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SONJA LAURILA  
DEVELOPING AN OPERATING MODEL FOR CONTRACTOR  
SAFETY MANAGEMENT AT A GLOBAL MARINE BUSINESS  
ORGANIZATION

Master of Science Thesis

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## ABSTRACT

**SONJA LAURILA:** Developing an operating model for contractor safety management at a global marine business organization  
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Globalization, market fluctuations, increased competition, the deregulation of markets (e.g. EU), cutting costs and adding workforce flexibility have all affected on the increasing of outsourcing and contracting to enable companies focusing on their core competences, being efficient, ensuring flexibility and meeting with fluctuating demand. If contractors are not managed properly, they can significantly influence on safety of the operating organization. Possible safety consequences can be related to ensuring sufficient information flow and communication, aligning safety management systems or coordinating simultaneous tasks. Similar trend of increasing number of contractors has been recognized at Wärtsilä Marine Solutions. Despite of which, there was no coherent and global contractor safety management practices to ensure their systematic safety management.

The research was performed as a mixed-method design, first analysing past near misses and injuries offering a quantitative perspective and second analysing current stage of contractor safety management practices in Wärtsilä offering a qualitative perspective. Based on the findings and former researches, the aim was to create an operating model for contractor safety management at Wärtsilä Marine Solutions level.

Analysis of past near misses and injuries showed that reporting of contractor employees is not on the same level as of in-house personnel and it should be emphasized more. The focus of the analysis was more on the activity of reporting, since available working hours or reporting activity did not offer reliable basis for calculating safety related KPIs. Analysis of causes led into recognizing the most underreported causes of injuries.

The operating model created was combining continuous improvement and contractor lifecycle together with practical tools to cover each step. The operating model at Wärtsilä MS was based on '*Prequalification & Contract*', '*Pre-job planning & Risk assessment*', '*Induction & Training*', '*Monitoring & Communication*' and '*Post-job evaluation*'. To help applying the operating model, main defining factors for determining practices were recognized to be: '*HR / Procurement competence check*', '*Inside / Outside Wärtsilä premises*', '*Short / Long-term working period*', '*Internal / External supervisor*', '*High / Medium / Low risk level*', '*Routine / Non-routine work*' and '*Local law*'. An action plan for the ramp up of the operating model, was also created to enhance the implementation-readiness of it.

## TIIVISTELMÄ

**SONJA LAURILA:** Toimintamallin kehittäminen ulkopuolisten työntekijöiden työturvallisuuden hallintaan globaalissa meriteollisuuden yrityksessä

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Globalisaatio, markkinoiden vaihtelu, lisääntynyt kilpailu, markkinoiden vapautuminen (esim. EU), kulujen leikkaaminen ja työvoiman joustavuuden lisääminen ovat kaikki osaltaan vaikuttaneet ulkoistamisen ja alihankinnan lisääntymiseen. Näin yritykset voivat keskittyä ydinosaamiseensa, olla tehokkaita, varmistaa joustavuus ja vaihtelevaan kysyntään vastaaminen. Mikäli ulkopuolisia työntekijöitä ei hallita asianmukaisesti, he voivat vaikuttaa merkittävästi asiakasyrityksen turvallisuuteen. Mahdollisia turvallisuusvaikutukset voivat liittyä riittävään informaationkulkuun ja kommunikaatioon, turvallisuusjohtamisjärjestelmien yhtenäistämiseen tai samanaikaisten työtehtävien koordinointiin. Samanlainen ulkopuolisen työvoiman kasvutrendi on tunnistettu myös Wärtsilä Marine Solutionilla. Tästä huolimatta ei ollut yhdenmukaisia globaaleja ulkopuolisten työntekijöiden turvallisuusjohtamisen käytäntöjä heidän turvallisuutensa systemaattisen johtamisen takaamiseksi.

Tutkimus toteutettiin yhdistämällä kvantitatiivinen ja kvalitatiivinen näkemys analysoimalla sekä läheltä-piti- ja onnettomuusraportit että nykyiset ulkopuolisten työntekijöiden turvallisuusjohtamisen käytännöt Wärtsilässä. Näihin löydöksiin ja kirjallisuuteen pohjautuen tavoitteena oli luoda Marine Solution -tason toimintamalli ulkopuolisten työntekijöiden työturvallisuuden hallintaan.

Läheltä-piti-tilanteiden ja onnettomuuksien analysointi osoitti, että ulkopuolisten työntekijöiden raportointi ei ole samalla tasolla kuin omien työntekijöiden ja sitä tulisi korostaa lisää. Analyysin fokus oli enemmänkin raportointiaktiivisuudessa, koska työtunnit ja raportointiaktiivisuus eivät tarjonneet luotettavaa pohjaa turvallisuusaiheisten KPI:den laskentaan. Syiden analysointi auttoi tunnistamaan heikoimmin raportoidut onnettomuuksien syyt.

Luotu toimintamalli yhdisti jatkuvan parantamisen, ulkopuolisten työntekijöiden elinkaarimallin ja kaikkia vaiheita kattavat käytännön työkalut. Toimintamallin perusteita olivat: *'Pätevystarkistus & sopimus'*, *'Työn suunnittelu & riskienarviointi'*, *'Perehdytys & koulutus'*, *'Valvonta & Kommunikaatio'* ja *'Jälkiarviointi'*. Tunnistettiin myös tärkeimmät muuttujat, joiden avulla määrittää toimintamallin toteuttamiseksi sovellettavat käytännöt. Kriteerit olivat *'HR:n / Hankinnan pätevystarkistus'*, *'Wärtsilän tilojen sisä- / ulkopuolella'*, *'Lyhyt / Pitkä työskentelyaika'*, *'Sisäinen / Ulkopuolinen esimies'*, *'Korkea / Keskimääräinen / Alhainen riskitaso'*, *'Rutiini / Ei-rutiinityö'* ja *'Paikalliset lait'*. Toimintamallin implementoinnin mahdollistamiseksi laadittiin lisäksi toimintasuunnitelma.

## **PREFACE**

The last chapter of my studies at Tampere University of Technology has for sure been the most teaching one and I did not foresee, how much the last 30 credits would be able to deepen my knowledge about safety management. This learning would not have been able without many people helping and supporting on the go.

First, I would like to thank you Wärtsilä for this amazing opportunity to work in such an interesting global environment. Especially I want to thank my supervisor Juliusz Kurjanski for having time to support me throughout the whole thesis project despite of his occupied calendar. As well I want to thank Maria Paula Sartori for helping with creating practical tools and brainstorming. Also, a big thank you belongs for all the interviewees for their time and help. Finally, thank you for all the new friends from work who made my day.

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## LIST OF SYMBOLS AND ABBREVIATIONS

CoC	<i>Code of Conduct</i>
CPM	<i>Contractor Project Manager</i>
CSL	<i>Contractor Safety Leadership</i>
DC	<i>Delivery Centre</i>
EHS	<i>Environment, Health and Safety</i>
EMR	<i>Experience Modification Rating</i>
ES	<i>Energy Solutions</i>
HR	<i>Human Resources</i>
HSE	<i>Health, Safety and Environment</i>
IMS	<i>Integrated Management System</i>
IOGP	<i>International association of Oil and Gas Producers</i>
JHA	<i>Job Hazard Analysis</i>
JSA	<i>Job Safety Analysis</i>
KPI	<i>Key Performance Indicator</i>
LTI	<i>Lost Time Incident</i>
LTIF	<i>Lost Time Injury Frequency</i>
MS	<i>Marine Solutions</i>
MTC	<i>Medical Treatment Case</i>
NM	<i>Near miss</i>
OH&S	<i>Occupational Health and Safety</i>
OH&SMS	<i>Occupational Health and Safety Management System</i>
PAUSE	<i>People, Activities, Unexpected events, Scope of Job and Exposures</i>
PDCA	<i>Plan-Do-Check-Act</i>
PFMA	<i>Process Failure Mode Analysis</i>
PPE	<i>Personal Protective Equipment</i>
QHSE	<i>Quality, Health, Safety and Environment</i>
RWC	<i>Restricted Work Case</i>
SCC	<i>SHE Checklist for Contractors</i>
SCoC	<i>Supplier Code of Conduct</i>
SQS	<i>Supplier Qualification System</i>
SSDP	<i>Supplier Sustainability Development Program</i>
SSE	<i>Short Service Employee</i>
TOM	<i>Think, observe, manage</i>
TRI	<i>Total Recordable Injury</i>
TRIF	<i>Total Recordable Injury Frequency</i>
WDC	<i>Wärtsilä Delivery Centre</i>
VMS	<i>Vendor Management System</i>
WeCare	<i>Wärtsilä's safety reporting program</i>
WoW	<i>Way of Working</i>
Wärtsilian	<i>Wärtsilä employee</i>

# 1. INTRODUCTION

Globalization, market fluctuations, increased competition, the deregulation of markets (e.g. EU), cutting costs and adding workforce flexibility have all affected on the increasing of outsourcing and contracting to enable companies focus on their core competence and to outsource financial and even safety risks. Even though, some organizations have used outsourcing to manipulate safety KPIs by moving the responsibilities to contractors, that is not sustainable business. It is the responsibility of the operating organization to also manage contractor safety, to make sure contractors are aware of the safety requirements to be able to work safely. By not managing contractor safety it indirectly has an effect towards in-house personnel safety as well, because contractor employees can cause dangerous situations affecting people around them, operating organization's property and environment.

The same increasing trend of contracting has seemed to disembark also in Wärtsilä, especially in Wärtsilä Finland and Wärtsilä Italy, but also in other locations. The occupational safety evolution for example in Wärtsilä Finland has been clearly positive from 2012 until 2017. However, the performance trend reached a plateau last year, remaining quite stable, but without previously seen continuous reduction. This may have a connection with increasing contracting among other reasons. It has been a wake-up call for the need of more systematic contractor safety management. Also, the new ISO 45001 standard will require more engaging safety management of contractors.

The research is pursued at Wärtsilä on Marine Solutions (MS) business level and it applies to contractors aka external employees (blue- and white-collar) working at Wärtsilä MS premises. The focus is on contracting services or manpower, not e.g. supplying products, which are produced outside Wärtsilä MS premises. Two other main divisions, Wärtsilä Services and Wärtsilä Energy Solutions are not in the scope of this research.

Previous research related to contractor safety management has studied reasons behind contracting, its effect on safety and some best practices, and contractor management lifecycle. Many of the contractor safety management researches are made on construction industry, where contracting has been flourishing the longest. Also, some research has been made for nuclear power and chemical industry, but not especially for marine industry. Globality also needs special attention at Wärtsilä, which is operating in dozens of different countries. The blank area of the research is to create the operating model for Wärtsilä Marine Solutions' contractor safety management, based on the best practices found in the literature and in different Wärtsilä subsidiaries to be fit for the global environment and locally applicable in each Wärtsilä MS subsidiary.

Research questions to be answered are briefly:

- What is the current state of near miss and injury reporting of contractor employees?
- What is the current state (best practices and problems) of contractor safety management and how to improve the contractor safety management at Wärtsilä MS throughout contractor lifecycle?

Answering research questions is to be resulting in the development of a proposal for an operating model of improving the occupational safety of contractor employees working for Wärtsilä MS. The research will be performed by analysing the current state, finding out the best practices globally and based on those developing a contractor safety management operating model to improve ways of working in the induction, training, processes and control of occupational safety of contractor employees working in Wärtsilä MS premises globally. The analysis will be based on near miss and injury data, a questionnaire for contractors and interviews about the practices used in various Wärtsilä MS locations. Also, relevant literature and legislation will be investigated. The operating model developed will be tested in one of the locations analysed to validate it. Feedback will be gathered to ensure that the operating model will work as it is supposed to.

To clarify, in the context of this thesis ‘*operating organization*’ or ‘*operating company*’ refers to Wärtsilä kind of main contractor company aka client organization. ‘*Contractor*’ refers to a company working for the operating organization and ‘*contractor employee*’ refers to their employees. ‘*Subcontractor*’, if mentioned, refers to a contractor of a contractor of operating organization.

## 2. BACKGROUND AND THEORETICAL FRAMEWORK

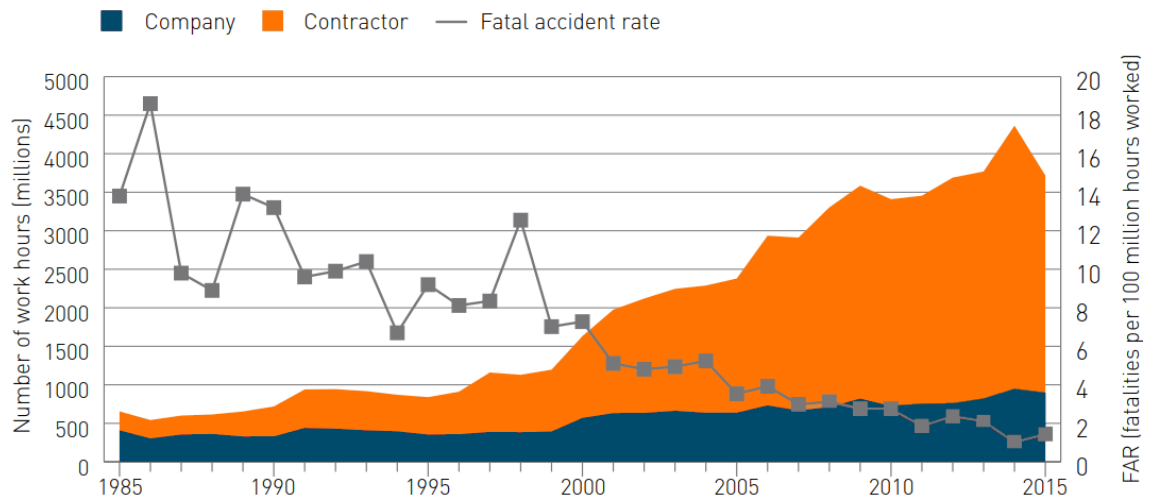
In the 90's there was a trend in the management literature to promote contracting as a competitiveness factor, because it led to cost reductions and thus the savings made could be allocated in core competence development work. Since 90's until today, the level of contracting has become even deeper. It started from the contracting of activities with no added value for operating companies, such as cleaning, logistics and catering services, continuing to the contracting of direct support for the business, like maintenance services and currently even reaching core competence business. (Walter 2017). Today there exist companies where 100 % of the blue-collar work has been contracted.

Deregulation of markets and globalization have together enabled workforce mobility and international business making. Market fluctuations together with the cost point of view have added the need for workforce flexibility which directly affects contracting when trying to balance the peaks while still being cost efficient.

Contracting has become a possibility to control both financial and safety risks, by only focusing on core competencies. Researches show that in some companies, contractors have multiple times more accidents than in-house personnel due to the amount of risks their work includes (Mayhew et al. 1997). There has been a way to “improve” organization's safety KPIs, when similar KPIs are not shown for contractors. In Walter's case study (2017) the other case company even only hired inexperienced contractors who had less than six months of experience, which means the safety risks were higher, but costs were lower.

Still to practice sustainable business the safety of the contractors should be managed so that they are able to work without injuries and unsafe conditions. Also, standardization organizations have woken up for this reality and the new ISO 45001 standard, replacing OHSAS 18001 standard, changes the safety management requirements towards contractors to be more engaging and participative.

As an example, in oil and gas industry, contracting has increased tremendously since 1985 as seen in Figure 1. Both the total amount of working hours and the portion of contracting have increased.



**Figure 1:** Contracting in IOGP member companies since 1985 (IOGP 2015).

Key thing to point out from the figure is that even though the total amount of working hours has increased, in-house personnel working hours have not increased a lot. This refers to growing business but with more flexible workforce. Might be that only core competence employees are kept in-house, and rest of the work is outsourced to maintain efficiency. During the same period, the number of fatalities has decreased.

In this chapter, the literature review has two things to combine: safety management and contracting. How are these related and what kind of special aspects contracting brings to safety management? How contractor safety management goes according to the scientific articles and what kind of examples there are about real-life cases? Safety management is based far on standards and the requirements set by the standards in terms of contractors are also presented.

## 2.1 Occupational health and safety management standards

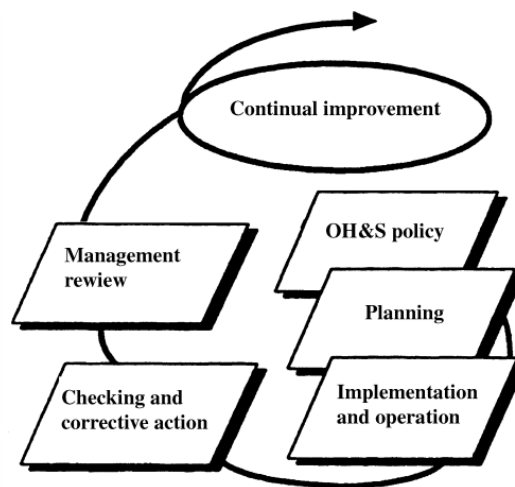
Occupational health and safety management is quite standardized. Currently, OHSAS18001 is widely used over the globe as also in Wärtsilä, but new ISO 45001 standard, published on the 12<sup>th</sup> of March 2018, will replace OHSAS 18001 after a three-year transition period until 2021. To support the implementation of OHSAS 18001 there is a guideline standard OHSAS 18002 *Guidelines for the implementation of OHSAS 18001:2007*. OHSAS 18001 also refers to ILO-OSH, which has some guidance over the management of contractors.

In addition to this, each country has their own occupational safety regulations, laws and labour agreements, which all must be followed locally. In many countries, this does not create controversy with the standards, but for example in Italy there are laws, which for example forbid (1) the follow up of working hours of procured services if they are not paid by manhours but as a piecework and (2) stopping hazardous work being done, since the commands should be given directly by the contractor supervisor. In some countries,

there is no legal difference between the employees of contractors or operating organization.

### 2.1.1 OHSAS 18001, OHSAS 18002 and ILO-OSH

OHSAS 18001:2007 has been the occupational health and safety management system (OH&SMS) standard recognized since 1999, when it was first published. In 2007, it got an update to fit better together with ISO 14001 environmental management and ISO 9001 quality management standards. OHSAS 18001 standard is based on the Plan-Do-Check-Act (PDCA) cycle of continuous improvement as shown in Figure 2.



**Figure 2:** OH&S management system model presented in OHSAS 18001:2007.

OHSAS18001:2007 requires an organization to have an OH&S policy shortly describing organizations' OH&S objectives and stating the commitment of top management. Planning consists of setting targets and creating processes to be able to fulfil organization's OH&S policy. The implementation and orientation are concrete performing of planned processes towards reaching the targets set. Checking and corrective actions are measuring and monitoring how processes are progressing against the set policy, targets and any related requirements. Management review takes place periodically to check the OH&SMS is suitable and efficient. Possible improvement or change needs are discussed.

OHSAS 18001:2007 also includes contractors in the OH&S management system, but the approach is more informative than engaging. It says the procedures including communication shall consider activities of all persons, who have access to the workplace, including contractors and visitors.

OHSAS 18002:2008 is used for more detailed guidance on applying OHSAS 18001:2007 into practice. At the appendix pages of OHSAS 18001:2007, it also states that further guidelines on applying OH&S requirements for contractors are defined on ILO-OSH:2001.



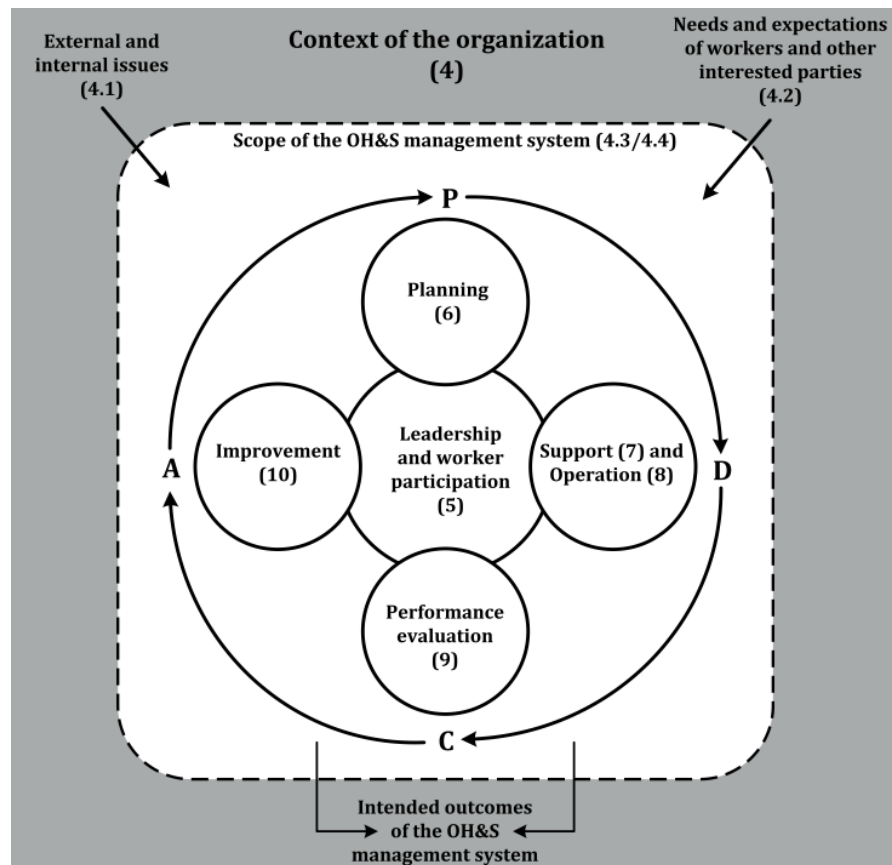
OHSAS 18002:2008 suggests that OH&S communication to employees, visitors and contractors shall be provided via for example OH&S briefings and meetings, induction, newsletters, posters, emails, suggestion boxes, websites and OH&S focused notice boards. Communication should include the OH&S performance requirements as well as consequences of OH&S requirement nonconformity. Usually, requirements of this kind are communicated in contracts but in addition some OH&S related meetings or other on-site activities may be necessary. Communication should take place already before contractor employees arrive at the site and be supplemented on-site, for example, with a site tour. If changes affect contractors' OH&S, they should also be consulted. Alignment of OH&S policies among contractors should also be considered if relevant, when multiple contractors on the same site. Arranging daily communication activities and processes for incident investigation, the reporting of nonconformities and corrective actions may be necessary. OH&S performance should be evaluated, monitored and regularly re-evaluated.

ILO-OSH:2001 Section 3.10.5 Contracting requires equivalent OSH requirements for contractors as for in-house personnel and it lists the following arrangements for contractors, who work on site:

- OSH criteria included in evaluating and selecting contractors.
- Establishing effective ongoing communication between the organization and contractor before starting the work. Including communication about hazards and the measures to prevent and control them.
- Provide a near miss and injury reporting tool while working for the organization.
- Provide OSH hazard awareness and training.
- Monitor OSH performance.
- Ensure OSH procedures and arrangements are followed.

### **2.1.2 ISO 45001**

ISO 45001 standard will be answering many questions risen via world-wide trading markets and globalization. Currently widely used OHSAS 18001 standard and national laws create a mixture of varying safety practices making it challenging to promote global conformity. With ISO 45001 standard, certain benchmarks for the health and safety policies and practices can be set globally. (Lloyd's Register Group Limited 2017). ISO45001 standard will be one step closer towards Integrated Management System (IMS) combining ISO 9001, ISO 14001 and ISO 45001 standards.



**Figure 3:** *OH&S management system model presented in ISO45001:2018.*

The OH&S management system model of ISO 45001 standard (Figure 3) is based on the PDCA cycle likewise its predecessor. ‘Planning’ is as it used to be and ‘Support and Operation’ is with a nuance difference replacing the former ‘Implementation and Orientation’. ‘Checking and Corrective Action’ has changed into ‘Performance evaluation’ which may have intended outcomes of OH&S management system. It is changing towards more goal-oriented safety management by evaluating the performance against the improvement objectives.

The biggest change between the OH&S management system models is that the role of the leadership and worker participation has been put into the centre, underlining the engagement and participation of both the top management and the workers into the OH&S management system. In OHSAS 18001 the management had a role as reviewing, but ISO45001 changes their role into more active. In addition, in OHSAS18001 workers used to have only the receiving role instead of participation as in the upcoming ISO45001. Engaging workers enables the focus of the safety management to be on the right matters by identifying and understanding the factors, which need to be managed.

The key change from the interest point of view of this thesis is the further requirements set for contractors, outsourcing and procurement arrangements. ISO45001 defines worker as “a person performing work or work-related activities that are under the control of the organization” including an additional note stating those “may be performed by workers

*employed by the organization, workers of external providers, contractors, individuals, agency workers, and by other persons to the extent the organization shares control over their work or work-related activities, according to the context of the organization*” (ISO45001:2018). This is a fundamental change and can be interpreted so that workers shall not be separated whether they are contractor employees or in-house personnel.

In addition, the chapter 8.1.4 states that the procurement process shall be organized so that all services procured are conformant with the OH&SMS. When selecting contractors, there shall be OH&S criteria included and contractors shall meet with their OH&SMS requirements. As an additional note ISO 45001 standard states it can be useful to include the OH&S criteria in the contractual documents. (ISO45001:2018).

In procurement process organization shall identify hazards and assess and control the OH&S risks. Risks can be caused by contractor’s activities and operations for organization’s employees or other interested parties. On the other side, OH&S risks that organization’s activities and operations may cause for contractor employees. (ISO45001:2018).

## **2.2 Occupational health and safety management**

Occupational health and safety (OH&S) can be considered to consist of physical and mental health, ergonomics and hygiene. Hämäläinen and Lanne (2001) define safety management as *“comprehensive, systematic and continuous management for controlling safety and health risks to ensure employees’ safety and health and to result in productive, safe and healthy workplace”*. The aim is to control OH&S risks, to improve well-being at work by improving working conditions and working environment and by decreasing the amount of sick leaves.

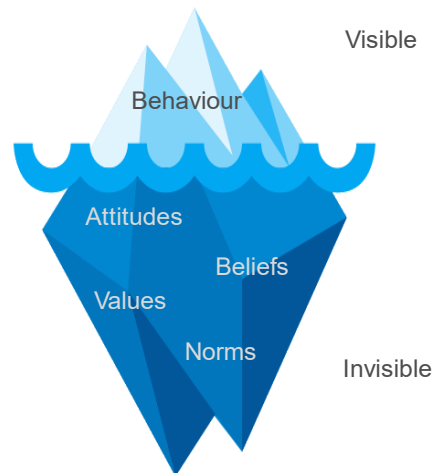
OH&S management bases far on standards and practical studies rather than specific theories. OH&S has been studied from the perspectives of example prescriptive literature, systematic OH&S management studies, success-based studies, error and disaster-based studies and culture, climate and reliability studies.

OH&S management is basically managing OH&S related issues; executing the OH&S standards to fulfil organization’s OH&S policy. From the interest point of contractors, the OH&S management of contractors shall be included in the policy and there shall be practices to monitor and measure their performance and continuously improve.

In the following subchapters, OH&S management has been approached from the viewpoint of safety culture, measuring and reporting, KPIs and safety ratios aka pyramids and their benefits and limitations.

### 2.2.1 Safety culture

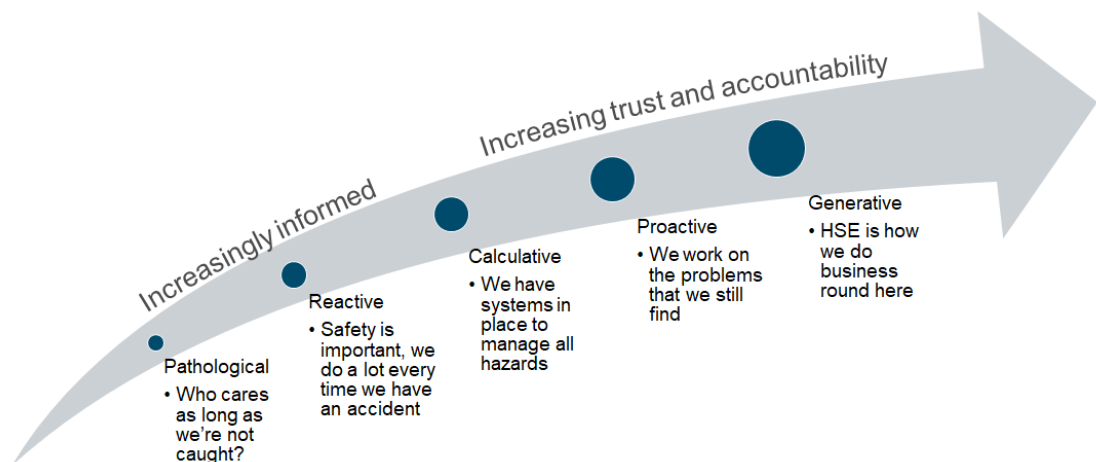
When an organization has a good safety culture, people are alert to expect the unexpected, they understand what they are supposed to do, they are open for suggestions, they believe that they have the power to make a difference with their actions and managers instead of managing, show genuine leadership (Energy Institute 2018). Safety is always set first and valued. Safety culture can be seen consisting of the visible and invisible part. A floating iceberg can be used to visualize the components of safety culture as visualized in Figure 4.



