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THE APPLICATION OF HOLOGRAMS IN TRAINING: A DISRUPTIVE APPROACH TO TRAINING SERVICES

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ABSTRACT:

The statement of training services' management to have a hologram technology utilized in the case company's training marks a beginning for the thesis. To find out a suitable technology and relevant interest groups' perception towards it are aimed to be figured out. In addition, improved training quality, sped up training process and reduced time involved in travelling are to be achieved.

The research is a case study carried out within a case company's training services and the nature of the research is qualitative. Due to lack of completely fitting theory, the theoretical framework is created by combining different relevant theories in the field. Empirical data collection methods are customer feedback analysis, participant observation, survey and interviews. Case company's training development manager guide the research project from start to finish and clarify doubts.

A limited number of suitable hologram technology providers were recognized. Expected benefits, such as enhanced understanding on trained equipment and more effectively conveyed information were figured out, but due to number of constraints in terms of use of technology, the most desired outputs like 3D-view and demonstration of inner parts of the equipment could be achieved by means of alternative technologies, which are affordable, more convenient to use and convey information more efficiently.

Theory of sustaining and disruptive innovations were reflected to training services and they provided a holistic approach to develop the company's training in the future. Based on the acquired dataset, sustaining and disruptive approaches were discussed. Sustaining approach was expected to provide incremental improvements on training and increase satisfaction among the relevant interest groups. However, in order to meet strategic objectives, customer demand and resolve current challenges in training, the suggested approach was disruptive in nature. That was projected to enable as individual training as possible, disconnection of training from time and place and elimination of redundant training.

KEYWORDS: Hologram technology, training, disruptive innovation, development

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TIIVISTELMÄ:

Koulutuspalvelujen johdon ilmaus hologrammiteknologian hyödyntämisestä yrityksen koulutuksessa toimii tämän työn aloituksena. Sopivan teknologian löytäminen sekä asiaankuuluvien sidosryhmien näkemys teknologian käytöstä ovat tarkoitus selvittää. Sen lisäksi parantunut koulutuksen laatu, nopeutunut koulutusprosessi ja vähentynyt matkustamiseen kuluva aika koulutuksen vuoksi ovat määrä tulla saavutetuksi.

Tutkimustyö on tapaustutkimus, joka suoritetaan kyseessä olevan yrityksen koulutuspalveluissa ja työ on luonteeltaan laadullinen tutkimus. Täysin sopivan teorian puuttumisen vuoksi teoreettinen viitekehys saadaan aikaan yhdistelemällä eri asiaankuuluvia teorioita. Empiiriset tiedonkeruumenetelmät ovat asiakaspalautteen analysointi, osallistuva havannointi, kysely sekä haastattelut. Yrityksen koulutuksen kehittämisestä vastaava esimies ohjaa tutkimusprojektia alusta loppuun ja selventää havaittuja epäkohtia.

Rajallinen määrä sopivia hologrammiteknologian tarjoajia pystyttiin tunnistamaan. Oletetut hyödyt, kuten parantunut ymmärrys koulutettujen laitteiden suhteen sekä tehokkaampi tiedonkulku saatiin selville, mutta monien teknologian käyttöön liittyvien rajoitteiden vuoksi tavoitellut hyödyt, kuten 3D-näkymä ja laitteiden sisäisten osien näyttäminen voitaisiin saavuttaa muiden teknologioiden avulla, jotka ovat edullisia, helppokäyttöisempiä ja välittävät tietoa tehokkaammin.

Kestävien ja disruptiivisten innovaatioiden teorioita pohdittiin koulutuspalvelujen näkökulmasta, jotka tarjosivat kokonaisvaltaisen lähestymistavan yrityksen koulutuksen kehittämiseen tulevaisuudessa. Perustuen hankittuihin tuloksiin, kestävä ja disruptiivinen lähestymistapa tarkasteltiin. Kestävän lähestymistavan odotettiin tarjoavan vähittäisiä parannuksia koulutukseen ja lisäävän tyytyväisyyttä asiaankuuluvissa sidosryhmissä. Silti koulutuksen strategisten tavoitteiden, asiakaskysynnän ja tämänhetkisten ongelmien ratkaisemiseksi esitetty lähestymistapa oli disruptiivinen. Tämän arvioitiin mahdollistavan niin yksilöllisen koulutuksen kuin mahdollista, koulutuksen irrottamisen ajasta ja paikasta sekä turhan koulutuksen poistamisen.

AVAINSANAT: Hologrammiteknologia, koulutus, disruptiivinen innovaatio, kehittäminen

1 INTRODUCTION

For improving and maintaining the quality of human capital, it is crucial to invest in human capital through education and training. Effective training provides firms with a singular and differentiated position that is able to improve the standard and quality of service or products, resulting in continuous innovation, and increased productivity and profitability (Hyland, Soosay & Zheng 2007). That is why training is the most important factor in the business world as it increases the effectiveness of both employees and the organization (Khan, Khan & Khan 2011). Therefore companies must focus on assessing their training policies, applied methods and corresponding technologies.

1.1 Background and objectives

Figures regarding actual spending on corporate training vary between different sources, but one can suggest that a global expenditure to soar up to hundreds of billion US dollars. For instance Paul (2014) suggested that U.S. companies spent over 70 billion dollars on training in the United States and 130 billion dollars on training their employees globally. Another estimation is provided by Mohammadyari & Singh (2015), who say global corporate training industry amounts to 200 billion dollars, e-learning representing a one third of it. According to Forbes (2014) high-performing companies are spending more on training than the rest of the companies, which shows investment pays off. In addition, technology is revolutionizing the training market as an explosive growth in technology tools to train people has seen the light of day.

The researched multinational case company is a leader in complete lifecycle power solutions for the marine and energy markets. It employs approximately 18 000 persons in 70 countries and is present at each inhabited continent. The research is conducted at the company's training services and it aims to map out current state of the company's training and tries to find solutions on arisen issues. The analysis of results was conducted based on the principles of disruptive innovation.

In 2014, training services' management stated that there is a demand for hologram technology to be utilized in training activities. The aim was to investigate, define and select the best equipment for such purposes. Once the subject was refined, the desired study objectives were validated as follows: to improve quality of training, to speed up the

training process and to reduce time involved in travelling. Objectives were supposed to be achieved by means of hologram technology, which enables 3D-experience for viewers without wearing any glasses or goggles in approximately life-size images. Additionally, the aim is to investigate how stakeholders involved perceive the use of 3D-technology.

1.2 Research question

An initial definition of the research question is important in building theory from a case study (Eisenhardt 1989). The research question, which is steering the entire research, is: **How could hologram technology be applied in training?** To answer the research question, it has been divided into four subquestions:

- How is the concept of hologram understood and perceived by the case company's trainers and internal customers?
- Which training issues are found arduous and too time-consuming to train and how could they be done more efficiently?
- What hologram technologies are available on the markets?
- How can the theory of sustaining and disruptive innovation be reflected in terms of the training services?

The first subquestion aims to find out the perception of holograms by the case company's relevant stakeholders, who are the ones to use it, if it is found and implemented in training. As the technology in itself is a mystery for the majority of people and it has not been utilized in training purposes in the past, the idea is to find out of how people understand that concept. The second subquestion is assessing the current state of training. The goal is to understand, which issues are prolonging training delivery and how could they be done more efficiently and in less time-consuming way. The third subquestion seeks to answer the question of available hologram technologies to be utilized in the company's training operations. The final subquestion aims to figure out how theory of sustaining and disruptive innovation could be applied in the company's training services. By answering the aforementioned four subquestions it is possible to answer the primary research question.

The material for this research is predominantly designed and collected by the researcher himself, but if needed, support has been provided by the training development manager

and colleagues. Research results are to be assessed against aforementioned questions and how extensively they have been covered.

1.3 Structure

This research has six chapters and three major sections can be recognized in it. The first two chapters provide a theoretical foundation for the research and set up the empirical part of the research presented in the following two chapters. The last two chapters refine studied results, address the limitations of research and possible topics for further research and summarize the research project reflecting research results on initial objectives and the research question.

The first chapter presents the background for the research, the objectives and the research question. A short insight of literature and data collection is provided. The second chapter presents theoretical literature, the case company, study methods and technology as much as required to understand the following chapters of the research. Moreover, theories of sustaining and disruptive innovations are discussed as managerial implications are based on them. The third chapter presents the dataset and how the empirical data was acquired. The fourth chapter presents results based on the dataset. Chapter five provides managerial implications and recommendations for future actions. In addition, the limitations of the research and other applicable technologies are discussed in brief. Chapter six sums up the whole thesis from start to finish analysing how the objectives and research questions were answered and covered. Furthermore, possible future research topics are discussed.

1.4 Literature

As there are no previous studies regarding the application of holograms in the existing literature due to lack of technology availability, multiple different theories are combined in order to conduct the research. A combination of various sciences provides a theoretical foundation for the research. Addressed sciences for creating the theoretical framework are training, qualitative and case study research methodologies and various hologram technologies. In addition, the theory of sustaining and disruptive innovations are provided as they are applied for managerial implications. The aforementioned sciences are broadly

studied subjects and a great deal of information is available excluding hologram technologies of which it is hard to find valuable information extensively. Even if it is found, it is very physics- and engineering-oriented, and therefore lacking relevancy in this research. Due to lack of directly applicable literature, research methods and strategy are discussed broadly so the reader is able to understand acquired empirical results. In addition, there may be a need for further studies on the topic in the future, therefore the research methods are presented exceptionally extensively.

Historically there has been a bias in favour of quantitative approaches in training research (Gummesson 2007). Foster (2002) states that case study analysis is an appropriate choice for technology and industrial-educational researchers who study a topic in depth, so it is the best suited for those areas in education where foundational questions remain unanswered. The application of holograms in training is definitely such. Hologram is an optical technique based on diffraction that encodes information in both the phase and amplitude of light and allows reconstruction of 2D and 3D objects (Cabrero-Vilatela, Hofmann, Milne, Montelongo, Tenorio-Pearl, Wilkinson & Williams 2015).

The training research today is empirical in nature, and theoretically based, moreover it is grounded in the science of learning. Today's training is deemed as a system that is pivotal to promote learning and enhance on-the-job performance instead of being a mere event occurring in a classroom. (Kraiger, Salas, Smith-Jentsch & Tannenbaum 2012.)

1.5 Empirical data

The collection of empirical data for the research was done in four different ways. The case company has been collecting customer feedback in the past, which is stored into an internal database. That existing data is analysed in order to get insight of the state of training today and what development actions could be taken. Such an analysis has not been done earlier by anyone, therefore acquired results are valuable for the case company's management for assessing quality of training in the past.

The researcher participated in training courses to observe how training is delivered. Questionnaires were created based on customer feedback and observations to find out how relevant interest groups find training services and hologram technology. Answers

were collected either through a training portal or e-mail. Finally, interviews were arranged to figure out disruptive approach to facilitate training in the future.

1.6 Research approach

The research is commenced from an inductive position where a theory is sought to be built up that is grounded in research data (Lewis, Saunders & Thornhill 2007: 487). That means that the research approach involves the development of a theory as a result of the observation of empirical data (Lewis et al. 2007: 599).

This is a case study research, which seeks to assess applicability of hologram technology in the case company's training services. Eisenhardt (1989) defines the case study as being a research strategy which focuses on understanding the dynamics present within single settings. It offers freedom in the choice of data generation and analytical techniques (Gummesson 2007). There are three main reasons to carry out a case study: a pilot research, to develop new theories and to challenge traditional theories (Study.com 2015). Wilson (2010: 301) sums it up by defining case study as a research design used to examine a single phenomenon in its natural setting. Therefore, it is the most suitable research strategy for this research.

The nature of this research is qualitative. The qualitative research method is suitable for situations, where the phenomenon is as an object of research, a more in-depth view on the phenomenon is wanted and to create new theories and hypothesis (Kananen 2013: 31-37). The goal is to produce rounded understandings of the basis of rich, contextual and detailed data (Manson 1996: 1-4). Participating in the setting, observing directly, interviewing in depth and analysing documents and material, with varying emphases are major methods for collecting data (Marshall and Rossman 2011: 137). Hoon & Ridder (2009) state that interviews are extensively employed because they provide an efficient and well-developed way of understanding one's perspective and getting expertise. Analysis based on qualitative data is very much exploratory in nature, so it can be defined as any kind of analysis producing findings or concepts and hypotheses, as in grounded theory, that are not arrived in at by statistical methods (Wilson 2010: 254).

According to Metsämuuronen (2006: 92) the case study is considered to be an essential strategy in qualitative research in seeking information, since qualitative research is most

of the time a case study. Distinctions between various qualitative information seeking methods are dependent on applied methods and research objects.

2 BACKGROUND AND LITERATURE REVIEW

This section presents the theoretical foundation on which the research is based on. The chapter begins with presenting the case company in brief and its training services more in depth. Followed by a literature review on training, hologram technology and applied research methods in order to provide the theoretical foundation for the empirical part of the research. The chapter is completed by innovator's dilemma as it works as a foundation for the analysis of results. Only issues found relevant to the case are discussed.

2.1 Case company

The case company is a global leader in complete lifecycle power solutions for the marine and energy markets. In 2014, the company employed nearly 18 000 people in 70 countries and in 200 locations in every continent. Total net sales amounted to 4.8 billion euros. The company's mission is as stated in the first sentence whilst creating better technologies that benefit both the customer and the environment. The vision is to be their customers' most valued business partner and the company has three core values: energy, excellence and excitement. In order to strengthen its technology leadership position the company invests approximately three percent of net sales in research and development annually. The organization is structured in three divisions and each represents a certain business: ship power, power plants and services. This case study is conducted in the services division, which offer a wide range of expertise and services. The training services is one of them, in which this case study is conducted. The services strategic goal is to be recognized as their customers' most valued and competitive partner while being competent, reliable and an easy business partner.

2.1.1 Training services

The training services unit is a part of field services. Since the delivery of the first product manufactured by the case company, training activities have been conducted in the company's facilities. Its global network of training centres covers all aspects of management, operation, maintenance and safety issues, optimizing the safety, availability, reliability and performance of one's power or marine installation. The training services unit is the proactive service provider, which delivers as promised and strives to be the most valued partner of the company's internal and external customers, transforming training investments into real business results. One of its strategy pillars, utilization of modern technologies to provide competence, matches greatly the research topic, therefore providing desired relevance. By meeting such strategy objective it becomes easier to achieve other corner stones of the strategy. The company's training centres are shown in Figure 1.

Figure 1. Company's training centre locations.

In its 11 centres it is arranged approximately 1.200 training courses in a year, which encompasses roughly 42.000 course-man days and 11.000 trainees. 40 percent of trainees are internal customers, while approximately 30 percent of course-man days are devoted to internal training.

The training services unit is managed through a management team, which is led by a general manager. In addition to the general manager, the management team consists of managers in charge of sales support, development and operations. This research is conducted under supervision of the training development manager, who is denoted by "Manager Y" in Figure 2. He is responsible for, among other things, prioritising and development of new training courses and solutions. Furthermore, he is assigned to monitor and seek involvement in new and innovative training methodologies and philosophies. Hence, he is the right person to supervise and assess the research process and findings on behalf of the case company.

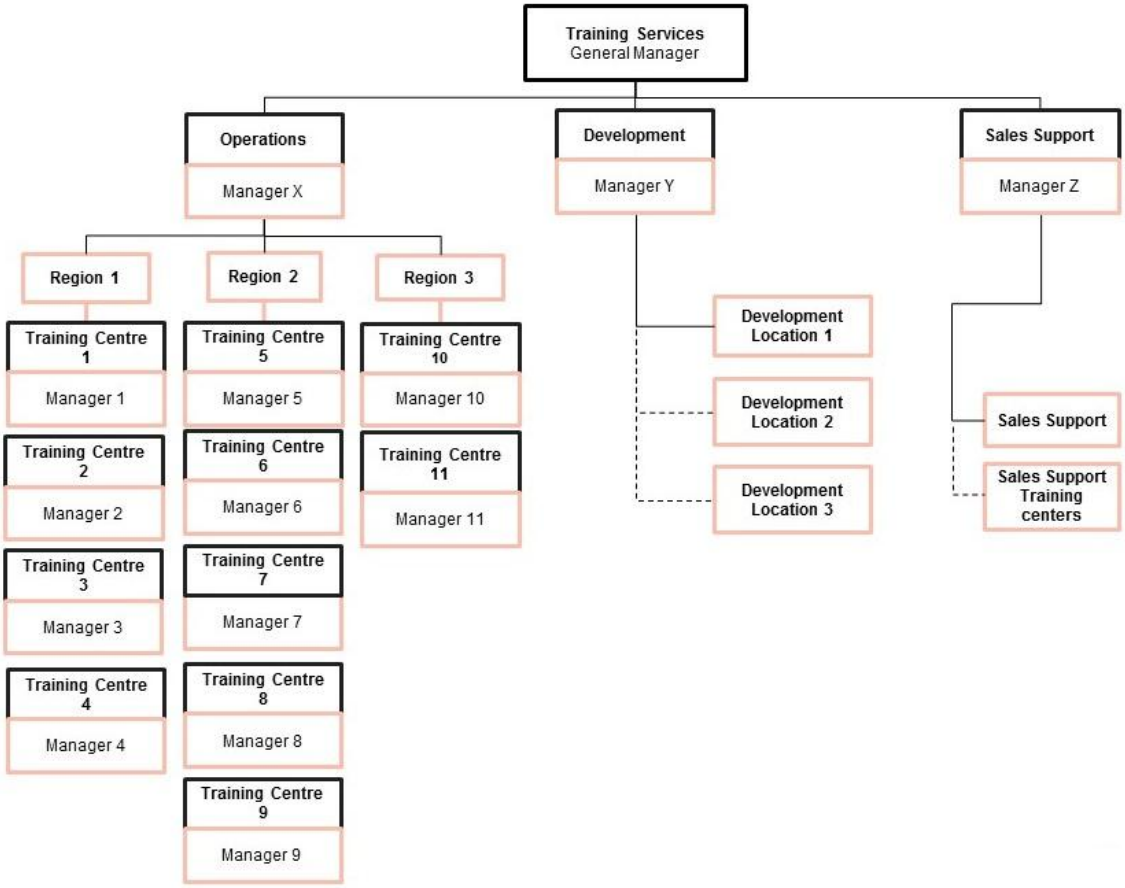


Figure 2. Training services' organization.

Overall, there are three different functions in training services: training delivery, sales support and training development, each having its designated function presented in Figure 3. Training delivery is responsible for arranging training and conducting it. In addition, it collects feedback, reviews it and takes corrective actions if necessary. How the time is allocated between classroom and hands-on training varies between courses and is up to the trainer's preferences, course structure and desired learning outcomes. Sales support is primarily responsible for sales related matters such as inquiry review and drafting larger scopes, checking resources, time, profit margin and creating an offer. It is to be noted that each training centre is accountable for selling training themselves. Since this research is addressing training development, it is discussed in the next subchapter.

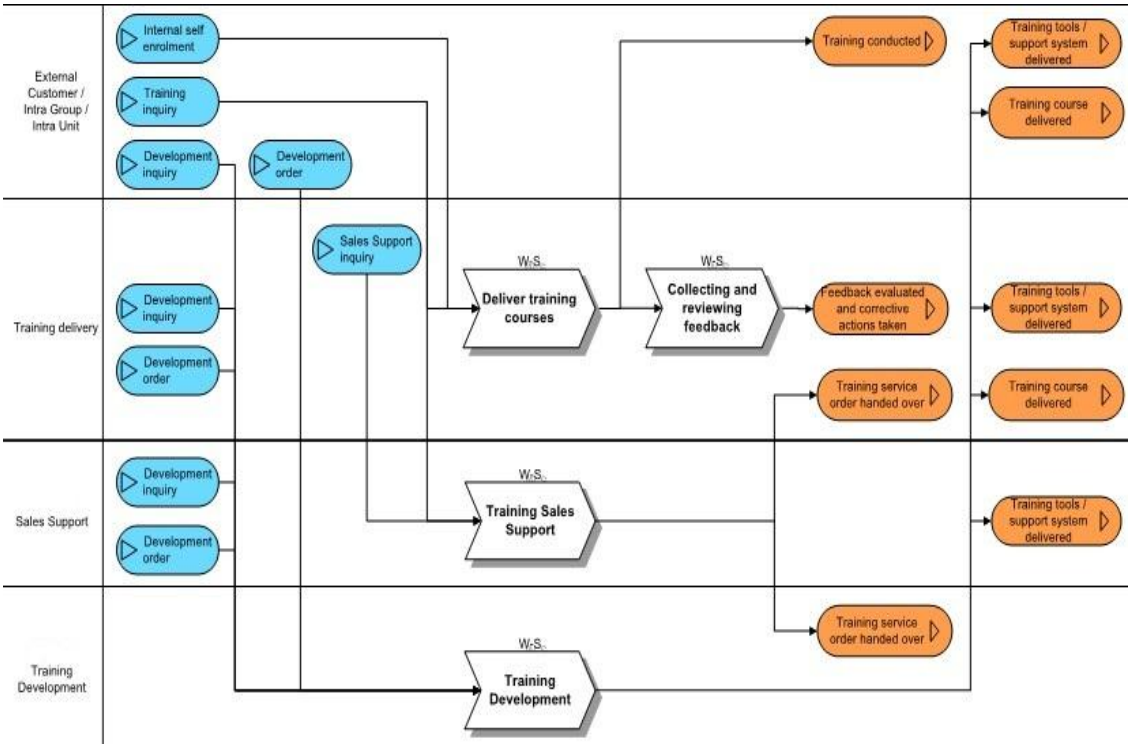


Figure 3. Training delivery.

2.1.2 Training development

Training development process is depicted below in Figure 4.

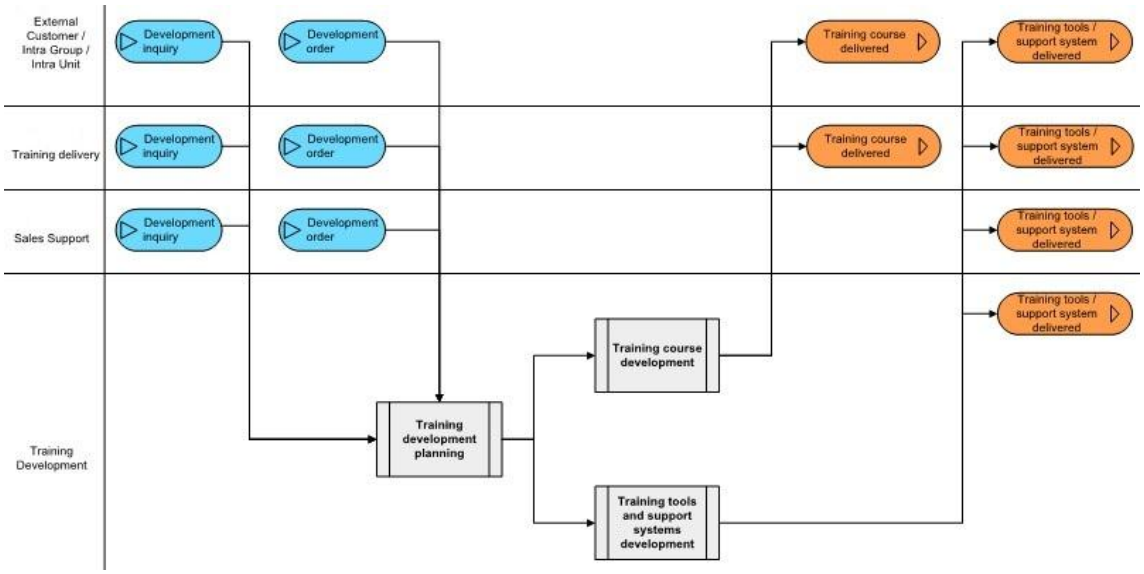


Figure 4. Training development.

Development inquiry or order can be initiated by any stakeholder and will be processed by training development organization. First, in development planning phase development needs and existing solutions are analysed. If any of existing solutions are not fulfilling needs and new development is needed, feasibility of the project is evaluated. Assuming the project is feasible, a possibility to improve or update existing solutions are screened. If they meet the requirements, a preliminary project plan is done. If not, other solutions are considered, which leads to either rejection of plan or a preliminary project plan.

Once the project plan has been accepted, the training course or tools and support systems are developed. Both processes are divided into five different stages: defining, designing, creating, verification and releasing. After all stages have been accomplished, new materials, tools or support systems are delivered and implemented to training delivery.

Considering the objectives of this research, the focus is primarily in training tools and support systems development. Though, the research contributes to training course development by assessing of how the training is conducted, so the research has a very holistic impact on training services.

2.1.3 Current challenges in training services

Unit's strategic roadmap poses challenges for training development. This research topic is derived from the need to develop modern training methods and utilize modern technologies to provide competence. By means of them training should be delivered in a shorter period of time, quality of training is to be increased and time involved in travelling to be decreased. Reliance on classroom-based training and physical presence of people is obviously hindering quicker training delivery process.

