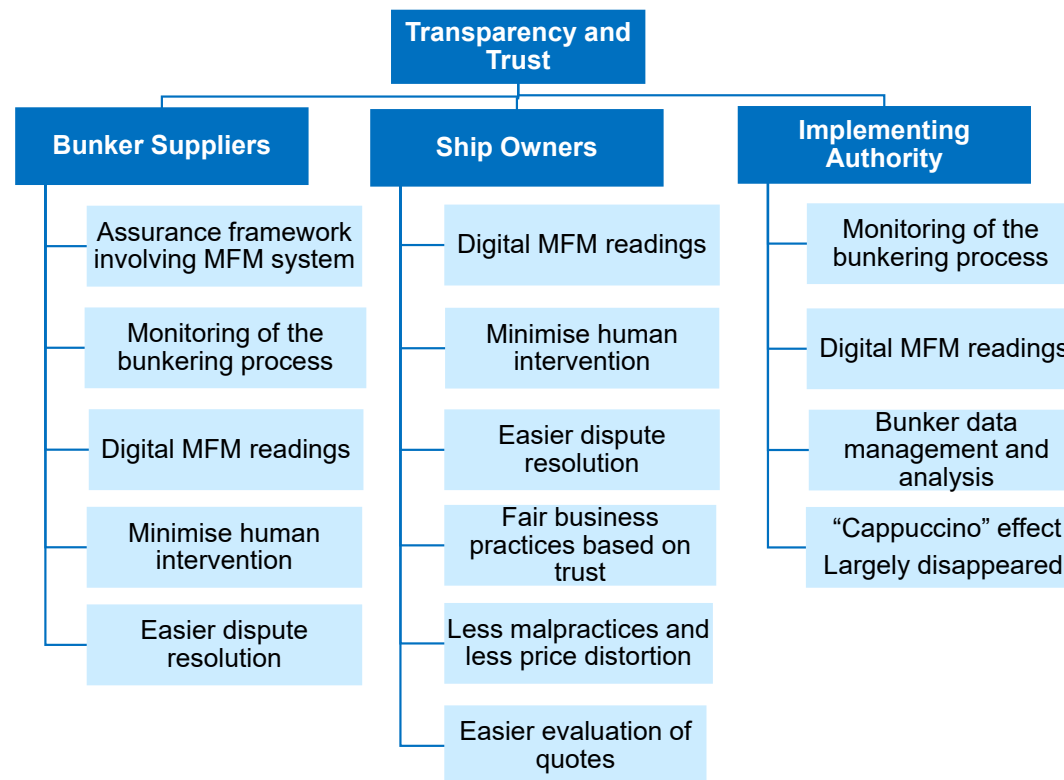
➤ Efficiency and Productivity



Evaluation – Singapore Bunkering Ecosystem

(2) Qualitative Benefits

➤ Transparency and Trust



Evaluation – Singapore Bunkering Ecosystem



(2) Qualitative Benefits

➤ Innovation and Digitization

- 1) Innovative efforts to apply MFM to bunkering industry through cumulative joint efforts of:
 - ✓ Implementing Authority
 - ✓ ESG through its national TC for Bunkering and WG for MFM managed by SDO@SCIC
 - ✓ National Metrology Centre (A* STAR) and the Weights and Measures Office (SPRING Singapore now known as ESG) for dimensional and legal metrology respectively
- 2) Open up the possibility of further digitization of the bunkering sector:
 - ✓ Application of MFM upstream of the bunker supply chain.
 - ✓ High quality digital MFM data from an MFM system with good system integrity that allows for traceability throughout the bunkering delivery has resulted in savings of time for operations when coupled with stringent regulatory requirements and oversight.
 - ✓ Software products are also being developed commercially for ship owners and other players in the bunkering industry.

Note: A*STAR is the Agency for Science, Technology and Research.

Evaluation – Singapore Bunkering Ecosystem



(2) Qualitative Impacts

➤ Reputation and Competitiveness

- 1) All stakeholders interviewed were positive on the impact of TR 48 on the reputation of Singapore' bunkering industry.
- 2) Ship owners appreciated the critical involvement of the Implementing Authority.
- 3) The following factors influencing competitiveness of a bunkering port based on literature review and survey are as follows and the case study shows that TR 48 has a positive impact on these same competitive factors :
 - Fuel price
 - Supply waiting time
 - Clear and precise information about services
 - Industrial disputes
 - Transparency (e.g. higher trust)
 - Bunker price competitiveness
 - Reliability and punctuality of bunker
 - Bunkering facility (e.g. adequacy and efficacy)
 - Quality of bunkering services (e.g. efficiency)
 - Government policies (e.g. quality control) and incentives

Conclusions



- 1) Implementation of TR 48 has a significantly positive impact on the Singapore bunkering ecosystem:
 - ✓ Implementing Authority (IA)'s strong support in the plans for the TR 48 implementation & their strategic involvement in the initiation and development of TR 48 with the IA as co chair for the WG for MFM were key to the success to the implementation of TR 48
- 2) Extrapolated to the Singapore bunkering ecosystem, the estimated potential annual net savings is between USD 59.3 million to USD 146.6 million
 - ✓ Largest impact is the reduction in the cost of operations, accounting for approximately 66% to 76% of all financial savings for the bunkering industry.
 - ✓ It is followed by savings in dispute resolution of approximately 34% to 26%. The increase in costs of 0.6% to 2.3% comes from the bunker suppliers and the Implementing Authority in the engineering function
- 3) The semi-quantitative impacts are potential benefits from shipboard's manpower reassignment of duties and potential reduction in time and manpower for ROB inspection. Data handling benefits were seen for the Implementing Authority while these were qualitative benefits for these suppliers and ship owners.