**Figure 4:** *Safety culture iceberg.*

Visible part of the safety culture consists of safety behaviour and the invisible part of attitudes, beliefs, values and norms. Together they create the safety culture and the way of working in terms of safety. Visible part is easier to change and measure than invisible parts.

Another framework to approach safety culture can be the level of it. In Figure 5 safety culture is shown as rising ladders towards better safety culture via increasing informing, trust and accountability.



**Figure 5:** *Hearts and Minds safety culture maturity ladder (adopted from Energy Institute 2018).*

Ladders can be used to measure on which level of safety culture an organization lays on. It shows where they have been and how the next step looks like, since climbing ladders leads to higher safety culture.

The ladders start from the pathological level, where an organization is just trying to sweep safety issues under the rug. Reactive organizations already care about safety, but safety improvements are running late, and they only happen after an accident has already taken place. Calculative safety culture already collects a lot of data and performs audits, but it is still not yet truly proactive. The proactive level means the focus is already on preventing future accidents and the workforce starts to be aware and involved in safety practises so that less HSE personnel is needed, since they are only needed for guidance. In generative safety culture organizations' people live in chronic unease, because they are used to not having accidents. In this kind of organizations people learn from near misses and to find the root causes to mitigate all risks before anything happens. Failure is used for improvement instead of blame. (Energy Institute 2018).

When working with contractors, the safety culture levels among the contractors can differ a lot. It is important to communicate the safety expectations, identify possible gaps and pursue to align the clashing safety cultures.

### 2.2.2 Safety reporting and KPIs

A famous statement of management guru Peter Drucker “What gets measured, gets managed” sums up the reason behind reporting. Safety is not something easily measurable due to its intangible nature and to be able to set goals and targets, some tangible measurements are needed. Measurements can be for example but not limited to injury frequencies, severities, costs, absence rates, occupational diseases, sicknesses, numbers of safety talks, audits, training days, near misses. (Häkkinen et al. 2015).

Reporting is a commonly used way for collecting these measurements thus enabling safety management via measuring. Reporting can be made for example via an on-line system or on paper. From the reports, selected Key Performance Indicators (KPIs) can be calculated. Typically, in larger organizations KPIs are shared in organizations' annual reports or sustainability reports. Total Recordable Injury Frequency (TRIF) and Lost Time Injury Frequency (LTIF) are the most commonly used KPIs and those are in use in Wärtsilä as well. In addition, Wärtsilä follows the amount of safety walks performed.

The equations for TRIF and LTIF are shown below.

$$TRIF = \frac{TRI * 1,000,000}{worked\ manhours} = \frac{(LTI + RWC + MTC) * 1,000,000}{worked\ manhours}$$

$$LTIF = \frac{LTI * 1,000,000}{worked\ manhours}$$

To come up with the frequencies, Total Recordable Injury (TRI) and Lost Time Injury (LTI) are multiplied with 1,000,000 in Europe and divided with the worked manhours. In the USA, they multiply with 200,000. TRI includes all kinds of injuries, even the smallest ones, which only need first aid or any small action like plaster. LTI means more severe injuries, leading to lost time or in other words absence from work.

In Wäertsilä, for example, TRI consists of three types of injuries:

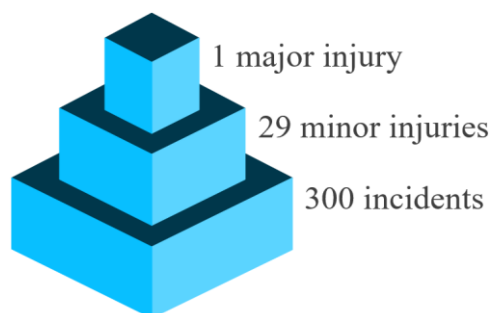
1. RWC means restricted work cases, e.g. fatalities or becoming permanently disabled to work in their current position.
2. LTI means lost time injury, which means such severity of injury, which leads to sick leaves.
3. MTC means a medical treatment case, which is the least harmful type of injury and does not lead to lost work days.

By reporting near misses, organizations can also learn from them without having to experience the actual injury, which could have been caused. Mitigation of near miss causes may thus reduce the frequency of accidents enabling more proactive safety management. (Jones et al. 1999). However, this has not been proved to be true neither false and many researchers argue if it only reduces the number of minor incidents. (Rebbitt 2014).

Reporting several types of injuries and near misses enable calculating ratios between them. Those ratios can be visualized for example in a shape of a pyramid or an iceberg.

### 2.2.3 Safety pyramids

In addition to enabling calculating KPIs, safety reporting data can be utilized for determining ratios between different injury types. Several researches have been done to examine the ratio constancy between near misses and injuries, of which Heinrich's safety pyramid (1931) is the original one (Figure 6). Different safety pyramids have been widely used as occupational safety management tools since then for almost a century.



**Figure 6:** Heinrich's (1931) safety pyramid.

Heinrich's safety pyramid is based on incident data from insurance companies. He also found out that 88 % of incidents were due to unsafe acts, 10 % unsafe conditions and the

residual 2 % could not have been avoided. The original work of Heinrich is not accessible leaving many questions about for example the definitions, but the same 90 % of unsafe behaviour has been recalculated later. (Rebbitt 2014). In addition to the original Heinrich's pyramid, there have been several similar studies later as we can see in Table 1. Those are in time order from left to right.

**Table 1:** *Safety pyramid comparison (Rebbitt 2014).*

	Heinrich 1931	Bird & Germain 1966	Fletcher 1972	Tye 1975	Conoco Phillips 2003
Fatal				1	1
Major injury	1	1	1		30
Minor injury	29	10	19	3	300
First aid only				50	
Property damage		30		80	
Noninjury / near miss	300	600	175	400	3,000
At-risk behaviour					300,000

As we can see, the variation between the ratios of safety pyramids by different authors is quite vast. The ratio between near misses for one major injury varies from Fletcher's 175 to Bird and Germain's 600. Conoco Phillips Marine and Tye have the ratio for fatality and thus they are not directly comparable. In case of Conoco Phillips Marine, the ratio is 30 major injuries to 3,000 near misses, which in other words means 100 near misses for one major injury, but they have in addition a concept of at-risk behaviour.

Even though some believe in safety pyramids, safety pyramids' correctness is really argued, both from the ratio and concept point of view. A statistical validation was made recently for Heinrich's pyramid by Marshall et al. (2018). The test was made with over 50,000 companies in Chile for 28 months. The result was that it is not statistically valid, because the proportions vary. Nevertheless, in case used for practical purposes, the variation is small enough and the proportion is quite constant. (Marshall et al. 2018).

Also, the ratio variation seen in Table 1 supports the fact that the ratio depends considerably on one's source data. However, in Jones' et al. research (1999) he states that the rate of near misses can be an indicator of industry's safety awareness, because it shows how well one's employees identify risks.

In the current state of research, safety pyramids may be good for visualizing, but they cannot be taken as scientifically solid. Each organization may have their own personal ratios, which may vary according to different industries and even inside the same industry. The number of fatalities or major injuries should not be tried to estimate by the number of near misses, but the increasing safety awareness can be measured by increasing the number of near misses reported. Also, the state of reporting can be assessed until some point (Rebbitt 2014), for example if there are many accidents but no near misses, it reveals poor reporting.

## 2.3 Business networking

As discussed before, businesses are changing and focusing on core competence leading to more networked businesses, where each company offers their own core competence. The aim is this way to be more competitive and create value. A business network consists of the operating organization, suppliers (including contractors), substitutes, competitors and customers (Johnston et al. 2004). In this research, the focus is on networking between contractors and operating organization, which together form a shared workplace.

### 2.3.1 Contractor

A contractor can be described as any third-party organization hired by the operating organization to provide certain material or service through contract work (Nygren et al. 2017). In the literature, the word ‘Contractor’ can refer to the main contractor, subcontractor or contractor employees. It also has many synonyms such as external employee or temporary worker. The operating organization can be referred to as main contractor, contractor or client company.

In this thesis, the focus is only on the ones providing work or services. A contractor means the company working for Wärtsilä (operating organization). Their employees are called contractor employees.

The working period of the contractor employees may vary from hours to years, which affects greatly on their familiarity with the operating organization’s safety procedures. It also affects the efficiency of the ways to manage their safety.

Contractor and operator relationships can be divided into three categories: ‘Inside the fence’, ‘Running loose’ or ‘Other’ contractors. (Haight 2013). The first contractor type means a smaller company working inside the operating organization’s premises. Ensuring contractor’s safety management programs’ effectiveness is quite straightforwardly controllable due to continuous interaction. The operator can control the access to its premises and thus ensure everyone has had the basic trainings and orientation before gaining the access. (Haight 2013).

‘Running loose contractors’ are doing their job in someone else’s premises. In the case of Wärtsilä, a portion of contractors perform their work e.g. in the shipyards. The managing of this type of contractors is more difficult because: firstly, the operating organization may not have direct control on the contractors, and secondly, management system may be missing in case the operating organization is just a group of investors and thirdly there may be conflicting management systems, which may lead to extra work done to fulfil both requirements. From a legal perspective either or both organizations may have a policy of keeping their “hands off” by not sharing certain information, e.g. by filtering or



prohibiting incident or personnel contact information or media communication. (Haight 2013).

The third contractor category is ‘Others’, consisting of two cases: “big frog, small pond” and “big frog, no pond”. These are cases where the contractor is bigger and taking advantage by dominating and the operating organization may even get ran over by the contractor. (Haight 2013). This type is not valid in the case of Wärtsilä.

Wärtsilä MS has both ‘Inside the fence’ and ‘Running loose’ contractors. ‘Inside the fence’ contractors are the ones, who work at Wärtsilä premises and ‘Running loose’ contractors are the ones, who work for Wärtsilä in our customers’ or partners’ premises such as in shipyards or onboard of customer’s vessel. In Wärtsilä, ‘Inside the fence’ type of contractor employee can be performing for example, janitorial services, cleaning, logistics, repairing or contractor employees doing any work that Wärtsilä’s own employees could do, such as assembly or production. A closer look on the tasks of contractor employees will be taken at Chapter 4.1. Wärtsilä MS also has other external employees, such as ad hoc repairmen, staffing agency employees and other temporary employees. Also, a lot of visitors such as customers or employees from other Wärtsilä locations enter Wärtsilä premises.

### **2.3.2 Shared workplaces**

Shared workplaces (or multi-employer workplaces) mean fragmented workplaces consisting of multiple companies working for the same target in the same location, for example operating company and contractors. Fragmentation complicates communication and coordination in large projects and broken information flows can occur. (Nygren et al. 2017). Fragmentation can also diffuse to production processes and work tasks when multiple companies work together (James et al. 2007).

If poorly managed, shared workplaces can get problematic in terms of for example equality, safety or quality. Inequality can take place on shared workplaces due to contracts of a different kind, payments, terms and conditions. Practical examples can be variation in salaries and piecework rate versus hourly paid employees. Also, the boundaries between work tasks, quality and details must be clearly defined on contracts if the work tasks are sequentially. Otherwise it may lead to a situation where the following contractor needs to fix mistakes caused by the preceding contractor. Also, there can be a huge gap between in-house and contractor employees, leading to jealousy. The following chapter describes more the safety impacts of contracting on shared workplaces.

## **2.4 Impact of contracting on safety**

Contracting changes working environment and may affect safety, safety culture and safety management. In this chapter, the effects on safety have been approached via

specific risks, that contracting creates and safety challenges of shared workplace from contractor point-of-view and, more concretely, via comparison of most common root causes and corrective actions between contractors and in-house personnel. Clashing safety cultures may cause problems and confusion. Also, contracting influences on safety management, when all parties have their own safety management systems or ways of working, which should be aligned.

### 2.4.1 Safety risks of contracting

When the turnover of workers increases, what usually happens when contracting, it causes risks. Some identified risk factors related to contracting are being listed in Table 2. The original research was performed from aircraft maintenance perspective, but the risks identified are quite general and could be applied for any industry.

**Table 2:** Risk factors in contracting and contingent work arrangements (adopted from Quinlan et al. 2013).

Economic / financial pressures	Disorganisation	Regulatory failure	Spill-over effects
Insecure work	Short tenure, inexperience	Poor knowledge of legal rights, obligations	Extra tasks, workload shifting
Contingent irregular payment	Poor induction, training and supervision	Limited access to OH&S, workers comp rights	Eroded pay, security, entitlements
Long / irregular work hours	Ineffective procedures and communication	Fractured or disputed legal obligations	Eroded work quality, public health / safety
Multiple jobs (may work for several agencies)	Ineffective OH&SMS / inability to organize	Non-compliance and poor regulatory oversight	Work-life conflict
Piece rates and profitability → hurrying	Unfamiliar working environment	Lack of collective bargaining power / unionization	Treated like ‘second class citizens’
	Fragmentation of production processes and work tasks		

Each risk factor may have serious safety related consequences, such as shortcuts under pressure, unsafe behaviour due to lack of knowledge or fatigue. Contractors can also feel pressure about getting new job opportunities and thus try to rush. Working with minor injuries is also common because of being afraid of losing their job. (Campbell Institute 2015). Some contractors may also accept higher risk levels than in-house personnel due to many reasons like, for example, lack of knowledge, powerlessness or getting accustomed to being a ‘second class citizen’.

One key risk added to the Table 2 above is ‘Unfamiliar environment’, which can be considered as part of disorganization and lack of experience. (Nygren et al. 2017). Some

contractors change workplaces all the time and so their environment and related risks vary as well. They should learn how to observe constantly changing environment effectively. Also, all workplaces have their own safety practices, which requires quite a lot of effort to remember by the contractor.

Another risk added is related to payments – piece rates (Nygren et al. 2017), which often leads to a situation where the faster you perform, the more you earn, because it is directly related to the profitability of the project and contractor's business. This may also cause lack of reporting, poor risk assessing and planning, because it is considered extra and not as productive work. Sometimes also contractors avoid reporting or underreport injuries to keep their safety KPIs good and this way keep getting new contracts and business opportunities (Kenny & Bezuidenhout 1999, Quinlan & Bohle 2004).

Mayhew et al. (1997) found in their research the loss of collective bargaining power, which refers to the disabilities to stand up against their employers or in this case against the operating company. It is not as common for contractor employees to be part of a trade union and contractors are also quite easily replaceable usually, which together leave contractors into a quite powerless basis.

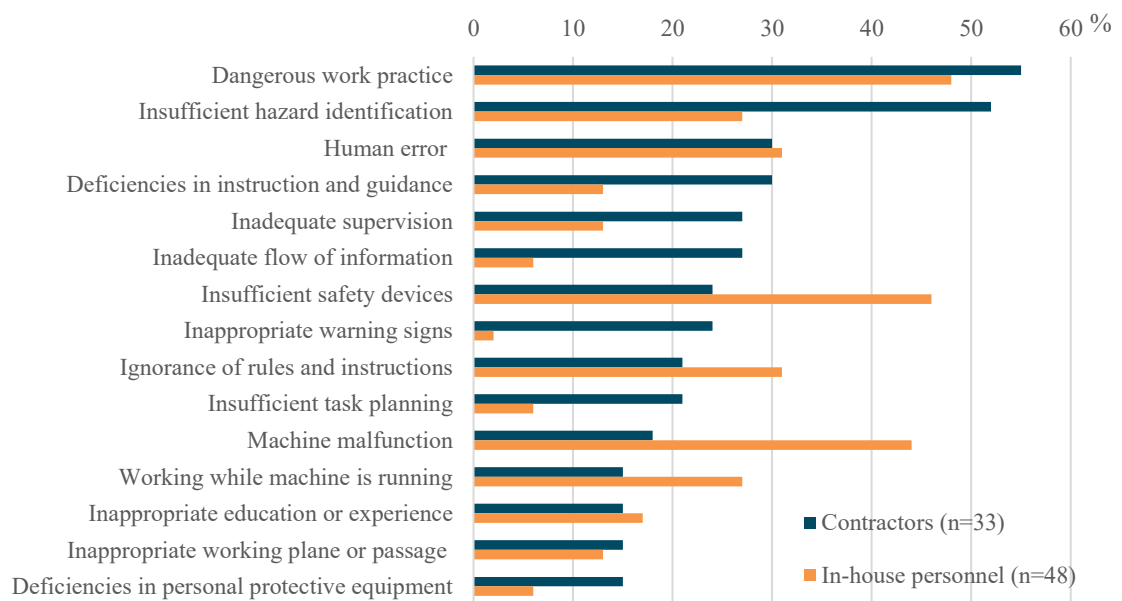
#### **2.4.2 Safety challenges on a shared workplace**

Nenonen (2012) has made a research about implementation of safety management in outsourced services, but from service provider point-of-view. In her research, she has identified six challenge categories when operating at multi-employer worksites: '*Attitudes / safety culture*', '*Communication*', '*Coverage of instructions*', '*Planning of work tasks*', '*Responsibility issues*' and '*Variation in practices*'. More detailed examples of challenging situations are visible as Appendix A. (Nenonen 2012)

Attitudes and safety culture refer to poor safety attitudes in operating organization or contractor company, which may for example appear as unsafe working practices. Communication challenges can be related to information flow between employees or between the operating organization and contractor company or between other relevant parties. In some cases, the supervisor may not be present, which can also cause information flow interruptions. Challenges can occur with the coverage of instructions in case those are unavailable, inadequate or improperly communicated for the employee, who is performing the work. Planning of work tasks can result in challenges for example if one has haste, work changes from the original plan or if the coordination of simultaneous work tasks fails. Responsibility issues can be for example associated with induction training, investigating injuries or near misses, insurances or when working abroad. The last challenge category, variation in practices, can include quite vastly any types of practices which can influence on safety. Variation can occur on the level of company's own units, customer worksites or even countries. (Nenonen 2012)

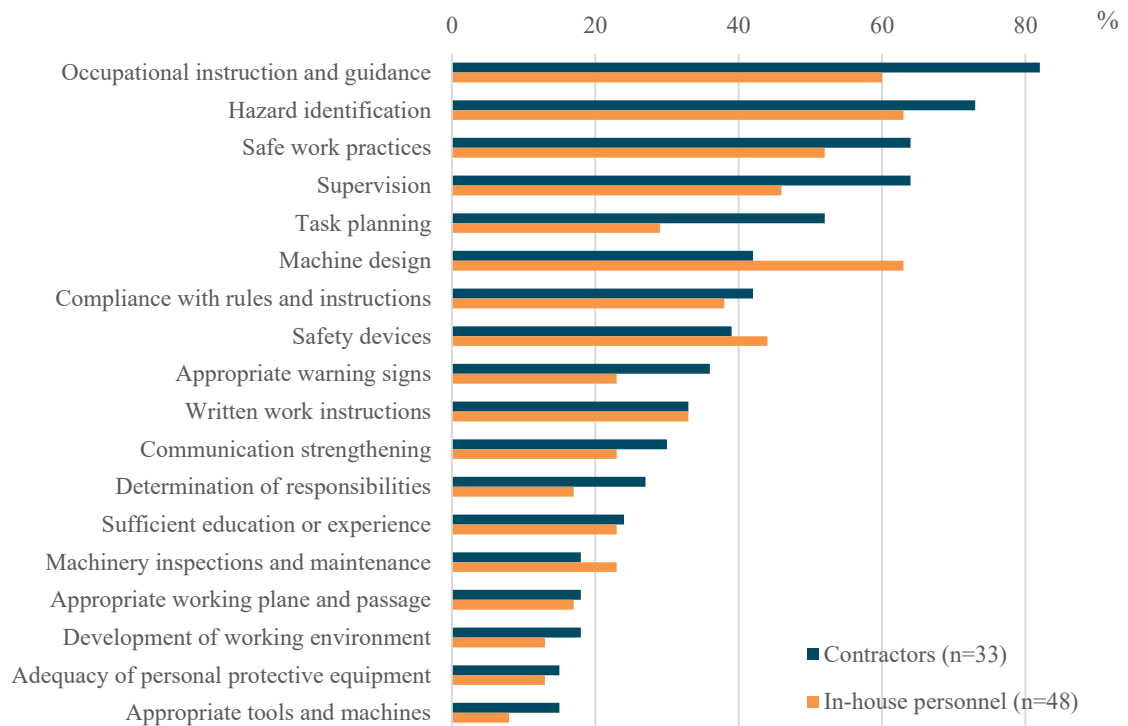
### 2.4.3 Most common root causes for fatalities and improvement actions

Nenonen (2011) was doing a case study research about the most common root causes and recommended improvement actions for fatalities in Finland for both contractors and in-house employees. The results can be seen below in Figure 7 and Figure 8. The sample of the research was quite limited, only 33 contractor fatalities and 48 in-house fatalities investigated, but it gives a picture of the nature of the root causes and improvement actions in Finland. Globally, this kind of statistics are not available.



**Figure 7:** The most common root-causes for fatalities in the Finnish manufacturing industry, 1999–2008 (Nenonen 2011).

Some of the root causes are multiple times more common for contractors than for in-house personnel, such as poor instruction, task planning and information flows, missing warning signs and missing PPE. In comparison to in-house personnel, it is multiple times more typical to be caused by machine malfunction, working while a machine is running (most probably hurrying or frustrated of the machine being too slow) or ignoring of rules. To summarize, the root causes of contractors were in general related to the lack of experience and knowledge. For in-house personnel, more typical was safety ignorance or not obeying rules, using adequate safety devices, working while a machine is running. In Figure 8 most commonly recommended corrective actions, which have been used to prevent fatalities are being listed.



**Figure 8:** The most commonly recommended corrective actions for preventing fatalities in the Finnish manufacturing industry, 1999–2008 (Nenonen 2011).

The recommended corrective actions are in line with the solutions for the root causes, but there is not as significant difference between contractors and in-house personnel. To highlight some key points, better occupational instructions and guidance, supervision, task planning and appropriate warning signs are seen a lot more necessary for contractors than for in-house personnel.

Contractors with poor safety performance may also affect the safety of in-house personnel. (Campbell Institute 2015). This is due to causing unsafe situations or circumstances, which can also impact others working close by.

Research shows that fragmentation of workplaces is not necessarily causing unsafe conditions since the operating company can still offer safe working conditions and similar facilities for contractors. The reason behind, may lay on the fact that usually contractors are small or medium sized companies with limited resources to invest in safety management systems. (James et al. 2007)

#### 2.4.4 Impact of contracting on safety management systems

The impact of contracting may influence on both - the safety management system of the operating organization and of the contractor company. The operating organization can also have a separate contractor safety management system to cover the gaps.

Contractors usually have their own safety management systems, which may differ significantly from other contractors or the operating organization, hence being problematic. The problem is not always caused by a contractor having poorer safety management or being less safe, but because of having multiple safety management systems and lacking trust against other systems. (Bahn 2013). Attention should be paid on aligning the differing safety management systems together with contractors.

According to Smallwood's research executed in construction industry (2017) operating organization's contractor safety management system affects contractors' safety performance. Thus, it is recommendable to have one in place.

According to Haight (2013) the safety management of contractors can follow a similar PDCA-based viewpoint as shown earlier in OHSAS 18001 or ISO 45001 standard. Simply by starting from setting guidelines, making a safety plan, sticking to that plan, periodical reviewing and finally acting based on the findings. The cycle becomes a full circle when the actions based on findings will be carried out further to become guidelines. (Haight 2013). However, the concrete practices differ more since the contractors cannot be treated like permanent employees. In Chapter 2.6, a closer look for practices of this kind is taken.

## **2.5 Cultural differences and occupational safety**

Culture in short can be described as *“the collective programming of the mind, which distinguishes one group or category of people from another”* (Hofstede 1991). In this chapter cultural differences are seen from the country of origin point of view and how this relates to occupational safety. Occupational safety level variations are seen by regions and how foreign workforce makes the situation even more complicated.

It has been examined that there is a relationship between national culture and safety culture. National culture may influence on employees' safety attitudes and practices. It also argues precaution when benchmarking best practices globally, because some practices might be just for a specific need in some country. (Noort et al. 2016).

Starren et al. (2013) argued that safety knowledge is related to risk awareness, which can be increased with evidence, pictograms and training. The attitude towards risks however is related to person's sensation seeking level, which is more difficult to change. Employees might know something is dangerous and still do it. Their level of knowledge can be improved but it is more difficult to change their mindset and attitude. It was also underlined that although national culture may be related to higher safety risks, it is not the only factor and many other factors should be considered as well. (Starren et al. 2013)

### 2.5.1 Occupational safety level by region

Occupational safety levels vary significantly between regions. Below in Table 3 one can see the difference between high- and low- & middle-income countries, which are furthermore divided by regions. High income countries consist of developed countries such as Australia, Canada, France, Italy, the Netherlands, Germany, Denmark, Norway, Sweden, Finland, Singapore, Switzerland, United Kingdom, the USA and similar welfare countries. The fatality and non-fatality ratios have been calculated per 100,000 employed workers. Non-fatality in this research was defined so that it leads to at least four days absence from work. (Nenonen et al. 2014). The full version of Table 3 is shown as Appendix B.

**Table 3:** Global estimates of occupational accidents annually by region (adopted from Nenonen et al. 2014).

Region	Injuries reported to ILO		Global estimates of occupational accidents			
	Fatal	Non-fatal	Fatal	Non-fatal, average	Fatality ratio	Non-fatal ratio
High income countries	4092	4120618	11396	11222581	2,6	2515,2
Africa (low&middle)	263	24024	59301	52458752	55,6	49175,1
Americas (l&m)	3096	1184336	18433	16306040	7,4	6555,0
Eastern Mediterranean (l&m)	0	0	19229	17009979	13,6	12015,3
Europe (l&m)	5893	257348	14609	12923133	7,4	6540,2
South-East Asia (l&m)	683	147348	114732	101493739	56,9	50312,2
Western Pacific (l&m)	195	3759	115069	101792125	13,1	11579,0
Total	14222	5737433	352769	313206349	15,9	14098,0

The estimate is used because of poor and unreliable reporting and thus missing statistics from developing countries, which one can easily see from the number of injuries reported to ILO. For example, according to the estimate in high income countries the reporting level of both types is around 36%, but in contrast in Africa, Eastern Mediterranean, South-East Asia or Western Pacific less than 1%. In the low- and middle-income countries of Europe, the fatality reporting is quite high 40%, but still only 2% of non-fatalities. In the Americas, the percentages are 17% of fatalities and 7% of the non-fatalities. Poor reporting can be considered as a signal of poor safety awareness or poor safety attitude.

According to the estimates, the most critical regions in terms of occupational safety lie in South-East Asia and Africa, which are also famous for being the most undeveloped regions. As a summary from the Table 3, the ones reporting most, have the lowest number of accidents according to the estimates.