In order to achieve the given strategic goals, new training methods such as blended learning are developed constantly. Technology-wise the most pivotal issue is to incorporate 3D-technology in training. Therefore a hologram technology is studied as it could be a solution to solve a given issue according to training services' management team.

There is room for improvement on how the training could be delivered and how could the course participants' learning be enhanced too. Therefore a current state of training is

mapped out in order to meet the strategic corner stones: listening to and understanding customers and operating in a structured and unified way. That means a way of working, training material and equipment need to have same standards in every location in every single course. Furthermore, well known and clear processes are to be followed. Unfortunately, only the processes presented earlier are available today, how the training itself is delivered and desired training objectives are met depend on trainer's personal know-how and preferences. Training services is currently lacking a process of how to deliver training itself. That has resulted in varied quality of training, hence one has to reflect whether that could be solved by creating a process for training delivery too. Furthermore, training is very rigid. It is lacking individuality in terms of delivery: training delivery is following a philosophy of "one size fits for all", even though studies prove that everyone tends to learn in different ways. Although instructors may inquire participants' preferences in terms of course structure in the beginning of course, yet from a single person's point of view tailor-made training does not exist at the moment.

2.2 Training

There are multiple definitions for training in literature. Auerbach & Silberman (2006: 1) say that training is a method of enhancing human performance. Whenever a person's ability to perform a job is restricted by a lack of know-how or skill, it is reasonable to bridge that gap by providing the required instruction. Lee, Mavin & Robson (2010) suggest that the most fundamental reason for providing learning and development is to ensure that an organisation's employees are able to carry out their current role, but organizations which are keen to improve their productivity, efficiency and profitability will look to move beyond compulsory training and look at more diverse learning and development activities enabling the employees to maximize their potential and provide a valuable resource for the organization. According to Ghosh, Joshi, Mukherjee, Ranjan & Satyawadi (2011) training can be described as an activity, which tries to change people's behaviour. A more extensive definition of training defines training as the act to increase the skills of an employee to perform a particular job by acquiring systematically skills, rules, concepts or attitudes that results in enhanced performance in another environment. Vital job-related competencies for successful job performance are skills, knowledge and behaviours of which planned effort by a company to facilitate employees' learning is referred to an area where industrial, organizational and individual development can match, furthermore where human resource and organization growth get blended together.

Iglesias & Salgado (2012) state training being a mechanism of increasing intellectual capital of organization through the improvement of their human capital, which benefits both organization and employees: organizations counting on personnel with better competencies to carry out their job functions and tasks whereas employees gain better competencies, which provide them added value to their professional profile and subsequently, can give them access to improved remuneration packages and promotions, to name a few.

Training should not be perceived as an off investment and solution, but as a process being more than just teaching staff a new set of skills and guiding them how to do things better. Considering it as an ongoing process with set goals and outcomes, which are monitored, refreshed and enhanced, it can provide benefits to business for years (Denby 2010). Lee et al. (2010) state that the training investment should be evaluated by reflecting on what was achieved in comparison to what was hoped for. In other words, an evaluation is carried out to ascertain the effectiveness of the training in line with the identified need (Awotungase, Chukwuemeka & Olusanya 2012). Aguinis & Kraiger (2009) suggest that training may not only affect declarative or procedural knowledge, further it has positive impact on strategic knowledge and for adaptive expertise, which means knowing when to apply a specific know-how or skill and enhancement of consistency in performance across conditions.

The benefits of training are extensively recognized and it is viewed as a pivotal element in improving organizational innovation, creating new knowledge and organizational learning, and increasing productivity and profitability (Hyland et al. 2007). Therefore, an ideal training shall become part of a company-wide strategy and it has to be linked to business goals and organizational performance (Awotungase et al. 2012).

Surveys of industry practice show than an increasing number of organizations are implementing technology-based training in support of, or instead of traditional forms of training. It is to be noted that both forms of training, traditional and technology-based, can work, but fail as well. People can sit and listen without learning, on the other hand, they can interact with the computer and make poor decisions leading to suboptimal learning. Some studies suggest that technology-based training provides better results and vice versa. That leads to argument that the medium does not matter, since well-designed instruction works irrespective of the mode of delivery. Technology-based training might be preferred to traditional classroom or one-on-one training due to being a cheaper and

easier to deliver option, regardless a lack of instructional benefits. However, there are few studies to validate such assumption, since training expenditure tend to remain constant. Reductions in staffing of trainers and travel savings are compensated by greater information technology support costs and investment in technology (Kraiger et al. 2012). Similar conclusion was achieved by Sitzmann (2011) who studied benefits of simulation games in training. The cost of developing simulation games may be offset by the reduction in travel costs for training that used to be delivered via classroom instruction.

2.2.1 Classroom training

Different professionals have different learning styles, but traditional classroom training is still prevalent (Corporate Education Group 2015). It can be defined as group-based training, where the delivery mode is face-to-face via an instructor and it takes place at a fixed time and location (Kraiger, Sitzmann, Stewart & Wisher 2006). According to Thomson Reuters Elite (2015) classroom training has been the foundation of employee and client education for years allowing participants to learn best and have the greatest opportunity for retention.

However, it has been argued that formal classroom training produces individuals who are just able to perform crude and forced imitations of target behaviours. Further, meta-analytic evidence suggest that the post-training impact of interpersonal skills is modest. Researchers have stated that training is better not to be an isolated classroom activity if the advantages of training are to be completely utilized. Pre-training supplements are to motivate and prepare persons for learning in the classroom setting, whereas post-training supplements are to motivate transfer and promote further skill development (Tews & Tracey 2008). That statement is supported by Kraiger et al. (2012), who state that it has been recognized for a long time, traditional, stand-up lectures are not efficient and engaging strategy for imparting new knowledge and skills.

Advantages are method's efficiency to present a large body of material to large or small group of employees, it is a personal face-to-face type of training and ensures that everyone gets the same information at the same time. It can be considered cost-effective and storytelling is to grab people's attention (TrainingToday 2015). Furthermore, it provides important so called human touch, which technology-based training is lacking. Finally, especially if desired group interaction pans out, the setting also teaches employees how

to interact with one another in a professional, productive, cooperative way, which is something other forms of training are conventionally lacking (HR.BLR.com 2011).

On the other hand, traditional classroom training has its disadvantages in addition to the aforementioned ones. It may lack interactivity, too much of participants' learning outcomes rely on the effectiveness of the lecturer and scheduling issues occur, especially when participants are in multiple locations (TrainingToday 2015). Hence employees have to be pulled off the job, which cuts into work time. Moreover, excessive classroom training leads to negligence of hands-on training, which is regarded as an obstacle to adult learning (HR.BLR.com 2011).

The content presented in the classroom is disconnected from its real-world context, so know-how conveyed in the classroom tends to be situated in the context of a classroom instead of the context in which know-how was created in the first place. That contextual dichotomy has been shown to negatively affect the learning process, especially adversely effecting learner motivation. Simultaneously, real-time learning situated in real-world contexts has been indicated to have positive effects on learning and learning motivation (Lunce 2006). Due to advancements in network-based information and communication systems and in light of economic pressures, such as reduced budgets and travel constraints, the use of technology to deliver content continues to rise (Massey, Montoya & Wu 2013).

2.2.2 Distance learning

Distance learning can be defined as receiving education through web-based remote sources including both synchronous and asynchronous learning (Krishnan 2012). Klein, Noe & Wang (2006) define distance learning as any instructional approach in which the instructor or trainer and learner are separate by time, space or distance. The instructor may be a person or instruction could be delivered without any human interaction (Klein et al. 2006). By eliminating barriers of time and distance the learning can take place in anytime, in any location providing more efficient use of time at reduced costs (Gunasekaran, McNeil & Shaul 2002). Kember (2007: 90) says the reigning character is the lack of instructor and peers for most of the time. Meyer (2014) states that by online learning it is referred to distance education and as web-based learning, e-learning and online education. Briefly, it is often described as effort of providing access to learning for those who are geographically distant (Dickson-Deane, Galyen & Moore 2011).

According to Tarr (1998) distance learning has to be divided into manageable chunks so the trainees are able to build up their skills and knowledge over a period.

Dickson-Deane et al. (2011) studied research articles to find out how the literature defines the learning environment and concluded that there was apparent inconsistent use of terminology for different types of delivery modes. Such inconsistency in terminology inevitably has impact on not only the researchers who would like to build upon the findings, but also impacts designers who are creating similar types of environments (Dickson-Deane et al. 2011). However, such classification is out of scope of this study, therefore the aforementioned definitions stand.

The most used form of distance learning in literature is e-learning. According to Gunasekaran et al. (2002) it delivers accountability, accessibility and opportunity. Provided faster learning, increased access to learning and clear accountability enable companies and their workforce to turn change into an advantage in today's fast-paced culture (Gunasekaran et al. 2002). Nunamaker Jr., Zhang, Zhao & Zhou (2004) state that e-learning is to become a real alternative to traditional classroom training. Even though it provides richer resources than the traditional classroom instruction it is noted to have some shortcomings, for instance learners have to be highly self-regulated and independent due to lack of supervision and enforcement mechanism, which may result in low effectiveness of study method (Wang 2014). That is supported by Bovee, Fryer & Nakao (2014), who say motivational problems persist with any form of independent study including e-learning. Lo (2014) says the level of involvement in e-learning can be defined as the level of relevance and attention the staff feel towards e-learning.

The Figure 5 presents relative strengths and weaknesses of classroom- and e-learning. E-learning has gained ground as on-the-job workforce training method (Nunamaker Jr. et al. 2004), though it is to be noted that companies tend to stress their own particular preferences and how each method is perceived depend on individual. Therefore Figure 5 can be conceived as generalization.

	Traditional Classroom Learning	E-Learning
Advantages	• Immediate feedback • Being familiar to both instructors and students • Motivating students • Cultivation of a social community	• Learner-centered and self-paced • Time and location flexibility • Cost-effective for learners • Potentially available to global audience • Unlimited access to knowledge • Archival capability for knowledge reuse and sharing
Disadvantages	• Instructor-centered • Time and location constraints • More expensive to deliver	• Lack of immediate feedback in asynchronous e-learning • Increased preparation time for the instructor • Not comfortable to some people • Potentially more frustration, anxiety, and confusion

Figure 5. Traditional classroom versus e-learning. (Nunamaker Jr. et al. 2004)

Mohammadyari & Singh (2015) confirms the benefits of e-learning presented above a decade later by suggesting e-learning is increasingly being utilized by organizations to train their employees due to lower cost of training delivery, increased flexibility of learning in terms of place and time, encouraged self-management of learning and enabled on-demand training.

In their extensive study on the relative effectiveness of web-based instruction over classroom one, Kraiger et al. (2006) found out that web-based instruction was six percent more effective than classroom instruction for teaching declarative knowledge but was equally effective for teaching procedural knowledge. Though, when the same instructional methods were applied in both forms of instruction, there were no differences in the relative effectiveness of either media (Aguinis & Kraiger 2009). Paul (2014) studied whether e-learning, traditional face-to-face classroom instruction or mobile learning is more effective based on change in scores between pre- and post-assessment of statistical test performed. Skills needed to succeed in such test, for instance logical reasoning and ability to apply theoretical numerical knowledge, are similar to those of skills, which are needed in the industry case company is operating in. Paul (2014) found no difference in learning performance across three typical modes of workforce training. The finding was not significantly affected by any common factor, therefore investing in the training method which is the most effective for firm is suggested (Paul 2014). According to Mohammadyari & Singh (2015), despite of e-learning being used more

intensively in recent years, many organizations still hold reservations about becoming involved with innovative pedagogical tools and have not yet understood what really can be achieved with them, so the range of possibilities offered by e-learning has not been fully exploited by today.

One drawback of technology-delivered instruction, which strongly links to distance learning, is presented by Aguinis & Kraiger (2009) and may explain relatively slow adoption. Low-ability or inexperienced learners under high-learner control conditions may make poor decisions about what and how to learn. They state that high-learner control has advantageous effects on learning only by tiny margin, and in many studies high control has adverse effect on learning, but suggest to tackle the issue by coupling learner-driven instruction with technology to supplement learner control with adaptive guidance. Adaptive guidance means providing trainees with diagnostic, future-oriented information to aid decisions about what and how much to study and practice in training (Aguinis & Kraiger 2009).

2.2.3 Blended learning

Klein et al. (2006) define blended learning as the use of distance learning along with traditional face-to-face instruction in different forms or combinations to facilitate instruction and learning. The use of blended learning is stemming from learner preferences for synchronous instruction and face-to-face contact with the instructor and other learners (Klein et al. 2006). Al-Qahtani & Higgins (2013) suggest a few definitions for blended learning, such as it being the interaction between e-learning and face-to-face instruction. On the other hand, it is defined as simply a combination of online learning and face-to-face instruction or as hybrid courses with a more sequential perspective as traditional courses with certain parts instructional activities running online resulting in considerably cutting down the time learners spend in physical classrooms (Al-Qahtani & Higgins 2013). Briefly, it is an education model combining different types of traditional and distance education and making use of all technology types (Deperlioglu & Kose 2013). That is depicted in Figure 6.

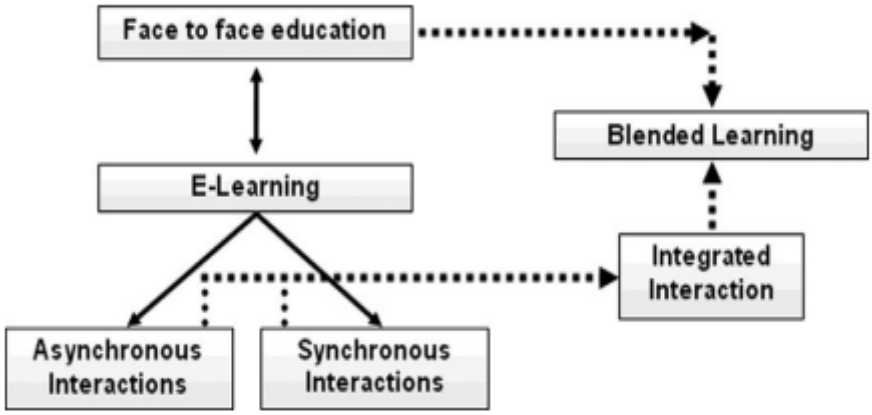


Figure 6. The blended learning approach. (Deperlioglu & Kose 2013)

Obviously, by incorporating different aspects of traditional educational and e-learning corresponding advantages and disadvantages are also combined in a designed blended learning model. E-learning environment offers the flexibility and the efficiency, which cannot be assured in a conventional classroom environment whereas a face-to-face education aspect ensures the socialization in which guidance for learning is needed. As a result, the goal is to define a combination motivating and assisting students to master the given course successfully (Deperlioglu & Kose 2013). Clark (2012) says that the main advantage of the method is the opportunity for instructors to make use of the features to each delivery environment that optimize learning. Long, Lottrecchiano, Lyons, McDonald & Zajicek-Farber (2013) agree with them by suggesting blended learning is a potentially a more robust educational experience than neither of the traditional or fully online learning alone. By combining the two learning environments, which retains the potential for the instant feedback the learners value while enabling greater participation on the part of learners who require more flexible schedules (Long et al. 2013).

According to study of Klein et al. (2006) learners in blended learning setting achieved better results than their peers in the classroom condition. The primary differences were that the technology used in the blended learning condition gave learners more control over when and where they learned and provided them with a larger variety of tools to facilitate learning (Klein et al. 2006). Chandler, Levin, Morse & Park (2013) analysed more than 6000 learners internationally and concluded that the incorporation of face-to-face tasks in online course improved learning outcomes and knowledge gained. Demirer

& Sahin (2013) studied that participation in the blended learning generally produce better results for transfer of learning. On the other hand, Deschacht & Goeman (2015) examined the effect of blended learning on adult learners' academic success and found out that blended learning has a negative effect on course retention rate through increased dropout rates, but a positive effect on student performance through higher exam scores. However, it is to be noted that it may be hard to establish a cause-and-effect relation between blended learning and effect on individual performance, because it is challenging to demonstrate that blended learning alone results in better or worse performance (Deschacht & Goeman 2015). There are few, but very risky methods, to estimate counterfactuals: to do with-and-without comparisons, to control factors correlated with performance for eliminating selection bias, to use randomized experiment or to compare the performance of individuals before and after the introduction of a blended learning programme (Deschacht & Goeman 2015).

It is notable, that blended learning just like previously presented methods produce varying results in terms of their impact on performance. Therefore it is not justified to proclaim one method being superior to another, but their applicability and effectiveness are highly dependent on individual and organizational preferences and features. Considering a corporate training, the major advantage is the opportunity to simplify course's logistics (eLearning Industry 2015) in addition to previously presented benefits.

2.2.4 3D-experience in training

Even the natural world is three-dimensional, we still prefer a use of two-dimensional media in education, because it is very convenient, familiar, portable, flexible and inexpensive (Kesim & Ozarslan 2012). But it is static and is lacking dynamic content, which 3D creates (Kesim & Ozarslan 2012). Considering the context of this study, effects of 3D-experience on learning have been able to have studied only in virtual and augmented reality, therefore a subject is studied through studies conducted addressing such topics as they create 3D-experience, which resembles the one which hologram technology is expected to be capable of. Therefore studies considering virtual environment are not considered. Virtual reality can be defined as the computer-generated simulation of 3D images of an environment or sequence of events that someone using special electronic equipment may view, as on a video screen, and interact with in a seemingly physical way (Kang, Kim, Li, Love & Wang 2013), whereas augmented reality means technology that allows computer-generated virtual imagery information to be

overlaid onto a direct or indirect real-world environment in real time (Lee 2012). In brief, the main difference is that augmented reality operates in a real environment whereas virtual reality does not (Diaz, Paramo, Peniche & Trefftz 2012).

According to study of Bockholt, Preusche, Engelke, Gavish, Olbrich & Webel (2013) maintenance technicians trained with augmented reality-based training platform made less errors and gained better results than their peers, who were trained with traditional training methods. Lee (2012) suggest augmented reality being a very effective technology for trainees to improve their knowledge and skills, especially on complex theories or mechanisms of systems or machinery. A use of the augmented reality platform for training of industrial maintenance and assembly tasks should be encouraged whereas use of virtual reality platform for similar purposes is better to be further assessed (Bockholt, Gavish, Gutiérrez, Peveri, Rodríguez, Tecchia & Webel 2013).

Based on their experimental study, Carlson, Gilbert, Oren & Vance (2012) suggest, that training in a virtual reality leads to a reduction in real task completion time when tested, even though training time is three and half times longer in a virtual reality than the training time when using physical components for completing a cognitively complex assembly. Therefore they suggest that virtual assembly could provide advantages when part fabrication is expensive to offset the cost of additional operator time needed during the training phase (Carlson et al. 2012). Barak, Perlman & Sacks (2013) found out that virtual reality training was more effective in terms of maintaining trainees' attention and concentration than the traditional classroom training in the context of construction safety. For general safety the effect was not found though (Barak et al. 2013).

Diaz et al. (2012) examined combining of virtual and augmented reality in mechanical assembly training process in manufacturing. They concluded that virtual and augmented reality have different applications under certain conditions, making another better for some cases, and the other one better for other cases, so they complement each other. By enhancing real world, augmented reality based training systems may transfer skills in a greater extent compared to virtual reality, but it does not provide all the advantages that virtual reality does, as it makes extensive use of resources like traditional methodologies do. In addition, the development of those technologies are needed, so companies could not only to train employees more effectively but improve the productivity of the processes in the future too. (Diaz et al. 2012.)

2.2.5 Holograms in training

U.S military ground troops training is considering to replace two-dimensional cutouts with virtual 3D characters (Magnuson 2014) once they become available. Another application for military purposes could be a strategic communication, as technology allows a person to appear simultaneously in multiple locations providing there is equivalent number of monitors as there are locations in which a person is to be appeared (Magnuson 2014). EdTechReview (2013) envisages potential and applications of holograms to engage learners by means of interactive whiteboards or projector screens which are used to bring a real-world learning experience as follows:

- By enabling educators to share their knowledge with thousands of learners globally at the same time, being an effective method as learners see you in person in 3D.
- By illustrating processes in 3D live, which supports both visual and kinaesthetic learners.
- By connecting globally remote classrooms in a real conversation in 3D.

For having many uses of implementing holographic technology, it is one of the emerging technologies to engage learners in a real-world learning environments, for instance demonstration of an engine feature by a great engineer (EdTechReview 2013). Solutionz Conferencing (2012) had similar thoughts concerning advantages of holographic technology in distance learning a year earlier: having experts to give in person presentations, connecting remote classroom, simultaneous multi-classroom lectures and personal holographic projectors. Lee (2013) suggests that hologram technology holds promise for an effective teaching and training tool to promote a switch from teacher- to student-centered learning, placing students in the center of their learning environment and enabling them to interact with it and construct knowledge based on their own learning experience. The educational potential of 3D holographic technology could be further enhanced, if the interactive and immersive characteristics of augmented and virtual reality were combined (Lee 2013).

In Hackett's (2013) study static, full-colour holograms were created depicting medical content. He found out that the medical holograms treatment presents a significant performance improvement over traditional textbook handout primarily for their superior visual capabilities due to their 3D-nature (Hackett 2013). Ghuloum (2010) examined the

importance of 3D hologram technology in the learning environment. He found out that 60 % of respondents found such technology as an efficient tool while less than a half in total found it as an effective teaching tool for the future. Though 47 % of teachers mentioned that given technology could not change the face of education, but it could help them to some extent in their teaching (Ghuloum 2010). Sudeep (2013) studied 3D holographic technology as a teaching tool, especially in mechanical engineering and found out that 68 % of respondents confirmed the importance of such technology as an effective teaching tool in the future. However, remaining 32 % were not convinced by technology's envisaged features, while great majority were concerned by its implementation costs and difficulty of integration with the learning environment (Sudeep 2013). Lee (2013) reports challenges, which technology may face: the quality of 3D renderings, severe visual fatigue and virtual reality-induced sickness have been reported after the interaction with 3D reality and may not be appropriate for some learners. The final and the most important point, regardless of the type of technology, learning outcome should always have a higher priority than technology itself (Lee 2013).

2.2.6 Future of training

The next 50 years are going to pose multiple challenges to the science of training. Because population gets older, wiser, more technology savvy, more insistent of receiving just-in-time knowledge, more supportive of collaboration and more involved in multitasking, the science will have to be relentlessly more multidisciplinary, integrating findings from diverse areas such as neuroscience, human performance modelling, augmented cognition, expertise, change management and skills acquisition. (Kraiger et al. 2012.)

Kraiger et al. (2012) elaborate that it is obvious that technology will affect on how people learn. An increased number of technologies are very engaging, fun, realistic and motivational. Though, it is to be noted that technology in and of itself does not create learning, but the instructional features embedded onto and surrounding technology are learning enablers. Therefore, there is emerging need to understand, despite of promising early results, what really works and why and contribute to skill acquisition. Though technology is taking over training and learning, we still learn not only in the classroom but on the job as informal learning is probably the one where most learning occurs in organizational setting. That is why it is pivotal that future research should further explicate how to utilize informal, non-classroom-based techniques to build tacit knowledge and promote ongoing learning as extensively as possible.

Chryssolouris, Mavrikos, Mourtzis & Papakostas (2013) concur in their study addressing future manufacturing. They emphasize ongoing, life-long learning schemes to assist in keeping up with the pace of change. Multidisciplinary set of learning is needed for addressing learning in a holistic way (Chryssolouris et al. 2013). To be able to respond future cognitive requirements and challenges, a framework in Figure 7 is proposed.

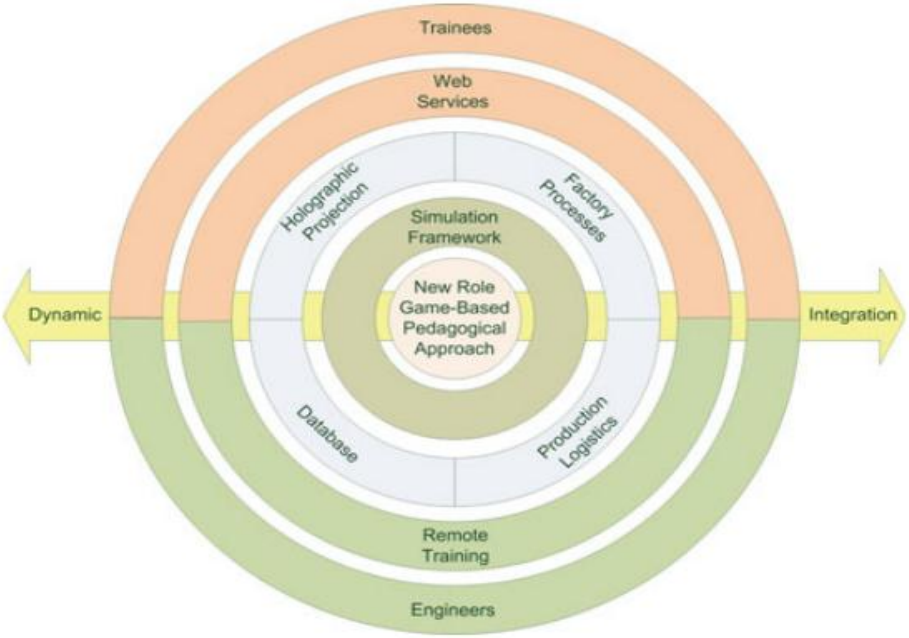


Figure 7. A pilot instantiation of the technology framework. (Chryssolouris et al. 2013)

A proposed framework includes such activities as management of knowledge, interactive hands-on training, skills development, team work and collaborative decision making. The overall approach aims at allowing sooner introduction of research developments in the learning process and faster and cost efficient digital training. That is supposed to result in reduced need of real hands-on practice, integration of a broader range of realistic training scenarios, in the learning process, and shorten time elapsed on innovation process. (Chryssolouris et al. 2013.)