Conclusions



4) Qualitatively:

- ✓ the main impacts are the improvement in the efficiency and productivity of the delivery of an assured quantity of bunker fuel and the greater transparency of the delivery leading to a trusted system.
- ✓ Better scheduling and inventory management were also qualitative impacts for supplier and ship owners respectively.
- ✓ Digitization of the bunkering process has also been initiated with the use of modern measuring and data processing equipment.
- ✓ The result is the significant elevation in the reputation of Singapore bunkering industry and the competitiveness for legitimate players vying for business from their international clients, the ship owners.

5) An observation can also be made that the many of the expected benefits of TR 48 in the New Work Item Proposal and which were articulated when TR 48 was launched in 2015 turned out to be similar to the benefits determined or observed in this case study. Higher efficiency and productivity , greater transparency, less disputes, better operation control & preference for bunkering in Singapore.

Recommendation



Some of the changes in operations were not uniformly applied by all stakeholders due to differences in internal practices:-

- The study gives clear evidence of the benefits of TR 48 in quantitative, semi- quantitative and qualitative terms with the involvement and commitment of the :
 - ✓ Implementing Authority,
 - ✓ Enterprise Singapore [Standards(TC Bunkering & WG MFM ,SDO@SCIC)); Weights and Measures] and
 - ✓ A*STAR(NMC)

- Stakeholders can therefore confidently rely on these benefits in deciding to dispense with operational practices e.g. tank sounding which is no longer required by bunker suppliers.

Background – Advisory Committee



Small group of TC for bunkering and Working Group for MFM members under the Chemical Standards Committee, acting in their individual capacity, did the preparatory work for the TR 48 case study and assisted in the development of the structure of the case study:

- ✓ Identified the 3 stakeholder groups to be interviewed
- ✓ Developed draft value chains for the 3 stakeholder groups after consultation with ISO methodology expert
- ✓ Participated in the identification & discussion with potential IHLs to participate in the case study with an ISO methodology expert
- ✓ Identified & contacted the suppliers and shipowners to be interviewed
- ✓ Members in this small group became members of the Advisory Committee with ESG invited to join this committee after the case study was approved
- ✓ Advised on Working Committee chairmanship and membership which had Lee Wai Pong stepping up to take on the Working Committee convenorship.
- ✓ Advisory Committee provides technical direction and guidance on TR 48 and the bunkering industry.

Background - Advisory Committee



No.	Name	Representation	Designation	Organisation
1	Seah Khen Hee	Individual Capacity	Chairman	Technical Committee for Bunkering, SDO@SCIC
2	Capt. Yoon Peng Kwan	Individual Capacity	General Manager	Fleet Division, Pacific Lines International
3	Neo Tiau Gee Simon	Individual Capacity	Executive Director	SDE International Pte Ltd (Previously Regional Manager of IBIA Asia till Jul 2019)
4	Rahul Choudhuri	Individual Capacity	Managing Director	(Asia, Middle East, Africa), Veritas Petroleum Services Pte Ltd (Bunker surveying and testing services)
5	Chew Siu Keong	MPA	Assistant Director	Bunker Services, MPA
6	Loh Yuan He	MPA	Senior Manager	Bunker Services, MPA
7	Steven Phua	ESG	Deputy Director	Standards (IEC & Manufacturing), Enterprise Singapore

Note:

Advisory Committee provided technical direction and guidance on TR 48 & relevant aspects of bunkering industry, assisted in case study structure, identified & provided links to case study participants

Background – Working Committee



Contracted members :



- Maritime Energy and Sustainable Development Centre of Excellence contracted as project executor with Associate Professor Lam Siu Lee, Jasmine, the principal investigator and her co-principal investigator Mr Koh Eng Kiong to supervise and coordinate contributions by NTU team members. Funded by Singapore Maritime Institute & NTU
- ISO Methodology Expert, Mr Reinhard Weissinger, to provide guidance on the ISO methodology for the economic benefits of standards , the development of the assessment framework and the questionnaires and verification that the case study is being conducted in line with the ISO methodology. Guidance was provided for the extension of the application of the ISO methodology from single entities to the industry.

Background - Working Committee



No.	Name	Representation	Designation	Organisation
1	Lee Wai Pong	Individual capacity	Deputy Chairman	Technical Committee for Bunkering, SDO@SCIC
2	Dr Lam Siu Lee, Jasmine	Individual capacity	Centre Director, Associate Professor	MESD CoE, Nanyang Technological University
3	Koh Eng Kiong	Individual capacity	Assistant Centre Director	MESD CoE, Nanyang Technological University
4	Ang Zhi Qian	Individual capacity	Project Manager	MESD CoE, Nanyang Technological University
5	Yang Mengyao	Individual capacity	Research Associate	MESD CoE, Nanyang Technological University
6	Susan Chong	Individual capacity	Advisor	SDO@SCIC
7	Elane Ng	Individual capacity	Assistant Manager	SDO@SCIC
8	Reinhard Weissinger	Individual capacity	Lecturer, Standardization and Sustainability (Former Senior Expert, Research and Education, ISO Central Secretariat).	University of Geneva

Note: Working Committee planned, developed, drove and executed the case study with involvement of ISO Methodology expert

Acknowledgement



**Advisory Committee
(Chair : Seah Khen Hee)**

**Working Committee
(Chair : Lee Wai Pong)**

IBIA Asia



Principal Investigator
Assoc Prof Jasmine Lam

**Senior ISO Methodology Expert
Mr Reinhard Weissinger**

Supported by SDO@SCIC

Note: IBIA Asia provided complimentary training on TR48 and SS 600 standards



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