## 2.5.2 Foreign workforce

Thinking about the effects of cultural differences can go even more complicated when foreign workforce is utilized. Schubert and Dijkstra (2009) have studied safety effects when working with foreign contractors and personnel in the Netherlands. They found five key problems: communication regarding work permits, instructions and risks, uncertainty about qualifications, cultural differences, specific employment situations and cooperation between operating organization and contractor. (Schubert & Dijkstra 2009)

Communication problems can be eliminated by ensuring necessary translations are available and a supervisor fluent in the language spoken by the contractors. Stork GLT had developed “communication cards” with 20 key phrases, both in their national language and in the language where the workplace was located. (Schubert & Dijkstra 2009)

Uncertainty about qualifications refers to level of education, which is caused by unclarity about available qualifications and lack of training. Detailed instructions in specific toolbox meetings or working with certificates removes the problem. Stork GLT has a specific pre-evaluation tool to find out whether extra instructions are needed and in case yes, it is provided via courses. However, safety managers find it quite frustrating to keep giving the instructions all the time due to the short contracts and constantly lacking experience levels. (Schubert & Dijkstra 2009)

Cultural differences in terms of safety culture were mostly visible at risk-acceptance level and safety regulation awareness. Watertight solutions were not shown and typically supervision was added to ensure required safety behaviour. (Schubert & Dijkstra 2009)

Specific employment situations may be more about contractors’ situation rather than about cultural differences, but the research brought up that poor reporting and exceeding working hours with no supervision are typical. The motivation of the contractors is to work as fast and earn as much as they can in that time, to be able to return home. As a solution it was stated that supervisor should work overtime as well but this does not eliminate risks caused by fatigue, for example. (Schubert & Dijkstra 2009)

When working with foreigners, a permission to work with them is required. Getting the permission causes unproductive extra work for contractors and is considered hindering cooperation. Due to the lack of qualified personnel, it is a necessity for contractors to work with foreigners. As solutions, operating organization can organize a safety day to harmonize expectations and constantly evaluating those projects with foreign workforce. (Schubert & Dijkstra 2009)



## 2.6 Safety management throughout a contractor lifecycle

Contractor management can be considered as loss prevention by selecting qualified contractors, who are able to perform the needed service without risking the safety of anyone affected. The dilemma with contractors usually culminates in money. Clients want to minimize the costs but still get highly skilled workforce with expensive specialty equipment. In addition, there usually is a need for a bigger labour pool to be able to adjust for the changing schedules and workloads. As the icing on the cake comes training when contractors should be able to train their workforce for each client's short jobs. The key players of contractor management are supply chain management, management team, site supervision and site safety representatives. (Haight 2013)

A lifecycle approach can be combined to contractors so that contracting is considered as a lifecycle process starting from prequalification and ending in the post-job evaluation. In-between are pre-job planning and risk assessment, training and induction and monitoring of the job. Contractor lifecycle can be seen in Figure 9.



**Figure 9:** Contractor lifecycle (Campbell Institute 2015).

To make the contractor safety management efficient, it should cover the entire contractor lifecycle. One key part of successful contractor safety management is continuous safety communication between the operating organization and the contractor. Clear communication of corporate values via email, bulletin boards, in-person meetings etc. (Campbell Institute 2015) shall be established throughout the whole lifecycle.

Knowledge exchange between contractor and operating organization is crucial for learning from failures. By monitoring contractor feedback and verifying training of contractors, research showed that contractor relationship management had substantial

positive effects on knowledge exchange between contractors and operating organization, which furthermore enables failure-based learning and increased safety. (Gressgård & Hansen 2015)

It is important to consider a contractor safety management program's fitness for its purpose. Input from contractors should be collected as well to ensure it fits the ones who in the end must live with the program. (Haight 2013)

### **2.6.1 Prequalification**

The focus of this thesis relies on the last four steps of the contractor lifecycle, rather than the first one. Prequalification practices are of course reviewed from the safety point-of-view, but the details of procuring process are not in the scope of the thesis.

The purpose of prequalification is to find out whether a contractor has experience, resources and qualifications to perform the work required. It takes place at the beginning of the bidding competition and aims at eliminating bidders who lack qualifications. (Baird III & Puglionesi 2014). Some organizations have their own prequalification program while others use third-party prequalifying companies, such as Achilles and BROWZ. However, some question their reliability and thus perform prequalification in-house with their own measurements.

In the prequalification process all kind of performance data is being collected, including but not limited to management and technical capability, previous experience and performance, reputation, proposed work methods and EHS-performance. A typical mistake is overlooking safety by weighing other criteria. (Campbell Institute 2015). Most weighted factors according to Walters' and James' (2011) research were contractor experience, quality record and company's reputation.

The prequalification process has received positive feedback because it can help to develop solid relationships and it boosts contractors to perform better while hoping for more business opportunities. It can also be seen enhancing continuous improvement, since it forces contractors to work more systematically. (Campbell Institute 2015).

Contractors want to win the bidding competition and if safety requirements are communicated properly already in the bidding phase, they want to fulfil those requirements to get the contract. This is one way to communicate to the current and future contractors that safety matters in the selection process, to encourage them to perform better in terms of safety to be able to continue their business. (Baird III & Puglionesi 2014). In Table 4 one can see several types of safety related prequalification items.

**Table 4:** Possible prequalification items from safety perspective (adapted from Baird III & Puglionesi 2014).

Type of information	Examples
Safety performance	Experience Modification Rating (EMR) Recordable injury/illness information (e.g. OSHA 300A) Fatalities, injuries, working hours, LTIs, LTIF, TRIF List of safety notices of violations or fines Safety/health-related judgements, claims, contract terminations or pending/outstanding lawsuits
Safety routines	Safety meeting routines (e.g. regularity, frequency, agenda, responsible person, compulsion) Disciplinary action policy on safety violations / disobedience JSA utilization state HSE audits + corrective actions Injury & near-miss investigation “Stop-work” program
HSE programs	Certification that contractor follows all applicable regulatory requirements e.g. OHSAS 18001 / ISO 45001 certificate Description and copy of the contractor’s HSE program Safety and health policy Detailed description of the contractor’s HSE training (e.g. course listing, frequency, periods of validity, syllabus) <ul style="list-style-type: none"> <li>• Training examples: company HSE policies/programs, new employee induction, emergency action plan, fire prevention plan, confined space entry, excavation safety, fall protection, PPE, respiratory protection, lockout/tagout, hot work, electrical safety, bloodborne pathogens, scaffold, hazard communication, hearing conservation, injury/illness record keeping</li> </ul>
Licences/certifications	Copy of licenses, certifications, training or experience documentation <ul style="list-style-type: none"> <li>• Crane / Forklift licences</li> <li>• Trainings attended by each employee</li> <li>• Working permits for all high-risk tasks</li> </ul>
Experience/references	Projects and references for similar scopes of work

Table 4 shows some possible safety related prequalification items, from which the organization can select the most suitable ones for their own purposes and create their own prequalification tool. Prequalification tool forms by setting certain requirements in safety performance and evaluating their safety routines and HSE programs, checking their licences and certifications and looking at their experience level and references.

For example, operating organization can ask for contractors’ safety records and KPIs or Experience Modification Rating (EMR), which means the ratio between company’s sickness and incident costs in comparison with the industry’s average. The classification goes following: 1.0 is average, 2.0 is double the average, which means twice higher costs,

and 0.5 is half of the average, aka twice lower costs, and so on. Organization can for example compare this value between contractors or set a certain limit value for it.

There are also some ready-made tools for evaluating the safety management of contractors. Some of them are more for the contractors to prove their safety commitment and capability. Such as SHE Checklist for Contractors (SCC), commonly used in high-risk work or environment, e.g. in construction or petrochemical industry. SCC communicates of contractor's safety commitment, competent employees and professional safety management system. This can be utilized to cover the safety part of the prequalification process. (DNV GL AS 2015). Other equivalents include for example Diekemper & Spartz (D&S), CHASE, ISRS and SafetyMap (Safety Management Achievement Program).

However, when selecting contractors, safety is not the only selection criteria, but also costs, reliability and efficiency, for example. Also, injury statistics should be looked at with scepticism, because they can just be poorly reported and thus low. Safety management will usually lead to a little bit higher costs, since it takes time away from the productive work, when organising trainings, safety meetings and administrative support for example. (Haight 2013). Nevertheless, injuries lead to huge costs as well and those should be considered when comparing the bidding companies.

Audits may be part of the prequalification program, if during the prequalification arises some doubts about any specific area. The content, scope or process of an audit may vary, and they may for example focus on safety programs, training programs, evaluating contractor's safety awareness. Typical problems with the audits can be the lag time before finishing the findings and changing contractors (who participate in the audit and other contractors, who work on site), because their working periods may differ between hours to years. (Haight 2013). Audits can also take place in latter parts of contractor safety management process such as in the monitoring phase.

One tool besides traditional audits available is so called "real-time snapshot", which means comparing corporate's safety program with front-line employees understanding about it. (Haight 2013). This helps to notice whether the safety program has really been implemented or just verbiage and big words on organization's webpage.

If a contractor has a longer contract or it is renewed multiple times, periodical reassessing shall be in place, to confirm that contractor still meets with the requirements. Depending on the risk-level of the work contractor is doing, reassessing could be for example annually or every second or third year. Also, if any documents have the dates of expiration, the new ones should be delivered before that date.

As a result of the prequalification, each contractor gets a classification. It can be numerical, percentual, alphabetical or verbal. The classification affects future business opportunities and required improvement actions.

The prequalification process may also have some stumbling blocks. Firstly, in some distant places, service offering may be limited, even just one or two service providers. In this case if the operating organization wants to do business in that area, they must select either one and help them develop their safety practices to somehow make sure they meet with the requirements. Secondly, there might be some small providers with good service, but missing safety management system. For small service providers safety management costs may quickly become so high, that their business turns unprofitable. However, they may provide first-class service even though they lack a safety management system. However, the prequalification process gives them poor classification. The costs become an issue also if using third-party prequalification companies. Finally, the flaws of the grading system can lead into an unrealistic and wrong picture of a contractor. Prequalification should take in to account whether a contractor is local or new to the area, large or small, specialty or general service contractor and inside the fence or running loose. (Haight 2013, Campbell Institute 2015)

After passing the prequalification, the bidding competition continues between the residual contractors until one will be awarded by contract. Safety requirements should be communicated via contract and include possible additional safety guidelines or rules.

### **Occupational health and safety in contracts**

Litmanen (2008) has made his Master of Science Thesis about safety in contracts. According to his results, the most important responsibilities to be defined in contracts were supervision of work, induction, training, ensuring competence, subcontracting, co-operation and working environment. In Table 5 foci of contract responsibilities have been clarified.

**Table 5:** *Contract responsibilities (adopted from Litmanen 2008).*

Responsibility area	Support questions to be answered in contracts
Supervision of work	Will the workers be on the responsibility of contractor or operating organization?
Induction	Who is responsible of induction and how will it be performed?
Training	Are there any special risks on operating organization's workplace? Who will train workers to manage those risks?
Ensuring competence	What special competences are needed? Operating organizations requirements from its workers?
Subcontracting	Is contractor allowed to subcontract its work and what kind of requirements are set in place for subcontracting?
Co-operation	How will it be organized? What kind of aspects shall be considered?
Working environment	Which parts of the working environment will be responsibility of contractor?

Most tricky situations arise, when a contractor employee is doing something, which does not belong to the contract and the responsibility may shift to the operating organization (Litmanen 2008). Disagreement cases arise, when responsibilities are not well defined.

Manu et al. (2013) states that if contractors subcontract their work further, the subcontractor might not buy into the safety culture of the operating organization. Subcontractors have not gone through the same prequalification process and there may arise problems with governance, if the operating organization is not aware of the subcontractors.

## **2.6.2 Pre-job task & risk assessment**

It is operating organization's responsibility to inform its contractors about all the hazards related to the job. To find out the hazards of each job, sufficient pre-job planning and risk assessment procedures are necessary.

Campbell Institute depicts the procedures of their members. At Georgia-Pacific, they have two-level risk assessment: at first on the broad scope of work and secondly on contractor's detailed work procedure. Their risk assessment follows a risk matrix, which characteristics are severity, frequency and probability. For high-risk projects an additional written safety program is required. At NASA, they also include costs, security, schedule and other factors in their risk matrix. (Campbell Institute 2015)

Contractors can be divided into categories, for example in higher liability and lower liability contractors. Higher liability contractors may perform high-risk work and thus more in-depth risk assessment is necessary. Other tools may be hazardous job meetings or detailed job walkthroughs. (Campbell Institute 2015). Prequalification classifications can also be related to liability levels so that for performing high-risk work, contractor needs to have certain higher classification. Working permits are also closely connected with performing high-risk work.

Job Safety Analysis (JSA) or Job Hazard Analysis (JHA) is a tool for analysing the safety issues related to work before starting to do it. The four steps of it are (1) selecting the job under analysis, (2) breaking it down into steps, (3) identifying all potential hazards and risks, and (4) determining necessary mitigation actions. (Canadian Centre for Occupational Health & Safety 2018). JSA is already being used at Wärtsilä Services and on Wärtsilä Marine Solutions' projects e.g. in shipyards or on board.

When doing business with another organization with their own safety management system, it is important to have a HSE alignment kick-off meeting between the operating organization and the contractor to make sure their management systems fit together (Campbell Institute 2015). Also, to reveal all possible gaps and make sure they are

aligned. The HSE kick-off meeting may include going through the HSE rules, HSE plan, working procedures, emergency situations, most important hazards related to the tasks.

Contractor chains can sometimes get complicated when contractors subcontract work. Operating companies need to consider this and make sure contractors' prequalification standards meet with their own. Usually, it is contractors' responsibility to make sure their subcontractors follow the same guidance and requirements like themselves. (Campbell Institute 2015).

### **2.6.3 Contractor training & orientation**

Even though legally it is contractors' responsibility to train its employees, operating organizations typically have better safety training materials and programs. Thus, it would be reasonable for them to take responsibility for training contractors. (Rebitzer 1995).

To enable safe working procedures and possibilities to work safe, contractor employees need information about the hazards and they need to be "fit for the job" in terms of proper education and training. Trainings and induction can be online interactive trainings or webinars, videos, face-to-face school-class trainings, site walk-arounds or in a written form.

Each contractor employee should go through sufficient induction and orientation. It shall include for example: organization's HSE policy, safety rules, emergency evacuation practices, first-aid equipment locations, fire extinguishers and other fire prevention equipment, access control practices and possible restrictions, incident reporting and investigation practices, typical hazards related to their work and the premises in general, contractor management practices and risk control requirements including hazardous chemicals, PPE, required work permits, certificates, licences or trainings, tools, equipment. Induction should be recorded for traceability. In addition to induction, more specific trainings might be necessary to ensure safe work.

Work permits can be used to control performing high-risk work by requiring special training to attain each work permit. With health checks operating organization can ensure contractor employees are fit for the job. This becomes more important if the work period is long.

In U.S. Steel, all contractors need to take part into daily pre-shift safety meetings and annual safety awareness training. In AECOM, supervisors go through a 30-hour OSHA training and all contractor employees take part in OSHA's 10-hour version. At Norfolk Southern contractors receive the same trainings as in-house personnel. At BABCO, their contractors need to present a list of all the safety trainings of all their employees working for BABCO. (Campbell Institute 2015).

According to Bahn's research focusing on hazard identification and management training has a positive improvement impact on safety statistics. (Bahn 2013). This kind of trainings will instead of learning by heart all the hazards, give employees applicable tools to identify and mitigate hazards and risks. This kind of training in addition to their own work place's major hazards might be more successful than listing all possible hazards.

#### **2.6.4 Monitoring of job**

When monitoring a job, it is important to make sure the work is done as agreed and planned in the former phases of contractor lifecycle. In case something unexpected appears, for example JSA can be used to reassess changed working practices (Canadian Centre for Occupational Health & Safety 2018). If a contractor is not following the set requirements, consequences to disobedience shall be executed. Those consequences must be communicated before-hand. (Campbell Institute 2015).

Monitoring of a job includes all the daily, weekly, monthly and other periodical activities happening while performing the agreed work. These can include performance reviews, field verifications, compliance assurance with safety plans, non-compliance or unsafe conditions reporting and injury and near miss reports and logs. (Campbell Institute 2015). In Walter's (2017) research the case companies organized a focus group meeting, where the contractors were able to express their problems and possible improvement action ideas.

Near miss and injury reporting, investigating and making corrective actions together enable continuous improvement, when communicated efficiently to all parties. (Campbell Institute 2015). Might be that contractors have their own reporting systems, which leads into necessity to agree on how could information be shared efficiently for both parties.

H&S rewarding can help to motivate contractors to develop safety, increase near miss reporting and in general to work in a safer manner. Rewarding should be thought out so that its effect is only positive, and it shall not for example arise jealousy. The purpose would be to increase safety awareness and to help to communicate that safety matters. In a research of Manu et al. (2013) one of the case companies awards monthly one of the contractor supervisors, who have shown good safety behaviour, practice and innovative ideas. The monthly winner will be awarded with points and a 50-pound-voucher for a grocery store. (Manu et al. 2013)

#### **2.6.5 Post-job evaluation**

Post-job evaluation stands for evaluating the contractor at the end of or after the contract to utilize when selecting future contractors or renewing contracts. In some companies, it is integrated together with periodical reassessments (Campbell Institute 2015).

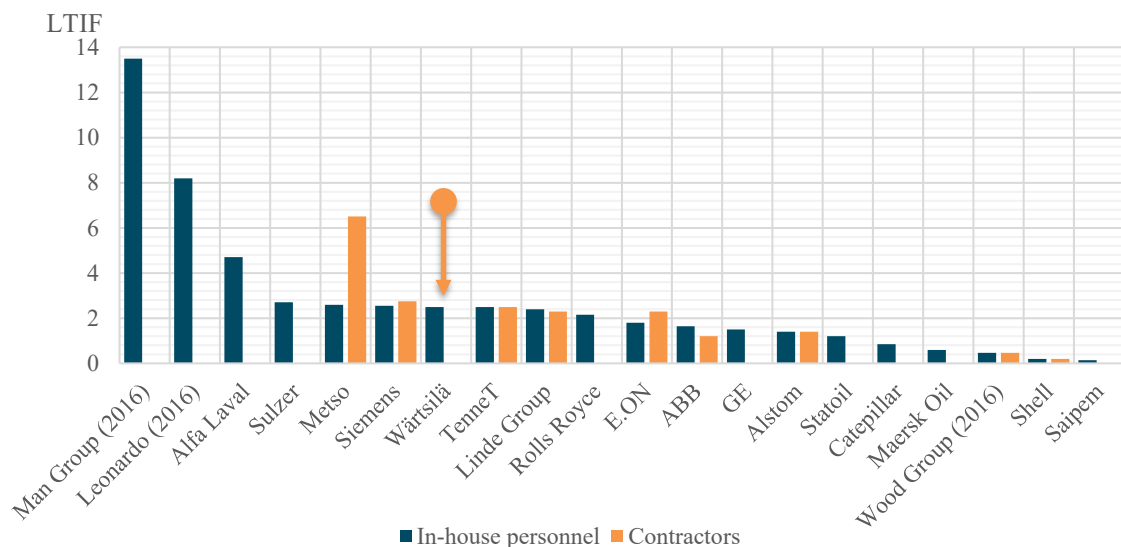


Post-job evaluation enables using the same, good contractors again, which helps to keep the contractor chain regular. This reduces resources from always training and guiding new contractor employees to do the same work.

Concretely post-job evaluation can consist of saving the injury or near miss statistics of contractors, giving them feedback about their performance for example in terms of safety and efficiency or reviewing the effectiveness of induction of a contractor. In short it is just giving feedback to the contractor about if the work was running smoothly or not. (Campbell Institute 2015).

## 2.7 Contractor safety management at marine, oil & energy industry

To compare the safety performance with other marine, oil and energy companies, both LTIF for in-house personnel and for contractors if available were looked at. Figure 10 shows the LTIF shared in the sustainability reports or public webpages of the companies in 2017.



**Figure 10:** LTIF comparison of key companies of the marine, oil and energy industry in 2017.

As one can note, few companies report their LTIF of contractors yet. It might be, that some companies do not want to share that information, since it is not compulsory or might be, that they just do not have that information. At Shell, Wood Group, TenneT and Alstom the LTIF shown includes both, in-house personnel and contractors and at Metso, Siemens, Linde Group, E.ON and ABB it is calculated separately from in-house personnel. Only Metso has significantly larger LTIF for contractors than for in-house personnel. Another interesting observation that was noticed when comparing the statistics (Appendix C) was that LTIF for in-house personnel has been decreasing whereas LTIF for contractors has

been increasing moderately, except at ABB. May this be because of the increasing number of contractors with poor contractor safety management?

Some companies on the same industry for example many shipyards are not sharing their LTIF statistics publicly and thus many key players are missing from the chart. However, comparison gives some perspective on LTIF of companies in the same industry. It also proves, Wärtsilä still has development potential, since it is behind of the best performing companies.

### **2.7.1 Contractor safety management practices in marine, oil & energy industry**

When looking at their contractor management practices, very few companies even mentioned their contractors or shared any relevant information apart from stating that “*we will work closely with our contractors, subcontractors and partners*” or “*our HSE management practices are equally shared by all parties*”. Some companies mentioned they require contractors to go through a third-party prequalification.

At Siemens, they also train contractor employees at their Safety Training Centres at several locations. EHS experts are also included in their selection process so that they need to approve HSE related parts before they are included in Siemens’ supplier database. (Siemens 2017). Alfa Laval had a program called three-prioritized-risks. Alstom has a proactive approach to train buyers and focus on sourcing sustainable products and services (Alstom 2017).

At ABB, they have Supplier Code of Conduct (SCoC) to communicate their sustainability targets towards suppliers. They also go through a supplier qualification process before being selected and after selection ABB has ‘Supplier Sustainability Development Program’ (SSDP) for high-risk suppliers, including training and on-site assessments according to 42 parameters linked to ABB’s SCoC. To promote SSDP for their suppliers, they have made after movies about successful cases. SSDP’s top 10 safety related global non-compliance issues are: unsafe working practices, lack of first aid or fire-fighting equipment, excessive working hours, lack of OHS risk assessment, lack of equipment testing, lack of compliance monitoring. (ABB 2017)

DuPont had shared their contractor safety management process (Figure 11), which follows similar steps as Figure 9 in Chapter 2.6. Mostly it is the same, but they have added

contractual steps and excluded or included somewhere else pre-job task and risk management.



**Figure 11:** Contractor safety management process at Dupont (DuPont 2018).

Ecomaine uses a contractor safety video to communicate the principal safety requirements and practices. They can ask contractors to make risk assessments. Changing work needs to be approved by Ecomaine supervisor. After the video, a contractor needs to sign a form that they have understood, and they will commit to those rules. (Ecomaine 2015)

Neste Oil's safest contractor award: a contractor, which has improved its safety practices, worked diligently for safety and performed its work safely and with a high quality. (Neste Oil 2015). At Neste, they ensure contractor safety by making audits, contractual safety requirements, PPE, safety policies and jointly prepared written risk assessments for high-risk works, necessary trainings, work permits and right timing in terms of schedule. (Neste Oil 2018).

## 2.7.2 Case study: Contractor safety management at Shell

Since Shell has been managing safety well also for contractors and they have been sharing many of their practices in public, a closer look on their contractor safety management was taken. As an overall view, Shell's safety tools and principles with contractors lay strongly on clarity, simplification and open sharing (Shell 2018f). Shell also works closely with International Association of Oil and Gas Producers (IOGP) to share best practices and raise industry standards. (Shell 2017a)

### Prequalification – Supplier Qualification System (SQS)

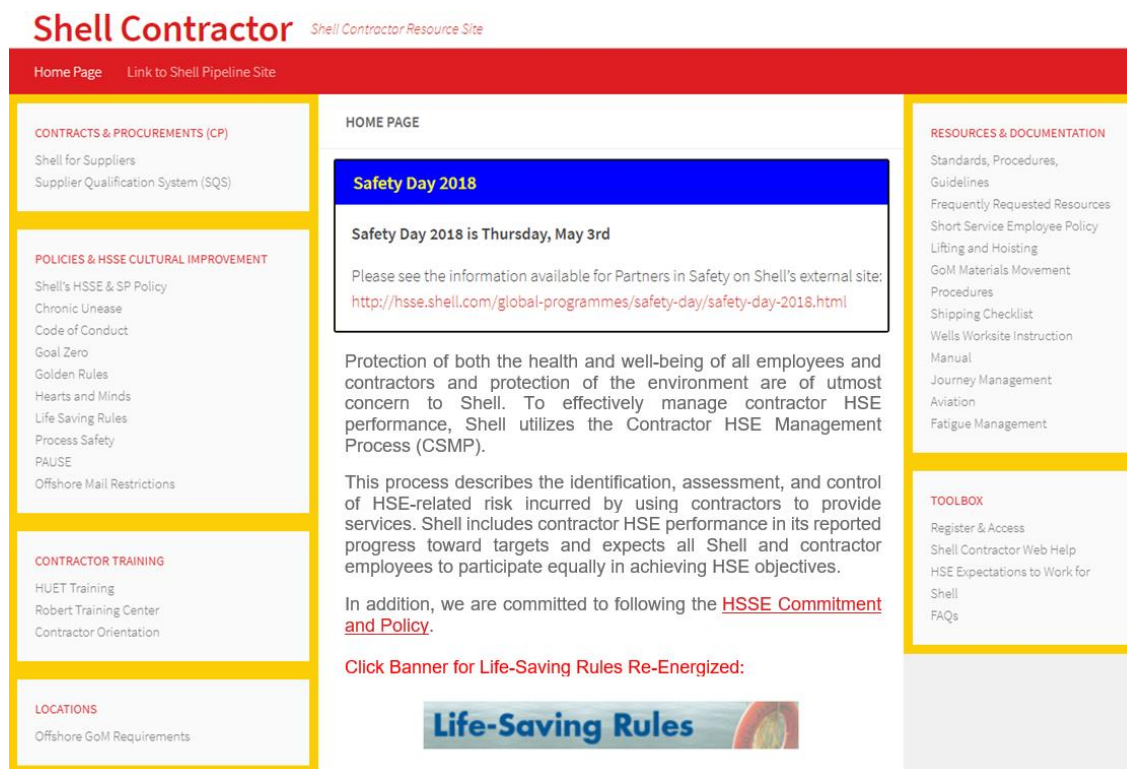
In 2017, Shell had goods and services from 33 500 suppliers globally. Since 2012, Shell has been using two-staged Supplier Qualification System (SQS) for the prequalification of suppliers. The first stage is a 20-minutes, charge-free online questionnaire and only if a contractor's risk level output is low, no further investigation is needed. The second stage will focus on assessing more detailed contractor's health & safety, ethics & compliance and/or labour rights. The further investigation will be performed by Achilles. Prequalification approval must be renewed every three years. (Shell 2018b)

When assessing their suppliers and contractors they apply risk filters, such as health and safety, labour and human rights, business integrity, finance and technical risks, to identify high-risk suppliers. Afterwards they work together with the suppliers to close those gaps and ensure they have a corrective plan. Typically, their gaps are related to freely chosen

employment, child labour, working hours, salaries, housing and working conditions, humane treatment, equality, the freedom of association and their suppliers. (Shell 2017b).

### Contractor Safety Management Tools at Shell

For communicating their safety requirements easily, Shell has created a dedicated Shell Contractor webpage including their safety principles and instructions. Shell may also have other communication channels, which are not available publicly. Figure 12 shows the contents of the homepage.



**Figure 12:** Shell contractor Resource Site (Shell 2018c).

From the left side of the website, one can see Shell's policies and HSSE cultural improvement tools. Some of them are similar to what Wärtsilä is using, such as QHSE policy, code of conduct, zero mindset and life-saving rules.

Chronic unease is about preventing complacency about being safe but being suspicious and improving continuously (Shell 2013a). For Shell it is essential since their safety performance is already on a really high level, e.g. their LTIF is 0,2, and thus their employees may start to overlook safety. Shell has a publicly available and animated Chronic Unease -training.

Golden rules are intervening unsafe acts, compliance with laws & regulations and respecting others. Wärtsilä has those as well, but not named in this way. Hearts and minds are toolkits for improving safety culture. Process safety includes industry specific process safety instructions and engagement packs.

PAUSE (People, Activities, Unexpected events, Scope of job and Exposures) is Shell's worksite hazard recognition and management tool, which is one of their ways of working towards goal zero. Physically, PAUSE is a two-sided pocket-sized card, which has divided hazards into eight groups, being like a small risk register. When PAUSE is done, workers stop the work and discuss the safe way to perform their upcoming task, meanwhile getting guidance from the PAUSE card (Figure 13). (Shell 2013b)



*Figure 13: Shell's (2013b) PAUSE card.*

On Shell contractor webpage the second part is about trainings offered for contractors, including orientation training. Orientation training is not available publicly, but only for registered contractors. Underneath trainings, there are locations, which include site specific minimum requirements as a clear list. The requirement list shows, what kind of trainings are needed, what kind of PPE to use, compliance requirements, fitness to work and prequalification requirements if medium- or high-risk work.

On the right-hand side of the webpage there are Resources & documentation, which are focusing on work-related instructions. One noteworthy thing is Short Service Employee (SSE) policy, which is a program focusing on (sub)contractors with less than six months of experience at their current employer and position. Its intention is to avoid injuries by ensuring that inexperienced contractor employees are identified, adequately supervised, trained and managed. (Shell 2018e)

In addition to the contractor website, Shell also has a Contractor Portal, which is used for managing their contractors' personal information, technical, safety and training certifications and courses, access to Shell facilities and reporting (Shell 2018a). Also, the mandatory online contractor orientation(s) can be accesses through it (Shell 2018d). This sounds a bit like Wärtsilä Solarium, which is used in WDC Trieste, but with more features.