Di Mascio, Ingram, Kraus & Lassk (2012) approached the future of training from a sales' perspective. They emphasized enhanced technology capability and stressed training programs are to be individualized, jointly determined, voluntary, tailored to fit mutual

needs and offered in various modes (DiMascio et al. 2012). Young (2015) suggest that workplace training has already been transformed by technology and that transformation is set to continue well into the future. He predicts the death of traditional classroom-based training resulting in expanded use of virtualisation retaining personal contact, which will become commonplace in the near- to mid-term future. Another major change concerns the incorporation of learning. A shift from formal structured training to more of a systemic process, where learning will become more holistic and embedded in daily life, is expected. Third, he states that the days when employers would dictate messages and working practices will be gone. The prevailing trend will be a technology-enabled learning ecosystem, which means using a blend of e-learning, colleague interaction and front-line experience (Young 2015).

Considering corporate training, conventionally it has been perceived as a training of technical skills. Ravindranath, Shareef & Thomas (2012) point out the emerging need of life skills training in the future. Life skills are set of psycho social skills that enable an individual to develop their capacities and competencies and to deal with the challenges in various situations. They can be grouped into two categories, which are personal skills and people skills. Such skills enable social competence and they complement the technical skills, which are the practical requirements of any job. As such life skills stand with equal importance alongside the technical skills, but they should not be distorted to cover up a person's shortcoming of proficiency in particular areas (Ravindranath et al. 2012).

2.3 Training in corporate environment

Corporate training expenditure is the investment for firm-specific, internal training that aims to achieve skill building and performance gain, which directly deal with today's and tomorrow's training needs of company. To commence training programs that are primarily developed and delivered in-house to provide company-specific and position-relevant instructions, which are designed and to be delivered to persons in various formats. A study shows that interpersonal and organizational learning practices have remarkable and positive effects on the organizational learning. It is to be noted that individual knowledge itself might not contribute to innovation unless it is shared and integrated within the organizational context. (Choi & Sung 2014.)

Therefore, the most effective companies focus on sustaining skills and linking learning to business performance, whereas the most notable challenges are a lack of learning-related metrics and difficulty of ensuring the continuous improvement of skills (McKinsey 2015). This subchapter addresses corporate learning primarily based on two studies (McKinsey 2010; McKinsey 2015).

2.3.1 Effectiveness of corporate training

McKinsey's (2010) survey encompassing responses from 1440 executives representing the full range of regions, industries, functional specialities and seniority, revealed that nearly 60 % of respondents say that building organizational capabilities is a top-three priority for their companies, yet only a third of them actually focus their training programs on building the capability that adds the most value to their companies' business performance. In addition companies are lacking of alignment as only 33 % of respondents say their training and skill-development programs focus on developing their companies' most important capability (McKinsey 2010).

Furthermore, companies do not focus on day-to-day activities that could maintain or improve the capability that contributes the most to their business performance (McKinsey 2010). It is a very worrying sign that group of employees, which are most involved in end-customer interaction, only approximately 20 % of them can say their companies' training programs are very effective as depicted in Figure 8.

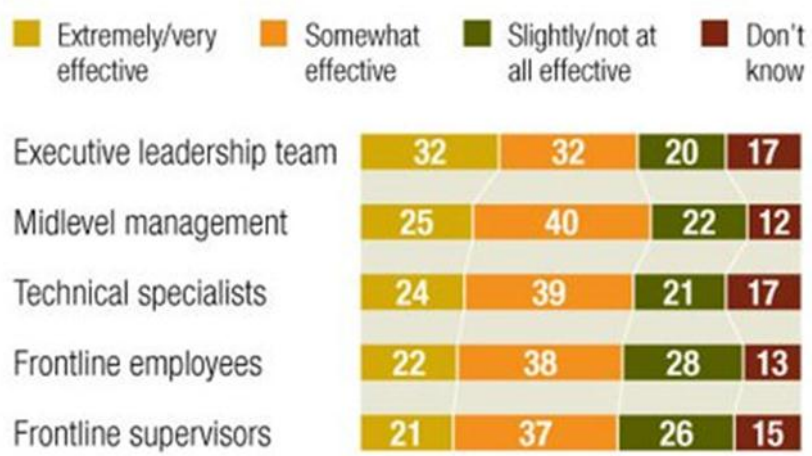


Figure 8. Effectiveness of company's training programs in preparing given group of employees to drive business performance. (McKinsey 2010)

2.3.2 Success drivers in corporate training

In their research, Brotherton and Evans (2010) examined the factors that affect customer satisfaction in the training services sector. They found out that the role of individual trainer is the pivotal factor in retaining business clients, with quality of training delivered and the professionalism of the trainer being of utmost importance, so the quality of training can be considered more important than the price of training. Ultimately, in a successful long-term customer relationship, the contribution of individual trainer was more critical than the actions of training organization. Gilleard (1998) says a critical success factor in any training program is to ensure that the trainer has the fundamental competencies, vision and strategic aptitude to deliver their program objectives, therefore trainers have to practice what they preach because experience is not enough to add value to organizational learning as the foundation for future competitiveness.

According to McKinsey (2010) companies rely on on-the-job-teaching. However, only one third use any other method of training extensively as illustrated in Figure 9. When companies try to replicate or scale up their training across more geographies, alternative ways of delivering it will become crucial as it has been shown that on-the-job training is the most effective when it is reinforced through some sort of formal teaching and feedback loop (McKinsey 2010). In addition, companies whose training programs are effective in maintaining or improving the drivers of business performance say tools that support or enable capability building, such as standard operating procedures, IT-systems, and target setting and metric tracking, are kept in higher regard compared to others.

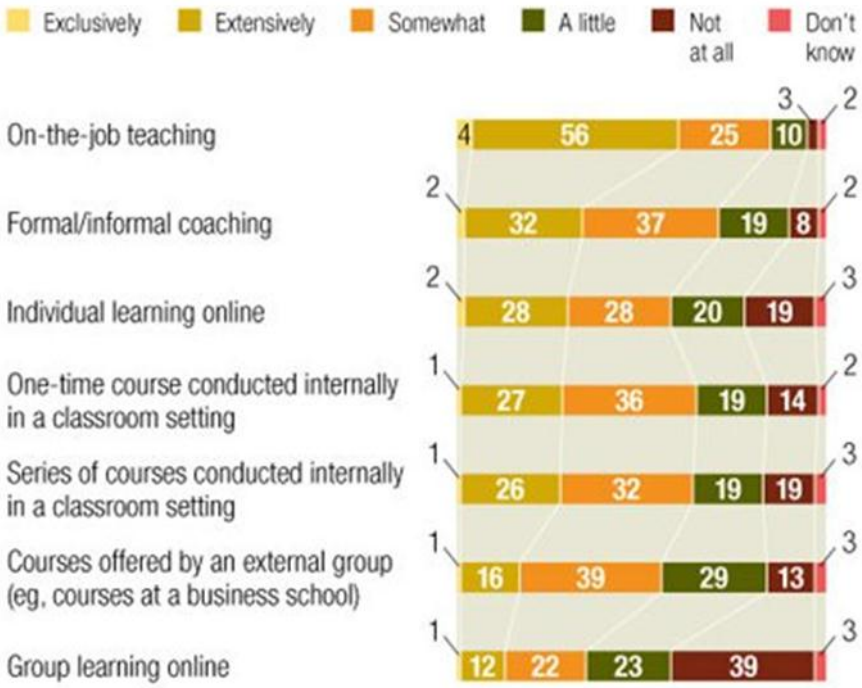


Figure 9. The extent to which company uses given training method for training and skill development. (McKinsey 2010)

The results were more or less identical four years later as there were not notable changes in training delivery as companies still rely on same methods to deliver learning and build skills. The most successful companies supported the idea, that coaching can successfully complement many other types of interventions (McKinsey 2015).

Today fewer respondents use more leading-edge learning methods, such as experimental environments or digital interventions beyond individual online classes. These include model factories or simulators and mobile learning exercises or group-based online courses, respectively. Even the most successful companies are at their infancy in using of these novel methods. Only one fifth reports a use of experiential methods to train adults in an experimental, risk-free environment that fosters exploration and innovation. Such leading edge training methods could enable organizations to replicate or scale up their learning programs quickly and cost-effectively across multiple locations. Yet companies tend to plan and execute large-scale learning programs with a train-the-trainer approach or with help from external providers to roll out their programs. (McKinsey 2015.)

2.3.3 Challenges in corporate training

Companies are struggling to measure the impact of training on business performance. As they are not aware of impact of training, they appear to set their agendas using different measures, including prioritizing by employee role, which may not actually result in the most impact to the bottom line. It is to be noted that companies who report training to be least effective are likely least spend on front line, even though that group of employees has immediate impact on operations (McKinsey 2010). However, in the study four years later, a shift was evident in capability building as companies had started to focus more on frontline employees according to Figure 10 (McKinsey 2015). That shift underlines importance of customer-facing position upon a company's profit.

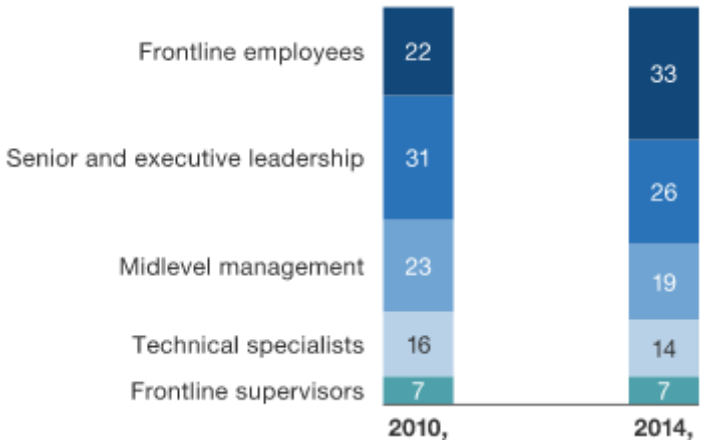


Figure 10. Employee groups for which organizations have used the most resources on learning and skill development. (McKinsey 2015)

As stressed earlier, fundamental metrics are prerequisite for building capabilities in a sustainable way. When enquiring companies' biggest challenges in building capabilities, the growing concern of credible metrics were evident, which is highlighted in Figure 11. One fifth report not to measure the impact of their learning programs at all whereas only 13 % percent say their organizations calculate the quantifiable returns on their learning investments. (McKinsey 2015.)

Figure 11. Challenges for capability building. (McKinsey 2015)

McKinsey (2015) proposes three principle to tackle these challenges:

1. Diagnose systematically – for building strong capabilities, on both institutional and individual level, that have the most positive impact on the business, the capabilities have to be identified systematically.
2. Design and deliver learning to address individual needs – the core principles of adult learning require that companies tailor their learning programs to employees' specific strengths and needs, rather than developing a one-size-fits-all program for everyone.

3. Align with and link to business performance – learning objectives must align with strategic business interests, and, ideally, capability building should be a strategic priority in and of itself. In order to ensure that their learning programs have real business impact, the focus needs to be on metrics as the most effective capability builders often do. It is advised to establish rigorous performance management-systems with robust metrics and then measure progress against clear targets, to know where and how skill gaps are, or are not, being closed. (McKinsey 2015.)

2.3.4 Mechanisms for improving corporates' learning

Bain & Company (2013) studied Australian bank, which aimed to far-reaching cultural change in its organization. That asked people to be both self-directing and self-correcting. The role of frontline employees, in this case call center employees, was great. The learning begins with formal training, but will not stop there. Indeed, there are at least six tools or mechanisms to encourage and reinforce employees in adopting new ways of doing things.

Formal training is used to introduce new concepts to employees. It spells out the expectations, the guidelines, the rules of thumb, and some of the tools employees are going to need but it has a limited impact. As it is often removed from the day-to-day tasks, the real learning comes when people try to apply the lessons and then get feedback on how they are doing. That necessitates high velocity feedback. Observation and coaching allows employees to see what works and what does not. Team learning and organizational learning help them to become self-directing and self-correcting. Collaboration of hundreds of people may reveal pattern that would not be apparent to any individual team. In addition, recognition and rewards are considered important since they are important at avoiding a coercive perception for change of people's behaviour. The previous is depicted in Figure 12. (Bain & Company 2013.)

Figure 12. Facilitate, accelerate and reinforce natural behavioural learning process. (Bain & Company 2013)

As a result of improvement model, the scores soared up and variance from one centre to another declined significantly in a given Australian bank. Even though the focus had shifted on customer metrics rather than operational ones, basically every operational measure had improved as well. (Bain & Company 2013.)

2.4 Hologram technology

The word hologram is composed of the Greek terms, "holos" for "whole view" and "gram" meaning "written" (Ghuloum 2010). Dennis Gabor, while working on advancement research for electronic microscopes, discovered the basic technology of holography in 1948 (Ghuloum 2010). In his paper Gabor (1948) suggested a novel two-step imaging process known as holography. He figured out that when a coherent reference wave is present with the light diffracted from a rough object then information about the amplitude and the phase of the object, it is viable to record wavefield (Gabor 1948). Technology was not completely utilized until the 1960s when laser technology was improved, which enabled 3D holographic technology. 3D holographic technology has advanced notably since the 1980s owing to low-cost solid-state lasers that easily accessible for consumers in various devices (Ghuloum 2010). For the sake of simplicity in this research, the only word to describe such technology is a hologram, even sources may use different word.

A hologram is a 3D record of the positive interference of laser light waves, technically it can be defined as a wave front reconstruction (Sudeep 2013). Holograms are considered to be truly 3D, because they allow the viewer to see different perspectives of a reconstructed 3D object from different angles and locations (Phys.org 2015). Where holograms differ from photographs is that they are created using lasers, which can produce the complex light interference patterns, including spatial data, required to re-create a complete 3D object (Phys.org 2015). Holograms have essential properties, which are the following:

1. The light coming from hologram to eye is physically similar to light coming to eye looking at the original scene.
2. The standard of 3D hologram are not in natural colour, but monochromatic at the colour of the reconstructed wave.
3. Cutting a hologram to pieces for reconstruction preserves a whole image.
4. The feeling of 3D vision through a hologram is a real effect, not psychological one.
5. The maximum depth of field that can be seen in a hologram is the function of the coherence length of the laser. The maximum brightness and details that can be seen on the hologram are function of laser. (Raza & Sharma 2012.)

2.4.1 How holograms work

A hologram is a photographic technique that records the light scattered from an object, and then presents it in a way that appears in 3D. To create a hologram, it is needed to have an object or a person that is wanted to be recorded, a laser beam to be shined upon the object, a recording medium with proper materials needed to help clarify the image and a clear environment to enable the light beams to intersect. (Live Science 2013.)

A laser beam is split into two identical beams and redirected by the use of mirrors. Either illumination or object beam is pointed at the object and some of the light is reflected off the object onto the recording medium. To avoid a conflict of the second beam, which is the reference beam, and any imagery that comes from the object beam, the reference beam is directed onto the recording medium. This way more accurate image in the hologram location is achieved. Two beams intersect and interfere with each other. The interference

pattern is that what is imprinted on the recording medium to recreate a virtual image for our eyes to see (Live Science 2013). The entire process is shown in Figures 13 and 14.

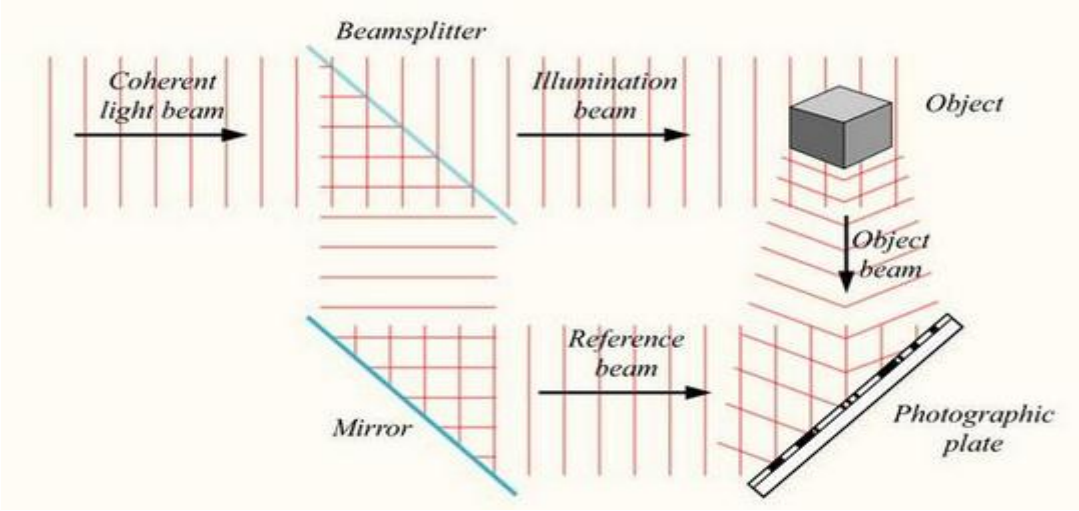


Figure 13. Recording of hologram. (Live Science 2013)

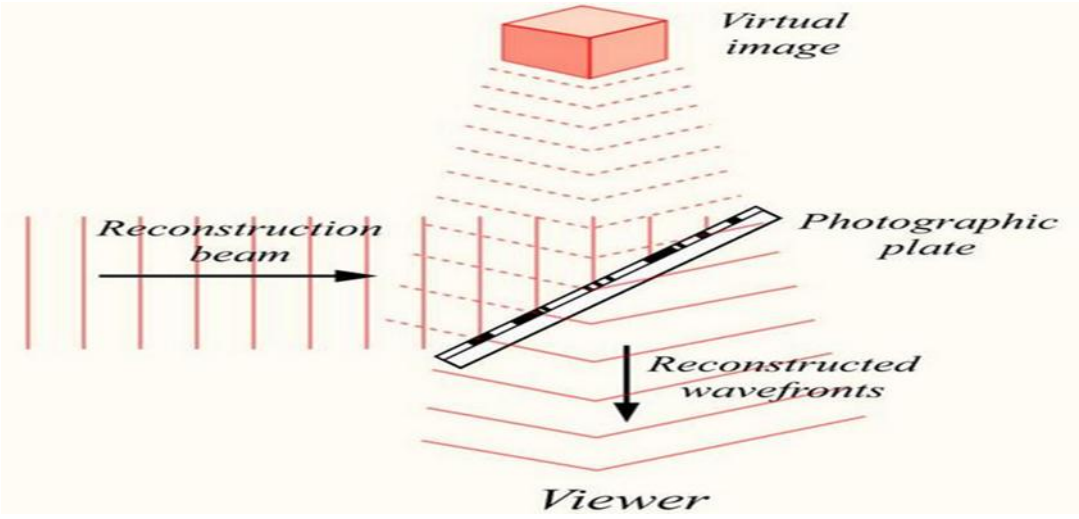


Figure 14. Reconstructing of hologram. (Live Science 2013)

Majority of technologies creating 3D-experience today without any wearables is based on above presented technique. If not entirely, then in outline with small modifications.

2.4.2 The latest studies in technology

Carter, Long, Seah & Subramanian (2014) presented a method for creating 3D haptic shapes in mid-air using focused ultrasound by applying the principles of acoustic radiation force, whereby the non-linear effects of sound produce forces on the skin which are strong enough to generate tactile sensations as shown in Figure 15. That mid-air haptic feedback eliminates the need for any attachment of actuators or contact with physical devices. (Carter et al. 2014.)

In their study participants were able to identify each created shape, on average accuracy of 80 %. The greatest advantage of technology is that it allows the user to walk up and use the system. It has major shortcomings at the moment though. Firstly, the shape created has to be in the working volume of the device for it to function correctly. Secondly, the system only functions with hands. Thirdly, system is limited by the size and power of the transducer array in the number and strength of control points. (Carter et al. 2014.)

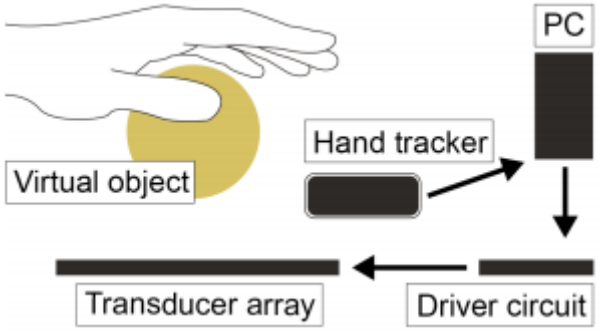


Figure 15. The setup of system for generating 3D haptic shapes. (Carter et al. 2014)

Researchers from the University of Cambridge have designed a new type of pixel element and demonstrated its unique switching capability, which could make 3D holographic displays possible (Cambridge 2015). According to Cabrero-Vilatela et al. (2015) limitations of state-of-the-art 3D holographic display technologies are pixel density, pixel pitch and complex modulation limits. The underlying problem is that a hologram encodes an enormous amount of optical information and dynamic representation of this requires vast amounts of information modulated on a display device. Their work highlighted the opportunity for utilizing the plasmonic properties of optical antennas to enable multi-

functional pixel elements for next generation display technologies (Cambridge 2015). That is to be achieved by scaling up the pixels, which would mean a display would have the ability to encode switchable amplitude, wavelength and polarisation information and a stark contrast to conventional pixel technology (Cambridge 2015).

Japanese company Burton Inc. was able to develop a true 3D display, which can produce bright dots in the air so people can see 3D images in a true 3D space as Figure 16 depicts. The display device uses the plasma emission phenomenon near the focal point of focused laser light. By controlling the position of the focal point in the x, y, and z axes, it displays real 3D images constructed by dot arrays in the air. It is capable of projecting 50 000 dots per second and works at up to 15 frames per second. Conventional hologram is reflecting the light, but their technology is creating the light. Therefore a viewer can go around the image and see it from any angle as one can do in a real world. In 2015 they had found a way to make holograms safe enough to be touched as conventionally ionised air molecules would burn human skin. Still many questions remain unanswered, such as the expensiveness of technology and the fact that it may be dangerous to perceive a laser for human eye, so commercialization of the product cannot be expected anytime soon. (Burton 2011; Humphries 2011; Youtube 2015; Russon 2015)

Figure 16. Burton's true 3D display. (Burton 2011)

There are number of other studies about hologram technologies, which are supposed to take 3D-experience to a whole new level. Unfortunately their truthfulness cannot be verified and they are rumoured to be nothing but a hoax. However, all of the three

presented technologies have potential to meet the case company's demands of 3D-experience without glasses or goggles once they become further developed and commercially available. When that will happen, cannot be predicted credibly.

2.5 Theory of qualitative research

Qualitative research methods are applied when the data is not in the form of numbers, which has be seen as a less rigorous method and employs more flexible tools of investigation compared to quantitative research (Elliot-White, Finn & Walton 2000: 8). The essence of the method is that qualitative research does not try to transform a verbal output to numeric one; data remains as presented whether it is research participants' own words, the words written in documents or words used by researcher to describe observed discoveries (Dolan, Donnelly & Hogan 2009: 8). Qualitative research is based on methods of data generation, which are flexible and sensitive to the social context in which data are produced (Manson 1996: 1-4).

One can state that qualitative research seeks to get findings without any use of statistical or quantitative methods. The purpose of research method is to avoid making any generalizations as opposed to quantitative method. The goal is to describe and understand a phenomenon in detail and provide a reasonable interpretation for it. Collected data produces a subjective interpretation which means a result of research depends a lot on researcher. (Kananen 2013: 31-32.)

2.5.1 Validity and reliability

Creswell (2009: 190) states that qualitative validity means that the researcher checks for the accuracy of the findings by employing certain procedures, whereas qualitative reliability indicates that the researcher's approach is consistent across different researches and projects. Furthermore, the author is recommended to document as many procedures as possible during the research project and constitute a detailed case study protocol and database if feasible. Thus validity is one of the advantages of qualitative research (Creswell 2009: 191).