Shell and some other organizations also have a booklet called ‘Contractor HSE handbook’, which is delivered to their contractors to communicate about Shell’s safety and environmental requirements. Especially in Australia these are common and even some universities had safety booklets of this kind. After familiarizing oneself with the contractor HSE handbook, contractors must sign that they have read, understood and are capable of fulfilling the requirements of the handbook. There are consequences to any violations up to eliminating from the workplace and termination of the contract. (Shell 2012)

Shell also organizes learning sessions after all incidents for both, contractors and in-house personnel. It focuses on, how it could have been avoided and how to apply lessons learned in their own work hence enabling continuous development. (Shell 2017a).

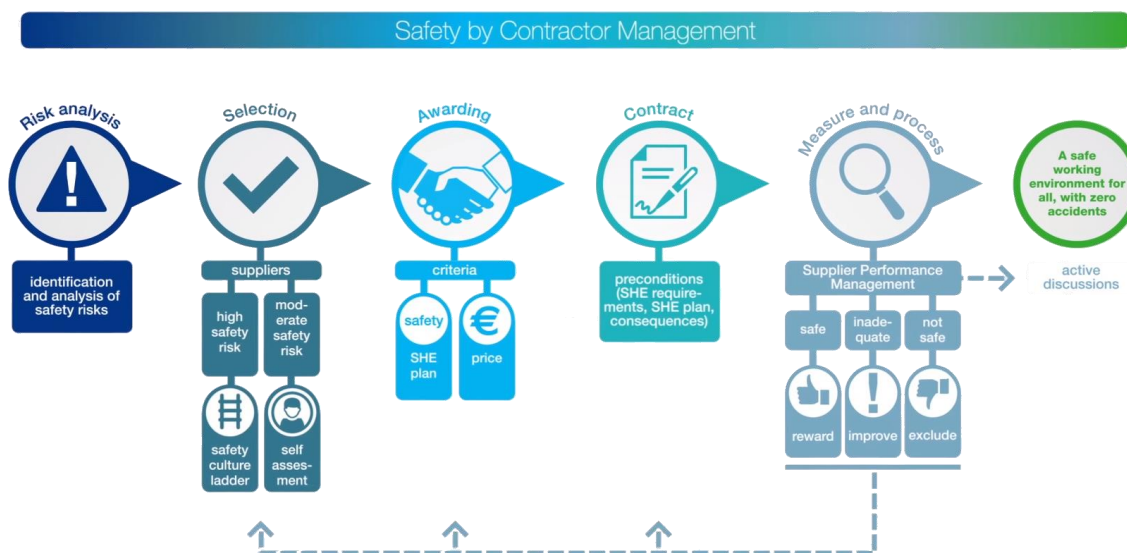
### **Contractor Safety Leadership (CSL)**

In 2014, Shell started a project called Contractor Safety Leadership, to create stronger safety culture. They gathered 12 CEOs of their main contractors together to reduce the complexity of safety management in projects and improve their safety. After the contractor safety workshop, they came up with 18 initiatives including a shared office, work packs, crew-led toolbox talks, cross-department safety-tours and hazard observation cards. (Fugro 2016).

A shared office refers to having open doors to ensure more effective communication on the vessel and to increase information sharing. Work packs are hard copy folders made available for everybody and they include instructions about how to perform daily tasks correctly. Crew-led toolbox talks are led instead of the supervisor, by team members and the purpose is to move the ownership of safety issues to the team and ensure all relevant tasks are done and understood. Cross department safety tours mean personnel visiting other departments and workspaces to observe them from a safety perspective giving the employees new perspective to everyday hazards and to enable the sharing of ideas and experiences. Hazard observation cards are meant for giving safety feedback, which again adds ownership and helps to cross cultural barriers and document safety issues. (Fugro 2016).

### **2.7.3 Case study: Contractor safety management at TenneT**

Due to open sharing of good contractor safety management practices, TenneT was selected for closer observation together with Shell. Contractor management at TenneT is a key element of their Safety Vision 2018. (TenneT 2018a). Their contractor safety management process (Figure 14) consists of risk analysis, selection, awarding, contract, measure and process and is after for a safe working environment for all parties involved without any accidents (TenneT 2016).



**Figure 14:** *Safety by Contractor Management (TenneT 2016).*

At TenneT, they focus on procuring safe suppliers and helping them to develop their safety up the safety culture ladders (Figure 5). They are including a SHE-plan made by contractor into their contract to ensure early adaptation of the importance of safety. (TenneT 2016).

TenneT makes quarterly ‘*Partners in safety*’ newsletters to communicate about latest news, the progress with the Safety Culture Ladder project, and incident investigation. As well as Neste, TenneT also has annual safety award for contractors. It goes to the contractor, who has implemented the best safety initiative in the past year to improve safety at TenneT (TenneT 2018b).

TenneT Contractor Forum was held in January to gather together over 100 managing directors of their major international contractors and offshore partners. The focus of the forum was in sharing knowledge and ideas for the upcoming challenges in energy transition, related to safety, sustainability and innovation. Multiple executive board members and senior managers were involved emphasizing the importance of contractor safety. (TenneT 2018b)

#### **2.7.4 Case study: Contractor management at a large shared workplace company**

A large shared workplace actor from related industry to Wärtsilä was interviewed about their contractor safety management practices. They wanted to stay anonymous and thus later in this chapter, they are referred as ‘*the case company*’. They have daily a couple of thousand people inside their fences, who are approximately 50:50 in-house and contractor employees. All information has been received from their HSE Engineer, who interviewed multiple people inside the case company.

On a management level, the case company is engaged in safety of both in-house and contractor employees. To fulfil their commitment, their HSE policy is covering also contractor employees of all levels.

Their contractor chain may reach multiple levels so that their partner contractors can have their own contractors, which can further have subcontractors. Partner contractor companies are quite stable due to the length of projects and thus the major fluctuation takes place on the lower levels of the contractor chain.

Their process starts with making contracts with the partner contractors, who are required to ensure all their contractors and subcontractors will follow the rules. Attached to each contract, the case company has HSE rules, which each actor shall follow, and which shall be communicated downwards in the contractor chain.

To be authorized to enter the premises of the case company, several documents are required from all contractor companies and afterwards from contractor employees of all levels. The documents from contractor companies include register of employers, retirement pension insurance, accident insurance and occupational health service, all from the operating country and maximum three months old. In addition, they require business information document, contact information in the operating country and inside the fences of the case company. They also collect the information of which collective labour agreement the company is following to ensure at least minimum salaries are being paid.

To be able to identify and control accesses, they use ID badges, which are connected to a system with all contractor employee related information and competence. Their competence is checked with several types of qualification certificates related to certain type of work and additionally work permits are being used for certain work tasks. Work permits are shown in helmets as stickers of different colour and picture.

Their induction is done on a circa 40-minutes electrical interactive training including videos, exercises and test in the end. It is available on 14 different languages to improve understanding. They are also offering internal safety trainings, where also contractor employees are authorized to participate.

Related to monitoring of job they are performing several types of safety rounds, and having weekly meetings also considering safety. Certain PPEs are required to wear inside their fences by all. They also have co-operation managers, who are for example responsible of communicating and aligning simultaneous jobs, and HSE officers responsible of monitoring the use of PPE and acting safely. Also an external party is auditing part of the contractors due to a national shared workplace project.

Everyone inside their fences is entitled and required to stop work, if anything unsafe is noticed. In case of safety breaches, they have three level disciplinary actions consisting of giving guidance on the correct way of working, sending home for the rest of the day



or the most severe is sending home for a week and giving a fee of 500 euro for the contractor.

They are developing their reporting and after the upcoming change, they will have a system which works via a provided link, making it efficient to report as an external party without having user to the case company's systems. All LTIs are reported and LTIF calculated for both internal and external employees separately and combined.

They also have an annual HSE day, where contractors are invited to join, but for motivational or communicational reasons they are not all reached. In the future they are investing on increasing the amount of billboard displays, also outdoors, to boost communication related to all types of communication. They also used to have a HSE knowledge sharing forum, consisting of both contractor and case company employees, but due to lack of resources, it has been on a break.

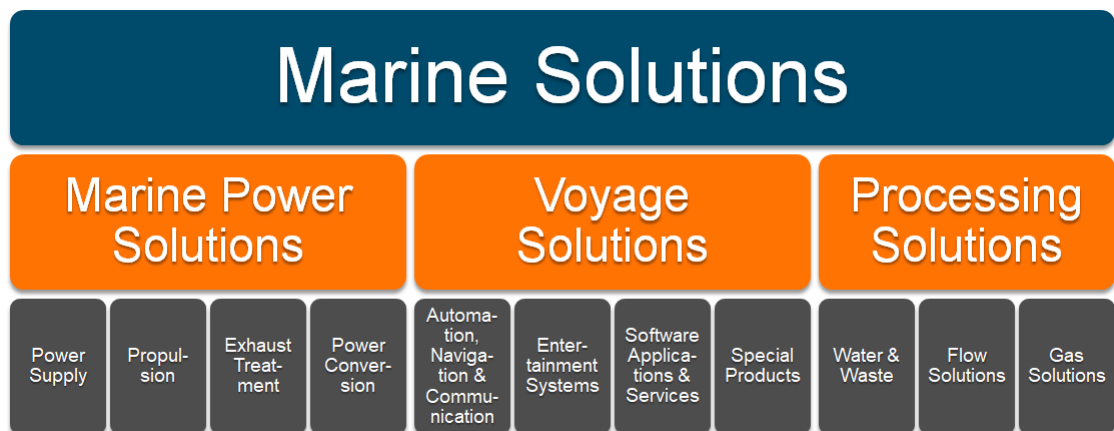
### 3. THE CASE COMPANY AND THE RESEARCH PHASES

Wärtsilä wants to be their customer's most valued business partner by shaping the marine and energy markets with advanced technologies and by focusing on the lifecycle performance of their vessels and power plants. This way their customers will be economical yet also environmentally friendly. In 2017, Wärtsilä's net sales were 4.9 billion euro in total. In 2017, Wärtsilä had approximately 18,000 employees in over 200 locations and more than 80 countries. (Wärtsilä 2018a). Wärtsilä consists of three business divisions: Energy Solutions (ES), Marine Solutions (MS) and Services. The scope of the thesis is Wärtsilä MS.

This research is a constructive research aiming at creating an operating model of contractor safety management. The research phases are described later in Chapter 3.2.

#### 3.1 Wärtsilä Marine Solutions

Wärtsilä MS is divided into Marine Power Solutions, Voyage Solutions and Processing Solutions, which again are divided in total in 11 business lines as shown in Figure 15. (Wärtsilä 2018b). From the beginning of 2019 there will also be fourth business line when services will be merged with MS and ES (Wärtsilä 2018c). The upcoming change was however not considered in the thesis, since it was announced in October (thesis had already proceeded quite far) and not taking effect during the making of the thesis. Including marine services would widen the scope of the thesis quite significantly. The administrative departments are not seen relevant to the research and thus left out from the Figure shown here.



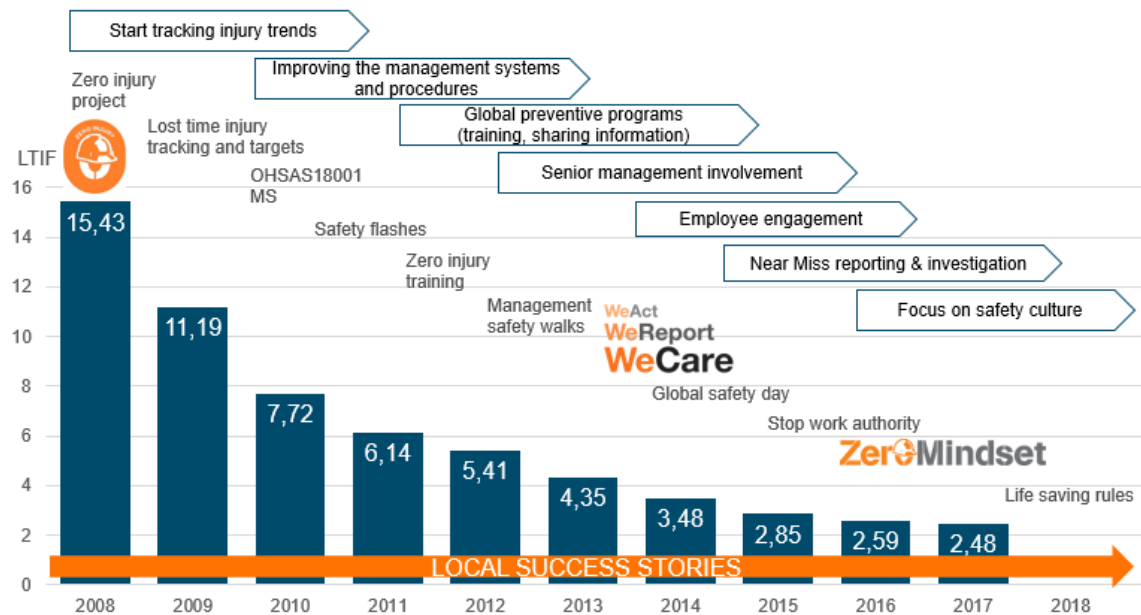
*Figure 15: Wärtsilä MS organisational chart (Wärtsilä 2018b).*

In each business line, there are multiple locations and several types of products. Marine Power Solutions is mainly in Finland, Italy, Spain and China; Voyage Solutions in Italy, Germany, Denmark, Norway, the USA and Finland; whereas Processing Solutions in the UK, Germany, Denmark, Norway, Finland, Sweden and France. In addition, Wärtsilä has so called joint-ventures in China, Korea and Shanghai, which Wärtsilä co-owns with the venture companies.

Wärtsilä MS' product portfolio consists of medium-speed diesel and dual-fuel engines, propulsion systems and gears, seals and bearings, navigation and automation systems, entertainment systems, communication and control systems, power distribution and management systems, electrical design for complex vessels, energy management systems and hybrid solutions, environmental solutions, including for example, exhaust gas cleaning and ballast water management systems, pumps and valves, gas systems, including LNG, LPG and biogas handling, inert gas systems, compressors, liquefaction, regasification, and equipment for small-to-medium scale onshore gas installations and ship design. Wärtsilä MS has both, individual components and turn-key project deliveries. (Wärtsilä 2018a)

### **3.1.1 Safety management evolution at Wärtsilä MS**

The Zero Injury project can be considered as the first step of the safety management journey of Wärtsilä started in 2008. The ZeroInjury project has evolved into the ZeroMindset project concentrating on safety leadership, shared safety mindset and effective safety tools and practices. '*Leader in Safety, leader in business*' training was rolled out in 2017 to support the safety leadership progress. The training is to be covering all Wärtsilä line managers at all management levels and other selected employee groups, who are actively influencing front-line employees' work. Until the end of September 73 % of the line managers have had the training. (Sulonen 2018, personal communication on 30<sup>th</sup> October). The project has had a significant impact on the lost time injury frequency, which has decreased 84 % since, from 15.43 until 2.48 last year. Figure 16 shows the safety evolution timeline until today and the key global practices implemented.



**Figure 16:** Wärtsilä safety evolution timeline (adapted from [Sulonen 2017](#)).

In recent years, improvement seems to have slowed down. Still Wärtsilä's safety performance (2,48) compared with many other companies in the same industry is not enough as was already seen in Figure 10 before. Also, the LTIF of 2017 has even increased during 2018. There is a lot of local variation in LTIF evolution and for example the trend of Wärtsilä Finland Oy has turned out to be poorer after 2017. While some smaller subsidiaries have been able to maintain zero injuries for a long time.



**Figure 17:** LTIF evolution of Wärtsilä Finland Oy (Backman 2018).

As we can see from Figure 17, the safety performance has been deteriorating the last two years. After the second quarter of 2018 it is already double the Wärtsilä global LTIF, which is quite concerning. This negative evolution trend has been also one of the reasons for ending up in the topic of this thesis.

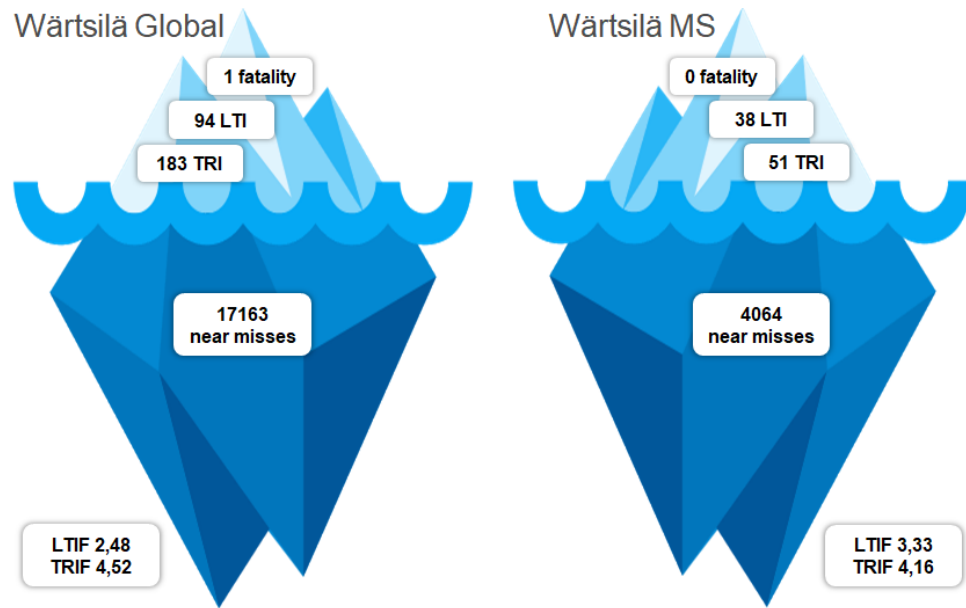
### 3.1.2 Safety reporting at Wärtsilä MS

For reporting Wärtsilä uses a system called WeCare, where one can report an environmental incident or fire, a near miss or a hazard observation, an occupational injury, a safety walk or a security event. In addition to the WeCare desktop version, there is a SynergiLife mobile app. System enables to separate whether the issue concerns external or internal employees and later on in this research we are taking a look on their near miss or hazard observations and occupational injuries.

There are several different types of reports created from the WeCare data on different levels of Wärtsilä, to visualize gathered information and to show the development of LTIF and TRIF, the number of LTIs and near misses. ZeroMindset monthly safety report is created for the whole Wärtsilä, showing the safety performance of each division. The report shows both the lagging indicators (e.g. TRIF, LTIF, severity of injuries, injured body part and action follow-up and lessons learned), and the leading indicators (e.g. number of safety walks and the participants of '*Leader in Safety, Leader in Business*' training). The injuries related to contractor employees are however not included here, because their exact working hours are not available on business division level.

Safety Flashes are made of LTIs or any incident with a possibility of lessons learned. Safety Flashes are detailed descriptions of occurred injuries or near misses, which describe what happened, why it happened and how it could have been avoided. It bases on Think – Observe – Manage (TOM) way of working. It is delivered globally for all HSE contacts to ensure continuous learning.

Figure 18 depicts in-house employees' reporting activity at Wärtsilä globally and at Wärtsilä MS. These are shown to have some perspective to compare KPIs on. To get perspective on the increase in reporting activity, when comparing with 2016, reporting increased 49 % and LTIF decreased 4% (Mäkelä & Sulonen 2018).

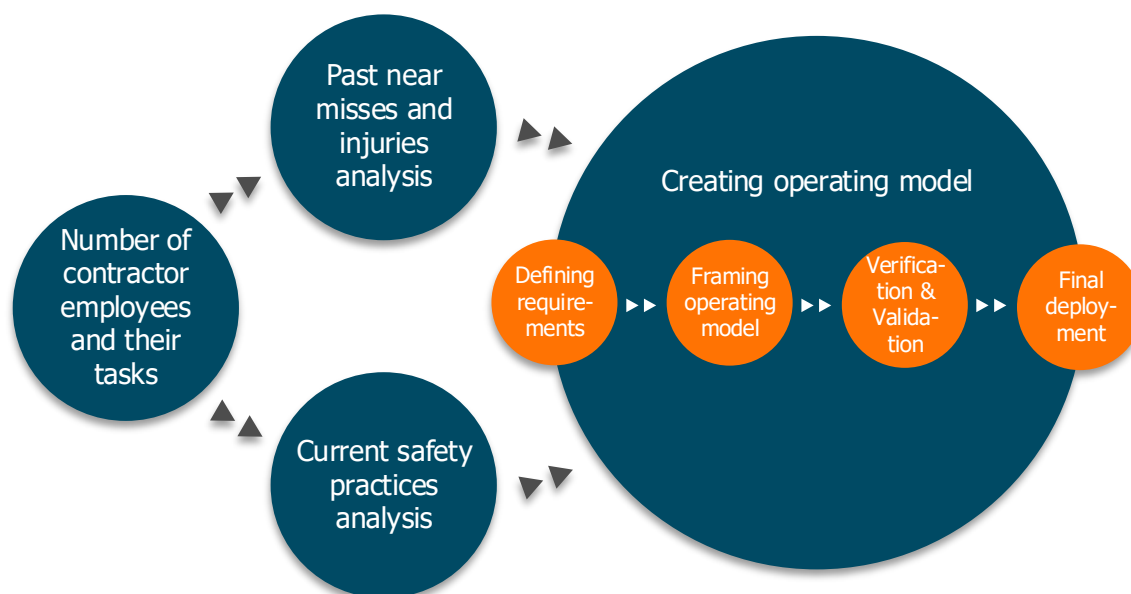


**Figure 18:** Wärtsilä Global and Wärtsilä MS injuries and near misses in 2017 (adapted from Mäkelä & Sulonen 2018).

As one can see, Wärtsilä Global has a little bit lower LTIF than Wärtsilä MS, but TRIF numbers are the other way around. This can be interpreted so that when Wärtsilä MS has injuries, they are more severe than the global average. This can also be due to the poorer reporting of not so significant injuries.

### 3.2 Research phases

The research is being operated as a constructive research consisting of four main research phases and four sub phases as shown in Figure 19. First phase ‘*Number of contractor employees and their tasks*’ works as a basis for two concurrent phases, ‘*Past near misses and injuries analysis*’ and ‘*Current safety practices analysis*’, which together represent a mixed-method design, the prior one offering a quantitative perspective and the latter one the qualitative perspective for this research. The research can also be considered two-folded, consisting of analytical and constructive parts.



**Figure 19:** Research phases.

First three phases offer the background for the creation of the operating model. Then according to the requirements set for the operating model, it will be framed, verified and validated and finalized according to the feedback received.

### **Estimation of number of contractor employees and their tasks**

The working hours of contractor employees have been collected for GRI reporting in 2016 and 2017, but those working hours are divided by subsidiaries, which may include operations of multiple business divisions and thus cannot be used here. To elude the problem, timely (July 2018) average number of contractor employees and their tasks was asked directly via Skype from each Wärtsilä MS location.

### **Analysis of past near misses and injuries**

The near misses and injuries of non-Wärtsilä people were analysed. The reporting of non-Wärtsilä people has been enabled since 2014, which set the starting point of the examination. All reported accidents since 2014 were downloaded in an Excel file and analysed.

Analysis was focusing on reporting activity and relation between near miss and injury reporting rather than the quality of accidents, since poor reporting level does not offer statistically valid results. If combined with the estimated number of contractor employees, calculating TRIF and LTIF for injuries reported on those years would be possible. However, in most locations, those KPIs jumped significantly already after one accident due to the small number of working hours.

## Analysis of current safety practices

Analysis of current safety practices was performed via:

- Semi-structured theme interviews according to Appendix D for (Q)HSE representatives from each location
- Additional unstructured interviews with;
  - Supplier development manager, responsible for prequalification process
  - Wärtsilä supervisors and workshop managers in Vaasa and Trieste
  - Contractor supervisors in Vaasa

Locations to be interviewed were selected according to the estimation of the number of contractor employees in each location so that locations with no contractor employees or under five contractor employees were excluded.

Interviews were held mainly via Skype apart from Wärtsilä Finland. Skype interviews were roughly following question set shown as Appendix D, however leaving space for open discussion. The question set had similar division as the contractor lifecycle model (Figure 9) focusing on finding out current practices at Wärtsilä MS on each step of the lifecycle. In addition, possible development ideas and problems were asked. All questions were not valid for all locations or for all interviewees, and thus the interview was adapting to the position of the interviewee and some questions were skipped. This was the case especially for locations with only white-collar employees, since their work is less risky and as consistent contractor safety management practices were not in place. The question set was used more as a stimulator for the conversation and as a check-list to remember, what kind of topics to discuss. Typically, the discussion was flowing and changing its direction towards the practices in each location and then returning to the questions to ensure covering all steps of the lifecycle. Screen, with the questionnaire set showing, was shared during the interview to help the interviewee to follow. Interviews were recorded to be able to re-listen misheard answers. They lasted about 30-60 minutes. The people interviewed with the questionnaire were (Q)HSE professionals from each location. In addition, a supplier development manager was interviewed about the prequalification process.

Interviews in Vaasa, Finland were held face-to-face during a three-day visit in August. In total nine interviews were held with Wärtsilä supervisors, workshop managers and contractor representatives. The responsible for the prequalification system is Supplier development manager Federico Fronda and thus he was interviewed about the details of it.



## Creating operating model

Requirements for the operating model were defined to ensure the model will be fit for its purpose and operating environment. The requirements proposed by the researcher were confirmed by Juliusz Kurjanski, who is better familiar with Wärtsilä MS.

To verify and validate the operating model, its correspondence with the set requirements and its credibility, transferability, dependability and confirmability of were examined. In practice, verification and validation were done throughout the project by discussion with MS QHSE Director Juliusz Kurjanski and MS QHSE Manager Maria Paula Sartori. The final validation and verification were done by presenting the operating model and its complementary tools in detail in a validation meeting on Skype, where all interviewees from Wärtsilä MS were invited. In case someone was unable to attend, a separate session was held with them.

After presenting the operating model and its complementary tools feedback was collected with following question set:

- Operating model
  - What do you think about the operating model?
  - Do you think the operating model covers the contractor lifecycle well?
  - Do you see the model could be implemented in your location? If not, what do you see it misses?
- Defining factors funnel
  - Do you see the funnel helpful when applying the operating model at your subsidiary?
  - Do you think it has recognized all the key factors?
- Action plan
  - Do you think the action plan has all the necessary actions recognized?
  - Do you have ideas on how could the launch be done?
  - In the last sub-phase, final deployment, the operating model was improved according to the feedback received.

## 4. RESULTS

Due to the variety of locations and tasks, the practices used to manage safety of contractors vary significantly. Thus, gathering those practices together was seen reasonable further enabling creating the operating model for contractor safety management at Wärtsilä MS.

### 4.1 Contractor employees at Wärtsilä MS

Wärtsilä MS has several types of contractor employees around the globe working in wide scope of tasks, both in white- and blue-collar positions. Based on the analysis of numbers and tasks, the main contractor types at Wärtsilä MS were recognized and described in Chapter 4.1.3.

#### 4.1.1 The number of contractor employees at Wärtsilä MS

To get an overview of the number of contractor employees in the whole Wärtsilä, the working hours, reported for GRI, can be utilized. On Wärtsilä Corporation level in 2016 contractor employees performed in total 5.4 million working hours (on average 2700 contractor employees daily) and in 2017 6.1 million (on average 3000 contractor employees daily). This means that the increase in contractor work power used has been 13.5 % since the year before. However, some subsidiaries work with multiple divisions, not only MS division, which means the GRI data could not be used to estimate the amount of contractor employees at Wärtsilä MS.

The average numbers of contractor employees and their tasks were asked from each location via Skype or e-mail (Table 6). They were asked during July and August in 2018. Due to confidentiality, fluctuation and thus lack of accuracy, the accurate numbers are not shared, but only indicative numbers.

**Table 6:** Indicative average numbers of contractor employees. Subsidiary is shown with italic letters if excluded from the interview.

Number	Subsidiaries
300+	Wärtsilä Italia, Wärtsilä Finland
40-70	Wärtsilä APSS, Wärtsilä Oil & Gas Systems
15-30	Wärtsilä FUNA international GmbH, Wärtsilä Water Systems, Wärtsilä SAM Electronics, Wärtsilä Moss, <i>Wärtsilä Valmarine</i>
6-14	Wärtsilä Netherlands, Wärtsilä Ibérica, Wärtsilä ELAC Nautik, <i>Wärtsilä JOVYATLAS EUROATLAS</i> , Wärtsilä Propulsion Wuxi

1-5	Wärtsilä SAM Taihang Electronics, Puregas Solutions, <i>Wärtsilä Valves</i> , <i>Wärtsilä Suzhou</i> , <i>Wärtsilä Svanehøj</i> , <i>Wärtsilä Lyngsø Marine</i> , <i>Wärtsilä SAM Electronics Netherlands</i> , <i>Wärtsilä Pumps</i> , <i>Wärtsilä Ship Design Poland</i> , <i>Wärtsilä Ship Design Norway</i>
0	<i>Wärtsilä Serck Como</i> , <i>Guidance Marine</i> , <i>Wärtsilä Singapore</i> , <i>WCME Zhenjiang Propeller</i> , <i>Wärtsilä Ship Design Singapore</i> , <i>Wärtsilä Dynamic Positioning</i>

As one can see, the main locations, in terms of contractor employees, are Wärtsilä Finland and Wärtsilä Italia. Wärtsilä Oil & Gas and Wärtsilä APSS 48 also have quite a few contractors, but the rest of the locations have under 30. According to the information collected, the number of contractor employees at Wärtsilä MS fluctuates between 1000 and 1500, which means approximately 15-25 % of the in-house personnel of Wärtsilä MS. Subsidiaries to be interviewed were selected according to the number of contractor employees exceeding ten contractor employees and a few otherwise, which were considered as risky locations or performing risky tasks. Some subsidiary representatives replied they do not have any relevant input and those were left out, which was the case in some locations, which only have white-collar contractor employees. Subsidiaries excluded from the interview are being shown with italic letters.

The way to keep track on the number of contractor employees varies by location and not all numbers are reliable. In some cases, contractor employees are added to SAP HR and the working hours are tracked as for the in-house personnel. For some, the working hours are calculated from the invoices and the hours can be changed as the number of employees. The most sophisticated way is in Wärtsilä Italia, where they have a system called Solarium, which is focused on contractor related document management and for example enables getting the accurate number as well.

#### 4.1.2 Tasks of contractor employees at Wärtsilä MS

At the same time with the numbers, the tasks of contractor employees were asked, and Figure 20 depicts those replies. Tasks include both blue- and white-collar jobs. The size gives an idea about the occurrence of contractor employees performing tasks of this kind, but it cannot be taken as absolute truth or valid information, due to the same reliability issues as described before in this chapter.



D	Field service contractors	Working outside Wärtsilä premises, e.g. in shipyard or on board.	Commissioning, maintenance, service on behalf of Wärtsilä
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In case categorized by ‘*Inside the fence*’ or ‘*Running loose*’, groups A, B and C are representing the first type, and D the second type. A type represents agency workers, B type contractors procured as service and C type short term/special service contractors. A and B types are furthermore divided into subtypes to be able to get a clearer picture.

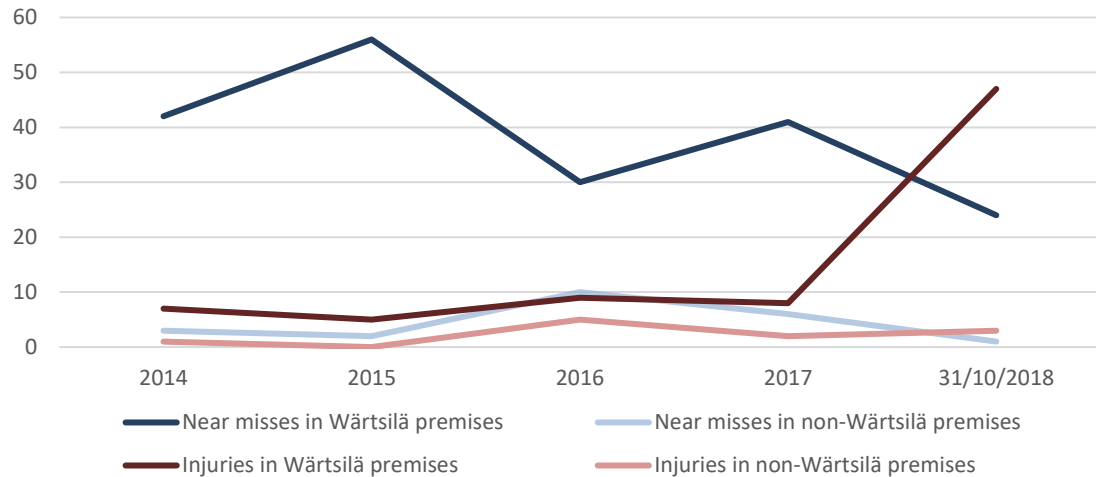
Nature of employment influences on the integration level of the contractor employee, because if they are employed via a staffing agency, they are managed by a Wärtsilä supervisor and they are almost treated like internal employees. If work is procured as a service, they work under the supervision of the contractor company and the number of the employees may fluctuate according to the daily demand.

## 4.2 Analysis of past near misses and injuries at Wärtsilä MS

WeCare is an internal reporting system of Wärtsilä and thus only people with Wärtsilä user ID can access there. Currently, the reporting from contractor employees or other non-Wärtsilä people is done on paper form or otherwise indirectly via an employee of Wärtsilä. White-collar contractor employees might have direct access if separately requested to WeCare since they have laptops and Wärtsilä user accounts. This may affect the reporting activity of blue-collar contractor employees.

WeCare data for the analysis came from Wärtsilä MS globally and it is divided in two: Wärtsilä premises and non-Wärtsilä premises, consisting of customer premises, shipyards or on-board situations. Throughout the analysis blue is used to describe near misses and red to describe injuries.

Reporting for contractor employees was enabled in 2014, which sets the starting point for the reference period. Only since 2017 the reporting of contractor employees has been emphasized to the line managers, which can be one reason for increased injuries reported. However, the near misses reported in 2017 stayed on the same level with former years, which argues against the effectiveness of the emphasizing operations. Below in Figure 21, one can see the overall contractor employee reporting state until the end of October 2018.



**Figure 21:** Total injury and near-miss reports for contractor employees from 2014 to 31.10.2018.

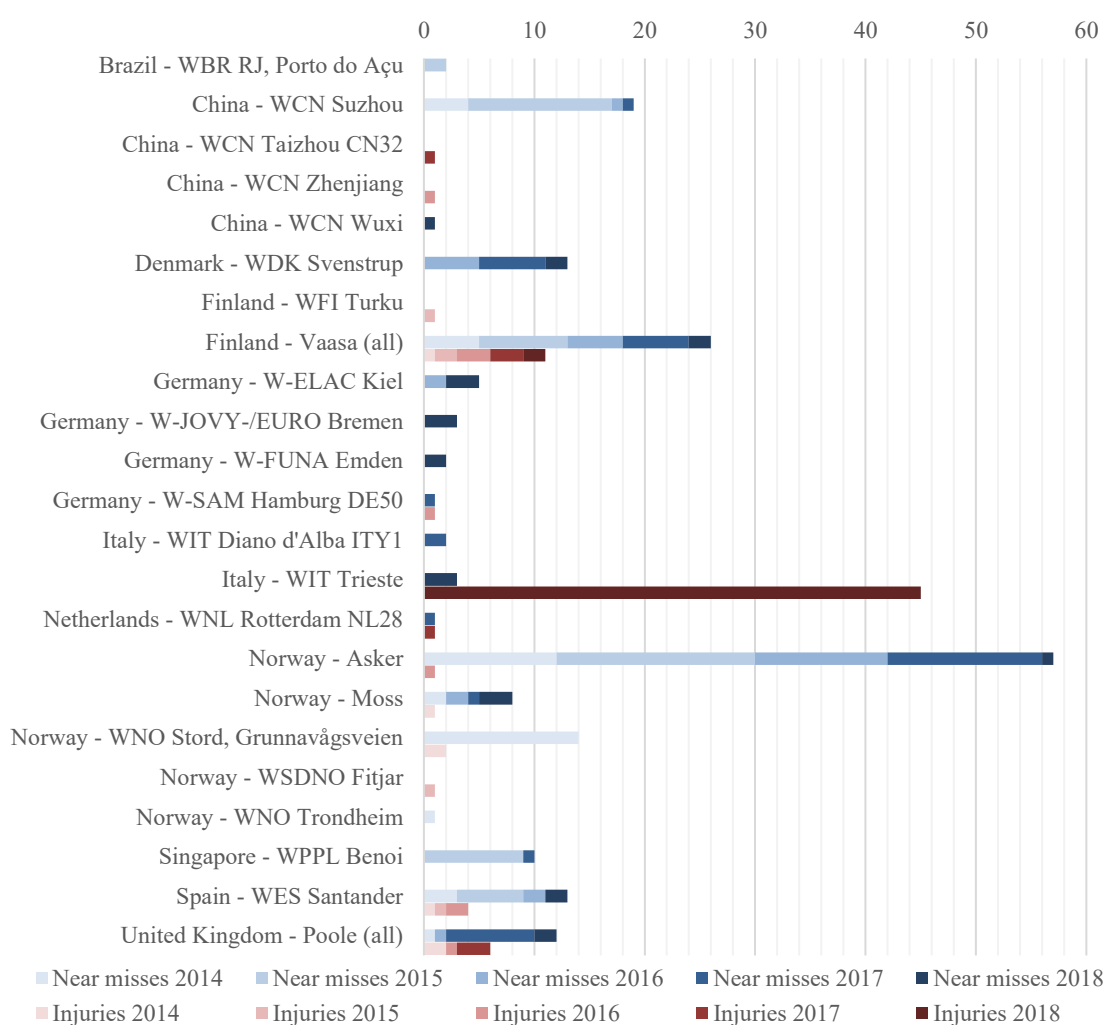
Since 2014, in total 193 near misses and 76 injuries in Wärtsilä premises and 22 near misses and 11 injuries in non-Wärtsilä premises were reported. This means that 90 % of all reported near misses have been reported happening in Wärtsilä premises and 87 % of all reported injuries have taken place in Wärtsilä premises. However, it is in place to think whether the reporting activity varies between the two, due to the availability of reporting when in non-Wärtsilä premises.

The number of injuries reported has been growing having already exceeded the number or near misses reported. The near miss reporting of contractor employees is lagging and it has even deteriorated since former years. The ratio does not represent the ideal reporting ratio, and in addition, the development should be the other way around: more near miss reporting and less injuries. This figure however, does not take working hours into account, which would be relevant information. Thus, the figure cannot be interpreted directly so that the Total Recordable Injury Frequency (TRIF) would be increasing, since also the number of contractor employees has been increasing the recent years. However, the figure shows that the absolute number of injuries has been increasing, which is never a good sign. However, to form a valid opinion, the number of LTIs should be combined with reporting activity, since it might be the case, that there used to be as many injuries, but they were just not reported.

To depict the reporting activity, the ratio between near miss and injury reporting can be calculated. According to the Bird's safety pyramid (1969), which is in use in Wärtsilä, statistically the rate should be 1:10:30:600. This means 600 near misses for a fatality, 10 LTIs or 30 TRIs. For contractor employees working in Wärtsilä premises the ratio since 2014 is 1:16:70:193, which already shows the lack of near miss reporting. These numbers however cannot be completely trusted, since it cannot be trusted, that all injuries have been reported throughout the reference period.

### 4.2.1 Near misses and injuries for contractor employees in Wärtsilä MS premises

Figure 22 below shows the reporting situation by each Wärtsilä location and by the year. Each location has one to two stacked bars where red represents injuries and blue near misses. Both colours have five shades from light colour to dark colour so that the darker shade represents more recent occurrence on a year's scale. If a location only has one colour bar, it means they do not have any reports of the other type. Locations, which are not shown on the figure, have not reported anything.

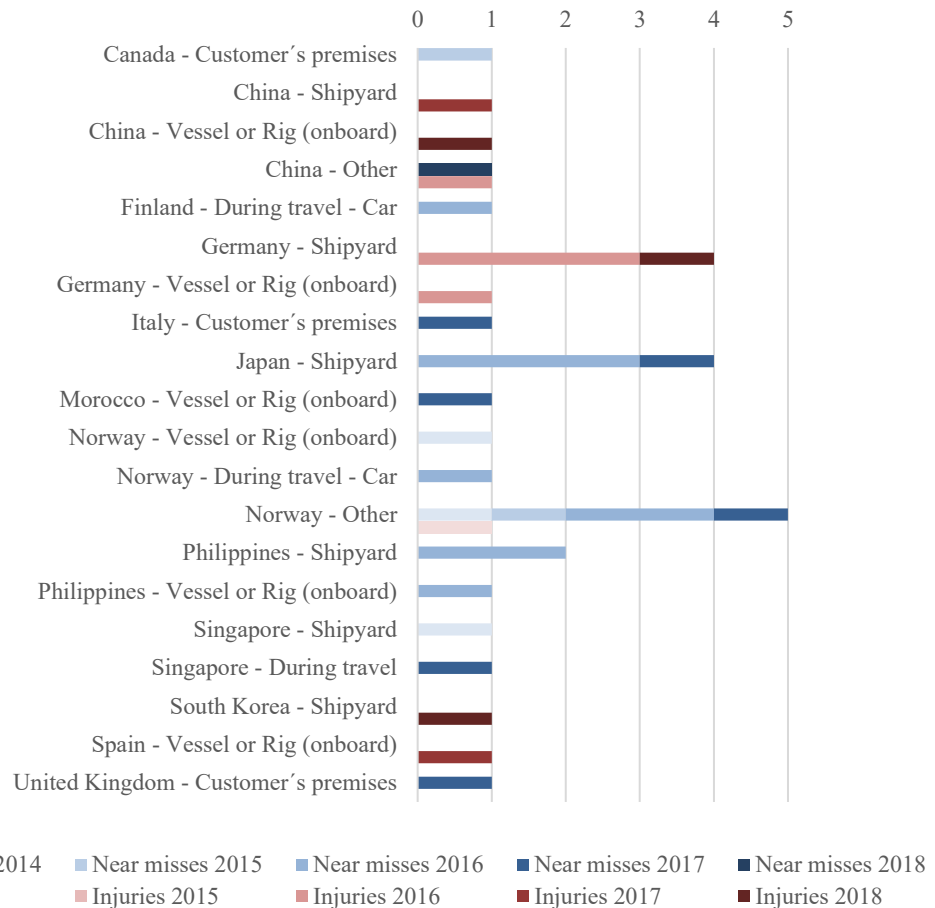


**Figure 22:** Near misses and injuries for contractor employees from 2014 to 31.10.2018 in Wärtsilä premises.

Most of the near misses came from Asker Norway, Vaasa Finland and Suzhou China. In comparison most injuries have been reported in Trieste Italy, Vaasa Finland and Poole UK. In Italy, they have only reported since 2018 and almost only injuries, which shows their near miss reporting should be improved.

#### 4.2.2 Near misses and injuries for contractor employees in non-Wärtsilä premises

Non-Wärtsilä premises mean customer premises (e.g. shipyards or on-board), during travel (e.g. car, plane) or other non-Wärtsilä premises. Injuries and near misses of all this kind can be seen below (Figure 23).



**Figure 23:** Near misses and injuries for contractor employees from 2014 to 31.10.2018 in non-Wärtsilä premises.

As one can already see from the axis bounds (0-6), injuries and near misses are way less reported in non-Wärtsilä premises than in Wärtsilä premises, where the axis bound continues until 60. Five out of nine of the injuries have taken place in shipyards, two on board and two in other locations.

#### 4.2.3 Analysis of causes of near misses and TRIs of contractor employees at Wärtsilä MS

All data since 2014 was taken into consideration in the analysis of causes. To examine the nature of the TRIs and the near misses of contractor employees reported, those were



categorized by the reported cause. Causes are listed from the most typical to the least typical by the number of near misses (Table 8).

**Table 8:** Causes for TRIs and near misses (NM) of contractor employees from 2014 to 31.10.2018.

Cause	No. of NM	% of all NM	No. of TRIs	% of all TRI	TRI/NM
Defective tools, equipment or materials	30	14,5	6	8,5	0,20
Poor housekeeping disorder	22	10,6	0	0,0	0,00
Improper placement of material	14	6,8	5	7,0	0,36
Inadequate guards, barriers or protective structures	13	6,3	3	4,2	0,23
Failing to use personal protection properly	13	6,3	11	15,5	<b>0,85</b>
Slippery floors or walkways	10	4,8	3	4,2	0,30
Inattention to footing and surroundings	8	3,9	2	2,8	0,25
Fire and explosion hazards	8	3,9	0	0,0	0,00
Failure to warn	7	3,4	1	1,4	0,14
Inadequate illumination or ventilation	7	3,4	0	0,0	0,00
Improper lifting technique	6	2,9	3	4,2	<b>0,50</b>
Improper use of equipment or choosing wrong tool	5	2,4	16	22,5	<b>3,20</b>
Unprotected height or inadequate access way	5	2,4	1	1,4	0,20
Improper position or posture for the task (employee)	5	2,4	5	7,0	<b>1,00</b>
Removing or making safety devices / barriers Inoperable	5	2,4	0	0,0	0,00
Inadequate personal protective equipment provided	5	2,4	8	11,3	<b>1,60</b>
Failure to secure or isolate (load, log out, etc)	6	2,9	1	1,4	0,17
Inadequate warning or isolation system	4	1,9	0	0,0	0,00
Limited or inconvenient work space	4	1,9	0	0,0	0,00
Extreme temperatures	3	1,4	0	0,0	0,00
Noise, vibration or radiation	3	1,4	0	0,0	0,00
Operating or moving with inadequate speed	2	1,0	3	4,2	<b>1,50</b>
Inadequate measurement system	2	1,0	0	0,0	0,00
Storms, earthquakes, floods or other acts of nature	2	1,0	0	0,0	0,00
Exposure to energized systems (electrical, hydraulic, pneumatic)	2	1,0	2	2,8	<b>1,00</b>
Heavy load	2	1,0	1	1,4	<b>0,50</b>
Hazardous chemicals	2	1,0	3	4,2	<b>1,50</b>
Biological exposure or contact with animal	3	1,4	1	1,4	0,33
Using defective equipment or material	1	0,5	0	0,0	0,00
Substandard conditions	1	0,5	0	0,0	0,00
Operating equipment or entering space without authority	1	0,5	0	0,0	0,00
Horseplay or violence	0	0,0	1	1,4	NA
Servicing equipment in operation (running)	0	0,0	1	1,4	NA
Using excessive manual force (lifting, pulling, pushing)	0	0,0	1	1,4	NA
Not complying with road safety rules	0	0,0	1	1,4	NA
-- Not selected --	14	6,8	5	7,0	NA

When looking at the absolute numbers of near misses or injuries, one can identify the most typical causes in both categories. The table follows the order of most typical causes of near misses and if looked at the causes on top, they are all quite black-and-white hazards to spot and leave no doubt, whether condition is safe or not. When looked at the causes lower on the table, there are more causes, which need more professionalism to

spot, like *'Improper use of equipment or choosing wrong tool'* or *'Hazardous chemicals'*. Also, on the bottom there are causes, which occurrence can be quite rare, for example *'Storms, earthquakes, floods or other acts of nature'*.

The most typical causes of injuries have been *'Improper use of equipment or choosing wrong tool'*, *'Failing to use personal protection properly'*, *'Inadequate personal protective equipment provided'*, *'Defective tools, equipment or materials'* and *'Improper placement of material'*. The issues with PPE have been quite well spotted, and it might be due negligence or lapses of memory, that there are still injury and near miss observations related to them.

In addition to observing the absolute numbers, a ratio of the numbers of near misses and injuries can be determined to figure out the most underreported causes of injuries. This ratio reveals what kind of injuries are not proactively considered to be able to prevent those. The bigger the ratio, the more underreported the cause. Ratios above or equal to 1,00 have been marked on the table with orange and bold and the ratios between 0,50 and 1,00 with bold and black. The ratio concept is based on the safety triangle.

According to the ratio, the most underreported causes (above or equal to 1,00) are *'Improper use of equipment or choosing wrong tool'*, *'Inadequate personal protective equipment provided'* and *'Operating or moving with inadequate speed'*. Some of the causes are quite basic knowledge and it should be better ensured that all contractor employees are aware of the right tools, they have the necessary PPEs, they know the speed limitations and places with the hazard of energized systems and how to protect themselves against those. It should also be emphasised that the instructions and rules are for their own safety and to be obeyed in case the reason is in their attitude.

### **4.3 Analysis of current practices for contractors at Wärtsilä MS**

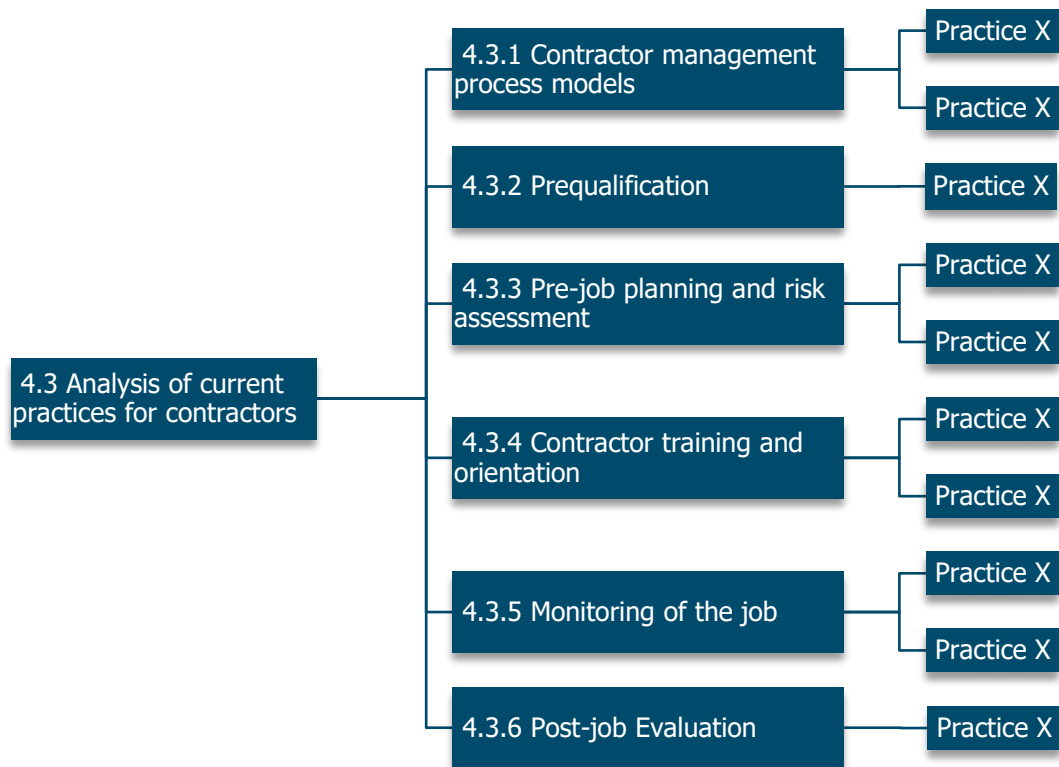
Currently, Wärtsilä MS has not harmonized contractor safety management practices globally and practices vary according to location. There are many practices for in-house personnel, which could easily be spread also for contractor employees. The most noteworthy Wärtsilä in-house personnel safety practices, which are not yet implemented in all locations for contractors are for example life-saving rules, WeCare on-line reporting, safety walks and safety meetings. Wärtsilä also has lots of internal safety trainings, which contractor employees are not able to access without Wärtsilä user accounts and separate request and approval for each training.

To figure out local practices, in total, over 40 people were contacted from 17 locations. All interviews were not fruitful in terms of finding out contractor related practices or processes. This was mostly the case in locations, where there were only non-risky white-collar employees or very few contractor employees. In Germany and Norway, the contractor employees were controlled almost the same way as in-house personnel, apart

from having on-line access to all Wärtsilä systems. Also, in many of the places, where they only had quite few contractor employees, they did not have any best practices to share but they were basically just applying the process, which in-house personnel goes through.

The analysis follows structure shown in Figure 24. First, before presenting the individual practices, all contractor management process models found in Wärtsilä are being presented. Then, all the noteworthy practices found in the interviewed locations are being presented by each contractor lifecycle step.

A shortened summary of all the practices applicable to contractors can be found as an Appendix F. Practices are divided by the contractor lifecycle phases so that Wärtsilä practices are listed first and then complemented with practices found in literature or other companies. All Wärtsilä practices, which are listed, are not coherent between the locations, but they can only be in one location.



**Figure 24:** Structure of analysis of current practices for contractors.

The prequalification process at Wärtsilä (Chapter 4.3.2) is centrally managed in all locations and thus there is not differing from practices in terms of location. The variations come into the picture with the contracts, but they were also due differences in for example

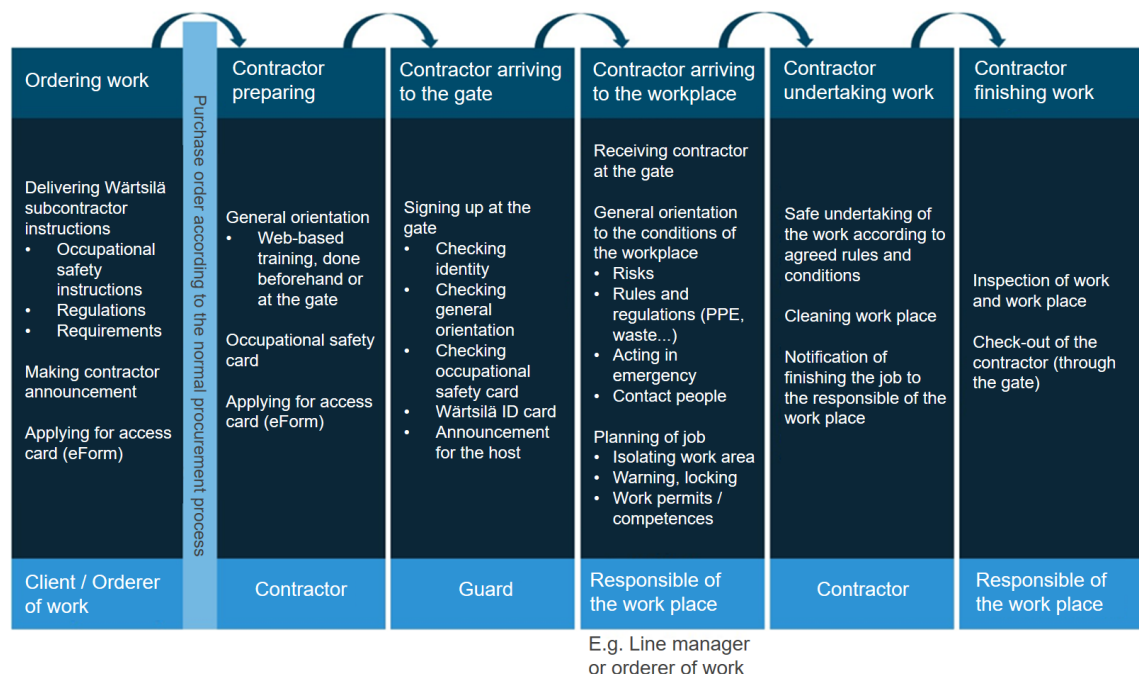
work tasks, environments and local legislation. Variation in the interpretation of an individual performing the prequalification practices has been left out from this research.

### 4.3.1 Contractor management process models at Wärtsilä MS

Few Wärtsilä MS locations had a contractor management model and those models were differing quite a lot. Wärtsilä Finland, Water Systems, Wuxi and Netherlands each had a model for contractor management, of which focus was not only on safety but the whole procedure. Those models are being presented here. Wärtsilä Italia did not have a model, but they had a system, which pretty much defines the entire process, so it will be presented in this chapter as well.

#### Wärtsilä Finland

In Finland Wärtsilä operates in Vaasa, Turku and Helsinki, out of which all manufacturing work is taking place in Vaasa. Wärtsilä Finland has operating instruction for contractors describing: general principles, Wärtsilä requirements and procedures, instructions for OH&S, environment, corporate security, traffic and work in the premises and applying for an access/identification card. OH&S instructions part includes occupational safety card, induction, workplace orientation, mandatory PPE, work permits, bringing chemicals and gases to Wärtsilä, and injury and near miss reporting. The operating instruction is used together with the contractor management process seen in Figure 25.