Lewis, Saunders & Thornhill (2003: 252-253) say that the lack of standardisation in qualitative interviews, reliability is concerned whether alternative researchers would

reveal similar information. The concern about reliability in qualitative type of interviews is related to issues of bias. There are interviewee or responses biases, which may be caused by actions of either of those behaviours in interviewing situation. Such behaviours may have impact on depth of the respondent's answers, which reflects to validity. Considering validity Lewis et al. (2003: 253) refer to the extent to which the researcher gains access to their participant's knowledge and experience, and is capable of inferring a meaning that the participant intended.

It has been said that there as many interpretations of the research results as there are interpreters. It is to be noted that one and the same research problem leads to large number of interpretations though as the one and same material can be interpreted from several angles or different problem settings. To ensure the interpretation of research results they are advised to be checked by another researcher. Identical interpretations made by two researcher create the consistency of interpretation, thus increasing the credibility of results. Therefore the simplest way of ensuring reliability and validity is to have research material read and interpreted by a person involved in the research. (Kananen 2011: 67-68.)

2.5.2 Primary and secondary data

There are two different types of data collected in qualitative research, which are primary and secondary data. Primary data is collected by the researcher himself. Major methods for gathering primary data are: participating in the setting, observing directly, interviewing in depth and analysis of documents and material, with varying emphases. (Marshall et al. 2011: 137.)

Secondary data is collected by others. Secondary data can be articles, researches, books or any written, oral or visual material. Lots of resources can be saved, by using secondary data. It can also provide wider and high quality database. Researches should compare primary data to secondary data, if feasible. (Marshall et al. 2011: 179-182.)

It is to be noted that quality and usefulness of acquired data is majorly dependent on the researcher's personal skills, that is why the applied method is up to individual's preferences and the explored subject (Belk, Fischer & Kozinets: 120). Theoretically any method to collect data in non-numeric form can be considered as a qualitative data collection method, yet there are few dominant ways of collecting qualitative data:

interviews, observations and focus groups, of which the first two are used in this study and are explained in the following subchapter.

2.5.3 Data collection

There are several types of interviews in order to collect qualitative data. It is possible to identify three main types of interviews, which are structured, semi-structured and unstructured interviews. The aims of certain research define which of the given techniques is used for collecting qualitative data (Elliot-White et al. 2000: 73). In all of the following types of interviews primary data collection methods are audio recording and writing down notes.

In structured interview, there is very little room for variation in response except where an infrequent open-ended question may be used. The questions are asked according to certain pattern, meaning order or sequence, which means there is very little room for variation as regards to question setting or how the answers are structured. The interviewer should avoid getting involved in long explanations of the study, letting another person to interrupt the interview or interpreting the purpose of question, only to mention a few. Briefly, the interviewer should never agree or disagree with the interviewee. Predetermined questions are aiming to minimize errors. Anyhow, those errors occur due to respondent's behaviour, the type of questionnaire or with flawed questioning technique. Structured interview category may include interviews by telephone, intercept interviews in shopping malls or interviews generally associated with survey research. As noted methods for conducting interview may vary between researchers and authors. (Denzin & Lincoln 1994: 363-364.)

In the semi-structured interview type, specified questions are associated, however it will allow more probing to seek clarification and further explanation. The given interview type has more latitude than structured interview (Elliot-White et al. 2000: 73). Occasionally, the semi-structured interview is also called focused interview, which has four criteria to be met as the interview is designed and conducted (Flick 2002: 75). Those are discussed in the next subchapter. Yin (2009: 107) says that the interviews likely remain open-ended and assume a conversational manner, but a certain predetermined set of questions is followed.

Non-direction is achieved by several forms of questions. The question pattern is the following: firstly unstructured questions are asked, then semi-structured and in the third, structured questions. This order of setting questions can be called flexible use of interview schedule. The aim of this interview order is to prevent the interviewer's frame of reference being imposed on the interviewee's point of views. The second criterion of specificity means that the interview should bring out the essential elements, which determine the impact or meaning of an event for the interviewee for preventing the interview from remaining on the level of general statements. (Flick 2002: 75.)

The third criterion range aims at securing that all aspects and topics vital for the research question are covered in the interview. This means that the interviewee needs to have a chance to present his or her own ideas and opinions on topic during the interview. The interviewer needs to pay attention that the interview is not getting on sideways though and interview remains on a relevant subject. The last criterion is depth and personal context. The purpose of criterion is maximum of self-revelatory comments concerning how the stimulus material was experienced by the interviewee. If the interviewer finds the level of responses is not deep enough he or she could switch to questions whose nature is deeper, for instance focusing on feelings. (Flick 2002: 76-77.)

Participant observation allows the observer to sense, what is going on in a particular, authentic setting. That allows a researcher to share his experience by not merely observing what is happening but also feeling it (Lewis et al. 2007: 283-284). When observing as a participant, one is not taking part in the activities in the same way as the real candidates. Lewis et al. (2007: 288) elaborate that the researcher identity as a researcher is clear for whom it concerns. Participants know one's purposes as would the trainers running the course. This allows the researcher to focus on his role, for instance jotting down insights as they occurred to one and involving them in discussions with the participants.

2.5.4 Data analysis

Qualitative analysis can involve an eclectic mix of data sources, including observations, the spoken word, written text and visual data (Wilson 2010: 253). The features of qualitative data have implications for its analysis, hence the data must be prepared prior to analysis (Lewis et al. 2007: 474). Berg (2004: 265) says the qualitative data is often not amenable to analysis until the information they convey has been condensed and made systematically comparable. Figure 17 illustrates the dimensions of qualitative analysis.

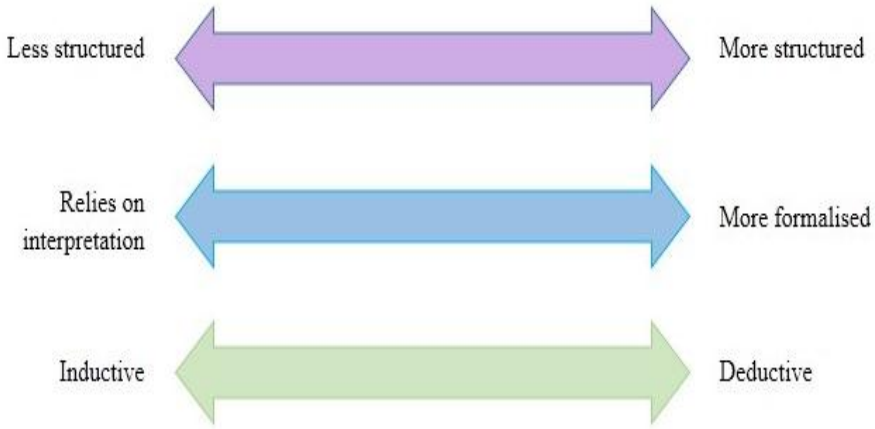


Figure 17. Dimensions of qualitative analysis. (Lewis, Saunders & Thornhill 2009: 491)

The data can be grouped into three main types of processes:

1. Summarizing/condensation of meanings.
2. Categorisation/grouping of meanings.
3. Structuring/ordering of meaning using narrative.

All of these could be used on their own, or in combination, to support interpretation of data. (Lewis et al. 2009: 490-491.)

The purpose of summarizing data is to truncate acquired data including long statements into shorter statements, in which the main sense of what has been said or observed is rephrased in a few words. Through summarising the researcher becomes conversant with the primary themes emerged from the interview or observation and how to study them further in data collection sessions in the future. Through categorisation of data, the researcher begin to recognise relationships and further develop the categories one is using to facilitate this. In this phase the data is fragmented into smaller entities, which may help the researcher to analyse the data. It is to be noted that some researchers propose not to categorise data and consider it inappropriate. Advocators of such policy support retaining the integrity of the collected data and commencing analysis using verbatim transcripts or complete sets of notes that are produced. The principal method to collect data used in narrative approaches is through in-depth interviews. During the interview process, by accident, deliberately or as a result of instigation by interviewer, participants may provide

accounts that, at least in part, take the form of narratives or stories. Therefore structuring with the use of subjectively told stories, which usually are related to real life event, ensures the data are organised both temporally and with regard to the social or organizational context of the research participant. (Lewis et al. 2009: 491-497.)

In inductively-based analytical procedure the process of analysis is composed of three concurrent subprocesses:

1. Data reduction
2. Data display
3. Drawing and verifying conclusions

Data reduction simplifies the collected data, possibly selectively concentrating on certain parts of data. Data display encompasses organizing and structuring reduced and selected data into a form, which allows drawing conclusion and implications basing on it. (Lewis et al. 2007: 492-493.)

Berg (2004: 267) suggests following a fairly standard set of analytical activities arranged in a general order of sequence:

1. Data are collected and made into text.
2. Codes are analytically developed or inductively identified in the data and affixed to sets of notes or transcript pages.
3. Codes are transformed into categorical labels or themes.
4. Materials are sorted by these categories.
5. Sorted materials are examined to isolate meaningful patterns and processes.
6. Identified pattern are considered in light of previous research and the theories.

It can be noted that the aforementioned methods resemble each other while having their own nuances. Therefore a statement by Lewis et al. (2009: 490) that, there is no standardised procedure to analyse such data appears credible.

2.5.5 Advantages and disadvantages

Qualitative research is a great approach to research complex phenomena by using open-ended questions. It provides to participants an opportunity to respond in their own words,

rather than forcing them to choose from fixed alternatives unlike quantitative methods do. Qualitative data add richness and details that numbers cannot provide. By encouraging people to broaden on their own responses may open up new topics not initially considered. (Mack, Woodsong, Macqueen, Guest & Namey 2005.)

Mack et al. (2005) elaborate that another advantage of qualitative methods is flexibility which enables a researcher to study initial participant responses asking ”why” or ”how”. Qualitative data provides depth and detail by looking deeper than a mere analysis of ranks and counts by recording attitudes, feelings and behaviours. Acquired data simulates people’s individual experiences, which provides a researcher detailed insight of individual behavioural patterns.

The research method has its weaknesses too. For a research to be very credible the sampling has to be enormous and preparation for such data collection is intimidating. Collection of the data can be very time-consuming since it is usually collected by means of interviews or group discussions. Interviews, observation and other data collecting methods are fairly labour-intensive too. In addition, the acquired data is very complex and difficult to interpret in many cases. (Luna-Reyes & Andersen 2003: 286.)

Generalization of acquired results is very hard. Sometimes generalization is preferred, but major idea is to avoid making any kind of generalization in qualitative research. The acquired data refers to the selected group of participants and their feelings and thoughts. The replication of the research is challenging or even unfeasible, as collected data is associated with certain unique case. (Creswell 2009: 193.)

Interviewees might be reluctant or uncomfortable sharing all information that the interviewer aims to study. The interviewer is better not to ask questions that may result in too long answers from the interviewees. The data collection is dependent on skills of the researcher particularly in the case of conducting interviews, focus groups and observation, which makes assessment of the qualitative research relatively troublesome and challenging. (Marshall & Rossman 2011.)

2.6 Theory of case study

The case study is the method of choice when the phenomenon under study is not readily distinguishable from its context, for instance a project or program can be used as an example (Yin 2003: 4). The method allows the researcher to retain the holistic and meaningful characteristics of real-life events (Yin 2009: 4). According to Wilson (2010: 108) in business research case study design often involves an in-depth analysis of an individual, a group of individuals, an organization or a particular. Briefly, the goal is to provide an in-depth analysis of a specific problem.

The case study approach is used as a guide to research by qualitative researchers. By focusing on a single phenomenon, individual or organization, the researcher aspires to reveal the manifest interaction of significant characteristics of this phenomenon, individual or organization. The method allows the researcher to capture various nuances, patterns and more hidden elements which may be overlooked by other research approaches. Since the case study focuses on holistic description and explanation, basically any phenomenon can be studied by case study methods. (Berg 2004: 251.)

2.6.1 Data collection

Yin (2009: 67-68) says there are desired skills, which are good to have on researcher for collecting data in a case study. Below mentioned skills are needed as the demands of a case study on researcher's intellect, ego and emotions are far greater than those of any other research method. That is virtually due to lack of routinized data collection methods.

Attributes of good case study researcher are:

1. Good at asking questions.
2. Being a good listener.
3. Great deal of adaptation and flexibility.
4. Knowledge of the issues being studied.
5. Bias avoidance.

The first attribute refers to being able to ask good questions and interpret answers. By being a good listener is meant that the researcher is capable of absorbing a large amount of new information without being trapped by his or her own ideologies and

preconceptions. Most of the case studies will not end up as initially planned. Therefore, the third attribute emphasizes researcher's ability to see situations as opportunities instead of threats when encountering. The fourth one means having a firm grasp of the issues being studied. Such attribute is very valuable for being able to interpret the information being collected and to know whether a deviation in information is acceptable or even desired. The last one is essential; all of the aforementioned attributes will be negated if the researcher aims merely to use a case study to substantiate a preconceived position. Hence, being sensitive and responsive to contradictory evidence is essential. (Yin 2009: 69-72.)

Yin (2009: 101) says there are six sources of evidence, which are conventionally employed in doing case studies: documentation, archival records, interviews, direct observation, participant observation, and physical artefacts. Of those methods interviews and participant observation are used for collecting primary data in this study and have been discussed in previous subchapter. Archival records are used as a secondary source of data too.

According to Yin (2009: 114) the benefits of the aforementioned sources of evidence are maximized by following three principles:

1. Using multiple sources of evidence.
2. Creating a case study database.
3. Maintaining a chain of evidence.

Yin explains (2009: 114-122) the idea of principles is to give credibility for the study. The greatest strength of the method is the opportunity to use many sources of evidence. Any finding or conclusion is going to be more precise and trustworthy if it is based on multiple sources of evidence. The lack of formal database is a major shortcoming for most case studies and it must be corrected by developing a formal, presentable database so other researchers can review the evidence directly and not be restricted to the written case reports. The third principle is to allow an external observer the derivation of any evidence from initial research questions to final study conclusions, in other words, being able to trace the steps in either direction. That is presented in Figure 18.

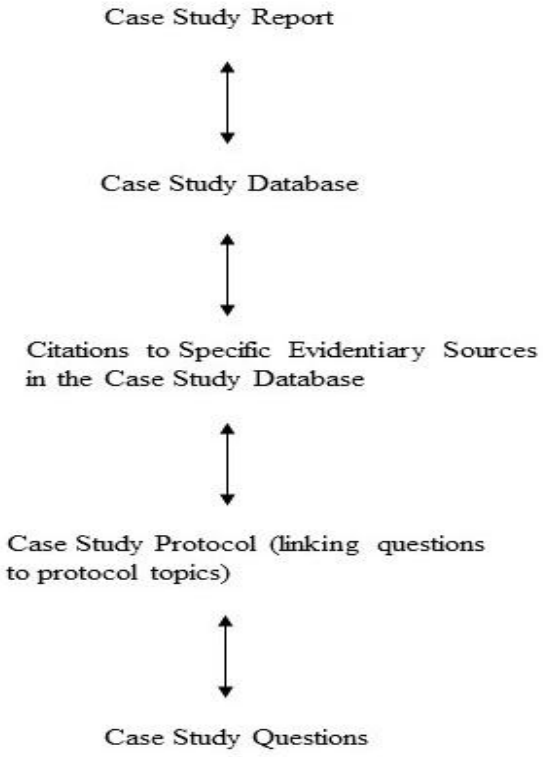


Figure 18. Maintaining a chain of evidence. (Yin 2009: 123)

According to Amaratunga & Baldry (2001) there are particular design tests with regard to various levels of research validity for research study to be valid. Those research tests are as follows:

1. Construct validity – establishing right operational measures for the concepts being studied.
2. Internal validity – establishing causal relationships.
3. External validity – establishing the domain to which a study's findings can be generalised.
4. Reliability – meaning data collection procedures can be repeated with the same results.

Validity and reliability of case study research can be ensured by following the design tests presented in Figure 19.

Tests	Case study tactic	Phase of research in which tactics occurs
Construct validity	Use of multiple sources of evidence	Data collection
	Establish chain of evidence	Data collection
	Have key informants review draft case study report	Composition
Internal validity	Do pattern matching	Data analysis
	Do explanation building	Data analysis
	Do time-services analysis	Data analysis
External validity	Use replication logic in multiple case studies	Research design
Reliability	Use case study protocol	Data collection
	Develop case study data base	Data collection

Figure 19. Validity and reliability in case study research. (Amaratunga & Baldry 2001)

2.6.2 Design and analysis

Case study research can be divided on the basis of single and multiple case studies. The former involves research that studies merely a single case, while the latter analyses multiple cases. A researcher can be categorized on the basis of analysis, either holistic or embedded. Holistic correspond single unit of analysis whereas embedded corresponds multiple units of analysis. Classification is illustrated in Figure 20. (Wilson 2010: 108.)

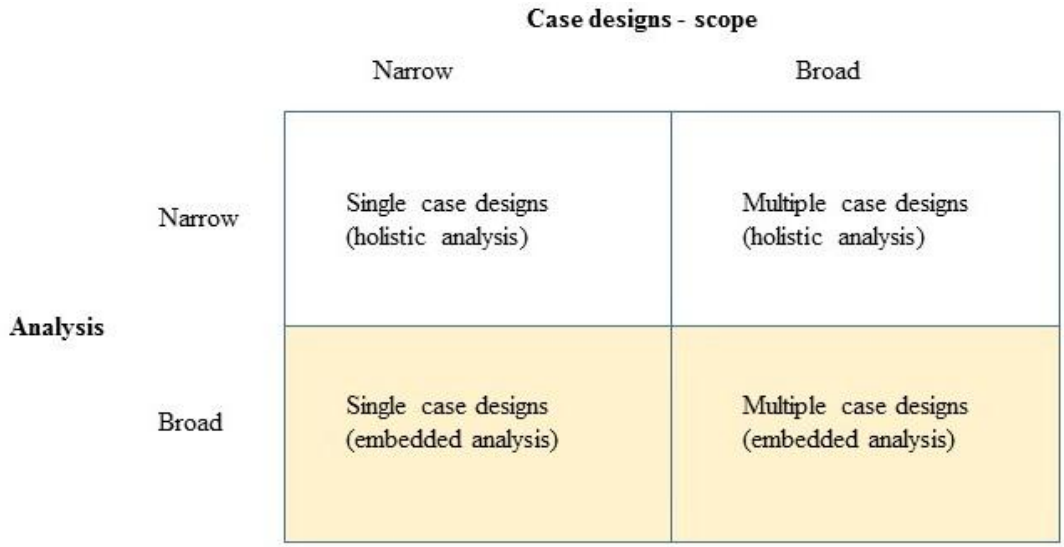


Figure 20. Case study designs. (Wilson 2010: 108)

Single cases are usually opted for cases, which are regarded as an extreme example or perhaps a unique case. Another applications are a testing a long-standing theory and part of pilot study before extending the study to multiple set of cases. Selecting a single case allows the researcher to conduct in-depth study involving a use of wide range of information and possibly a number of different units of analysis. On the contrary, multiple cases can be viewed as multiple experiments. The more cases that can be marshalled to accept or reject a theory, the more robust are the research end results. Cases are to be selected carefully so they either produce similar results or produce contrasting results but for predictable reasons. The former is called literal replication and latter theoretical replication. (Wilson 108-109.)

From the beginning of the research, it is essential to be clear what it is exactly that is intended to be analysed. That is the case with holistic cases and their analysis. A unit of analysis is helping researcher to set the boundaries in a research, therefore all of such analysis is focusing on the unit. On the contrary, embedded studies address a number of units of analysis. A distinction of cases are made between processes, organizations and events. (Wilson 2010: 109-110.)

The starting point for analysis is to manipulate the data and put it in some preliminary order. That can be accomplished by manipulation of data analytically, for instance, by putting information into different arrays, making a matrix of categories and placing the

evidence within such categories or creating data displays, just to mention a few. By playing the data a general strategy for the entire case study analysis has to emerge. (Yin 2009: 129-130.)

There are several analytic techniques to be used for analysing case studies:

- Pattern Matching – Compares an empirically based pattern with a predicted one.
- Explanation Building – Builds an explanation about the case. Trying to find out how or why something happened.
- Time-Series Analysis – The essential logic underlying is the match between empirical trend and either theoretically significant trend specified prior to the outset of the research or some rival trend specified beforehand.
- Logic Models – Consists of matching empirically observed events to theoretically predicted events.
- Cross-Case Synthesis – Mostly applied in studies consisting at least two cases. The idea is to use case studies, whether they were conducted single- or multiple-case studies, to test a certain predetermined theory.

None of techniques can be applied mechanically nor follow any simple procedure. Though, other conjunctive factor techniques is that they can be very effective in laying the groundwork for a top-notch case study. For laying such groundwork, the analysis should demonstrate that all the evidence have been attended, all major rival interpretations have been addressed, the analysis deals with the most significant aspect of the case study and the researcher should use his or her own prior, expert knowledge on subject if possible. (Yin 2009: 136-162.)

2.6.3 Reporting

Baxter & Jack (2008) state that the complex nature of the approach makes reporting difficult. Converting perceived phenomenon and large data set to concise report, which is understood by the reader, is a great task. The objective is to present findings in such a comprehensive manner that allows a reader to feel as if he or she had been an active participant in the study. Description of the context in which the phenomenon is taking place and the phenomenon itself is necessary. There is not a single correct way to report case study results. The most suitable for concerning this research is to address propositions. That ensures the report is not getting on sideways and deals with the

research question (Baxter & Jack 2008). Yin (2009: 185-189) says there are certain features, which make case study report outstanding: being significant and complete, it considers alternative perspectives and displays sufficient evidence. Furthermore, it must be composed in an engaging manner meaning a clear writing style, which possess allure to keep the reader reading.

2.6.4 Advantages and disadvantages

There are multiple reasons to use case studies. According to Zainal (2007), conventionally the examination of data is done within the context of its use, which refers to situation in which the activity occurs. Second, a case study provides lots of room for variation in terms of research methods. It allows both quantitative and qualitative data analysis, to be used independently or together. Third, the detailed qualitative accounts generated in studies help to explain complexities in real-life phenomenon in addition to exploration or description of the data. Eisenhardt (1989) says theory building from cases increases probability of generating novel theory. She adds the emergent theory is likely to be testable with constructs that can be readily measured and hypotheses that can either be proved false or verified as measurable constructs have undergone repeated verification during the theory-building process. That will likely result in the resultant theory being empirically valid.

Often case studies have been criticized for the shortage of rigor resulting in biased views to influence direction of findings and conclusions. Second, due to use of minor number of subjects, many times just one, case studies provide very little basis for scientific generalization. Third, studies are regarded too long, producing massive amount of documentation and being difficult to do. In general the criticism is directed towards its strong dependency on a single case exploration. (Zainal 2007.)

Eisenhardt (1989) emphasizes that some characteristics that lead to strengths in theory building also lead to weaknesses. Immense amount of empirical data may yield theory which is ambiguous and overly complex. Results being ultimately rich in detail but lacking simplicity of overall perspective is a common pitfall. In addition, another weakness according to Eisenhardt (1989) is that theories derived from case studies are about specific phenomena, therefore they may result in narrow and idiosyncratic theory.

2.7 Innovator's dilemma

One of the most consistent patterns in business is the failure of leading companies to stay at the top of their industries when technologies or markets change (Bower & Christensen 1995). Putting it simply, best firms succeeded, because they listened to their customers and invested intensively in technologies and capabilities to satisfy their customers' needs. But when the same successful companies failed subsequently, it happened for the same reasons. And that's one of the innovator's dilemmas: blindly following the maxim that good managers should keep close to their customers can sometimes be a fatal mistake (Christensen 2011: 4).

Leadership in sustaining innovations is not regarded completely important, as technology followers tend to do roughly as well as technology leaders. But it is a different story with disruptive technologies, where the market awareness is more or less non-existent, that there are such strong first-mover advantages. This is the innovator's dilemma. (Christensen 1997: 15.)

2.7.1 Sustaining innovations

According to Christensen (1997: 11) most of the new technologies or innovations foster improved product performance, either being discontinuous or radical in character, while others are incremental in nature. What all of them have in common, is that they improve performance of established products, along the dimensions of performance that mainstream customers in major markets have valued in the past. Therefore most technological innovations in a given industry are sustaining in character. In other words, Lewis (2004) says that all the improvements result in accomplishing the same thing, only doing it better. Therefore, established customers recognize the value of improvements, which leads to largely unchanged relationships in the market, cost structures and organizational dynamics.

Lewis (2004) says that established companies excel at change which involves given technologies. They are well aware of customer needs and service models are tuned over the long periods. Such attributes lead to improved quality and justifies higher prices. Because disruptive technologies are usually developed before their application is known, companies excelling at sustaining innovations do not have service models nor knowledge to respond when disruptive technologies take over the mainstream market.

2.7.2 Disruptive innovations

The term disruptive technologies was deployed by Bower et al. (1995) for the first time 20 years ago. Such disruption displaces an existing market, industry, or technology and produces something new, which is more effective and more worthwhile, furthermore it is destructive and creative simultaneously (Forbes 2013).