**Figure 25:** Contractor management process at Wärtsilä Finland (translated from Wärtsilä intranet 2016).

In Finland contractor safety management is largely based on occupational safety card and hiring competent contractors with necessary certificates. Before entering Wärtsilä Finland premises, contractor employee is obligated to watch an eight-minute safety video and answer correctly ten questions related to the video to pass the training. Video goes through the most important HSE rules and instructions.

### **Wärtsilä Italia: Solarium system**

Due to the great amount of the contractors, Wärtsilä Italia has a tailor-made system called Solarium to manage the contractor related data. On Solarium, there are roles of different kind: administration for Trieste office people, registrar who uploads the documents to the system, coordinator who manages the activities of the subcontractors. (Scocchi 2018, personal communication on 22<sup>nd</sup> May)

All the contractors have their own “files” in Solarium to store all the information related to the contract and the employees. There is contact information of the company and a lot of HR, environment and safety related documents. Every contractor must also deliver a list of the chemicals they use and their material data sheets. Under each contractor there is a list of all their employees included in the contract and their working permits, training information, and the validity periods of each document. (Scocchi 2018, personal communication on 22<sup>nd</sup> May)

To gain the authorization to enter Wärtsilä Italia premises, all the documents required and delivered must be valid and approved by Wärtsilä. If any of the documents goes out-of-date, that row on the system turns red and the contractor employees affected will no longer be authorized to enter until valid documents have been delivered. The ending of validity is tried to foresee by notifying contractors about soon-expiring documents to prevent unauthorization from happening. (Scocchi 2018, personal communication on 22<sup>nd</sup> May)

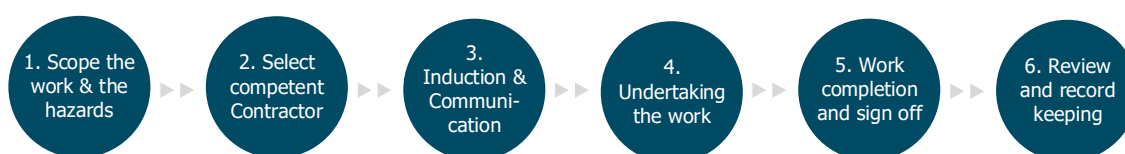
Currently, the list of the authorised people is updated manually and taken to the security people. However, Solarium is under development and after the next update there will be also a role for the security control people to know the status of the authorization of an entering person to enter the premise or not. They are also testing a cloud version, which would enable the contractor to log in and see their own documents and the status of the authorization process. With the same update, they would be able to add the automatic notification of any expiring documents to all the parties affected. (Scocchi 2018, personal communication on 22<sup>nd</sup> May)

The system has many benefits in terms of storing and keeping the documents in good order and seeing the status of each contractor and their employees, but it takes a lot of time to update all documents. It has a lot of development potential and in the future Solarium could be the only HSE communication channel between Wärtsilä Trieste and their contractors. (Scocchi 2018, personal communication on 22<sup>nd</sup> May)

Wärtsilä Services in Italy have a similar system but on SharePoint (Facchinetti 2018, personal communication on 27<sup>th</sup> September). This kind of data storage system would be effortless to copy for other locations as well, in case seen necessary. It could also be able to create and update internally, since it is part of the current Office 365 package.

### **Wärtsilä Water Systems, Poole, UK**

In Poole, they found the situation with contractors unclear and thus decided to create two guidelines to clarify the situation: a contractor on-site EHS policy and arrangements for managing contractors on-site (Morrow 2018, personal communication on 26<sup>th</sup> July). The arrangements for managing contractors include purpose, scope, definitions of terms, responsibilities of each affected party, contractor management process (Figure 26).



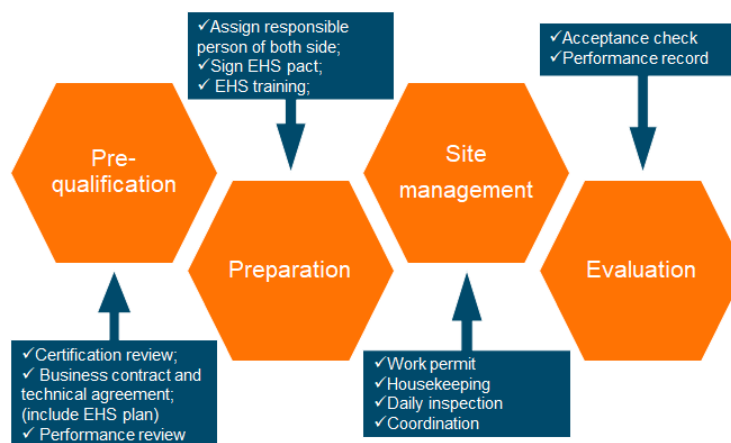
**Figure 26:** Contractor management process at Wärtsilä Water Systems (Morrow 2017).

In Poole, they have a role called Contractor Project Manager (CPM), who is a Wärtsilä accountable person with responsibilities for contractor management (Morrow 2017). It can be for example engineer, project manager, facility manager or any Wärtsilä employee bringing contractors on-site (Morrow 2018, personal communication on 26<sup>th</sup> July). CPM is responsible of confirming contractors' competence for the planned work and managing them while they are on site. Managing includes communicating all Wärtsilä requirements, policies, rules and their responsibilities, ensuring risk assessing, communicating hazards, ensuring reporting, reviewing the contractor upon completion of work. (Morrow 2017).

In Poole, all long-term contractors have been briefed on Wärtsilä Life-saving rules, which has not been the case in many locations (Morrow 2018, personal communication on 26<sup>th</sup> July). This indicates that their systematic way of working pays off and communication is effective.

### **Wärtsilä Propulsion Wuxi, China**

Wuxi's model (Figure 27) has the same idea as other ones, first there is a prequalification to check their compliance and competence, then preparations to be done before commencing working, managing while on site and evaluation after finishing.



**Figure 27:** Contractor management process at Wärtsilä Wuxi (Peng 2017).

A closer look on their practices is taken later in this chapter. One thing to point out is that, even though their model ends in evaluation, it is not documented, and the model does not say whether there are safety aspects included or no. Mainly the focus seems to be on quality aspects, such as checking whether their job is timely and thoroughly completed.

### Wärtsilä Netherlands

In the Netherlands, the contractor management process has been presented as a swim lane model (Appendix E). Their swim lanes are ‘Client’ or ‘Developmental manager’, ‘QEHS’, ‘Procurement’, ‘Reception’ and ‘Contractor’. The process represents their process in detail with all decision points and actions taken related to a contractor.

The swimlane model from the Netherlands gave an idea of creating a similar swim lane model for the ideal way to manage contractors, which are procured as a service, at Wärtsilä MS. However, the process created became more detailed and better covering the contractor lifecycle.

### 4.3.2 Prequalification

Prequalification process and making contracts are centralized and thus made in equivalent manner in each location apart from possible cultural differences in the interpretation of the instructions. Prequalification process is used when buying a service from a supplier. In case of agency workers, the competence is checked individually by HR, which is mostly the case with white-collars.

Wärtsilä Supplier Handbook includes Wärtsilä supplier requirements (Code of Conduct of Suppliers) states the minimum requirements to be able to be a Wärtsilä supplier including the requirements for compliance, social issues, quality, environment, occupational health and safety, security and business continuity planning. The OH&S part of the handbook requires that: The supplier shall have implemented occupational health and safety programmes, safety plan, hazard identification and mitigation

procedures, emergency instructions and procedures, commissioning instructions including safety aspects, safety equipment to ensure safe operations, accident and near miss reporting tools and they shall follow local OH&S legislation and regulations. (Wärtsilä 2016)

### **Supplier Assessment process at Wärtsilä**

The same assessment process is used for suppliers providing both products and services. To verify if a supplier complies with the requirements, Wärtsilä has a supplier assessment process, consisting of: (1) pre-assessment (32 pages questionnaire) to pre-scan potential suppliers, (2) rating and (3) technical capability assessment (Frona 2018). Prequalification expires after three years and needs to be revised within the expiration period. An audit will be performed according to the pre-assessment to confirm its correctness, if considered necessary (Frona 2018, personal communication 13<sup>th</sup> June). The pre-assessment questionnaire consists of following parts:

1. General business information
2. Contact persons
3. Organization
4. Production
5. Marine classification rules
6. Investments
7. Operating facilities
8. Process qualification
9. Product qualification
10. Quality
11. Environment
12. Occupational health and safety
13. Social issues

According to the pre-assessment questionnaire, and eventually evidence collected during audit suppliers will be rated. Vendor Management System (VMS) rating can be considered as a summary of the verification of the supplier. VMS consists of 14 indicators, of which half are seen critical and the other half as soft indicators. OH&S management is a critical indicator and negligence in that area will lead into banning. (Frona 2018)

Each indicator will be scored from one to five. For critical indicators two points will provide '*Approved with Remarks*' status, and soft indicators never lead into banning, but always at least into '*Approved with Remarks*' status. In the case of OH&S management this status requires willingness to develop OH&S practices and compliance with local legislation. Four points out of five will provide '*Approved*' level requiring implemented OH&S management practices, trainings and PPEs. The areas of OH&SMS under review



are implemented safety plan, safety precautions, adequate and operational safety equipment, sufficient competence and accidents and near misses. (Frona 2018)

After evaluating all indicators, the output of the VMS rating will be '*Approved – Excellent*' (green), '*Approved with Remarks – Improvement opportunities*' (yellow) or '*Banned – Weak*' (red). In case a supplier does not comply with the minimum requirements of one of the critical indicators, it will be banned. '*Banned*' status will block the supplier from Wärtsilä's development activities or ramp-up, or in case there is already an existing relationship, it will lead to creating an immediate action plan to get the supplier to the '*Approved with Remarks*' status or ramp-down of that supplier and replacement with another one. '*Approved with Remarks*' state will require an action plan and corrective actions by defined deadlines. Meanwhile the supplier will be monitored and will not be preferred in terms of development activities and ramp-up. '*Approved*' status does not have any limitations in its utilization. (Frona 2018)

Currently, supplier prequalification does not yet cover all the existing suppliers, because the prequalification process has not been in place always and they are now prequalifying some of the suppliers afterwards. Thus, the process is currently more reactive than proactive. The supplier prequalification process is however under transformation and there is an ongoing project pilot called '*Supplier Compliance Project*'. It will automatize the pre-assessment questionnaire so that suppliers themselves fill in the details in an on-line questionnaire and will get an automatized rating based on a matrix considering corruption, environmental, human rights and political risks. According to the pre-assessment, further details can be requested, or an audit can be made in case the risk assessment matrix states it as necessary.

### **Contract safety requirements and appendices**

Contracts with contractors are made by using a purchase agreement template for manpower services, which includes vague statements related to safety requirements. Those are, however, not publicly shared. The contract details may vary with each country's legislation and even with each contractor and the type of work they are about to do. At the time of writing the thesis, disciplinary actions for breaking Wärtsilä life-saving rules are not included in the contracts, but to make them truly effective, their inclusion is under discussion.

Attached to the contracts there can be several safety related appendixes, depending on division, business line, location and local regulations. At Wärtsilä MS, this is not systematic, since the tasks of different business lines vary significantly.

When in Yard or on Site, there is available a contract appendix with responsibility matrix for Security, Environmental, Health and Safety management. It is a document with a list of responsibilities, which are crossed either to be the responsibility of yard, client, Wärtsilä or not being applicable. (Wärtsilä Intranet 2014)

In many locations, the local site or factory rules are attached to the contracts. In some cases, the rules are signed by the contractor representative, who is responsible for the contract and in other cases, those are signed by each individual contractor employee.

Attached to the contracts in Wärtsilä Italia they use '*Rules for the companies and non-WIT people operating on the premises of Wärtsilä Italia S.p.a Business units*', which need to be accepted and signed by the contractor representative. In SAM electronics Germany, they have a '*Directive on external companies for contractor on the business premises and on construction sites of Wärtsilä SAM electronics*', which must be signed and obeyed by all contractors (Möller 2018, personal communication on 1<sup>st</sup> October).

In Wärtsilä Wuxi, they have '*Contractor EHS & 5S rules*' covering for example: required PPE, behaviour, use of certain equipment or chemicals, speed limits, use of ladders, cleaning, special jobs and required work permits and injury reporting. Rules need to be signed by contractor employees and in case breaches they are fined 500 Chinese Yuans, which depending on the rate is around 60 euro. (Wärtsilä Propulsion Wuxi). In Suzhou they have similar type of document called '*EHS agreement*', however tailored for their working environment.

### 4.3.3 Pre-job task & risk assessment

The pre-job tasks and risk assessment phase can be divided into two main types: routine work and non-routine work. The biggest difference is that for routine work, there might be ready-made risk assessments already, which can then be shared with the contractor employee in induction and orientation part. For non-routine work a work-specific pre-job plan and risk assessment are necessary to create. The practices vary among locations, whether they are done by Wärtsilä, by the contractor or together. However, they are at least reviewed and approved by a Wärtsilä employee. For white-collar employees, risk assessments or work plans are not made, since their work is less risky. Different risk assessment templates are not presented in detail in the thesis.

#### Wärtsilä Finland, Vaasa

Practices vary among different departments and according to the tasks of the contractor employee. The same tools are available, but their use varies by the user. Risk assessments for regular working tasks are available at IDM so these could be shared with contractors easily. For special work tasks in the maintenance department, there is a separate risk assessment template listing all possible risks and to be crossed whether they will be possible in the upcoming task or not. However, not all line managers find the tool user-friendly since it must be printed out instead of an interactive web tool for example.

For planning the work, there is also a template. A contractor work safety plan document is a structured form to be filled when planning bigger contracted projects. The form

includes subject matter, the description of the work, tools, materials and chemicals used, the schedule, the list of contractors and subcontractors, aligning with other work to be performed, necessary trainings, orientations and certificates, the main hazards related to the work, isolating work area and supervision, necessary PPE, environmental issues and waste and communication. The template is logical and thorough offering a useful tool for planning contracted work.

### **Wärtsilä Italia, Trieste, Italy**

Before starting the job, the contractor supervisor and the line manager have a co-ordination meeting, to ensure simultaneous work is not interfering and creating any safety risks or hazards. (Scocchi 2018, personal communication on 2<sup>nd</sup> August). In addition to RAs, a good tool to be utilized for more critical projects is process failure mode analysis (PFMA) (Fedrizzi 2018, personal communication on 19<sup>th</sup> September).

### **Wärtsilä Water Systems, Poole, United Kingdom**

In Poole, they have a tool called RAMS, consisting of a risk assessment and a safety method statement, which must be done before undertaking any job. In case, the work to be performed is a routine work, which already has a risk assessment, it must be reviewed to confirm its currency. Making a risk assessment for buildings and maintenance work is the responsibility of the contractor and it cannot be generic, but clearly based on the activity, existing conditions and competence of individuals. The safety method statement details about how the work is intended to be carried out so that the risks identified will be appropriately managed. (Morrow 2017).

## **4.3.4 Contractor training & orientation**

Each place has their own location-specific induction material. Wärtsilä Life-Saving rules and disciplinary actions were implemented for in-house personnel until June 2018, but the implementation process for contractor employees was not yet in place on the time of writing the thesis. Thus, their inclusion in the induction material of contractor employees varies by location. Implementation and disciplinary actions for contractor employees were discussed during the thesis project.

In all the places, there is available a location-specific '*Visitor and Contractor - Environmental, Health & Safety Information*' booklet, which should be delivered to each external party entering their premises. It includes briefly, for example, information about OHSAS 18001 and ISO 14001, transportation, fire & evacuation, visitor arrangements, smoking, security, contractor rules in two sentences, test facility PPE requirements and accident reporting.

Wärtsilä also has Safety Handbook, including thoroughly safety instructions of all kind, which are not location specific. Delivering it for all contractor employees could be easily emphasized.

Currently, no global training is given to contractor employees. There would be many eLearnings available about ZeroInjury and ZeroMindset on Wärtsilä internal WeLearn system, but those are not accessible by contractor employees. A training could be tailored to fit for contractor employees and discussed how to deliver it, in case not via an access to WeLearn. A dilemma also relies on how much training and effort shall be given to each contractor type, since the length of their contract can vary from hours to years.

### **Wärtsilä Finland, Vaasa**

In Wärtsilä Finland, they have an 8-minutes induction video including a 10-question test made for the contractors. The test is valid for two years, after which it must be done again. (Parkkonen 2016).

In Finland safety training system is largely based on the occupational safety card system, which is valid five years and used on national level in Finland. Contractor employees from abroad have many kinds of occupational safety card substitutes, and there is a list of accepted safety cards, but it has been considered as a problem of confirming safety compliance from employees outside the listed countries and cards. With some countries, they use so called ‘Certificates of excellence’ from foreign maintenance contractor employees who do not have occupational safety cards. (Hellman 2018, personal communication on 15<sup>th</sup> August).

### **Wärtsilä Italia, Trieste, Italy**

All the training and competence related documents are gathered to Solarium before contractor employees access Wärtsilä Italia premises to ensure the competence of contractor employees. Access is only given to contractors with proper and up-to-date documents. (Scocchi 2018, personal communication on 2<sup>nd</sup> August).

Before using any subcontractors, an induction training period must be accomplished, especially in case of production activities. The length of the period depends on the specific nature of the activities to be performed and it must be following relevant legislation and regulation. The induction period means that they must only follow another employee and watch. At the same time, a supervisor or a team leader is explaining the work and job instruction, which they need to follow, including necessary tools and equipment. After a final assessment evaluation done by supervisor and line manager they can work by themselves. (Fedrizzi 2018, personal communication on 19<sup>th</sup> September).

### **Wärtsilä Exhaust Gas Cleaning System & Inert Gas Systems, Moss**

In Moss, they make dedicated HSE trainings for each large test. Those HSE trainings have well-defined structure and topics to be covered by trainings (Leander 2018, personal communication on 26<sup>th</sup> July).

### **Wärtsilä China, Wärtsilä Wuxi, Wärtsilä Suzhou**

In Wärtsilä China, Wärtsilä Wuxi and Wärtsilä Suzhou they have in place a 3-level induction training to fulfil the requirements of the Chinese government. It consists of company, department and position level training. Company level training is done by the HSE representative for both, white- and blue-collar personnel, and it includes familiarizing with safety culture, QHSE policy, sharing safety videos and focusing on road safety, which is the biggest risk for office personnel. Department level training given by the department manager includes topics like QHSE policy, TOM, WeCare, JSA, Wärtsilä life-saving rules, sharing some past cases, PPE requirements and drug policy. The third level is position level, which is done by employee's supervisor. It focuses on the specific hazards related to their work, e.g. in welding, commissioning or depending on their position. (Wang E. 2018, personal communication on 27<sup>th</sup> July; Wang O. 2018, personal communication on 25<sup>th</sup> July; Du 2018, personal communication on 31<sup>th</sup> August)

Before starting the job in Wärtsilä Suzhou, the contractor needs to take a safety knowledge test including basic safety related questions. If a contractor fails it, they must take part into a training to meet with Wärtsilä safety standards. (Wang O. 2018, personal communication on 25<sup>th</sup> July)

In addition to the 3-level induction training, in Wuxi they offer safety trainings to all their contractors. Those are organized monthly, and all willing contractor employees can join. Also, once a year they are organizing a big training meeting for all suppliers to update them about relevant safety changes and review their safety performance. (Lu 2018, personal communication on 31<sup>th</sup> August). In Wärtsilä China, where contractors are mostly drivers or tea ladies, they also give road safety trainings for them (Wang E. 2018, personal communication on 6<sup>th</sup> of November).

### **Wärtsilä Water Systems, Poole, United Kingdom**

They are using an induction checklist to ensure all necessary activities have been communicated and performed before starting work. RAMS will be once more reviewed to ensure all risks are being covered. As a part of induction, each contractor employee will receive a contractor leaflet, which must be understood and signed. (Morrow 2017).

### **Wärtsilä India**

In Wärtsilä India, they have been drafting a safety induction training matrix so that all contents are listed and then selected for what type of employee they would be applicable. The employees are divided into three types: Wärtsilä employees, long- and short-term contract employees. The contents of the induction are listed and then selected in case valid for the type of employee in question. Entire program will be developed in one module and will be shown according to the selection of the type of employee. (Ghode 2018, personal communication on 31<sup>th</sup> August)

### **Wärtsilä Energy Solutions**

Safety cards to be handed for each employee including all the safety related information divided into five parts: HSE management, HSE guidelines, environmental monitoring, health plan and emergency action. Safety cards are a pocket-size “book” to always carry with them while at work. (Wärtsilä Intranet 2018)

#### **4.3.5 Monitoring of the job**

In general, monitoring of job is continual observation and communication from Wärtsilä side towards the contractor. A contractor then again has the responsibility to perform work safely and report about any safety concerns noticed. Realization varies locally.

WeCare is mostly not accessible by contractor employees. However, in most places the paper version of WeCare report is available. In places without the paper version, reporting is done face-to-face or via e-mail. The responsibility to report concerns on WeCare stays with the Wärtsilä employee receiving the information. As a side note, at Energy Solutions, they use WeCare for manhour reporting as well.

Disciplinary actions for contractors were not defined and implemented on corporation or MS level and both their existence and the actions vary by location. For example, in Poole they can write a letter, ask to leave the site or replace with different people. When once in Poole two contractors who were found to have deliberately defeated safety systems were asked to leave site. A formal notice of complaint was written to the contractor company explicitly stating the offending individuals were forthwith prohibited from entering the premises. (Morrow 2018, personal communication on 26<sup>th</sup> July). In China, they can give a fine.

In the ‘*Leader in safety, leader in business*’ training, practices called ‘*Safety walk*’ and ‘*Safety moment*’ are being taught for all line managers and other key employees. Currently, it varies by location, whether contractor employees are included in those or not. Also, the frequency varies by location and furthermore by the person.

### **Wärtsilä Finland, Vaasa**

Barona employees are included in all the daily practices as internals. They even wear the Wärtsilä outfit. However, they do not have access to WeCare or WeLearn automatically but only if separately given. Other contractors are mainly not and this could be improved minimum with the ones continuously working at Wärtsilä premises.

During the interviews held, the supervisor of DHL employees was hoping for a joint monthly safety meeting together with Wärtsilä and other contractor representatives. For example, he was not aware of the life-saving rules, which is a practical reason for organizing meetings of this kind on a regular basis. (Karjanmaa 2018, personal communication on 17<sup>th</sup> August).

Safety walks are taken by the line managers mostly quarterly. In addition, other Wärtsilä employees or managers are performing them irregularly. Contractors, apart from contractor employees wearing Wärtsilä outfit, are not mainly included, which could easily be changed to arise safety-awareness among the contractor employees.

Monthly safety briefings, which last around 15minutes, are delivered for internals and Barona employees, but could be easily forwarded for contractors as well. Those are left on notice boards, so that they are visible, but as well contractor employees could be involved in the sessions. The contents of safety briefings are every month focusing on a certain safety related theme, such as '*Summer trainee & safety*', '*Tips for well-being at work*', '*Foosling*' or '*Safety on the road*'. (Wärtsilä Intranet 2018)

Contractors typically also have their own internal reporting or risk assessment tools. For example, at Caverion they use this [ennakoi.fi](http://ennakoi.fi) -tool for making risk assessments on-site and at customer's premises. (Saarela 2018, personal communication on 17<sup>th</sup> August)

There used to be an annual contractor day in Vaasa, but it has not been organized for a few years. There is no documentation about past contractor days. Backman used to work already back then and based on her recollection on the contractor day, the HSE manager was informing contractors about Wärtsilä's current production situation, past injuries, near misses and fires, updated instructions and practices. Backman herself was informing about updated environmental instructions and gave waste sorting training and reminded them about cleaning. Contractors had an opportunity to share their situations, concerns or development proposals. To summarize, it was a chance for discussion, with a focus on sharing information and giving and receiving feedback and development ideas. (Backman 2018, personal communication on 22<sup>nd</sup> August)

### **Wärtsilä Italia, Trieste, Italy**

At the beginning of the day, line managers discuss with the contractor supervisors about the daily activities to be performed and the contractor supervisors are monitoring that the activities of contractor employees are performed safely. (Scocchi 2018, personal communication on 2<sup>nd</sup> August)

At least once a year, they organize a safety information moment with contractor supervisors. They have multiple meetings and invite not more than 10-15 contractor supervisors at once, to ensure good settings for deeper discussion and room for replying to all the questions. (Scocchi 2018, personal communication on 2<sup>nd</sup> August)

For in-house personnel, ‘Hearts and minds’ -project related to the observation of positive behaviour has been started. The main aim is to motivate employees to act safe and improve safety. (Sartori 2018, personal communication on 31<sup>th</sup> July)

### **Wärtsilä FUNA International, Germany**

Safety related documents such as general safety rules, customer safety rules and Wärtsilä specific rules like life-saving rules are handed out to contractor. By signature the contractor confirms those regulations are understood and will be adhered to. (Lindemann 2018, personal communication on 6<sup>th</sup> August)

### **Wärtsilä SAM Electronics, Germany**

In SAM Electronics there are multiple contractor employees working at shipyards. The site manager is organizing weekly toolbox meetings in the beginning of the project. After two or three months they change from weekly meetings to recorded meetings every two to four weeks to discuss safety related concerns and ensure continuous and sufficient communication. Since there are several phases in each project, the topics of the instructions also change. The toolbox meetings are attended by both Wärtsilä’s own employees and contractors’ supervisors. The supervisors are then responsible for training of their own employees with signed proofs. (Möller 2018, personal communication on 12<sup>th</sup> September)

In addition to shipyards, SAM Electronics has contractor employees also working at Wärtsilä premises and one thing to point out from their practices is reporting instruction triangle-shaped paper tents (Pohlmann 2018, personal communication on 24<sup>th</sup> July). Similar leaflets have been in other locations as well, but there is not a global version available. The reporting instruction leaflets are for internals, but for contractors it may be even more useful since for them the reporting practices are not familiar. They can be placed, for example, in the break areas to ensure employees know how to report or at least know from where to look for instructions.

### **Wärtsilä Water Systems, Poole, United Kingdom**

To ensure simultaneous work to be performed in good co-operation, they use a shared ‘*Contractor & Maintenance Calendar*’, which clearly indicates the start and end time of each work. It should be communicated for all relevant management inside and around the area. RAMS is also uploaded to the calendar. (Morrow 2017).



#### 4.3.6 Post-job evaluation

Wärtsilä Italia has been the only place showing they have systematic evaluation methods. Since June 2018, Supplier Periodical Evaluation is done weekly or monthly varying between departments and it consists of supplier performance, quality performance, environmental performance and safety performance. Each category consists of two to four subcategories, which have a weighting between 0.5 to 1.5 and scoring from zero to three. The weighting of safety categories in comparison with other categories is a little higher. To ensure coherent evaluation, there are separate score evaluation criteria guidelines depicting what kind of actions lead in each score. The plan is that periodical evaluations can be later on used as a part of an overall evaluation, including also other perspectives like for example disciplinary actions or WeCare reports. (Scocchi 2018, personal communication on 2<sup>nd</sup> August)

Mainly in other Wärtsilä MS locations interviewed, oral feedback is only given in case something negative appears. In addition, it is told for the procurement department, to avoid using the contractor in question.

According to a research made by Nenonen (2012), post-job evaluation in manufacturing industry, in Finland, is quite poor in general. Only 7 % of the respondents agreed on a statement '*Safety performance is assessed on expiry of contract*' and 10 % agreed on '*Safety performance is assessed at the end of work tasks*'. Statements being in the same order, 36 % and 38 % chose option '*Sometimes*' and the rest replied '*Rarely*' or '*Never*'. (Nenonen 2012).

## 5. OPERATING MODEL FOR CONTRACTOR SAFETY MANAGEMENT

Haight (2013) once put it well, when stating that “*Good contractor management system will serve as a matchmaker, so that one side is not investing too much, and nobody leaves angry and frustrated.*” This kind of approach in contractor management ensures both parties will be considered. The operating model was created this idea in mind, following the sub-phases defined in Chapter 3.2 and based on the practices found.

### 5.1 Requirements for operating model

To enable suitability in Wärtsilä environment and contractors, the requirements for the operating model were recognized to be:

- Suitable for all the contractor types at Wärtsilä MS;
- Offers practical tools (covering the whole contractor lifecycle) ready to be implemented;
- Scalability for large and small units (e.g. units with 5 to 500 contractor employees);
- Covers both white- and blue-collar contractors;
- Compatible with upcoming ISO45001;
- Fits globally (room for local variation); and
- Ability to be carried out with the current resources.

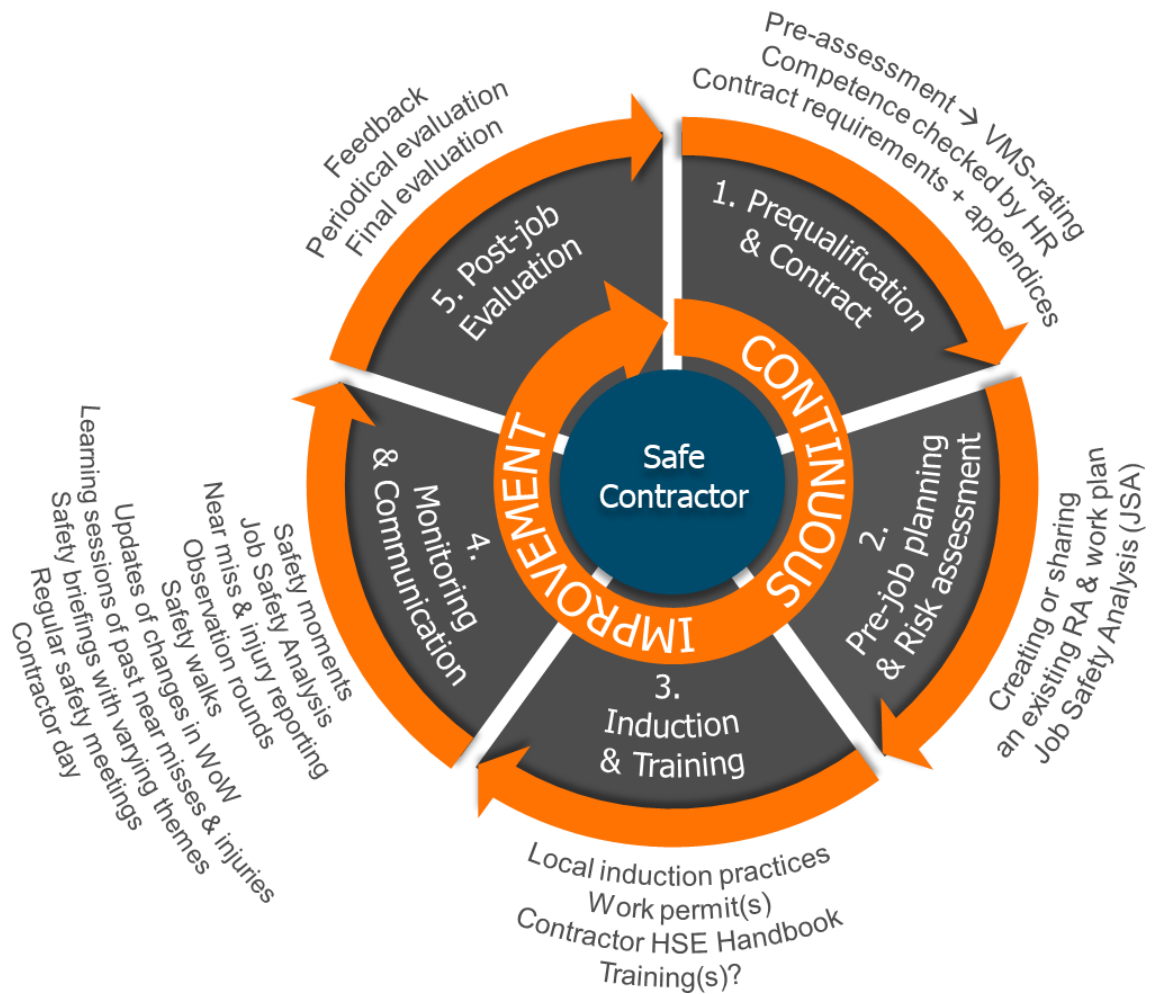
### 5.2 Operating model

The operating model (Figure 28) wanted to be framed so that it would offer a thorough management throughout the whole lifecycle of contractors and be in line with PDCA approach to ensure continuous improvement. Campbell’s model was modified to better cover the process at Wärtsilä and expanded with concrete practices to be applied in all Wärtsilä locations.

The operating model was supplemented with defining factors (Figure 30) to be utilized together with the model to help applying the model in the best feasible way. Also, an action plan for the ramp-up (Figure 31) was created of recognized barriers or pre-actions before the implementation of the operating model.

Framed operating model has ‘*Safe contractor*’ in the middle to emphasize the importance of the contractor-safety-oriented nature of the model. Surrounding the safe contractor

there is continuous improvement and the adapted contractor lifecycle steps. Right outside of each step there are concrete practices related to the specific step in question.



**Figure 28:** Operating model for contractor safety management at Wärtsilä MS.

In Wärtsilä's operating model (Figure 28), **prequalification** was complemented with the word **contract**, to emphasize the importance of contracts as tools for safety communication and setting safety requirements and disciplinary actions legally valid. Indefinite requirements related to safety are stated in contracts, but to implement the disciplinary actions, those might be stated in contracts as well. Prequalification can be made either by Human Resources (HR) in a job interview or by the procurement department in pre-assessment leading into VMS-rating, which were explained in detail in Chapter 4.3.2.

**Pre-job planning and risk assessment** seemed to have quite varying practices in each location, but it should be ensured that all blue-collar work has been planned and risks assessed and properly communicated prior to undertaking work. It is essential for being able to manage, mitigate and communicate risks. Concrete practices are divided in two depending on whether there is or is not ready-made work plan and risk assessments existing. In the field, Job Safety Analysis can also be used as a risk assessment tool.

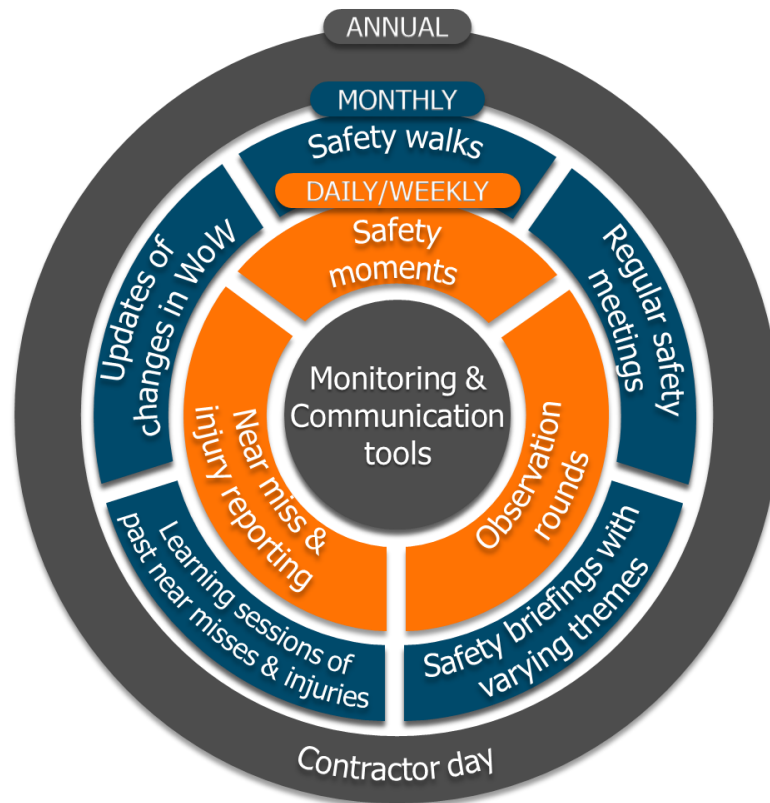
Each location has their own **induction** material with location-specific information as it should be. It should be ensured that the induction material in every location is up-to-date and for example includes information on life-saving rules or other updated WoWs. To increase safety-awareness of contractor employees, a contractor HSE **training** could be organized for the long-term contractors. However, in case their own organization is offering such trainings, dwelling on overlapping information is not efficient use of resources and necessary trainings shall be considered case by case or based on information gathered on the pre-assessment process. Delivering Contractor HSE Handbook together with Safety handbook systematically would already offer general knowledge, if ensured its contents would be read and understood. In addition to a general safety training, the focus could be on offering ZeroMindset kind of safety-awareness and mindset focused training. Work permits are used for the control of performing risky work.

Monitoring was complemented with communication to emphasize; the focus is not only in observation. **Monitoring and communication** was seen consisting of so many practices, that a separate monitoring and communication strategy was decided to create as a clarification (Figure 29). Monitoring and communication is largely based on expanding the practices used with in-house personnel to also cover contractor employees and supplemented with a few contractor-specific practices. The strategy will be discussed later in this chapter.

**Post-job evaluation** was only systematically done and documented in Italy. Procurement department is as well renewing the VMS-rating every three years but here the focus is different and based on the viewpoint of Wärtsilä line managers, who have concrete experience on working with the contractor under evaluation. However, periodical evaluation practice from Italy is only coming from one side and maybe it could be complemented with another practice collected from the contractor's side as well. A documented post-job evaluation practice, shall be put in place in other locations working with contractor employees as well.

### 5.2.1 Monitoring and communication strategy with contractors

Most of the practices were related to monitoring and communication, which were gathered together in a form of a yearly calendar of monitoring and communication (Figure 29). The yearly calendar is divided into daily or weekly, monthly and annual practices to be adapted for the local regulations and already existing practices.



**Figure 29:** Yearly calendar for monitoring and communication tools to be utilized with contractors.

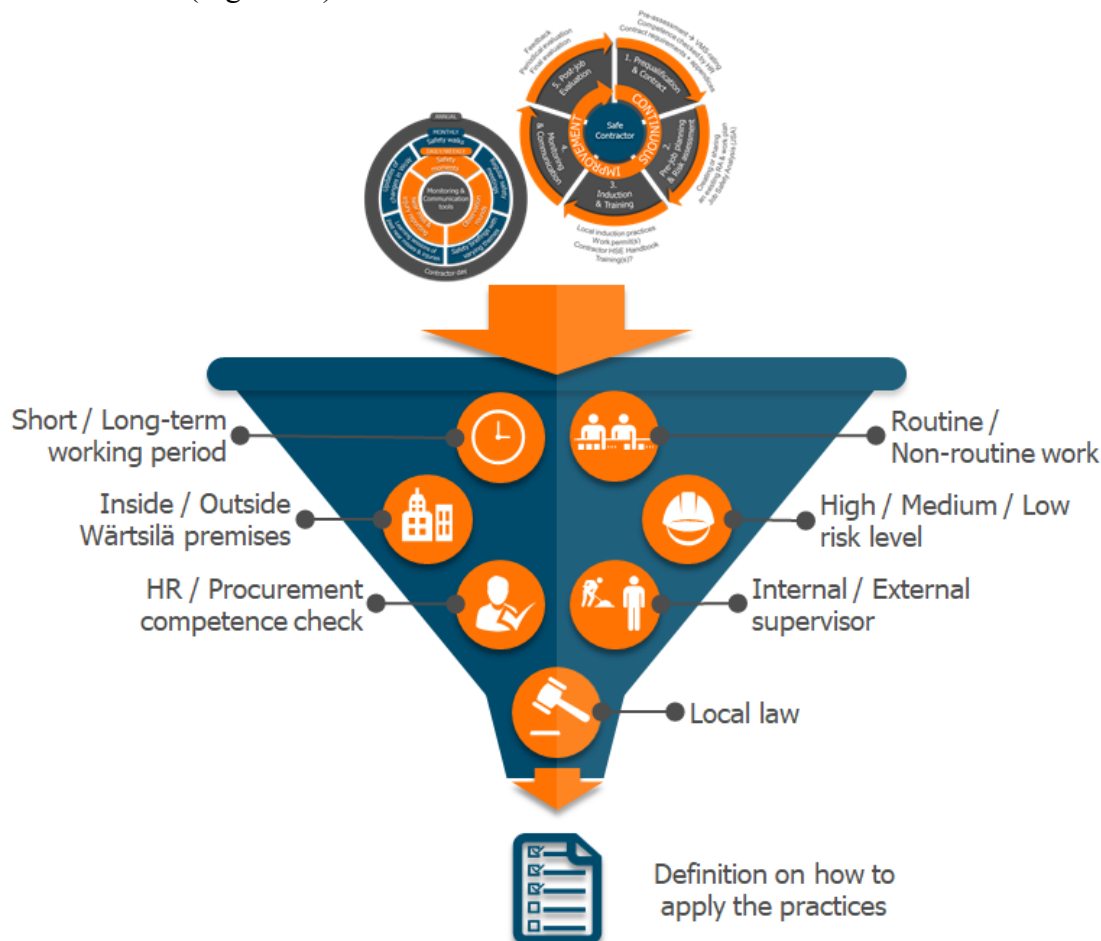
On a **daily** and **weekly** basis there are observation rounds, which mean non-recorded observation, which each employee is practicing when looking around. Safety moments are short discussions related to safety, which can for example be part of pre-shift daily task communication sessions. Near misses and injuries should be communicated always when necessary and thus raised on the most frequent level.

**Monthly** communication and monitoring can include for example recorded safety walks, regular safety focused meetings, ensuring communication of the updates of changes in Way of Working (WoW), learning sessions of past near miss or injury cases to ensure lessons learned and appropriate changes in WoW and safety-awareness of such hazards. Also, the monthly safety briefings, which are in use in Vaasa, could be globalized and ensured that other but in-house personnel, will be involved.

On an **annual** level there is a contractor day, which contents shall be determined on a global level. It has already been discussed how it used to look like in Vaasa, but it should be discussed, if it could be somehow included in the current safety day practice for in-house personnel. Involving them in the current practice would support the partners in safety -mindset and make sure it will not require too much extra resources. However, it shall be ensured, they are also getting specific focus and room for discussion related to contractor specific areas and development ideas.

### 5.2.2 Determining applicable practices for each contractor type

When, for example, line managers or HSE representatives are selecting what kind of practices to apply for each contractor type as recognized in Chapter 4.1.3, the main factors were identified (Figure 30).



**Figure 30:** Main factors when defining practices for contractor safety management at Wärtsilä MS.

In theory there are 96 possible unique combinations, but in practice the typical outcomes are the seven contractor types presented in Chapter 4.1.3 with some varying features. Each factor has a significant role in defining practices to be applied for the contractor.

**Short- or long-term working period** influences on the reasonability of using resources and causing costs by more thorough trainings or induction. It also affects how strict competence requirements there shall be for the contractor employee, if there is not space for extra trainings.

**Routine or non-routine work** influences mostly the risk assessment and work plan. Usually if the work is a routine work, the risks have been assessed and work has been planned before-hand and the results of those shall be communicated for the contractor. In case of a non-routine work, such as maintenance or repair work for example, those must

be created from the beginning. This can also have influence on the probability of an accident, but it is not relevant here.

Whether working **inside or outside Wärtsilä premises**, defines the extent on which a contractor employee will be able to influence, both the safety of the employees and the property of Wärtsilä. On the other hand, this factor also defines, how easy it is to monitor and communicate with them, if they are present or not.

The **risk level of the work** influences on all the steps of the contractor lifecycle. Whether the risks are high, medium or low, everything must be in line with the risk level. A typical high-risk work in Wärtsilä can be, for example but not limited to, production work, maintenance, commissioning, including high-risk work tasks like falling, confined spaces, hot work etc. A medium-risk work can be, for example, cleaning inside the factory, low-risk production work. A low-risk work can be for example a white-collar job, cafeteria personnel or cleaning inside office spaces.

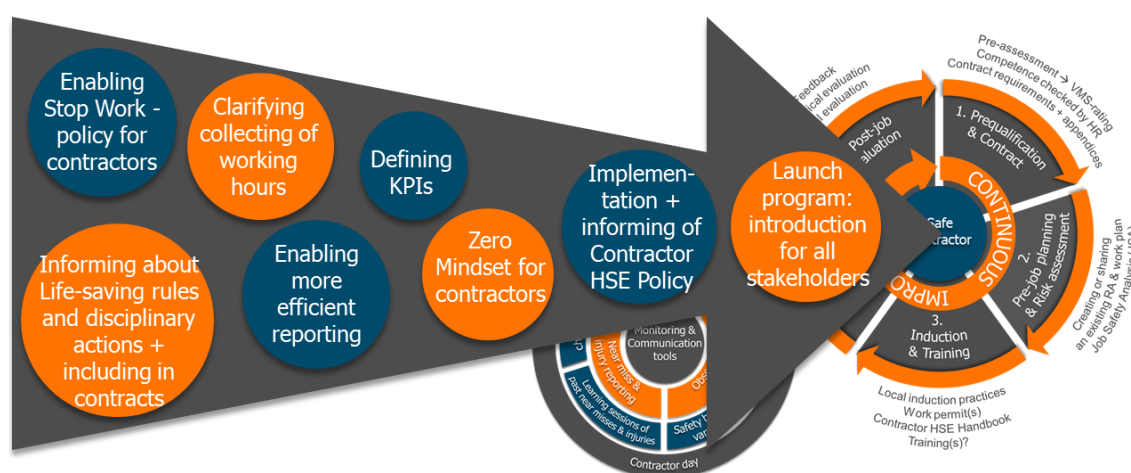
**Competence** can be **checked** either by **HR or by procurement** and the difference lays in the focus on either individual or contractor company competence. HR is checking the competence in case an individual external employee is being hired. Procurement department is checking the competence of a contractor company, which have their own HR taking care of the competence of their employees. On-site also supervisors are involved in checking their competence.

Having an **internal or external supervisor** affects the way to monitor and communicate with them in terms of whether it is direct or indirect, and whether they are mainly following the WoW of Wärtsilä or their own. For example, staffing agency workers usually work under a Wärtsilä supervisor and even wearing the same outfit as Wärtsilä in-house personnel. They are monitored typically by a Wärtsilä supervisor and thus also communication is directly between a Wärtsilä supervisor and a contractor employee. The opposite would be working as a contractor employee, under a contractor supervisor, where contractor employees mostly follow their own WoW and wear their own outfits and monitoring is typically performed by a contractor supervisor and communication between a contractor supervisor and a Wärtsilä supervisor.

A vital defining factor in a multicultural environment is **local law** of each operating country. Requirements and limitations can be set by legislation and regulations, which must be obeyed. This may limit or condition the utilization and application of some practices.

### 5.2.3 Action plan proposal for the ramp-up of the operating model

The action plan for the ramp up of the operating model was created to present, what is needed to be able to implement the operating model. The last point of the action plan is to have a launch program to introduce new WoW and tools for all stakeholders, including all Wärtsilä MS contractors, line managers, who are working with contractors, HSE representatives and all other parties working with contractors. The most important locations to consider are Trieste, Italy and Vaasa, Finland with most contractor employees. However, the implementation shall also cover other MS locations. The action plan will be shown (Figure 31) and explained in detail below.



*Figure 31: Action plan for the ramp-up of the operating model.*

Enabling **stop work policy** and informing about **life-saving rules and disciplinary actions** will be in the same document. During the thesis project, the disciplinary actions were defined but not yet approved. After approval, they can be implemented.

**Working hours** are currently collected in several ways depending on the location. In some cases, payment as a piece rate is hindering their collecting, because it is not allowed to require information on working hours in such cases. Currently, they are collected on a subsidiary basis, based on estimates in some cases. Guidelines should be made on how to collect the working hours systematically and divided in MS and ES instead of subsidiaries.

Enabling more sufficient **reporting** shall be discussed and implemented. WeCare access would be possible to get for all contractor employees with the mobile application, but it would require a lot of administrative work and it should be discussed, if it is seen necessary. An option would be providing the access to all contractor supervisors or to all contractor employees who are working in Wärtsilä premises over a longer period. The WeCare paper version should be made available in all the locations, since it easy to implement right with small resources. Instructions for making the WeCare report should



be part of induction and visible on a notice board or corresponding. Working hours and reporting are both in a key position for defining **KPIs**, since they form the basis for calculating the commonly used KPIs, such as TRIF and LTIF.

Currently the issue with **ZeroMindset training** is two-folded: resources in cases of in-class training and not having access in case of on-line training. Getting an access to the Wärtsilä internal system is difficult and thus it would be good, if there would be an on-line version tailored for contractor employees delivered in some other way. For example, behind a link like the induction video used in Wärtsilä Finland or even shared publicly on Wärtsilä Suppliers' webpage.

The contents of the **contractor HSE policy** consist of executing the operating model. Thus, the implementation of the contractor HSE policy cannot be made, before former steps of the action plan are solved.

The last point is a **launch program**, focusing on introducing and implementing the new operating model, contractor HSE policy and other related new tools and practices for all the stakeholders, meaning contractors and relevant employees of Wärtsilä, such as line managers and HSE representatives for example. Efficiency of communication must be ensured both internally and externally. Internally communication could be in meetings first globally and then locally to reach all participants, including all contractor employees. Externally there could be for example information on Wärtsilä public webpage to ensure continuity when hiring new contractors.

To conclude, before launching, there are a few matters to be solved, such as collecting working hours on a chosen level, defining which KPIs to use with contractors and what kind of source data will be needed, truly implementing Wärtsilä life-saving rules as well as stop work policy also for contractor employees, making reporting more efficient and deciding, whether there shall be some kind of a tailored version of ZeroMindset training for contractor employees as well. Contractor HSE policy shall be properly communicated and implemented.

### **5.3 Verification of fulfilling the requirements for operating model**

To verify the operating model, it was examined against the requirements set in Chapter 5.1 earlier. Suitability for all contractor types was ensured by recognizing the main defining criteria for determining the applicable practices for each contractor. Suitability for both white- and blue-collars was also ensured by the risk level factor.

To support contractor management on each step of the contractor lifecycle, many practical tools were either created, existing ones were modified to be ready to be implemented for

other locations with lacking practices or the existence of tools was ensured in interviews. New proposals for tools were for example:

- Contractor HSE policy;
- Disciplinary actions for not following life-saving rules;
- Contractor HSE handbook;
- Supplements to be added on the public Wärtsilä supplier webpage;
- Guidance material on contractor safety management for line managers or HSE representatives;
- A detailed process description of the most typical contractor type.

Scalability for large and small units with a varying number of contractors was ensured by a supplementary approach to the current practices. Administrative work was minimized and many of the tools are global, which means they can be centrally updated. The aim is to bring contractors closer to in-house personnel, which means the same practices would apply to both, thus decreasing the amount of administrative and non-productive work.

Compatibility with upcoming ISO45001 has been considered throughout the development process of the operating model and in the end, it was ensured in the validation meeting. To summarize, the main change in ISO45001 is to participate and engage contractors instead of them only receiving information, and to make them a part of the team. The foci here were to emphasize the enhancement of systematic communication and to improve the involvement of contractor employees in injury and near miss reporting. ISO45001 also requires OH&S criteria to be included when procuring services, but Wärtsilä Supplier assessment process already fulfils those requirements. OH&S is also already part of contractual documents.

Global fitness was also being discussed in the validation meeting with participants from all MS locations. The operating model was not made too detailed to be able to be modified for the local needs and legislation to fulfil the global fitness requirement. Global fitness was ensured by the defining factors funnel model, where special emphasize was put on local legislation by adding it as one of the defining factors.

One of the most important requirements for the operating model was the ability to be carried out with the current resources, to ensure the easiness of its implementation. The model is largely based on already existing in-house practices, which shall be extended to better include contractor employees. The part, which might require extra resources or at least reallocating of resources from MS (Q)HSE department, is carrying out the steps of the action plan for ramp-up as well as implementing the participative mindset of managing contractors. It also requires resources of line managers to internalize new WoW considering contractor employees. However after ramp-up, maintaining the contractor safety management would be able to perform with the same resources.

## 6. DISCUSSION

Despite advanced safety management at Wärtsilä MS, their practices in terms of contractor safety management, were really spread out in their dozens of locations. To squeeze the gap, more coherency and systematisms in the practices were needed. Both were recognized to be important: having contractor specific safety management practices, as well as, spreading more consistently the practices used with in-house personnel to also cover contractor employees.

Analysis of past near misses and injuries showed that reporting of and from contractor employees is not on the same level as of in-house personnel and it should be emphasized more. The focus of the analysis was more on the activity of reporting, since available working hours or reporting activity did not offer a reliable basis for calculating safety related KPIs. To enable calculating KPIs properly, the collecting of working hours should be required on more detailed level.

Analysis of causes led into recognizing the most underreported causes of injuries. Some of the underreported causes were quite basic knowledge and it should be better ensured that all contractor employees would be aware of the right tools, PPEs, speed limitations and other instructions and rules. When truly implementing life-saving rules and disciplinary actions also for contractor employees, it will simplify communication related to rules and hopefully reduce human errors of this kind.

During the research, a pilot test for WeCare mobile application was performed so that a reporting user was created for one contractor supervisor. Technically creating the user took about half an hour, but the administrative work to figure out the specifications took some days with all idle time. However, creating those users could be done centralized.

Best practices were collected from all available sources: literature, Wärtsilä and other companies until the extent shared publicly. The operating model created was combining continuous improvement and Campbell's (2015) contractor lifecycle together with practical tools for covering each step. The operating model at Wärtsilä MS was based on '*Prequalification & Contract*', '*Pre-job planning & Risk assessment*', '*Induction & Training*', '*Monitoring & Communication*' and '*Post-job evaluation*'. To help applying the operating model, main defining factors for determining practices were recognized to be: '*Short / Long-term working period*', '*Routine / Non-routine work*', '*Inside / Outside Wärtsilä premises*', '*High / Medium / Low risk level*', '*HR / Procurement competence check*' and '*Internal / External supervisor*'. An action plan for the ramp up of the operating model, was also created to enhance the implementation-readiness of it.

The yearly calendar of monitoring and communication was created to ensure the systematic and continuous communication, and better involvement of contractor employees in in-house practices. To make contractors equal, instead of contractor safety management, a suggestion was made to foster safety partnerships. To be aligned with other Wärtsilä practices, the slogan was suggested being '*Partners in safety, partners in business*', thus also emphasizing safety coming first. Making a safe first impression is extremely important and this kind of approach would underline that no exceptions are approved, and safety must be taken seriously. It must be ensured that expectations and possible consequences are communicated properly and explained thoroughly and in detail throughout their whole lifecycle.

## **6.1 Qualitative rigor of the research**

Qualitative research is based on qualitative information, which reliability and validity can be debated following the elements of qualitative rigor. Qualitative rigor consists of credibility, transferability, dependability and confirmability. (Thomas & Magilvy 2011)

### **6.1.1 Credibility**

Credibility enables others to follow and agree with the interpretation of the experiences of the participants. Credibility can be achieved via peer examination, reflexivity or member checking. (Thomas & Magilvy 2011)

The theory part of the thesis is based on dozens of peer reviewed scientific articles including the ones written by the most well-known researchers of contractor safety management topic. As well as multiple companies were benchmarked as far as information was available and found. Not to leave out the requirements set by OH&S standards. Local legislation was not taken into consideration as in a global company those would already create a topic for another complete thesis. Local legislation was put as one of the defining factors to be considered when implementing the operating model into action in each location.

Even though WeCare analysis was not based on qualitative data, the credibility of the WeCare analysis must be called into question when comparing the reporting activity between in-house personnel and contractor employees. It seems that some of the injuries and most of the near misses have not been under the reference period. Thus, results of the WeCare analysis cannot be considered reliable, but only to justify the necessity of improving the reporting of and from contractor employees.

The other part of the research mainly consisted of interviews, which therefore form the biggest impact in terms of credibility of the research. The subjective opinions, viewpoints and backgrounds of the interviewees may influence on the quality of the information received, especially considering recognizing and being willing to share problem areas.

Due to focusing on interviewing Wärtsilä personnel, the research cannot take a stand on whether all the practices depicted are really in use, due to not systematically interviewing contractor representatives. This however does not limit the ability to gather practices, which are or could be in use. After recognizing them, it will be all about efficient implementation.

As another limitation of the research must be mentioned not having the possibility to visit other locations but Vaasa. This affects the depth of understanding the business and sharing of tacit knowledge and information based on senses. The skills of depicting practices varied between interviewees according to their language skills as well as according to their individual conception of what was seen relevant to be explained and shared. Also, the interviewer's understanding is limited on not concretely seeing what and how is being manufactured in each location, since the product portfolio of Wärtsilä MS is really complex.

Multiple interviewees from the same subsidiary improved the coverage of finding out practices from each place. Also, similarities were recognized from many subsidiaries, especially from the same countries, increasing the reliability of the results. At the beginning of each interview, the topic and purpose of the thesis were introduced to ensure those were understood.