Disruptive innovations bring to a market a very different value proposition than have been available previously. They underperform established products in mainstream markets, but have other features, which the minority of customers value. Conventionally such innovations are affordable, simpler, smaller and many times more convenient to use. Even though disruptive innovations may underperform today in terms of what the market demands, they could be fully-performance competitive in that exactly same market tomorrow. (Christensen 1997: 11-12.)

Such disruptive technologies are usually brought to market first in emerging or less significant markets. Leading firms' most profitable customers generally do not want them, or better said, initially cannot use products based on disruptive technologies. Therefore, most companies with a practised discipline of listening to their best customers and identifying new products that promise greater profitability and growth are seldom capable of building a case for investing in disruptive technologies until the opportunity has passed by. New service models and pricing structures are needed. Because they actually promise lower margins, not higher profits, established companies are not keen on them. (Christensen 1997: 12; Lewis 2004.)

2.7.3 Understanding disruptive change

In order to understand, why disruptive technologies can top established companies with good products and terrific customer relations is Christensen's concept of performance oversupply (Lewis 2004). It is defined by Christensen (2011: 211) as "*in each of the several industries explored, technologists were able to provide rates of performance improvement that have exceeded the rates of performance improvement that the market has needed or was able to absorb".* Christensen (1997: 145) elaborates the previous sentence by a following definition of performance oversupply in a disk drive industry: "*once the demand for capacity was satiated, other attributes, whose performance had not*

yet satisfied market demands, came to be more highly valued and to constitute the dimensions along which drive makers sought to differentiate their products".

The following five principles provide managers the conceptual basis for dealing with disruptive technologies:

1. Companies depend on customers and investors for resources.
2. Small markets do not solve the growth needs of large companies.
3. Markets that do not exist cannot be analysed.
4. An organization's capabilities define its disabilities.
5. Technology supply may not equal market demand. (Lewis 2004.)

First, all companies operate and make decisions in the context of its value network. Since disruptive innovations provide a different type of value, established stakeholders do not see any added value or use in them. Second, products or services based on disruptive technologies are not highly profitable right from the outset, therefore, large established companies are not interested in them as they will not make needed return on investment. Third, it is not possible to estimate with any useful degree of accuracy how disruptive innovations are going to be used or how large their market will be. Companies investment processes tend to demand quantification of market size and financial returns prior to entering to market. Hence they will never enter to market as they demand data on market, which does not exist. Fourth, almost all companies have values and processes, which are steering people's working in that organization. Unfortunately, values and processes are inflexible and they do not comply with the value creation of disruptive innovations. Fifth, eventually the products on the mainstream markets will exceed the performance mainstream markets demand, while disruptive ones that underperform relative to customer expectations in the mainstream market today, might be fully competitive tomorrow. This is the performance oversupply discussed earlier. (Christensen 2011: 264-266; Lewis 2004.)

Usually, the biggest mistake that can be done, is trying to fight or overcome the principles of disruptive innovation. By applying traditional management practices, which are successful with sustaining innovations will always result in failure with disruptive innovations (Christensen 2011: 266). Those managers facing a disruptive innovation should apply the following advises:

1. By giving a responsibility for disruptive innovations to organizations whose customers are in need of them will ensure appropriate resource flow.
2. Establish a spin-off small enough to value small gains and profits.
3. Have a plan for possible failure. Try to think of initial efforts at commercializing such technology as a learning opportunity and make revisions as you gather data.
4. It's better not to count on breakthroughs. By moving ahead early and finding the market for the current attributes of the technology one will find the attributes that make disruptive innovations unattractive to mainstream markets are the attributes, which tomorrow's markets will demand. (Christensen 2011: 266-267.)

Frankly, keeping the disruptive organization independent cannot be stressed too much. Integrating a spin-off to mainstream organization once it has become commercially viable in a new market will lead to disaster with disruptive innovations. When those are folded together in order to share resources, debilitating arguments inevitably arise over which groups get what resources and whether or when to cannibalize established products. No matter the industry, a company consists of business units with finite life spans as technological and market bases of any business will eventually disappear. Disruptive innovations are part of that cycle. Companies must give managers of disruptive innovation free hands to realize innovation's full potential, so they can eventually take over mainstream business, because if a company does not kill its business units itself, it is absolutely certain someone else will. (Bower et al. 1995.)

However, it has been said that only two things change culture and they are war and famine. As current managers look at current business culture and reigning situation, they have to understand how different the culture that they have to create is from the culture of the recent past (Lewis 2004).

2.7.4 Disruptive innovation example

Beginning shortly after the Second World War until the 1960s, while the prevailing power source remained the diesel engine, a new mechanism emerged for extending and lifting the bucket: hydraulically actuated systems replaced the cable-actuated systems. Only four of the approximately thirty established manufacturers of cable-actuated equipment in business in the 1950s had successfully transformed themselves into sustainable hydraulic excavator manufacturer by the 1970s. Basically all others had failed. (Christensen 1997: 62.)

In general, contractors have tended to measure the functionality of mechanical excavators by their reach of extension distance and by the cubic yards of the earth lifted in a single scoop. Once hydraulically actuated excavators began slightly to gain ground in the early 1950s, they could only provide a fraction of the performance contractors required. Therefore, contractors had no use for them. The early users of hydraulic excavators were very different from the mainstream customers of the cable shovel manufacturers, in size, in needs and in the distribution channels through which they bought. Early use of them were for small jobs, such as digging narrow ditches from water and sewer lines in the street to the foundations of houses under construction, which had never warranted the use of cable-actuated systems. (Christensen 1997: 62-64.)

The Figure 21 presents in bucket size that hydraulics engineers were able to offer in the new excavator architecture. Given trajectory of improvement was far more rapid than the rate of improvement demanded in the markets, carried this disruptive hydraulics technology upwards from its original market through the mainstream market. As showed, hydraulics technology eventually reached the point where it could address the needs of mainstream excavation contractors. However, that point was achieved by entrant companies, who had first found a market for the capabilities of the technology at its infancy, accumulated design and manufacturing experience in that market, and then used that commercial platform to take over value networks above them. The established companies lost both the battle and the war since they lacked the design expertise and volume-based manufacturing cost position to compete as hydraulics invaded the mainstream. It is to be noted, that even today the cable-actuated systems can achieve much longer reach and have greater lifting capacity than the hydraulic excavators. But once both of the technologies could meet mainstream market requirements, the cable-actuated systems lost their competitive relevance. The pivotal character was, that hydraulic machines were drastically less prone to breakdowns than the cable-actuated ones. Therefore the basis of product choice in the market shifted to reliability. (Christensen 1997: 63-69.)

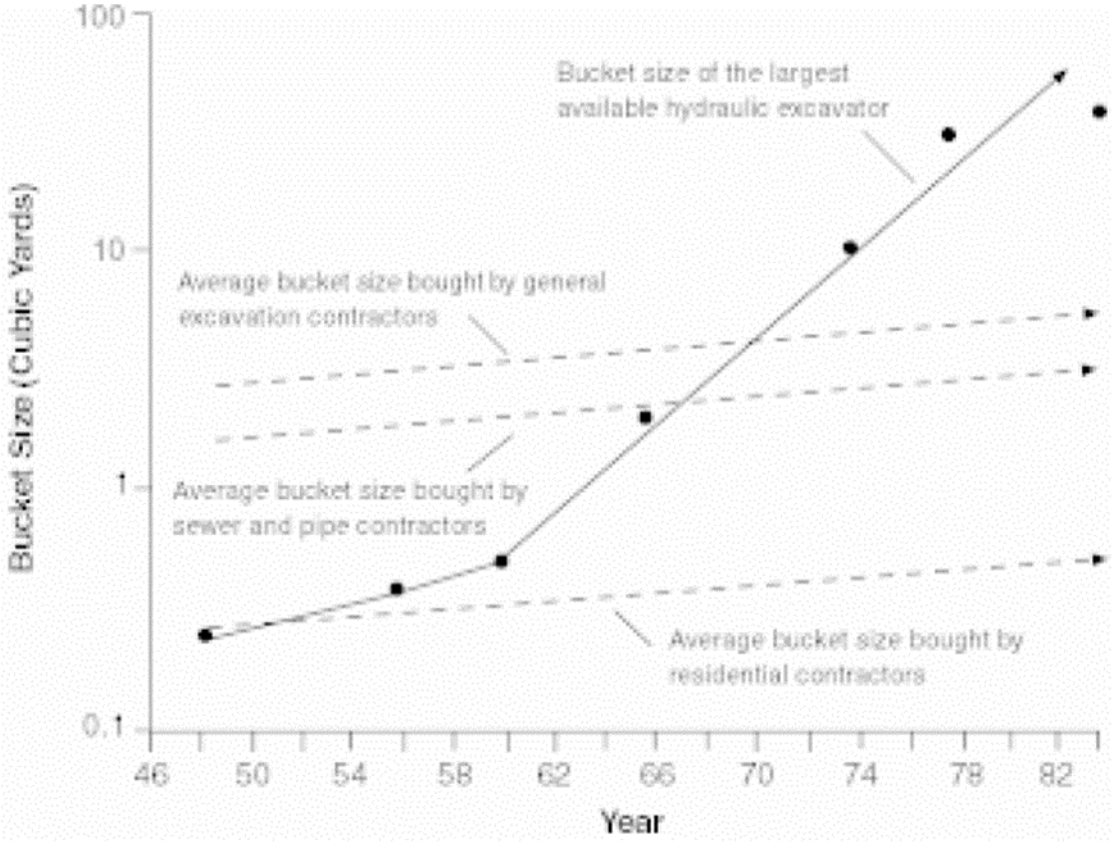


Figure 21. Disruptive impact of hydraulics technology in the mechanical excavator market. (Christensen 1997: 63)

What the companies dominating the mainstream market did wrong? Disregarding the benefits of hindsight, they did nothing wrong. Their customers did not need nor could use hydraulic machines due to technology's shortcomings in terms of performance. They focused to take away market share from their competitors, by developing better, sustaining products for profitable growth. If they took their eyes off their customers' next-generation needs, existing business would have been jeopardized. They did not fail because technology was not available, or they did not know how to use it. They could not have worked any harder, been smarter, invested more aggressively or listened to customer more carefully. The people in charge were not sleepy nor arrogant. They failed because hydraulics did not make any sense to them, until that ship had sailed. (Christensen 1997: 69.)

2.7.5 Disrupting class

In their book "Disrupting Class" Christensen, Horn & Johnson (2011) address innovations that will change the way the world learns. Even though the book deals with K12-education in U.S, it provides valuable insights for future learning in relation with corporate training too. According to Christensen et al. (2011: 186) it is evident that no longer will research on best practises or what works best on average across education suffice as the research has to move toward understanding what really works from the perspective of individual student in different circumstances.

For the past couple of decades, increasing attention has been paid to those individuals who have special needs. As consequence, there is constant struggle who is eligible for special teaching, which has resulted in standardized teaching for them not having such need because costs of special teaching soak up so many resources. Basically the individuals, who succeed in learning are the ones whose intelligence happens to match the dominant paradigm in use in a particular classroom or have found a way to adopt it. The suggested solution is a computer-based student-centric learning, which allows individuals to learn in ways that match their intelligence types in the places and at the paces they prefer by combining content in customized sequences. (Christensen et al. 2011: 34-35, 38-39.)

Even today classrooms still look pretty much same as they did before the personal computer revolution, since computers have been crammed into classrooms to sustain and marginally improve the way teachers already teach and run the schools rather than to displace the existing teaching and classroom models, just as most organizations do when they attempt to implement innovations. Such policies will never allow a migration of student-centric classroom, instead in order to implement change computer-based learning should be deployed in places where there are no teachers available to teach. The reason why computer-based learning has not taken over teaching is same as innovator's dilemma: unless top managers actively manage the process, organizations will shape every disruptive innovation, like computer-based learning, into a sustaining innovation, one that fits the existing processes, values and economic model, because organizations cannot naturally disrupt themselves. (Christensen et al. 2011: 72-75, 84.)

In traditional teacher-administrated examination individuals move on whether they have mastered the topic or not. Teachers cannot find out study results until the exams have

been graded, which takes some while. Even in the case of failure, students must move on as that is inherent in the model of monolithic instruction. The amount of time spent in learning to material is fixed, but the study results vary. The current model of instruction only tells what percentage of the students has demonstrated mastery of what percentage of the material. On the contrary when students learn through student-centric online technology, assessment has no need to be postponed until the end of an instructional module and then administered in a batch mode. The mastery can be verified continually to create firm, closed feedback loops. The amount of time involved in learning vary, but learning results are much more consistent. Hence testing and individualized assistance can be interactively and interdependently attached into content-delivery stage, rather than tacked on as a test at the end of process. As learning is projected to be no longer variable, students can be compared how far they have moved through a body of material. (Christensen et al. 2011: 108-111.)

Christensen et al. (2011: 243-244) state that there are five major messages, which explain the reform struggles for the past years and assist to harness a full potential of disruptive innovation in education:

1. The root cause of student's inability to learn has not been addressed.
2. Reforms have targeted to confront the system head on, which is opposite to how the disruptive innovation should take root.
3. Even though it has been acknowledged that student learn differently, the current system only allows monolithic teaching and hampers the efforts to teach students in customized ways.
4. Some of the places with highest potential to circumvent the system and create a new, modular education system that facilitates customization are the online facilitated networks.
5. To the extent that decision makers want to implement pivotal changes, they have to use the tools of power and separation.

To make things happen actions are needed from all the stakeholders involved. For instance to teachers that means to have skills relevant for student-centric learning environment, where teachers are required to be able to work one on one with the students and to build tools for different types of learners. (Christensen et al. 2011: 244-248.)

3 METHODS AND DATASET

This chapter explains the data collection methods and the acquired dataset itself, on which the results in the following chapter are based on. This research was conducted as a case study at the case company's facilities in Turku, Finland. Even though the study's results could be leveraged to other departments, a sole addressed department was training services.

The collection of data was conducted in four different ways: firstly, customer feedback for the past 10 months was reviewed and the researcher participated in two training courses to observe how training is actually delivered. As a result of observed findings questionnaires were created to assess observed findings and to see how relevant stakeholders think about the essential issues of this study. Finally, all preliminary results were reviewed in order to create interview forms for a round of interviews with selected stakeholders. Moreover, a market research of available holograms technologies was conducted in parallel. The case company's manager was guiding and evaluating data collection methods all the way of the research process. He contributed to data collection methods and selection of relevant stakeholders in a role of manager.

3.1 Customer feedback

Since September 2014, the case company has collected direct course feedback by means of the form presented in Figure 22. Until the end of June 2015, 699 different training courses were delivered, while 5129 people took part in them. However, feedback was available only from 394 courses containing feedback from 2536 participants. That means that feedback concerning 44 % of courses containing 51 % of participants were not available.

Feedback results were analysed in order to see a relative importance of each section. The case company is more interested in how the given questions compare with each other and how they evolve over the time and between various courses instead of actual values themselves. To present differences in results, index was defined to be equal to 100 corresponding total average of results 8.82.

The form contains relevant questions for training evaluation and development, hence being suitable to serve the case company's intentions. Questions are quite a lot general in nature and may only assess training delivery on the face of it. Unless participant is willing to share his or her thoughts in written words, which are fatter and convey more information, feedback collected through given form probably lacks of depth and utility in the intended extent. Moreover, participants are asked to fill out a questionnaire as a final part of course just prior to departure of training centre.

Please assess the statements below on a scale from 1 to 10. Leave empty if the question is not applicable.
The scale is 1-2 = poor, 3-4 = fair, 5-6 = average, 7-8 = good, 9-10 = excellent.

	1	2	3	4	5	6	7	8	9	10
1. I received information about the course (schedules, contents etc.) prior to the course	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. The instructors had the required expertise and experience	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. The instructors communicated fluently and clearly	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. The instructors were well prepared	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. The instructors kept to the agreed schedules	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. The structure of the course suited the purpose of the training	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
7. The length of the course was long enough	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
8. The course material was of high quality	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
9. The course consisted of topics relevant to my daily work	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
10. The course included the right amount of practical training	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
11. The course included the right amount of operational/simulator training	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
12. The objectives of the training course were clear	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
13. The training fulfilled my expectations	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
14. The standard of the lecture room and other facilities was good	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
15. The transportation was timely	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Improvement suggestions for future courses

General comments concerning the course

Figure 22. Direct course feedback form.

According to Hale (2003) roughly four fifths of organizations are testing participants' reactions by end of course evaluation questionnaires because it is easy to do. This is usually just slightly more than a litmus test for happiness at the time of answering the questions though. Happiness does not correlate with learning, on the contrary, the most powerful learning experiences are reported by people from difficult and painful experiences. Hale (2003) stresses the interconnection between post-course evaluation questionnaires and the level of experienced happiness of participant and states that if trainers are conscious of their assessment being judged based on the post-course evaluation results, they might be inclined to use applied psychology in ensuring that participants are in mood for completing their evaluation forms.

Results show in Figure 23 that instructors' input is valued and they are well qualified to conduct tasks they have been assigned to. On a negative note, it is evident that offered courses are too short and are lacking hands-on training according to customers, for which such training is the most needed form of training due to the nature of their jobs. Moreover, people wish to receive more information about the course beforehand and study material should be improved as their relative values are below index.

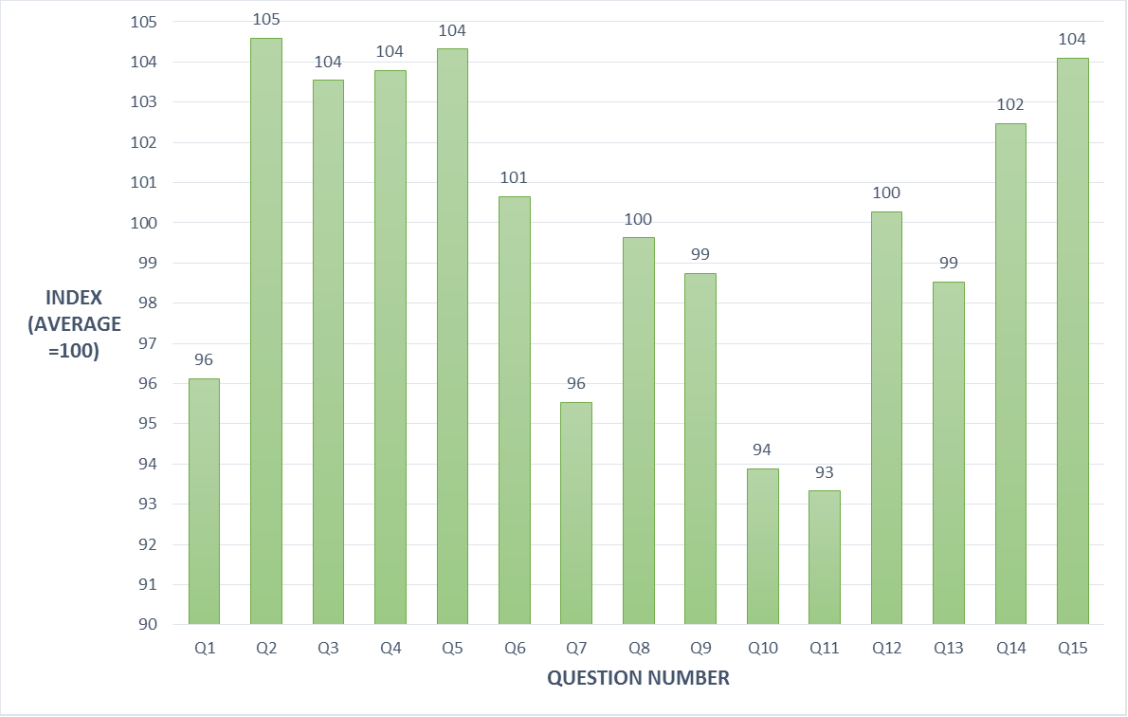


Figure 23. Customer feedback results per question.

It cannot be stated that a month would have impact on quality of training delivery. Feedback results are varying from month to another with minor fluctuations as depicted in Figure 24. Hence, the time of year is not explanatory variable, but the fluctuations are stemming from other factors.

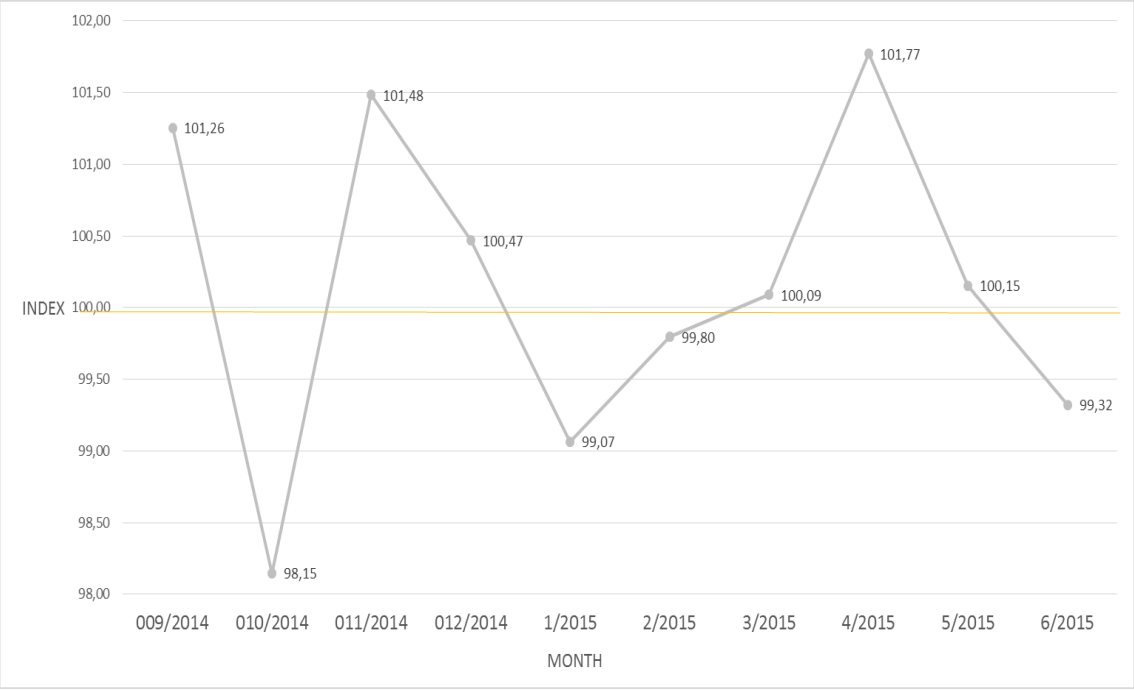


Figure 24. Customer feedback results per month.

Figure 25 shows that course length affects how people experience quality of training received. They may experience it too long and boring, on the other hand, they may think the course was too short and all the desired topics were not covered thoroughly. According to the results, participants prefer courses lasting 2-3 days or one full working week. It is to be noted that even it has been indicated that courses lasting approximately 6 days according to course specification, it will be delivered over five working days. An interesting point is that courses delivered over four separate days are not preferred. People either prefer to have a longer course or wish course was compressed into three days. Obviously courses spanning more than one full working week receive worse grading as people tend to get exhausted over longer periods of time.

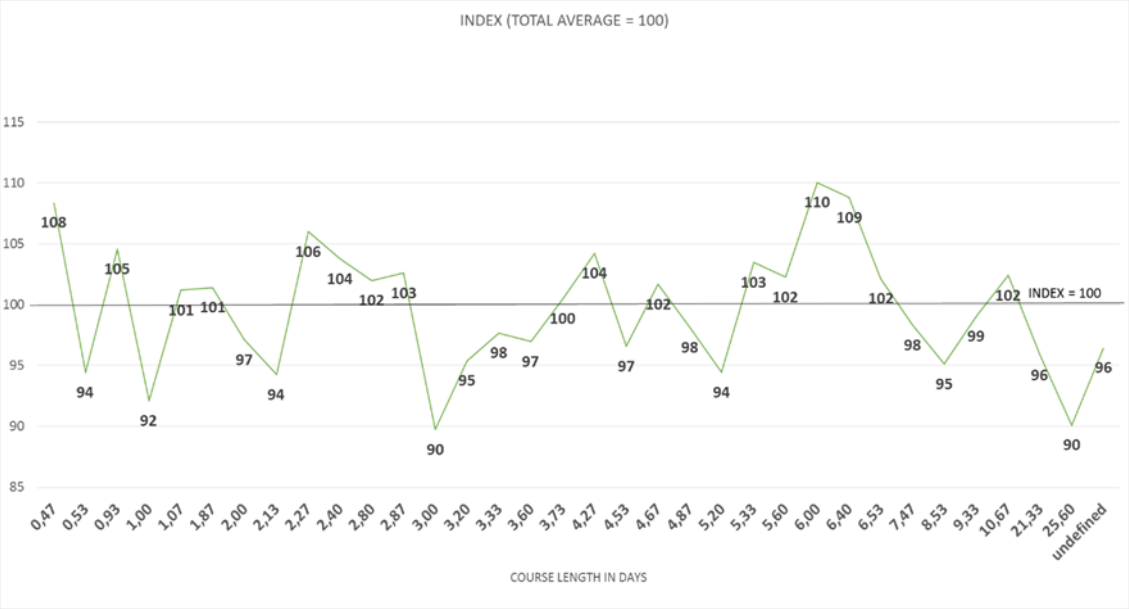


Figure 25. Course feedback results per length of course.

Some of the course types were delivered only once or a couple of times, therefore providing a bit of a distorted insight of their ranking in Figure 26. A striking point is that training of 2-stroke engines is performing better than training of 4-strokes, even they are the case company's core business. It is also evident that courses related to control and electrical systems are invariably receiving below average feedback results. Moreover, one can say that the longer a course has been available in the course portfolio the better feedback results it tends to gain. That is the case for instance with propulsion courses (PRO); the given course type is delivered by highly skilled trainers and any direct negative feedback has not been issued for the management team, yet the given course type scores below average on feedback results.

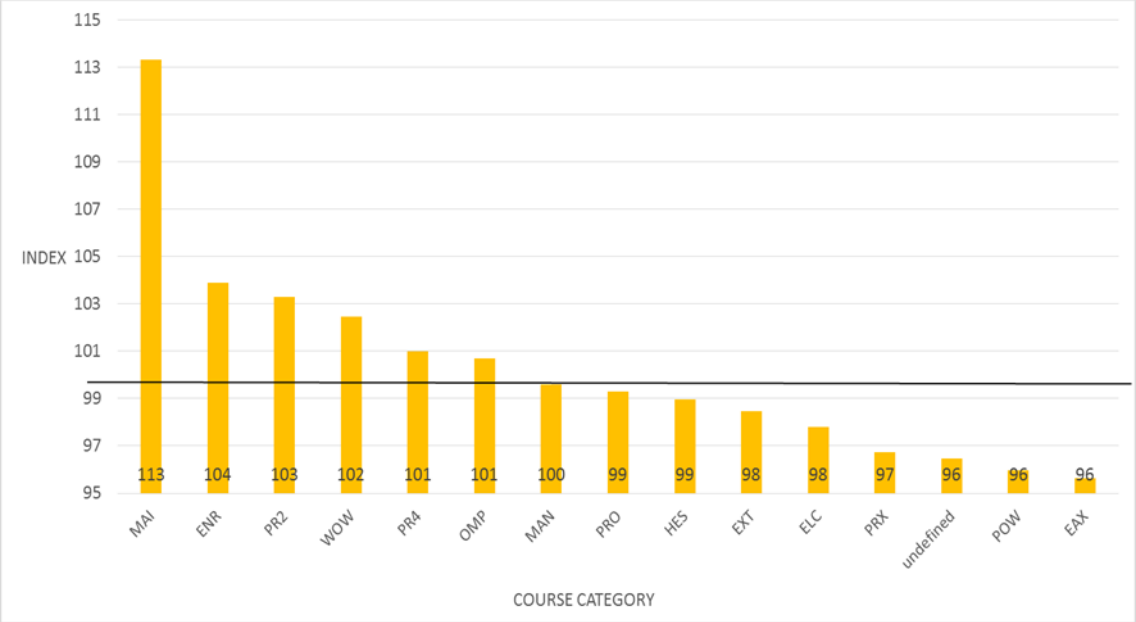


Figure 26. Course feedback results per course type.

Group size obviously has its impact on experienced quality of training delivery. The results shown in Figure 27 prove that average number of six participants per course has not got the best grading, but it has been the group size of ten. Only a minority of courses delivered has had more than 12 participants on the course, so the results regarding tens of participants per course might be a bit misleading, especially bearing in mind that given courses have likely been delivered in smaller groups in reality. The feedback result supports idea of delivering training in greater groups than it has been done in the past. That definitely could be expected to increase profitability and operational efficiency of training services.

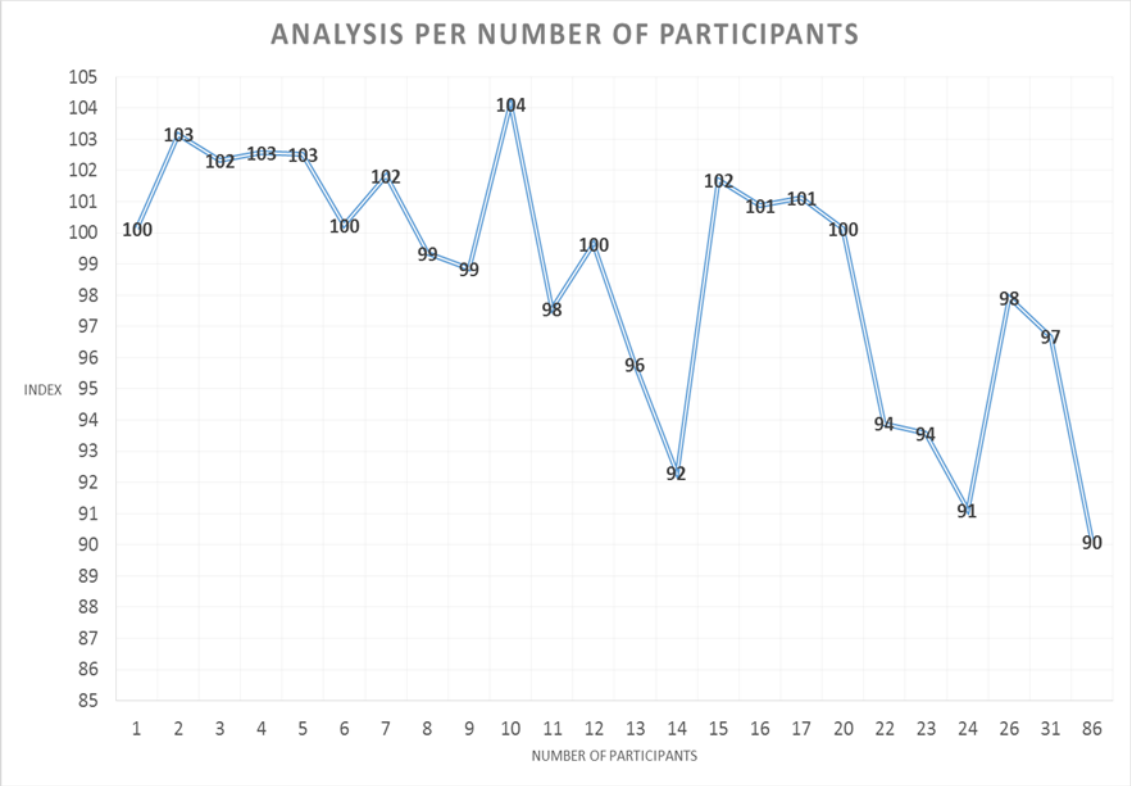
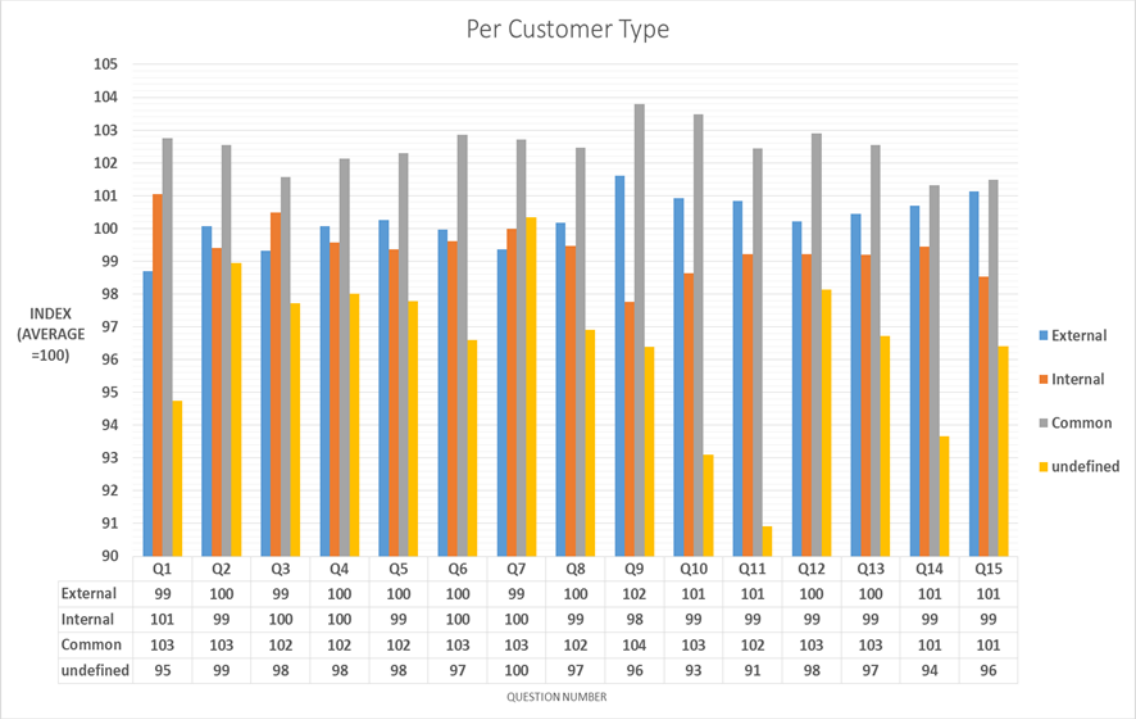


Figure 27. Course feedback results per number of participants.

In the Figure 28, the definition “common” denotes a group, which has a mixed pool of participants, both internal and external customers, whereas “undefined” are courses with undefined pool of participants. All in all, common courses have been receiving the best results out of all customer categories in each section. As regards to most of questions, external customers grant better grades for training courses than internal ones. That is expected as internal customers tend to be more demanding as they are more aware of need to have latest top-notch knowledge of addressed subjects and may have better readiness to demand high quality instruction. Only areas where internal customer are more satisfied than external ones in terms of training delivery are provided information and instructor’s fluency in terms of communication. The reason is that internal customers are more likely to have the same first language with the instructor than external customers. Even if the spoken language is English, having the same mother tongue and being familiar with the accent eases to digest imparted information.



	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
External	99	100	99	100	100	100	99	100	102	101	101	100	100	101	101
Internal	101	99	100	100	99	100	100	99	98	99	99	99	99	99	99
Common	103	103	102	102	102	103	103	102	104	103	102	103	103	101	101
undefined	95	99	98	98	98	97	100	97	96	93	91	98	97	94	96

Figure 28. Course feedback results per customer type.

In addition to numerical feedback, in total 373 different individuals provided a verbal course feedback containing 507 statements, which can either be regarded as improvement suggestions for the future or negative issues, which the management team can utilize and take into consideration in the foreseeable and long term future for delivering better training. It goes without saying that positive statements were granted, but they are not listed as they were quite a bit general in the nature and only supported top ranked questions presented earlier. The positive statements were as follows: course met my requirements, great course, there is nothing to be improved so keep it unchanged, great facilities, very nice and proficient instructor et cetera. Such comments basically do not add any value to numbers unlike negative and development-oriented comments do. Those statements help the management to figure out, what training services is actually missing at the moment in terms of training delivery and could those training shortcomings stated by customers be solved by refining their proposals further to meet their demands in a way or another.

Out of the aforementioned 507 statements, 284 various statements could be distinguished. A complete list of verbal feedback can be found in appendix 1. It is to be noted that few

dozens of verbal feedback were discarded because of unclear handwriting or because of the researcher being unable to understand the language a comment was written in. Statements were categorized into six different categories, depicted in Figure 29.

Category	Number of various statements	Number of individual comments
Planning	70	207
Scheduling	17	71
Arrangements	68	90
Facility/equipment	29	33
Delivery	85	89
Material	15	17

Figure 29. Categorization of various verbal statements.

“Planning” means those activities, which are related to course design and its content. “Scheduling” is to denote statements, which concern time allocation related to course. “Arrangements” mean all activities, which are related to course arrangements in general. The category “Facility/equipment” encompasses comments regarding course venue and applied technology whereas category of “Delivery” denotes feedback concerning training delivery itself. Finally, the category “Material” includes those statements, which have something to say about the applied course material.

Obviously, most statements address general course planning and how the course delivery is designed. Moreover, training arrangements and instructional delivery generated a lot of statements too. Provided feedback were very ambiguous and participants had divergent perceptions of how courses should be developed further. However, there were nine various statements, which were mentioned at least five times and they are shown in Figure 30. A reference to a given statement is denoted in parenthesis and can be found in appendix 1.

Statement	Count	Category
More hands-on (general)	85	Planning
Longer course preferred	45	Scheduling
More troubleshooting	17	Planning
More simulator training	14	Planning
Shorter course preferred	10	Scheduling
Material to be provided before the course starts	8	Arrangements
Split the course considering target group	8	Planning
Live training preferred	5	Arrangements
Have a theory part in the morning and corresponding hands-on in the afternoon	5	Planning

Figure 30. The most used verbal statements.

It is obvious that people demand more hands-on training, whether it is done with actual engine components or in simulator. The most important ingredient is that people need to have hands-on approach to training instead of just being seated in a classroom listening to an instructor delivering a presentation. The majority of respondents urge that they need to be allowed to participate in training in greater extent in a way that activates their mind and challenges them to do something more than just being a listener. As shown, the need of increased time devoted for hands-on training is evident in general. If people were to elaborate their suggestions, they demanded more training related to automation (IDs 316 & 340), electrical (IDs 3 & 204) or specific systems, such as gas system (ID 74), just to name a few. Conversely, a service engineer (ID 89) wanted to have less practical training as he did not find it necessary for his job whereas one participant (ID 245) thought that by increasing theoretical training time involved in hands-on training could be reduced. Overall there was only one person (ID 24) who directly expressed that he would have liked to have reduced time devoted to hands-on and have more theoretical training instead.

Moreover, feedback results suggest that it could be reasonable to reconsider course schedule and length and reflect them to material addressed over the course. For instance five respondents (IDs 333, 334, 335, 336 & 337) agree that it would be preferred to deliver training in a way they suggested on a given course, which can be regarded as a strong impetus to reshape training delivery within a given course. In total eight participants (IDs 7, 16, 27, 62, 112, 113, 116 & 318) on six various courses proposed that the course should be split into two sections considering a target group. People regarded training as a waste of time as they are trained to master things irrelevant to their jobs. In addition, one participant (ID 213) said that their background should be taken better into account and another (ID 328) proposed to have a pre-assessment to find out capabilities of participants. Another coherent statement is to have a live training instead of a remote one regarding a certain course (IDs 78, 79, 80, 82 & 83). Moreover, people (IDs 4, 12, 15, 60, 128, 224, 277, 299 & 341) want to have a look at course material to get a grasp in coming subjects beforehand and be prepared, whereas one wished to have suggestions for self-study (ID 372).

There were some single comments, which stood out of the rest and could be worth of further consideration. They are presented below.

- People (IDs 4, 14, 102 & 121) want to have accurate course schedule alongside the general information to be delivered in advance. In the worst case they may end up in a wrong course due to false information (ID 290 & 291).
- Participants (IDs 10, 67, 70, 71, 94, 97, 150 & 342), especially external ones, want to be trained subjects relevant to their special installations and products. They are not happy with training to remain on general level.
- Some people (IDs 114, 115 & 288) suggested that the course applied outdated course material on internal course, so training people to have expired and hence useless knowledge is not acceptable. Moreover, some external customers are not happy with the overall quality of materials either (IDs 40 & 127).
- Some customers (IDs 146, 150, 295 & 296) prefer training on customer's site to training in training facilities. Training should always be given in the customer's location if they wanted to and expressed that while booking.
- A participant (ID 26) wanted to have more "What if" –type of scenarios.
- More exercises were asked as well as more time for questions and answers would have been appropriate (ID 54 & 220).

- To ensure understanding more interaction is desired (ID 344).
- More real company's cases to be used as an example (ID 66).
- Many people (IDs 156, 187, 188, 189 & 190) suggest that PID-training should be reconsidered, for instance at which stage of course it is given or is there excess of such a training.
- Two people (IDs 31 & 176) proposed that separate UNIC-courses could be compiled into one course. Another participant (ID 159) agreed with them as he preferred to have less UNIC things whereas another one (ID 163) wished UNIC-training to have included more troubleshooting. One (ID 326) suggested that it would be good to have a one day UNIC –introduction with the use of simulator.
- In addition to automation related hands-on training, a greater emphasis on such issues is preferred (IDs 96, 316 & 317).
- One external customer (ID 324) urged that theoretical training should be related to real-life situations.
- One internal customer (ID 361) preferred to have a course divided into two or three chunks, which are delivered separately over the course of year. That would enhance learning as such scheduling would allow to apply learned information in the work before coming back to deepen knowledge even further.
- In order to shorten course length, the number of breaks should be reduced or training days should last longer (ID 355).
- Many participants indicated that in a way or another that they wished to have more visual aids to follow training: some parts to be brought to classroom for discussion (ID 321), to see a novel engine component before the course commences (ID 167), demonstrations at the screen were hard to follow (ID 8), mechanical movement hard to understand without video or image (ID 298), more 3D-item images preferred (ID 150), more videos and pictures in general (IDs 40, 200, 270, 368) and more specifically, videos are needed to demonstrate engine knocking and overhauling (IDs 202 & 300).

Verbal statements were not sorted out by the respondents in more detail, because training services basically is not concerned who originally gave a certain statement. All statements have to be treated with equal care and dignity, whether they are given by internal or external customer, since training quality have to be equivalent across the courses.

3.2 Observations

Observations were done by participating in two different training courses. The first course was a three-day course providing technical fundamentals for employees with non-technical background and another one a five-day course addressing electrical and automation systems. Both courses were basic level for internal customers. Observed findings can be found in appendix 2 and 3 as a whole. All the observations were made by the researcher himself. The applied method was participant observation, which was explained in chapter 2.5.3.

There were some significant observations made, which have direct impact on training delivery and its quality.

- Course material: in some cases it is outdated, has been created by a third party for other purposes than training in mind or otherwise it is not meeting required standards. They do not contain links for further study. Some slides are way too informative, which make a follow-up of them very tedious. In some cases certain courses are lacking a material framework, which might lead to failure at meeting of course objectives.
- Material delivery: provided in memory sticks during the first or second day of the course. However, material was wished to be provided in advance and suggestions and material for further study were desired.
- Training delivery: very instructor-led and is obviously lacking interaction between participants. People tend not to be engaged and interaction occurred just occasionally, usually when someone had to pose a question for further information or elaboration. Conversation effectively never catches fire, since people are reluctant to share their thoughts and experiences.
- Applied technology: predominantly PowerPoints, accompanied by pictures, videos and animations every now and then. A considerable reliance on whiteboard. Very limited number of visual aids overall. According to observations, possibly oversupply of visual aids is highly unlikely.
- Course assessment: it is poorly designed and executed. Currently assessment results do not correlate with learning.
- Instruction in hands-on facility: a huge reliance on instructor's verbal delivery and the engines themselves. A modern methods are not utilized even in the smallest extent. Instruction could be enhanced by applying modern technology to illustrate

engine functionality and technology. Moreover, customer specific installations could be demonstrated through modern technology.

- Overall course planning: course classification may need reconsideration. Furthermore, some courses are overscheduled and other way around.
- Overall training services philosophy: It is evident that delivery follows a mantra "one size fits all". Moreover, course planning is sort of done by assuming, that if one has not attended a certain course one knows nothing about it, whereas once one has completed a certain course one possess all relevant knowledge of certain subject. Frankly, training services provides no lifecycle services in terms of training delivery. By picking up available courses from the portfolio, a person can obtain appropriate knowledge. However, a drawback is that the courses are running every now and then, and may be fully booked. In the worst case scenario, an individual may have to wait for years to have an opportunity to gain preferred knowledge through courses provided by training services.
- Instructors: Even though some of them are lacking field experience, they are well qualified and know their business thoroughly. Based on observations, the company's trainers are the only major component, which are currently working near to perfection.

3.3 Questionnaires

Questionnaires were based on observed findings and thorough discussions with the training development manager. Moreover, subjects relevant to research question were examined too. One single questionnaire was created to map out current state of training, its development and relevant stakeholders' perception on hologram technology. The questionnaire was sent to trainers and internal customers globally. Due to high number of expected respondents and many people not being reachable, a questionnaire was the preferred option to more time-consuming data collection methods to find out intended topics. Two versions were created considering divergent viewpoints of respondents.

The selected respondents were trainers and internal customers globally. Trainers were asked to contribute through training online portal whereas internal customers were asked to fill out a questionnaire by hand on selected courses. The arrangement was done in a way defined because in such a large company it is hard to catch people and make them contribute. Eventually 12 trainers and 32 internal customers devoted their valuable time

to answer the questionnaire. A list of respondents is can be seen in Figure 31, where ‘T’ denotes trainer and ‘IC’ internal customer. The same classification applies to responses regarding non-open-ended questions later on. In addition, position, location, years in the company and the current position and number of courses given or participated in are presented.

Respondent ID	Position	Location	Years in current position	Years at the company	Number of courses given / participated
T1	Instructor	Finland	0	1	0, 1 assisted
T2	Advanced Application Engineer	Finland	8	8	200
T3	Instructor	Finland	1	6	20
T4	Instructional Designer	Finland	1,5	5	20
T5	Senior Trainer	Finland	10	20	250
T6	Senior Instructor	Finland	1	3	5
T7	Senior Instructor	Korea	7	20	175
T8	Trainer	Usa	7	12	Over 500
T9	Trainer	Netherlands	8	21	150-250
T10	Senior Manager Training	India	3	16	20
T11	Technical Instructor	Brazil	2 months	2 months	2-5
T12	Technical Instructor	Brazil	2 months	2 months	2-5
IC1	Sr Service Mechanic	USA	5	10	2-5
IC2	Service Engineer	USA	N/A	N/A	10 +
IC3	Engine Automation Coordinator	USA	< 1	< 1	1
IC4	Field Service	USA	1 month	1 month	0-1
IC5	Customer Support Engineer	Jordan/United Arab Emirates	4	4	2-5
IC6	Sr Technical Expert	Korea	9	18	10+
IC7	Automation Engineer	Dubai	9	9	2-5
IC8	Customer Support Engineer	Jordan	7 months	4	2-5
IC9	Senior Service Engineer	United Arab Emirates	2	9	2-5
IC10	Service Engineer	United Arab Emirates	2	7	2-5
IC11	Superintendent Engineer	Saudi Arabia	5	6	2
IC12	Mechanical Engineer	Philippines	6	11	2-5
IC13	Senior Service Engineer	Saudi Arabia	6	6	2-5
IC14	Service Engineer - Electrical	Saudi Arabia	6	6	2-5
IC15	Junior Field Service Engineer	Hungary	1	2	0-1
IC16	Senior Technical Superintendent	Finland	1	1	2-5
IC17	Service Engineer	United Kingdom	2	8	6-10
IC18	Service Engineer	United Kingdom	3	3	6-10
IC19	Senior Service Engineer	Finland	2,5	9,5	10+
IC20	Senior Warranty Supervisor	Finland	4,5	4,5	2-5
IC21	Superintendent	Italy	5	10	6-10
IC22	Warranty Supervisor	Finland	1	10	6-10
IC23	Warranty Supervisor	Finland	1	4	10+
IC24	Service Engineer	Finland	1	1	2-5
IC25	Senior Service Engineer	Finland	1	1	2-5
IC26	Master Data Engineer	Finland	6 months	5	0-1
IC27	Service Engineer, Business Development	Finland	2	2,5	2-5
IC28	N/A	Finland	6 months	12	2-5
IC29	Electrical Engineer	Saudi Arabia	6	6	0-1
IC30	Field Service Engineer	Hungary	2	2	0-1
IC31	Senior Service Engineer	United Arab Emirates	1	1	0-1
IC32	Service Superintendant	United Kingdom	1	7	6-10

Figure 31. List of questionnaire respondents.

The questionnaires can be found in appendices 4 and 5. Questions 1-18 are primarily seeking answers to current state of training whereas questions 19-32 reflect how training could be developed in a sustaining way. Questions 33-40 are aspiring to get insight of

how relevant interest groups perceive hologram technology and its possible application in training. Questions 1-5, 17-20, 32-35 and 40 are open-ended questions, therefore most frequent answers are sought as regards to them. On the contrary, questions 6-16, 21-31 and 36-39, due to their setting allowed respondent to perceive either as positive, negative or something in between with a question. Therefore answers are presented in a different way depending on the question.

The answers regarding to open-ended questions are shown in Figure 32. The most common themes are identified and categorized as per the group.