To increase the credibility of the thesis, peer examination was utilized, and it was read and commented by both MS QHSE Director and MS QHSE Manager. In addition, all quotations went through member checking so that each quotation was sent to the source to ensure they have been correctly transcribed from the interviews and complemented when necessary. Peer examination was as well utilized for the operating model to ensure it fits for its purpose. On the 26<sup>th</sup> of October, a validation meeting was held to present the operating model and its complementary models for the interviewees and to ask for feedback. According to the feedback the operating model was further improved. Feedback was mostly positive, and the biggest flaw was the clarity of the model in case observed from non-Wärtsilä point-of-view. Some locations with only a few contractors argued the model being too complicated, since there was not seen any problems with handling contractor employees. It was also seen to be more suitable in the factory environment than in shipyards for example.

### **6.1.2 Transferability**

A research can be considered as transferable, if its findings or methods can be applied to other contexts (Thomas & Magilvy 2011). The research method of this thesis was following a typical research structure, where the best practices are first chased and then generated into an operating model. Thus, the research method can be considered transferable for other contexts. However already in the interview questions, Wärtsilä

specific vocabulary were taken into use, which may weaken the applicability of the research in another context.

The findings of the research are quite Wärtsilä specific, but the idea behind is quite generic. The operating model can be easily modified to fit the needs of another organization, both inside and outside marine industry, due to its basis on continuous improvement and contractor lifecycle. The defining factors could be applied in another similar globally functioning organization. However, changes might be necessary if the industry differs a lot.

### **6.1.3 Dependability**

Dependability means the decision trail of the researcher can be followed by another researcher (Thomas & Magilvy 2011). The purpose of the study was precisely described in the research plan and also in introduction. Also the research method and its phases and sub-phases were depicted in detail in Chapter 3.2, including how information was gathered. Reasons why certain subsidiaries were selected to the interviews were as well described.

Dependability of the research can be considered swayed in some points of the research. When collecting the amounts of contractor employees by the subsidiary, limiting on Marine Solutions, there might be differences on how traceable the information is and how well it has been documented to be able to make the estimate. In some locations there are contractor employees, which are related to multiple business lines and for example support functions, so there might be variation also on how they were selecting the contractor employees to include or exclude from the estimate.

The interview questions were not all read and answered systematically but they were functioning as a basis for the discussion. The interviewees were able to see the questions during the Skype meeting to guide the discussion and remind what kind of information to include while describing their operations. This approach was taken to keep the discussion flowing and to enable receiving also all unexpected answers outside the pre-defined questions. However, this might influence on the dependability of the research and it can be questioned if the interviewees would have come up with the same answers without the leading questions.

When asking about development areas, very few interviewees had ready ideas to share, which can be either due to already doing their best, not recognizing or being aware of the development areas or unwillingness to share their flaws. In any of the before-mentioned case, a physical visit would have enabled better possibilities to create a confidential connection with the interviewee and to concretely see the working environments to be able to ask better questions. In addition, more contractor representatives could have been interviewed locally with the help of an interpreter, since they most probably might not

speak English. However, the focus of the research was in finding the best practices rather than flaws, because it was already recognized before the research that coherent global practices were not in place for contractors.

The dependability depends strongly about decisions related to which practices were selected as best practices along the operating model. They were chosen based on their existence in other locations and available resources. Rather it was based on expanding in-house employee practices to cover also contractor employees and at the same time to make sure to thoroughly cover the whole contractor lifecycle, which was with minor modifications recognized to fit in Wärtsilä environment. The practices chosen were shown and reviewed in the validation meeting and updated according to comments received.

If another researcher would redo this research by precisely following the research phases, the outcome could be assumed to evolve similar. However, due to the qualitative nature of this research, might be, that another researcher would have interpreted something differently leading into nuance differences. In addition, since the appearance of the model is largely based on the preferences of the researcher, might be that the outcome would have turned out to be different in case carried out by somebody else.

#### **6.1.4 Confirmability**

Confirmability in qualitative research is corresponding to objectivity in quantitative research and occurs when credibility, transferability and dependability have been established (Thomas & Magilvy 2011). Due to the research fulfilling the three other elements of qualitative rigor, it can further be stated to be reasonably confirmable.

Contractor safety management as a topic was fairly unknown for the researcher herself and thus subjective opinions had not evolved before performing the research. On behalf of Wärtsilä two other colleagues were continuously involved throughout the thesis project sharing their expertise and criticism to make the research more confirmable.

### **6.2 Scientific contribution**

New ISO 45001 standard will require a deeper participation of contractor employees, however not providing practical guidelines or solutions on fulfilling those new requirements. This research contributed to a thorough understanding on how to improve the contractor safety management with concrete examples from literature, other companies and Wärtsilä. The research complements the library of concrete contractor safety management practices from a perspective of a large multicultural organization.

The operating model created in the thesis offers a framework to continuously improve contractor safety management throughout contractor lifecycle with concrete tools for

covering each lifecycle step. The viewpoint enables contractor safety management to be performed in line with the PDCA-cycle deeply integrated in all kind of operational development.

### **6.3 Practical contribution**

The research was conducted to gather the best practices in contractor safety management and based on those to create an operating model for Wärtsilä MS to improve their performance in that area. As a result, the operating model with a few complementary models were created to enable improving the safety of contractor employees to the same level as the safety of in-house personnel on Wärtsilä MS level.

The operating model offers a framework and toolbox to improve and systemize the contractor safety management at Wärtsilä MS. The action plan for the ramp-up ensures closing the gaps currently hindering the implementation. The operating model is meant to supplement and structure local practices leaving room to be applied based on local business environment, regulations and legislation, which is vital in a global operating environment. To ease its application, the operating model was complemented with defining factors to cover multiple types of contractors to enhance its fitness in the global operating environment of Wärtsilä MS. The defining factors complementing the operating model enable its applicability also in other companies in the manufacturing industry. The fact of being based on continuous improvement and contractor lifecycle increases applicability on other industries as well.

Outside of the easily recognizable outputs of this thesis, it was noted that having several one-to-one discussions and interviews related to contractors and their safety also helped to generate discussion around the topic in the locations interviewed. Thus, helping to increase the awareness of contractor safety being important and, in the future, when implementing the model, easing the project, when its necessity has already been noted. This might have positive effect in terms of eliminating change resistance. Not to forget, the new requirements of ISO 45001 standard will function as another reasoning for the necessity.

Energy Solutions and Services, which were outside the scope of this research, can also utilize the information collected during the research and perform self-evaluation to decide whether any of the practices or information could be relevant for them as well. Some results of the research can even be considered to implement on Wärtsilä corporation level.

### **6.4 Ideas for further research**

In October 2018, it was announced that Services will be merged into MS and ES from the beginning of next year (Wärtsilä 2018d), which widens the scope of contractor employees and increases the number of contractor employees especially outside Wärtsilä premises.



It also increases the variation of practices, which should be aligned with Wärtsilä MS practices. This brings up new possibilities for research in Wärtsilä environment.

The case of Wärtsilä MS represents just one example of an operating model for contractor safety management in a globally functioning organization. It would be interesting to have insights from other global organization(s) to examine, whether the operating model developed together with the defining factors would work in other global organization(s). The action plan for the ramp-up is very Wärtsilä MS-specific, and it would most likely not work in any other organization.

As already discussed before, contractor employees can significantly influence the safety of others. An interesting research topic could: How to best support the contractor company to improve their OH&S management, preferably already in procuring phase? Also, it could be further investigated how to involve environmental and security aspects throughout contractor lifecycle. Another interesting research could focus on the motivational aspects of contractors when having a contractor safety management system in place. Similar research could be interesting for supplier perspective as well, when the settings are quite different due to lack of control.

It would also be interesting to investigate how could new digital solutions help in contractor safety management. There is multiple software available for storing contractor related documents and to structure the process, but how about revolutionizing the whole safety management by involving augmented reality and artificial intelligence into the picture. Augmented reality would enable virtualizing working instructions with specific safety warnings whenever necessary, whereas artificial intelligence would enable learning from past near misses and injuries. How is this related to contractor employees? It is typical for contractor employees to drift into unfamiliar environments, so this would enhance their ability to perform their job more safely in any workplace where this kind of service would be available. This would also eliminate deficiencies in communication, when information would always be available real-time. This would also reduce the time needed for introduction, when the focus would be 100 % for the relevant hazards and it would be available in real-time enabling multitasking.

## 7. CONCLUSIONS

Increasing contracting should not be negative for safety, it has a lot of potential, because it enables better specialization, skills and equipment due to focusing on core competence. The difficulty lies in aligning safety practices, ensuring sufficient information flow and communication and coordinating simultaneous work tasks. Systematic contractor safety management increases the probability of succeeding in overcoming these obstacles.

The research was performed as a mixed-method design, combining a quantitative perspective by the analysis of past near misses and injuries and a qualitative perspective by the analysis of current contractor safety management practices existing in different Wärtsilä MS subsidiaries. The best practices were gathered from those as well as from literature and other companies, as far as publicly shared. Based on the findings and former researches, the operating model for Wärtsilä MS was created and complemented with necessary tools to enable its correspondence with set requirements and implementation-readiness.

Analysis of past near misses and injuries showed that reporting of contractor employees is not on the same level as of in-house personnel and it should be emphasized more. Thus, the focus of the analysis stayed more on the activity of reporting rather than being able to calculate reasonable LTIR or TRIF KPIs, due to the inadequate quality of the available working hours or reporting activity. Analysis of causes revealed the most underreported types of injuries.

The operating model created was based on continuous improvement and contractor lifecycle complementing them with practical tools to cover each lifecycle step. The lifecycle was modified to better model Wärtsilä process, finally consisting of *'Prequalification & Contract'*, *'Pre-job planning & Risk assessment'*, *'Induction & Training'*, *'Monitoring & Communication'* and *'Post-job evaluation'*. To ease the application of the operating model, main defining factors for selecting the applicable practices were recognized to be: *'HR / Procurement competence check'*, *'Inside / Outside Wärtsilä premises'*, *'Short / Long-term working period'*, *'Internal / External supervisor'*, *'High / Medium / Low risk level'*, *'Routine / Non-routine work'* and *'Local law'*.

To prepare Wärtsilä MS for the implementation of the operating model, an action plan was created. The main gaps to squeeze before being able to truly implement the model as discussed before, are condensed expanding the in-house practices, such as reporting, stop work policy and life-saving rules, to cover contractor employees in each location. Also missing practical tools have to be spread between the subsidiaries to thoroughly cover the whole contractor lifecycle everywhere. This thesis offers concrete guidelines for Wärtsilä MS to start to improve their contractor safety management.

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## APPENDICES

### Appendix A: Service providers' opinions on the safety challenges of operating at multi-employer worksites

(Nenonen 2012)

Challenge categories	Examples of the challenging situations
Attitudes / safety culture	Ingrained unsafe working practices Friction between external and in-house employees Reliance on the employee for safe work performance Poor attitudes to safety in customer companies Poor safety attitudes or safety culture in own company
Communication	Different locations of the employee and the supervisor Limited safety information received from customers Insufficient information flow in handover of work shifts Poor information flow between/regarding different service providers at worksite Situations diverging from those planned Lack of awareness of appointed contact persons
Coverage of instructions	Devising instructions for urgent work tasks Ensuring flow of information to employee performing work task Inadequacy of instructions obtained from customer / available on worksite Relevance of work task instructions in different worksites
Planning of work tasks	Urgent work tasks Coordination of different performers' work tasks Constant haste Tasks diverging from those planned Work tasks performed at several worksites
Responsibility issues	Division of responsibilities when operating abroad Insurance requirements for service providers in different situations Practices for investigating accidents and incidents Organisation of worksite-specific induction training
Variation in practices	Divergent operating practices among company's own units Varying working cultures and requirements in different countries Varying working practices between different customer worksites

## Appendix B: Global estimates of occupational accidents annually by region

Adopted from Nenonen et al. 2014

### Region explanations:

High income countries (e.g. Australia, Canada, France, Italy, Finland, Singapore, Switzerland etc.)

Low- and middle- income countries of the African Region (e.g. Zimbabwe, Algeria, Ghana, Togo, Tunisia)

Low- and middle- income countries of the Americas (e.g. Argentina, Dominican Republic, Belize, Costa Rica, Mexico)

Low- and middle- income countries of the Eastern Mediterranean Region (e.g. Bahrain, Turkey)

Low- and middle- income countries of the European Region (e.g. Croatia, Czech Republic, Estonia, Latvia, Lithuania, Poland, Romania, Turkey, Ukraine)

Low- and middle- income countries of the South-East Asia Region (e.g. Cambodia, Laos, Malaysia, Myanmar, Thailand and Vietnam, Brunei, Filipinos, East-Timor, Indonesia)

Low- and middle- income countries of the Western Pacific Region

Region	Labour force	Total employment	Injuries reported to ILO		Global estimates of occupational accidents				Reporting activity	
			Fatal	Non-fatal	Fatal	Non-fatal, average	Fatality ratio	Accident ratio	Fatal	Non-fatal
High income countries	498833289	446194700	4092	4120618	11396	11222581	2,6	2515,2	35,9	36,7
Africa (low&middle)	341142486	106677471	263	24024	59301	52458752	55,6	49175,1	0,4	0,05
Americas (l&m)	279490780	248755700	3096	1184336	18433	16306040	7,4	6555,0	16,8	7,26
Eastern Mediterranean (l&m)	173814953	141569900	0	0	19229	17009979	13,6	12015,3	0,0	0,00
Europe (l&m)	224441282	197595200	5893	257348	14609	12923133	7,4	6540,2	40,3	1,99
South-East Asia (l&m)	759562909	201728000	683	147348	114732	101493739	56,9	50312,2	0,6	0,15
Western Pacific (l&m)	923223849	879108945	195	3759	115069	101792125	13,1	11579,0	0,2	0,00
Total	3200509548	2221629916	14222	5737433	352769	313206349	15,9	14098,0		

## Appendix C: LTIF benchmarking

LTIF Benchmarking	In-house personnel			Contractor employees			Contractor employees		
	LTIF 2017	LTIF 2016	LTIF 2015	LTIF 2017	LTIF 2016	LTIF 2015	TRIF 2017	TRIF2016	TRIF 2015
Man Group	NA	13,5	13						
Leonardo (Finmeccanica)	NA	8,2	NA				5	4,5	8
Alfa Laval	4,7	4,7	NA						
Rolls Royce	2,15	1,85	2,75						
Siemens	2,55	2,8	3,1	2,75	2,35	2,25			
Wärtsilä	2,5	2,6	2,8						
Metso	2,6	2,5	2,7	6,5	2,9				
Linde Group	2,4	2,2	2,9	2,3	2,2	2,2			
E.ON	1,8	1,9	1,9	2,3	2,1	2			
Sulzer	2,7	1,8	2						
GE	1,5	1,95	2,05						
Alstom	1,4	1,7	1,9	*own employee numbers include also contractors					
ABB	1,65	1,5	1,8	1,2	1,5	1,9			
Statoil	1,2	1,1	1,1				2,9	2,7	2,9
Catepillar	0,85	0,95	1						
Wood Group	NA	0,47	0,47	*own employee numbers include also contractors					
Maersk Oil	0,59	0,43	0,58						
Shell	0,2	0,25	0,26	*own employee numbers include also contractors					
Saipem	0,14	0,2	0,31						

These values are based on data available in the company sustainability reports 2017 / websites. LTIF calculated per 1 million manhours. Some key players within our industry have not issued comparable statistics (several Ship Yards). In case given by 200000h, multiplied by 5.

## Appendix D: Semi-structured theme interview for Wärtsilä HSE representatives

Background of the interviewee:

- Name
- Position / Role
- Experience in your current position / in Wärtsilä?
- Location and business line of the production plant / joint venture
- Are you directly working with contractors?
- Total number of employees at your premises

General contractor related questions:

- Number of contractor employees at your premises on average daily?
- What kind of tasks they pursue at Wärtsilä premises?
- For how long time on average their contracts last?
- What kind of data are you collecting of the contractors? How often? How is it stored? E.g. personal data.
- How are you following working hours? Is there any internal registration besides the contractor's one?

Pre-job task and risk assessment

- How is the work being planned and by whom (Wärtsilä personnel/contractor)?
- Are you and/or the contractor making a risk assessment for the work? How? Main considerations? Do you have a certain tool for making it?

Contractor training and orientation

- What kind of induction are the contractor employees having?
- (How) Do you communicate about the safety (requirements) to the contractors before they arrive to Wärtsilä premises?
- How are you checking that they are competent / trained / fit for work? Training requirements? What kind of trainings Wärtsilä offers for them?
- Do all the contractor employees have access to WeLearn & WeCare? (If not, why not?)
- Are the contractor employees also following the lifesaving rules? How is the implementation of those going?

Monitoring of the job

- Daily safety practices you require from the contractors? *E.g. safety toolbox meetings, work permit system, risk assessments, near miss reporting et cetera..?*
- Practices that you use to monitor their job's safety? *E.g. safety walks, safety moments, safety meetings et cetera..?*

- Are contractors working alone or always in a minimum of 2?
- Are you teaching the contractor employees to use the JSA or sth similar?
- What kind of motivators and consequences (e.g. awards or penalties/disciplinary actions) do you have for certain behaviour? When and how are those applied?
- What is done if you see a contractor doing risky things? / What are you personally doing?
- Are contractors reporting (all) near misses and accidents? How they report them? Do contractors also hear about investigation / actions taken afterwards to enable continuous learning?
- How are you following contractors' safety performance? E.g. LTIF, TRIF? How could it be done?
- How can contractors communicate / give feedback for Wärtsilä? Related to safety, improvements, problems et cetera.
- How is the feedback recorded and followed up if needed?

#### Post job evaluation

- How are you evaluating the contractors after they finish their job? KPIs?
- Do you have certain document / check-list for this?

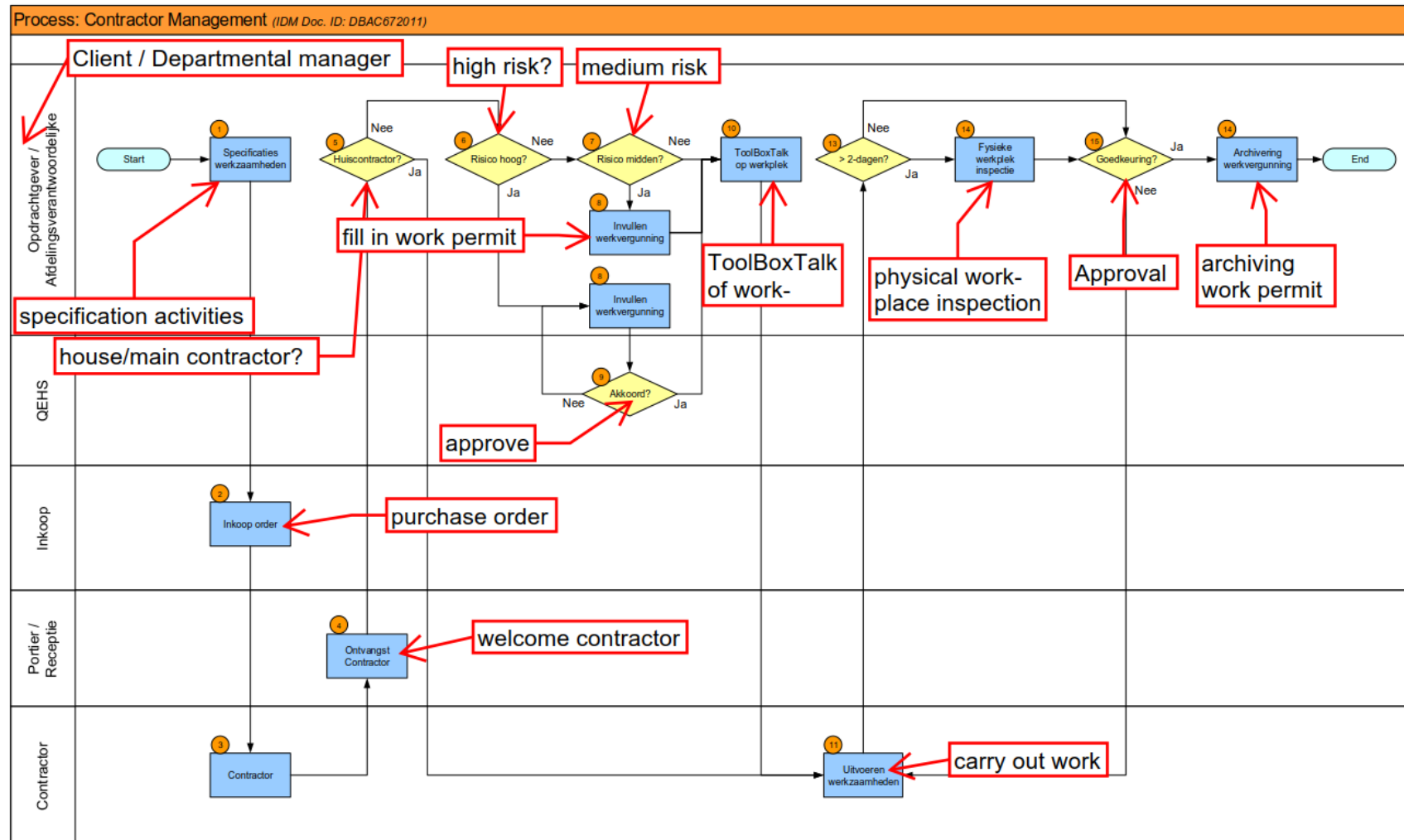
#### Development ideas:

- Your ideas to improve the occupational safety of the contractor employees at Wärtsilä premises?
- What kind of safety communication from Wärtsilä could be useful?
- What kind of trainings would be necessary for the contractor employees?
- How the reporting from contractor employees could be improved?
- Is there any tool you think could be useful to be in continuous touch with the contractor?
- Do you think a contractor management portal would help your work as a supervisor of the contractor employees? What kind of features would be necessary?

#### Problems:



- What kind of safety related difficulties (if any) have you encountered e.g. in spreading the safety culture of Wärtsilä to the contractor employees?
- How did you face the problems? Have you got any suggestion to solve these issues or an idea on how to improve communication with contractors in terms of safety?



## Appendix E: Contractor management process at Wärtsilä Netherlands B.V.






## Appendix F: Summary of contractor safety management practices found

 <p>Prequalification and contract</p>	<p>Wärtsilä:</p> <ul style="list-style-type: none"> <li>• Supplier assessment process:             <ul style="list-style-type: none"> <li>◦ Pre-assessment → VMS rating (→ Audit if needed)</li> </ul> </li> <li>• HR competence check (job interview) for agency workers</li> <li>• Contract requirements + attachments</li> <li>• Site rules</li> </ul> <p>Theory/benchmarking:</p> <ul style="list-style-type: none"> <li>• 3<sup>rd</sup> party prequalification services</li> <li>• Alstom: Trainings for buyers &amp; focus on sourcing sustainable products and services</li> </ul>
 <p>Pre-job planning and risk assessment</p>	<p>Wärtsilä:</p> <ul style="list-style-type: none"> <li>• Work safety plan</li> <li>• Pre-made RAs for regular work tasks</li> <li>• RAs made on-site when changed environment / new job (JSAs)             <ul style="list-style-type: none"> <li>◦ JSA mobile application (commissioning)</li> </ul> </li> <li>• Coordination meeting before starting work (line manager + contractor supervisor/manager)</li> <li>• RA for contracted work</li> <li>• PFMA</li> <li>• RAMS</li> </ul> <p>Theory/benchmarking:</p> <ul style="list-style-type: none"> <li>• Georgia-Pacific: two-level risk assessment: at first on the broad scope of work and secondly on contractor's detailed work procedure. For high-risk projects an additional written safety program is required.</li> <li>• Hazardous job meetings or detailed job walkthroughs</li> <li>• Dividing contractors into: higher liability and lower liability contractors</li> <li>• Job Safety Analysis (JSA) / Job Hazard Analysis (JHA)</li> <li>• HSE alignment kick-off meeting to fit together both OH&amp;SMS, reveal gaps (going through the HSE rules, HSE plan, working procedures, emergency situations, most important hazards related to the tasks)</li> <li>• Shell: PAUSE Card (What has changed in terms of <b>P</b>eople, <b>A</b>ctivities, <b>U</b>nexpected events, <b>S</b>cope of job and <b>E</b>xposure) is a two-sided pocket-sized card, which has divided hazards into eight groups, being like a small risk register</li> <li>• Caverion: on-site risk assessment tool <a href="http://www.ennakoi.fi">www.ennakoi.fi</a></li> </ul>

 <p>Induction &amp; Training</p>	<p>Wärtsilä:</p> <ul style="list-style-type: none"> <li>• Visitor / contractor HSE leaflet</li> <li>• Occupational safety card (Finland)</li> <li>• Work permit(s)</li> <li>• Solarium database system (delivery of all certificates, competences, trainings, work permits etc.)</li> <li>• 10min safety training video (Finland)</li> <li>• HSE induction (PowerPoint in most places)</li> <li>• Orientation round at work place</li> <li>• Induction checklist</li> <li>• 3-level training (China) <ul style="list-style-type: none"> <li>◦ Company + Department + Position level</li> </ul> </li> <li>• Safety-awareness / knowledge test (Suzhou, China)</li> <li>• Safety training for contractors (Wuxi, China)</li> <li>• Safety cards (ES)</li> <li>• Safety Handbook</li> <li>• Dedicated HSE trainings for large projects (Moss, Norway)</li> <li>• Induction training matrix (India)</li> </ul> <p>Theory/benchmarking:</p> <ul style="list-style-type: none"> <li>• Trainings and induction can be online interactive trainings or webinars, videos, face-to-face school-class trainings, site walk-arounds or in a written form</li> <li>• Health checks (more important if long work period)</li> <li>• U.S. Steel: Daily pre-shift safety meeting + annual safety-awareness training</li> <li>• AECOM: supervisors 30-hour OSHA training and all contractor employees 10-hour OSHA training</li> <li>• BABCO: a list of all the safety trainings</li> <li>• Samsung: Safety Training Centers</li> <li>• Shell, Chevron &amp; others: Contractor HSE handbook</li> <li>• HSE training matrix (which trainings needed and who is responsible)</li> </ul>
 <p>Monitoring &amp; Communi- cation</p>	<p>Wärtsilä:</p> <ul style="list-style-type: none"> <li>• Daily observing,</li> <li>• Daily safety communication (contractor employees/supervisor and Wärtsilä supervisor/HSE person)</li> <li>• Injury &amp; near miss reporting <ul style="list-style-type: none"> <li>◦ currently on paper or verbally in most cases</li> <li>◦ SynergiLife mobileapp</li> </ul> </li> <li>• Disciplinary actions</li> <li>• Monthly safety briefings (~15mins) in Finland, prepared by HSE engineer, delivered by line managers for the internals (+Barona agency workers)</li> <li>• WeCare reporting instruction leaflet</li> <li>• Safety walk</li> </ul>

	<ul style="list-style-type: none"> <li>• Regular safety meetings, safety information moment (10-15 contractor representatives, conversational/interactive) in Italy,</li> <li>• Hearts &amp; Minds (observation of positive behaviour) for internals starting in Italy</li> <li>• Annual contractor day for all contractors (Finland, discontinuous since 2016)</li> <li>• Safety moment</li> <li>• Contractor Project Manager position</li> <li>• Wärtsilä Supplier HSE Webpage: <a href="https://www.wartsila.com/about/suppliers/environment-health-safety">https://www.wartsila.com/about/suppliers/environment-health-safety</a></li> <li>• Shared Contractor &amp; Maintenance Calendar in Outlook</li> </ul> <p>Theory/benchmarking:</p> <ul style="list-style-type: none"> <li>• Performance reviews</li> <li>• Field verifications</li> <li>• Compliance assurance with safety plans</li> <li>• Non-compliance or unsafe conditions reporting and injury and near miss reports and logs</li> <li>• A focus group meeting (problems / improvement actions)</li> <li>• Near miss and injury reporting, investigating and making corrective actions</li> <li>• Shell: learning sessions about all incidents</li> <li>• H&amp;S rewarding</li> <li>• Neste: Safest contractor award</li> </ul>
	<p>Wärtsilä:</p> <ul style="list-style-type: none"> <li>• Supplier Periodical Evaluation (weekly/monthly) → average &amp; overall evaluation (Italy)</li> <li>• Oral feedback given on performance</li> </ul> <p>Theory/benchmarking:</p> <ul style="list-style-type: none"> <li>• In some companies, it is integrated together with periodical reassessments</li> <li>• E.g. saving the injury or near miss statistics of contractors, giving them feedback about their performance for example in terms of safety and efficiency or reviewing the effectiveness of induction of a contractor</li> </ul>