Question	Trainers	Internal Customers
1	Technology, Students, Material	Trainers and their expertise, Structure, Material / Technology
2	Familiar topics, Hands-on training	Hands-on training, Various engine basics
3	Familiarity, Support availability	Familiarity, Hands-on experience on topics
4	Various advanced technologies such as gas engine and PLC, Hands-on training	UNIC, Electrical systems, Gas systems, Other very technical systems in general
5	Lack of experience, expertise and appropriate material	Wide spectrum of things to learn, not being familiar with the topic because of nature of job
17	Time-consuming, Translator has to be a technical person	Training slows down, Translator has to be a technical person. Majority had not taken part in courses, which involved a translator though
18	Actions to be taken for smooth and high quality training delivery	More detailed material, Separate question & answer-session to be arranged, More hands-on training
19	Hands-on training, Simulator, Schedule	Hands-on training, Trainers, Material
20	Better preparation, material and resources	More hands-on, In-depth information on certain engines and systems, More visual aids

32	Investments on equipment	Material to be supplied before the course
33	3D image, Created by projector	3D, Created by laser, Light projection
34	Good option to support training, Useless	Simplifies and enhances understanding, Might not be helpful
35	Demonstrating inner parts of the engine, No opinion	Demonstrating inner parts of the engine, To be used partially or not at all
40	Has to be tested before implementation	Great addition to training, Not a substitute for real thing

Figure 32. Open-ended answers of trainers and internal customers.

Moreover, non-open-ended question are categorized as per the group too. The share of responses per question are presented in Figure 33 to provide insight of generic perception. For example question 6: Do you think the course schedule is allocated wisely (classroom / hands-on)?

- Positive – Respondent thinks it has been allocated wisely.
- Slightly Positive – Respondent thinks that it has been allocated somewhat wisely.
- Neutral – Respondent has no clear opinion on it, or his or her answer cannot be interpreted.
- Slightly Negative – Respondent thinks it has not been allocated somewhat wisely.
- Negative – Respondent thinks that it has not been allocated wisely.
- N/A – Respondent has not stated his or her opinion.

The same philosophy applies to all of non-open-ended questions.

	Positive	Slightly Positive	Neutral	Slightly Negative	Negative	N/A
6 T	58%	25%	17%	0%	0%	0%
6 IC	66%	6%	3%	13%	9%	3%
7 T	42%	25%	33%	0%	0%	0%
7 IC	91%	0%	3%	0%	3%	3%
8 T	17%	42%	8%	0%	33%	0%
8 IC	53%	13%	13%	0%	22%	0%
9 T	50%	8%	8%	8%	25%	0%
9 IC	72%	9%	6%	6%	3%	3%
10 T	42%	33%	8%	0%	17%	0%
10 IC	59%	6%	6%	13%	9%	6%
11 T	42%	8%	42%	0%	8%	0%
11 IC	81%	0%	9%	3%	3%	3%
12 T	50%	8%	33%	8%	0%	0%
12 IC	84%	3%	6%	0%	3%	3%
13 T	50%	17%	17%	0%	17%	0%
13 IC	50%	6%	13%	19%	9%	3%
14 T	0%	42%	17%	0%	42%	0%
14 IC	72%	3%	13%	0%	3%	9%
15 T	0%	8%	25%	33%	33%	0%
15 IC	78%	0%	6%	3%	13%	0%
16 T	83%	0%	0%	0%	17%	0%
16 IC	66%	0%	0%	3%	31%	0%
21 T	17%	17%	25%	17%	25%	0%
21 IC	56%	13%	9%	6%	13%	3%
22 T	25%	17%	42%	0%	17%	0%
22 IC	59%	6%	6%	3%	25%	0%
23 T	33%	17%	17%	0%	17%	17%
23 IC	41%	9%	6%	0%	28%	16%
24 T	75%	8%	0%	8%	8%	0%
24 IC	81%	0%	3%	3%	6%	6%
25 T	42%	25%	8%	8%	8%	8%
25 IC	31%	9%	6%	0%	34%	19%
26 T	83%	0%	8%	0%	8%	0%
26 IC	66%	13%	3%	0%	13%	6%
27 T	42%	50%	8%	0%	0%	0%
27 IC	69%	0%	13%	0%	16%	3%
28 T	42%	25%	8%	8%	8%	8%
28 IC	44%	19%	0%	9%	22%	6%
29 T	17%	8%	17%	25%	25%	8%
29 IC	22%	6%	13%	0%	34%	25%
30 T	50%	25%	8%	17%	0%	0%
30 IC	81%	3%	0%	3%	3%	9%
31 T	25%	17%	0%	8%	33%	17%
31 IC	25%	22%	3%	3%	38%	9%
36 T	50%	17%	17%	0%	8%	8%
36 IC	41%	16%	3%	0%	22%	19%
37 T	25%	25%	8%	8%	17%	17%
37 IC	31%	9%	22%	6%	9%	22%
38 T	33%	25%	0%	17%	17%	8%
38 IC	25%	13%	6%	3%	38%	16%
39 T	42%	17%	0%	8%	25%	8%
39 IC	25%	19%	9%	6%	25%	16%

Figure 33. Non-open-ended answers of trainers and internal customers.

There are a lot of useful single comments on current state of training, development and perception of holograms in addition to earlier discussed data, which provide a deeper insight of how relevant stakeholders find training services now and in the future. Moreover, those single comments impart knowledge, which may not be conveyed through the earlier figures at all or just slightly. Statements are listed below and ID in parenthesis refers to the list of respondents in figure 31, meaning certain respondent's statement in question. Some of the results are elaborated as the listing of answers may not be exhaustive in terms of certain questions.

1. It is easier to teach, when all participants are on a similar knowledge level, which applies to LNGPac training, but does not apply to many others (T4). Open atmosphere, conversations and participants sharing of their expertise are found positive (IC25).
2. The easiest and least time-consuming things to train are dependent on participants' skill level and their level of interest in topic (T3). Topics, which are questioned and discussed thoroughly (IC23 & 31) and the principles discussed through illustrations and hands-on training (IC9).
3. A use of simulator arouses participants' interest (T4). Hands-on training allows to see the results of changes on the spot (IC8) and use of simulator fulfils that condition (IC3).
4. The most difficult thing to teach is troubleshooting and the most time-consuming has been reading of software diagrams (T9). Maintenance related activities in case of project training and internal passages inside the engine block (T10). Material presented by someone, who has not made it himself (IC23) and complex theoretical topics presented without any pictures or illustrations in a form of text (IC9 & 28).
5. In the new engine installations, it is not possible to dismantle any engine components and participants find it difficult to visualise the components (T10). Even though learning to read software diagrams is very time-consuming, that is worth it since once this is mastered, trainees can read all the different types of propulsion software used in various applications (T9). The course material does not exist and there is a lack of time to prepare it (T3). Learning the most demanding details necessitates in-depth experience and knowledge, which is not achieved by classroom training (IC31). It is recommended to repeat the same training after gaining some field experience on system (IC7).

6. It would be challenging to change classroom/hands-on training ratio as there is a need for sufficient pre-training (T1). The schedule should be arranged in co-operation with the trainer (T7). It is better to keep things interesting by not having full day of particular training (IC25). Several people were requiring more hands-on training (IC14, 17, 18, 22, 23 & 26).
7. Participants' skill levels vary a lot between courses (T3, 5 & 8). Sometimes courses are too basic for engineer, who has worked on certain engines for several years (IC32).
8. People ask additional material for separator, turbocharger, governor and vibrator (T10). Several people have asked for 3D drawings, which are not available (T9). More detailed engine drawings are desired too (T8). There is limited time for study, but by means of adequate sources studying could go on later on (IC30). Having material prior course would allow the engineer to study and raise questions when on the course (IC32).
9. More co-operation and time should be reserved so that instructors could contribute to material development (T3). Material contain too much irrelevant information while relevant information is lost for the unnecessary 1000+ pages package (T5). Occasionally material is lacking customer specific features (T7 and 10). There are errors in drawings and in material, which confuse people (IC30). The material was created years ago by someone else (IC23).
10. Applied visual aids are videos, explosion images, animations and engineering drawings (T3, 4, 5, 7, 9 & 10). However, engine specific animations demonstrating fluid movements through the engine / power plant (T8).
11. Interaction depends on several factors; trainer's activity, amount of practical exercises and involvement and the interest and willingness of the participants to ask questions (T9). Interactive part should be added to each lesson (T5). Interaction is the best part of the course as it allows to relay different experiences (IC18). However, generally speaking interaction is evident, when someone poses a question, otherwise not.
12. Sometimes it is good to have attention of your audience, but sometimes it is good to work in groups as well, however, I am afraid there are very few possibilities for that in terms of mechanical training (T1). Interactive conversation is the best way to learn (T3). Even though being happy with a trainer as a centre of attention, yet training should involve more discussion on real case studies (IC14). The trainer has to be a centre of attention to lead the discussion towards the planned goal and

to show that he is in control and really knows everything about the course (IC30 & 31).

13. It is still the best way when teaching complex systems and the way they interact (mechanical, hydraulic, lubrication- and controls-wise). E-learning is suitable for more straightforward topics (T9). Current way is good, since questions can be answered right away. Discussions are good for knowledge transfer (T10). Some project work could be included in the course, which is based on real case (IC22).
14. None of the trainers have received any pedagogic training, only some internal training for trainers has been provided. Nevertheless, majority of internal customers regards their pedagogic skills as sufficient. Some of trainers stated frankly a desire to receive pedagogic training (T1, 3 &7).
15. Both trainers and internal customers think that the training location and trainer are vital components in meeting learning objectives. Trainer's competence and expertise play a major role in the outcome. If there is not proper hands-on equipment available, the quality is not good (T3). The basics are all equivalent, but everyone's experience is different, which can highlight different things (IC18).
16. Participants' proficiency in English also contributes to training quality (T1 & 9).
17. Translator's involvement causes information losses (T11). It would be better, if we used Google translator to translate the training material in slides and then use a translator too (T10). It could be a good idea to give a vocabulary or list of terminology used in hands-on training to do as a homework prior to practical part (T1).
18. Workload and time for proper preparation should be secured and back up trainer system to be implemented (T3). Unhappy with increased burden of administration, the rapid change of administrative systems, and lack of centralized database, which makes me to retrieve data from six different databases for training purposes (T9). There should be life-time support available regarding all course content, because having not utilized gained knowledge for a while after the course, it is hard to deploy acquired knowledge, once it is needed in the future (IC10). There should not only be courses, there should be a scheme instead, which all newcomers are obliged to take part in (IC23).
19. Sufficient preparation time, access to the state-of-the-art presenting material such as huge touchscreens or smartboards, whiteboards, large enough classrooms, access to working place, where training preparations can be done in peace and quiet and where are sufficient printing facilities (T9). It is essential to have

instructor-participant connection (T8). Giving all necessary materials, supporting documents, videos and all information related, competitive instructors and proper scheduling (IC31).

20. Specific customer installation information before the course to be provided for trainers (T6). There should be two CROL formats and assessment should be conducted after each course (T10). Classrooms are not so good, even some mandatory certification courses are not scheduled and the reservation system allows courses to be fully booked, yet one is usually able to get enrolled through a waiting list (IC25). More study material to take back after the course, to be able to use for reference later on (IC32).
21. A list of terminology or some background information could be provided, but not the issue to be trained (T1). Some people could find it as an excuse not to follow training (T9). There has to be a chance to prepare questions in advance (IC30).
22. It is better to let participant decide on their own, as some prefer an electronic version whereas some rather have a printout (T9). In a classroom setting, printouts are helpful, whereas after training all content in softcopy is very helpful (IC10). In digital format one can quick search and find a particular topic, part or system (IC30).
23. An increased number of interactions is regarded as a knowledge booster, especially in field-related problems and difficulties (IC 14). Also discussion with people on ongoing projects should be included (IC 23). It is to be noted that a notable proportion did not answer this question.
24. U-shape training arrangement would be the best where the trainer can walk in front of the participants being closer to them and try to clarify the doubts (T10). When using a smartboard or huge touchscreen, current arrangement is the one making the most sense (T9). U-shape and auditorium-like set-up were suggested by customers (IC 10 & 28).
25. Both trainers and internal customers are happy with trainer-led delivery instead of having more focus on products and interaction. It is to be noted that more than one third of internal customers are against the shift from the current form of delivery to a new one. Also one fifth decided not to reply. Non-trainer-centred option might be a better solution in some cases, but should be demonstrated before deployment (T6). Straightforward products could be trained through e-learning, while the more complex products generating unexpected questions are better to be trained by an experienced trainer (T9).

26. This is one of the most obvious findings as regards to spectrum of answers. People want to have hands-on training experience being enhanced by IT-technology.
27. It could improve the quality, but not necessarily speed up the training delivery process (T1, 8 & 9).
28. 3D-technology would be a major improvement, as it would help explaining of the systems (T1), yet engineers need a real hands-on experience (T8). Regarding theoretical slides it is hard to understand the functioning, whereas 3D-technology provides exact view of the function (IC 14). On the other hand, animation video is more useful than 3D (IC 13). All in all, the most vital thing is to have real engines to train with (IC 27).
29. Both trainers and internal customers think that the quality of course feedback is equivalent no matter when the feedback was collected. Also six out of ten internal customers found the idea of providing course feedback in other occasion than at the end of course either negative or chose not to answer.
30. More written feedback would be nice, since evaluating everything in a numerical scale from one to ten is not very informative (T3). The form itself is quite generic, normally we get our best comments about how to better develop our training in the comments. Why not to ask this directly in the form, for example: "how do you think we could improve this training?" (T9). It is more like a mandatory thing, not really effective, maybe open discussion after the course would work better (IC25).
31. By fixed questions we have answers to issue in our interest and by free word customers can provide feedback they find essential. However, feedback collected via e-mail could be a good idea (T1). There is no need to develop the feedback form further because it is not utilized at all (T2). Online feedback would work better, granting us freedom to give a feedback, when we have more time to focus on the subject (IC24). The feedback form must be filled out after finishing the course on the final day, since I do not want it online (IC31). I would engage to give a feedback online, but requiring it may reduce a quality (IC18).
32. Filming of technical videos, which we have stopped long time ago (T10). More training equipment and trainers, divide groups to do exercises two or three persons, smaller subgroups, rotate exercises (T2). More e-learning desired, they are handy and not dependent on time and place (IC25). More handout and videos to be taken away (IC32).
33. It is some kind of image formed by light beams (T11). Training is not trainer-centred, but it is more and more virtual like e-learning (T6). It is a virtual reality (IC4). A hologram is a physical structure that diffracts light into image. The term

hologram can refer to encoded material and resulting image (IC6). It is a Startrek-like hologram (IC20).

34. Either as a way to beam a trainer to a remote classroom, or alternatively as a way to demonstrate 3D representations of actual equipment (T9). They are not as useful as hands-on training (IC4). It will be very useful to use hologram technology so that we can understand the subject better. It is rather better than theory classes (IC14). They could be applicable in 20 years (IC20). It might be more like a "nice to have"-type of thing (IC26).
35. Technology to be used as a visual aid before actual hands-on training (IC4). The theory and slides could be replaced with this technology (IC14). It will not bring any additional value to training (IC26).
36. It could be utilized in the most general training topics, whereas I am not sure of applicability in terms of hands-on training (T6). Technology can be utilized to explain combustion process, flow of oil and water inside engine blocks, and demonstration of dismantled components of engine (T10). It can be utilized for training, if it is deemed worthwhile and not just for a show and best way of getting that particular point across (IC18). It could be nice, but how much it will actually improve my learning can be discussed (IC27).
37. Approximately only half of the respondents consider a use of glasses or headset bothersome. The more equipment we have, the more difficulties we are going to have. A use of holograms should be as easy as using presentations, therefore I prefer holograms being visible to the naked eye (T1). Glasses could be utilized in some special training or training exercise. However, extensive utilization of them would be annoying (T4). Even if glasses or headsets are required, I think it will not make much difference as far as the learning curve is concerned (T10). In some instances it is good, but sometimes we are required to understand more of the basics. Having advanced technology is not bad actually, but most important is to get knowledge about the subject and it is done by having more knowledge about the basics, which serve as a strong foundation (IC12). Whether glasses or not, it does not matter as long as the information is conveyed clearly and understandably (IC31).
38. It could be used if there was a good exercise, though it should not be used for the entire day and definitely not for the whole week (T4). This is just engine training and I believe that it is more important to put efforts to have a real tools and equipment, what people use at site up to date instead of playing some 'Star Wars games' (T5). Such a technology is always better than the slides and manuals as it

provides us more realistic insight (IC14). Sounds like a ‘nice to have’-type of thing. Main thing is that course material is clear and corresponding to course title (IC 28).

39. Very well-designed animations would be enough for now (T3 & 4). A 3D-experience could enhance learning, but may not necessarily shorten time devoted to training (IC9). Such technology is only a supporting feature (IC28). Visual reference are better than text and words (IC32).
40. The money could be spent in a more productive way (T8). It is good to use technology to improve training. However, it should not create the feeling as we are watching a movie and going back home and not remember anything. 3D and other technologies should only be used for specific or critical things that are hard to understand in 2D or PowerPoint presentations (IC 13). That also requires more from the trainer and course material compiler. 3D and holograms are not generally so important as well prepared and professional instructors (IC28).

3.4 Interviews

The interviews were conducted in order to find out how relevant interest groups perceive disruptive approaches in the context of training. Six different, hypothetical concepts to arrange training in the future were sketched, all of them being disruptive in nature from training services’ perspective. The concepts are merely outlines and going into details has been tried to avoid in order to leave room for varying opinions and development suggestions by interviewed stakeholders.

The interviews were conducted face-to-face or remotely either via a Skype meeting or via telepresence. 13 persons were interviewed in total, of whom eight were trainers and five internal customers. The selection of interviewers was done in co-operation with the training development manager. Four of the internal customers interviewed were non-Finnish persons, which enabled a more holistic and an international standpoint on the conducted study. The list of interviewees is presented in Figure 34, where the abbreviation “T” denotes trainer, whereas “IC” internal customer.

Respondent ID	Position	Location	Years in current position	Years at the company	Number of courses given / participated
T1	Senior Mechanical Instructor	Finland	8	8	200
T2	Senior Insructor	Finland	2	9,5	50
T3	Manager, Training Center	Germany	6	16	100
T4	Senior Manager, Training, Field Services	India	3	16	20
T5	Regional Trainer	USA	8	13	300
T6	Senior Insructor	Finland	7	7	140
T7	Instructor	Netherlands	7	7	120
T8	Trainer	Finland	2,5	5	25
IC1	Master Data Specialist	Finland	< 1	7	4
IC2	Sales Support Manager	Finland	4	7	2
IC3	Supervisor, Parts Coordination Management	Finland	5	13	30
IC4	Sales Support Engineer	Finland	< 1	5	3
IC5	Coordinator, Parts Coordination Management	Finland	4	4	3

Figure 34. A list of interviewees.

In the following rough outlines of the concepts are presented in the same way as they were presented for interviewees in the first chapter of each concept. Furthermore, the acquired answers are presented after each outline: how they are perceived and could be developed further in the respondents' opinion, what advantages and disadvantages do they have and what kind of technologies could be used to deliver training. Furthermore, the most notable side notes arisen in interviews are discussed in chapter 3.4.7. The ID in parenthesis refers to the list of interviewees in Figure 34.

3.4.1 No classroom

The first concept applies fairly well to the theory of blended learning. Participants are obliged to take over their own learning compared to the current situation. People would study theoretical topics by themselves online before attending the training centre, where practical training takes place as has been the case in the past. When people arrive to the training centre, a short recap on top subjects and safety issues is provided before moving on to practical training. Hands-on training would be delivered as it is done today.

People found it a good concept. It allows people to study at their own pace, assimilate information and to understand a topic, providing they are permitted to disconnect from

work and take their time to fully immerse in e-learning. Concerning the studying itself, the biggest challenge is to motivate people to study in totally new way and to find time to take the material. Some of the interviewees are concerned that people have to be forced to study. The most arisen matter is to make an assessment mandatory, thus people have to pass an exam in order to be entitled to take part in practical training. However, whether the assessment is to be mandatory should be evaluated case by case (T4, 8) as it is a lot more easier and straightforward to set a criteria for participations for internal customers than external ones (T6, 8). It is also essential that there has to be a chance to contact a trainer in one way or another while studying the theoretical part online (T5). E-learning should consists of small modules, where after each module a mid-assessment is taken and after completing all of them a major assessment is to be taken (T6,7,8). If failed, a chance to retake has to exist.

As far as training services is a business, there are certain things which have to be covered. The concept needs to be created with business in mind and it is essential to demonstrate that the concept really has added value for relevant interest groups. Furthermore, it is recommended to offer different things to different customer profiles, which requires tailoring a course content case by case.

It is expected that this concept would reduce training time at the training facility from five days down to two or three days, therefore costs are expected to shrink as well. Moreover, resources i.e. trainers would be in better and more effective use as they have more time to develop things and prepare for coming courses unlike today so that could be regarded as a considerable improvement (T6). Studying topics at the participants' own pace also evens out differences in language proficiency (IC2).

Naturally, a number of risks are involved in the concept. Due to lack of motivation people may not study on their own time or might be unable to digest a theory. E-learning may not be available for all customers either because of technology shortcomings or other IT-limitations for a remote location as e-learning sets high requirements for broadband connection, reliability and bandwidth. There might be challenges to convince customers that this really is a worthwhile concept and worth the money considering reduced amount of face-to-face training. Reduced interaction between participants and the trainer is an obvious disadvantage as well since that usually fosters knowledge exchange (T6, 7 & 8).

When it comes to applied training technology, it is obvious that e-learning is the one to go with. It is essential that there is a platform for message exchanges, where one can contact a trainer and get his or her doubts clarified (T1 & 6). To alleviate technology shortcomings, it is advisable to create content, which is accessible offline too (IC2). The more there are animations, the better for learning. They should especially demonstrate step by step, for instance, how to dismantle an engine, how fluids travel inside the equipment and how internal passages are built (IC4 & 5).

3.4.2 Technical training days

The second concept concerns only internal customers, thus external customers would be trained as today. In this concept there are scheduled training days, which all have relevant material, equipment and trainers available in each defined location, where the training of internal personnel would take place. In addition, external experts could be employed too. One stint of training days lasts, say, three weeks at a time and such events are arranged six times over the course of year. Outside of training days, and during the days as well, people would have an unlimited access to e-learning material, which would be upgraded from the current level. It is to be noted that such service, though for marketing and sales purposes, is already provided for external interest groups, so why could the training services not replicate the concept concerning internal customers in the context of training?

This concept is a great logistics challenge overall. The flow of equipment can be controlled by means of careful planning, though logistics of people may be too great of a challenge to be overcome. First of all people have greatly varying agendas (T7), which is associated with the fact that training services would not get all people to training they would like to have (IC2). Whether this concept makes training more accessible or not, can be discussed: trainers (T4, 6 & 7) think that training accessibility would be decreased whereas internal customers reckon it has no impact on availability (IC1, 4 & 5) or the concept increases it by going close to people, who otherwise would not have access to training at all (IC2 & 3).

The major concern, moving of equipment across the world, can be discussed. There are varying opinions whether and how much actual engines are needed in the training today and in the future. Some respondents state that most of practical training is predominantly delivered by software based simulators whereas some people insist that mechanical

training, such as pulling out a piston or removing a cylinder head, cannot be reduced from the current level at all. Therefore it is suggested to have such equipment available only in a few selected locations (T3) or to utilize remote training options and workshops (T8). As the majority of participants are likely to be field service engineers, combining this concept and their own technical days the benefits would be leveraged and economy of scale be achieved.

It can be expected that by means of technical training days, more internal people are reached, especially those who the training services would not reach otherwise. Training awareness would be increased presumably too and a lot of people gathering together opens up networking opportunities internally (IC4). Additionally, by having well ahead fixed slots for internal training external customers could be served better, therefore training services could avoid situations, where a training of external customers cannot be arranged due to overlapping internal training.

On a negative note, primarily logistics and its organization are concerns (T1, 4, IC2 & 4), especially people. In the worst case, there might be no one to train (T5) because of the aforementioned varying agendas or travel restrictions (IC2 & 5). The average group size is probably going to grow further in hands on training (T8). Even though logistics of physical goods could be managed, expenses still may soar up and related bureaucracy hinder a training delivery if having a very tight schedule (T6 & IC2).

Concerning technology used in training delivery, any breakthroughs are not expected, but methods would be very similar to ones in use today (T1, 2, 3, 6, 8 & IC 2). Like with the previous concept any technologies, which provide a 3D-view and therefore demonstrate inner parts and connections of the engine, are regarded as an advancement (IC2).

3.4.3 Mentoring

Today there are approximately 6000 persons in the field and 50 trainers employed by training services. All of the 6000 persons would be involved in the mentoring program, rest of the internal personnel and external customers would be treated as today. The idea is to form teams of trainers, who are specialized in a certain topic i.e. automation. The teams are responsible for providing mentoring and delivering training courses in the field of their respective special know how. The thread of this concept is that training services could expect that training demand would decrease significantly, since most of the internal

training courses are delivered to serve the aforementioned 6000 people working in the field. By proactively delivering new information for field services engineers, it could be legitimately expected that training services could eliminate given employees coming to training centres for a five day course, of which only a training of a half day or so would benefit them.

This concept is generally found a good way to arrange training (T1, 4, 5, 7, IC 1 & 2). The trainer's role is very organizing, which poses a challenge in terms of information relevancy. It is very hard to define the need of new information, who needs it and how much, hence a very accurate personal scorecard and tracking are needed (T5). However, at least today, such scorecard cannot be counted on as it is never up to date (IC4). The better model is that service unit managers become aware that there is new information relevant to field services published, so they would urge employees to take that training (IC4). As the case company has a matrix organization, a call from top is always prioritized over the one from side, in this case training services.

In some cases a trainer may not be a person to talk to (T7). It may become very hard to draw that subtle line to distinguish which cases belong to training and which ones to technical service due to the degree of difficulty in terms of inquiries posed by field service engineers (T6). However, instructors of training services are competent enough to resolve inquiries or to find out solutions on them. In the perfect world there would be a collaborative system, where the field services would contribute as well (IC2) since every now and then they get acquainted with new technologies, updates and issues in the field before training services do (T8).

The primary pros are flexibility and individuality. Redundant training would be reduced significantly, since all delivered information is relevant to the recipient, as a result more efficient training would be achieved (T1, 6 & 7). That is also associated with elimination of personnel coming to unnecessary training and therefore keep working with their daily duties and being in more profitable use from the case company's standpoint.

A number of setbacks are to occur too. During those weeks, when a trainer has a scheduled course, there is not time to proactively, or even at all serve the field service personnel (T6). The trainer's responsibility as a mentor is remarkable; information has to be checked on a regular basis, which may turn out to be an issue if resources, such as time, money and number of trainers, are limited (T1, 2 & IC2). Technology and a possible lack of it

will definitely cause troubles. People are temporarily out of an internet access while operating at a customer's vessel in the middle of Atlantic, for instance (T7 & IC 5). Also the direction of proposed information flow is not ideal since in case of urgency a call from top will be superior to the one from the side. All in all, there should be a platform for message exchanges to keep information flows under control (T4, 6, 7, IC1, 2 & 3). As time goes by, a built-in search tool and FAQ-section shall be implemented to reduce workload and to speed up the process (T6, 7 & 8).

3.4.4 Tailored training

Concept four is a tailored model, which aspires to meet the individual's needs. In this concept there would be no scheduled courses anymore, instead the idea is to provide as individual training as possible and to guarantee the person accomplishing training is capable of performing tasks assigned to him. That would be a major change to the current situation, where the responsibility of the individual's learning is not taken by training services. An example: Service unit China hires a new engineer. The employee is sent to a training centre for, say, three months to receive training. The training services guarantees that after the training period the person is capable of managing all tasks and duties assigned to him. Though it is obvious that it cannot be afforded to provide one-on-one training five days week for an extensive period, therefore means analysis should be conducted, thus combine participants' needs and create appropriate training packages for each.

Usually it takes two years for a person to be fully capable to operate alone at the customer's site (T2 & 7). As training services can only provide technical competence, this concept is not expected to reduce the time to be ready as competence is composed of many other things than just technical ones, which are not taught at training centres such as behaviour, taking responsibility and so on (T8).

It is obvious that different customer profiles need different types of training (IC2). Therefore a lot of time, interviews and effort are needed to get even started (T3, 4 & 7). In addition to the previous one, a group of people is needed to even arrange training, which reduces a sense of individuality (T7). It is also to be noted that being an extensive period in the training in one go is not preferred. Therefore intensive induction shall be divided into shorter periods, which involves on the job learning as well and runs for certain time (T3, IC4 &5). For field service engineers, the body of training should always

be identical to ensure equal competence, hence the perfect model taking into account both training services' and field services' requirements is to provide training in a stint of three months. In such a stint, the degree of difficulty increases constantly from basic to intermediate resulting in advanced one, while depending on personal experience one gets on board in an appropriate phase (T8).

Concerning responsibilities, it is not training's responsibility to take over individual's learning (IC4). Therefore a lot of support and guidance is needed from team leaders and line managers to be able to offer appropriate training for the field service (T3 & 6). That would also enhance the life cycle approach to training, as managers would become aware of how people in certain positions were trained in the past so newcomers could be trained in a similar fashion (IC2).

With certain adjustments, the concept gets as tailored as possible considering a great number of trained people and resources in hand (T1, 4 & 5). Thorough step by step-approach is a definite advantage (T3) and a newcomer is expected to gain quicker relevant information and basic understanding on relevant issues to his duties (T6 & 8). It is a very good idea to have a sense of tailoring, not just by training services, but other departments as well. However, that is a con at the same time, since a lot of responsibility is given to line managers, who may not have enough time to fulfil their duties in terms of training (IC2).

If the concept was kept like presented in the beginning, then a number of problems would occur. As a flow of newcomers is rather constant and stable with no big bunch at one time, it would burden training too much and to be fairly impossible to form groups fast enough (T8). Therefore, as mentioned earlier, it is a better idea to tailor a course portfolio and schedule. There would also be a significant risk of people taking advantage of offered tailor-made training and to leave a company shortly after (T5).

When it comes to applied educational technology, it is already in place (T3, 6, 7 & 8). Like with other concepts, 3D-animations and other technologies, which demonstrate inner parts, internal passages, fluids, oils, gas and so on would add value to training delivery considerably (T3 &4).

3.4.5 Training support

In the support concept, there would be no training organization or training centres in a similar way as there are today. Instead, there would be a training support-type of concept, which resembles a technical support. People would have holistic responsibility for their own learning. They would study merely by means of e-learning and could call on training support to get needed assistance, whose main responsibility is to provide assistance to arisen issues. It can be discussed, whether this concept should apply to all relevant stakeholders or just a specific interest group.

The greatest concern is a lack of hands-on training. As there would not be practical training, competence of field service engineers was dipped considerably. That would eventually lead to the demise of the field service business, which is vital for the case company. Field service engineers have to be trained with real equipment, especially newcomers (T3, 5 & IC4). One of the most important topics in the whole training, troubleshooting, would also be gone in this concept. It is vital for peoples' competence that real-life situations and challenges can be simulated in controlled circumstances (T6). As long as it is possible to have equipment to be broken available, it is good to use them.

However, it can be argued, whether some employee groups could be trained in this way. Certain persons, who are working in a non-technical positions, such as parts coordination or the like, could be excluded from hands-on training (T4, 5, 6 & IC 5). On the other hand, for instance sales engineers, are better not to be included in that group (T4, 5 & 7). The emphasis of individual learning online is evident, despite the number of people participating in practical training, hence synchronous support has to be in place. Trainers should be committed to clarify doubts and resolve inquiries in certain hours, otherwise a delay of a couple of days could be accepted (T8).

Savings are expected to be achieved in this concept, so if well designed and appropriately implemented, cost-effectiveness shall be evident (T1, 4, 6 & 8). Anyhow, it is to be noted that the aforementioned benefit will be very temporary, if hands-on training is not offered to field service engineers (IC4). It is still considered sufficient though for gaining basic knowledge, which is enough for non-technical personnel (T5 & 6), especially considering increased training accessibility online (IC1 & 5).

The aforementioned lack of hands on training, troubleshooting and simulation, which eventually would paralyze the field services' business, are the major disadvantages. Moreover, traditional human interaction fostering tacit knowledge exchange, which is very valuable especially for beginners and newcomers, would be gone in this concept too (T1, 2, 8 & IC1). Who would pay for such a training is a big question (IC2). The business model is very unclear.

The training support-concept would employ e-learning extensively, therefore a very robust platform or an online portal is required, where inquiries are cleared quickly. A coordination of information flows is expected to be a logistic challenge (T2, 3, 6 & IC2). To alleviate hindrances caused by a lack of hands-on training for certain employee profiles, disruptive innovations to deliver theoretical training are suggested, like advanced software based simulators (T8) and "less engineer like"-material, which enable the learner to participate, such as dismantling of an engine part by part (IC4). That basically utilizes the framework of gamification.

3.4.6 Dealer

Concept six is about utilizing dealers, so this could be called outsourced concept as well. The common thread is that the company wants to be able to provide training all over the world. However, it is not profitable to establish training centres in every location. Therefore, the case company could employ dealers, who would have a license to provide training on the company's products. In this concept the case company would be responsible for course planning and training and supporting the dealers, all other functions would be outsourced, which means outsourcing of business risks in a large extent as well.

Outsourcing of training delivery possess a business potential in theory, even though it is a challenge to make money in this model (IC2). Especially in the beginning, notable losses are to be expected (T8), since if the customer did not get training at a lower cost, then it would not make any sense from their standpoint (T8). That means, that case company shall control dealers' pricing (T8). However, in general the concept involves too great risks to be regarded as a worthwhile concept. The dealer may leak critical information out for wrong quarters, which likely would cause major patenting and copyright issues (T5, 6, IC2, 4 & 5) and therefore jeopardize the case company's entire business. It would be very difficult to find a credible dealer, especially in a global scale

(IC3, 4, 5 & 8). Brand image is probably to be decreased, if training is delivered by a non-company person. That is expected to have a negative impact on training sales (T2, 6 & 7). On the other hand, internal customers disagreed and thought, that as long as training is delivered by credible party and carefully marketed, the brand image is not damaged (IC2 & 3). From the case company's viewpoint, running the concept successfully requires so much control and monitoring constantly that it is considered to be fairly unfeasible to execute (T4, 6 & 7).

It is the case company's responsibility to guarantee a high quality of training delivery and meeting the training objectives. In a case of safety violation or any other damage caused by subpar or false training, customers would call on the case company and ask for reimbursement (T4). In the given scenario it is the case company's duty to compensate damages, even such situations could be prevented with contracts, but that would hamper sales and the blame would still put on the case company, at least in customers' eyes (T6, 8, IC 4 & 5). There are only bad options available, if bad training causes engine failure at the customer's site: either demanded compensations drive a dealer to bankruptcy or the case company has to deliver a compensatory engine or system for free.

In certain cases, universities could work as dealers. That would provide a positive and advanced image in customers' eyes (T3 & IC2). It is to be discussed how much and which training could be outsourced to universities though. They could deliver basic theoretical training, but hands-on training should be kept inside the company as that is not where universities usually excel (T4, 6, 7, IC4 & 5). That is because universities tend to generalize issues for the sake of theory, therefore their approach is considered too scientific and not being applicable in real-life situations from the training services' standpoint. If the concept and co-operation with educational institutions were keen to take further, outsourcing of facilities and equipment to universities could be worth further reflection (T5 & 7).

The expected advantage is increased training availability and flexibility from a customer point of view (T1, 4 & 8). Cost-effectiveness, thus savings could be achieved as well by having less training centres (T1, 2, 3, 5 & 8), but would projected savings be temporary or sustainable shall be reflected. Because even one single equipment failure caused by poorly delivered training will remove all the savings and even more (T6), not to even mention damages concerning manpower (IC2 & 5). Furthermore, decreased brand image (T2, 4 & 6) and the fact that customers are to be trained by non-original equipment

manufacturer are major barriers in addition to very high risk of intellectual property leakages (T5, 7, IC3, 4 & 5). Decreased training quality would be a major concern as well, especially when bad experiences tend to spread all over the world in no time (T2, 5, 6 & 8).

In terms of educational technology, it is the case company's job to define it strictly (T3 & 5). One option is to provide guidance and set a framework, so dealers may choose application by themselves as long as it meets the quality standards (T4 & 6) or the case company could take charge of creating flash-based simulators and supply them to dealers for fee (T8).

3.4.7 Side notes

During the interviews interviewees revealed things, which could be taken into account, when developing training further. They are presented below.

People are not taking e-learning seriously as long as a valid certificate is not granted upon successful completion of the course (IC3). That requires, as discussed earlier, that assessment is well constructed, preferably in multiple sections, and contains open-ended questions instead of multiple-choice ones to make sure people really master intended topics (T3). However, the current degree of e-learning is not sufficient for granting certificates, as the material is not up to mark and the process has not been verified (T8).

There are multiple courses, which trainers are unable to deliver due to lack of expertise, competence, equipment and specification (T2). Therefore it is suggested to move to modular training and make sure, that everything needed is in place to deliver offered modules (T6). Finally, as long as training services is regarded a business, it is better to separate internal and external training, thus create corresponding KPIs for each (IC2).

3.5 Hologram technologies on the market

Suitable hologram technology was sought by contacting companies, who initially were expected to be able to deliver such a technology. Major constraints to even discover companies to be contacted were requirements set for technology by the case company. As the desired hologram technology was expected to provide 3D-experience for a number

of spectators at the same time while being visible for the naked eye, the number of options was very limited. Therefore, virtual or augmented reality could not be considered, since using them requires wearing glasses or goggles. Even though they are not holograms, they would meet prerequisite of 3D-experience.

After thorough screening, six companies were contacted to find out, whether they could meet the case company's requirements. Each company was asked to answer questions, which can be found in appendix 6. Based on the received answer and screening the applications online, one could evaluate whether a given company's technology is appropriate in terms of the case company's requirements. The first section under each section provides a brief insight to application and the final subchapter provides information acquired by contacting companies. Since the idea is to assess, whether offered applications could fulfil the case company's aspirations, only an overview is provided. Technical details are not discussed as they are not on the agenda in this study. Instead, what they enable is what is sought.

3.5.1 Musion

Musion has various technologies, but the one the case company is after is Eyeliner, which is the core of the company's technology with its imagery referred to as a hologram. The technology utilizes a Victorian theatre trick with a twist of the 21st century called Pepper's Ghost. The visual effect is worked out through a holographic projection system. The specialist foil, which is invisible to the naked eye, is suspended across i.e. the stage, creating a life-like 3D image. By means of smart illumination, the result is a convincing, realistic effect. All the systems are tailored to meet the customer's special needs. (Musion 2015a.)

Musion's technology provides a thorough 3D-experience, but it does not allow people to move around it. However, it can be interacted with, for instance being on stage standing next to it while giving a presentation. Basically it is a flat image but provides a 3D-view when viewed from correct angle. Therefore 3D-glasses or any other wearable technologies are not needed to see it in 3D. The hologram can be either live- or prerecorded according to the storyboard and size of budget. The technology can be used both in a meeting- and classroom setting, but a large footprint of 49 square meters is needed to have it fully functional. Therefore it is recommended that room height should be four meters in a perfect world, but it could be fitted into a space of 3.2 meters in height

or even lower with some modifications. Sun light cannot be reflected directly to the hologram, therefore the venue is better to be relatively dark. Musion's technology would also allow a beaming of product or an instructor to another location, but the same requirements in terms of venue would still apply in receiving location. Professional installation of technology would cost 150.000 euros in the low end and 250.000 in the high end.

3.5.2 Hologram USA

Hologram USA executes projects based on various technologies, the one offered for the case company is Musion's EyeCandy with some modifications. It replaces the stage and projector for a high brightness high definition television (Hologram USA 2015). According to Musion (2015b) it is a smaller and more cost effective evolution of Musion's holographic display technology. Using similar techniques to EyeLiner, it produces a bright image with an integrated audiovisual media server in creating the same 3D effect in a more compact scale. It can be described as a freestanding three meters high pod, running on standard power supplies. It is designed for areas of high ambient light unlike Eyeliner, and design can be personalized to fit one's branding.

The given technology provides a 3D-experience for end-users providing that it is seen from the right angle, thus spectators cannot move around the object. Wearable technology is not needed and the hologram can either be live or prerecorded. Hence technology enables user to modify the image on the fly, at least to some extent. When it comes to requirements for use of technology such as illumination, space et cetera, it is totally dependent on one's use, since every projection stage is built custom. Also beaming of an object is feasible. Price estimation cannot be provided without knowing all the details in the use so it can vary greatly. However, the starting purchase price can be expected to be at least 100.000 euros (Hologram USA 2015).

3.5.3 Holografika

Generally speaking, Holografika's HoloVizio displays generate the whole "3D light-field", not just a limited number of views, thus there are no jumps between discrete views, and one has continuous motion parallax in the field of view. The 3D image can be seen by multiple viewers simultaneously, with the possibility of seeing different details, having a real spatial feeling, even look behind the displayed contents, similarly to real objects.

There are no side effects, like discomfort or restrain and no invalid zones. Furthermore, the displays are compatible with 2D content, without the need for changing anything, or switching over. (Holografika 2015.)

Therefore their technology allows a 3D-experience for viewers and that view is retained inside the field of view of the display. The field of view ranges from 40 degrees up to 180 degrees depending on the display model. Wearables are not needed and the image can be either real-time rendered or recorded. The displays allow a use of technology both in a classroom- and meeting room setting, the only requirement is that the seats are arranged properly so that everybody can see the image. It is essential that viewers are inside the field of view, which depends on the display in question. Dimensions vary from a display to another being in the following range (width x depth x height in meters): 1.8-3.2 x 0.9-2.15 x 2.22-2.85. In terms of beaming, an object or person can be captured in 3D and show the 3D image in a different location later or on the spot, however it requires a 3D camera system and a high bandwidth transmission medium between the capture site and display site. It is to be noted that the camera systems is not part of the display. The price range is from 45.000 euros up to 180.000 euros depending on selected display model.

3.5.4 Christie Digital

When Christie Digital was contacted, the message was forwarded to the former technical support and design engineer for the Nordic region of the company, who is now running his own business and represents many companies. He proposed a number of technologies, of which only Christie Digital's Touch Screens could meet the requirements of a 3D-experience and not needing glasses or goggles. Therefore, as it is a screen, it is tied to fixed location and 3D-view is available only, when seen from a certain angle. The price varies a lot and depends on software, size et cetera, but prices can be expected to start from 20.000 euros.

The display is pretty much as simple as they come, and it is only a matter of displaying the needed pixels. Hence the software is a vital piece of solution as the case company creates very large and complex datasets and training needs to be up to date with CAD-information, then the application has to be based on a true engineering approach using CAD-data.

3.5.5 RealView Imaging

RealView Imaging is working on the world's first 3D holographic display and interface system, initially targeted for medical imaging applications. The proprietary technology projects immensely realistic and dynamic 3D holographic images floating in mid-air without a requirement to wear any type of eyewear or a conventional 2D screen. The projected volumes appear in free space, allowing the user to literally touch and interact precisely within the image. (LinkedIn 2015.)

When a company was asked to reply to an inquiry, they came back by saying that they are in pre-commercialization phase so they are not keen to provide requested information at this time, even though they would be happy to be in touch in the future. That is reasonable in a way, but raises doubts considering that their claimed technology defies law of physics as the light is reflected from nowhere according to the available information.

3.5.6 Trade Show Hologram

Trade Show Hologram image size ranges from 30 centimeters up to 1.80 meters while being six meters wide at its maximum providing floating mid-air image. The image is visible to the naked eye and holographic presentation can be fully animated video in full color. Therefore any image, in this case the case company's engine, can be converted to holographic form. (Trade Show Hologram 2015a; Trade Show Hologram 2015b.) Their application is shown in Figure 35.

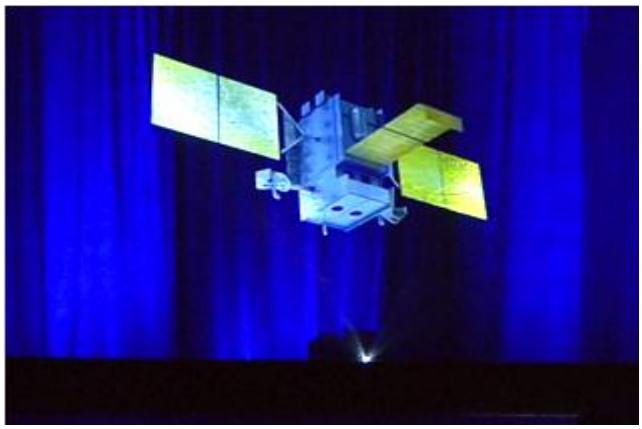


Figure 35. Large Scale Hologram. (Trade Show Hologram 2015c)

When asked about possible application in the case company's training services, Trade Show Hologram stated that the hologram effect, which were asked, is not feasible and is only found in Hollywood movies at this time. They provide a special effect for trade shows but it is in a very controlled environment and will not work in the application the case company is after, even though the training services' environment pretty much is controlled in a way.

4 RESULTS

This chapter discusses the results of the dataset based on customer feedback analysis, observations, questionnaires, interviews and available hologram technologies on the markets. Chapter 4.1 discusses results related to training development in a sustaining way whereas chapter 4.2 presents the results of disruptive approach to training development.

4.1 Sustaining approach

Results in terms of trainers, course material, training delivery and planning are discussed in this subchapter. In terms of each section, a current state and areas of development are presented in such extent they were figured out.

4.1.1 Trainers

It is evident that the case company has highly qualified and skilled trainers. There are anything but negative comments and findings on their job performance. It is beneficial for trainer's competence to have experience from working on customers' sites as then they can reflect theory on their own experience, and hence impart knowledge, which might be out of reach for customers otherwise. All of the trainers have not gained hands-on experience at the site though, but that has not been regarded as an obstacle to be an accomplished trainer, since they have been able to acquire relevant skills and knowledge in alternative ways. The dataset reveals that trainer's competence alongside training location has had a major impact on experienced quality of training. Moreover, instructors are considered to be fluent in the language that training is delivered, which invariably is English.

The trainers' job is to train customers as well and as much as possible. Therefore, time devoted to training delivery and corresponding preparation should be secured. Currently, this is not the case. Trainers are bothered by administrative tasks, which take away their valuable time, which could be used more profitably. They have to source and retrieve information from multiple databases in order to create course material, which is laborious, time-consuming and inefficient.

Trainers think that the hardest and the most time-consuming things to train are hands-on training and advanced technologies, even though there are varying opinions as some of the trainers find the hands-on section as the easiest and the smoothest thing to train. They are hard to train because trainers do not master the new technologies due to lack of experience. Below average results in the course feedback in terms of advanced technologies courses confirm that perception. Time devoted to hands-on training is acceptable due to the nature of training, but advanced technologies are not, just for the fact that they are hard to assimilate. At present, trainers have to learn novel and advanced technologies on their own by browsing, usually scarcely available material in databases or through conversations with colleagues from research & development or product support departments. Virtually there is no systemic approach to teach trainers to master products and systems, which they will be training eventually. Lack of process is evident and the responsibility is saddled with trainers. In addition, trainers are overemployed and a proper back-up trainer system has not been established.

The only formal training the trainers are receiving, is 'train the trainer'-course, where the company's internal person gives a training on how to structure lecture, give presentation and so on for trainers. This is the only training, which can be regarded even slightly pedagogic and it is delivered every now and then, basically on demand, not systematically. Any pedagogic training delivered by an external service provider is not offered.

Actions should be taken, so that trainers can focus on training delivery, have the latest knowledge and be prepared to give training on specific installations. It is to be noted that trainers are the ultimate power source of the training services, therefore they should not be bothered with redundant tasks, which are not related to their actual job. All actions in the training services should be taken to secure that trainers have necessary skills and tools to deliver high quality of training. Trainers are willing to receive pedagogic training provided by external provider in order to enhance their instruction skills.

Trainers should be consulted in the material creation process, so they could rely on provided material containing necessary information and no further editing would be needed, at least in the present extent. For sure one has to make customer specific modifications on presentation material from time to time. In order to do them, needed material should be available with ease, unlike currently, as relevant information needs to be compiled from multiple databases. Therefore necessary information should be

consolidated in one single database. Additionally, trainers are burdened increasingly with administrative tasks.

Actions for reducing trainers' workload, especially if new trainers are not allowed to be recruited, should be designed and implemented. A credible back-up trainer system should be developed as current policy of finding a suitable substitute for a regular trainer in case of a sick leave is a very risky strategy and jeopardizes the training business. Moreover, due to a lack of workforce, trainers have a limited time to prepare for coming courses, which have negative effect on courses.

4.1.2 Course material

In a broad perspective, the course material is meeting the requirements. People like to receive course material stored on a memory stick in courses to have a chance to reflect addressed topics later on. Both trainers and internal customers consider it one of the most positive things in courses. It is to be noted that simultaneously trainers mention that material in general is one of the things to be corrected in training. Conversely, customers say that material should not be altered and according to their direct course feedback the material has been high quality for the majority of time.

However, negative issues arose as well. In some cases, the material is lacking relevancy in terms of customer installation. Some courses do not have a material framework, thus the trainer has to compile course material from various data sources. As a matter of fact, there are a handful of courses with no course material at all. That may result in decreased training quality and not meeting the course objectives. Moreover, the course material includes irrelevant information and in worst cases, it imparts false knowledge. Many courses addressing new and advanced technologies have insufficient course material. In addition, there are courses, which have been given for years, but they are utilizing outdated material or material created by a third party, which has been created for product marketing or sales in the first place.

So far course material has not been provided to participants in advance and trainers seem not to be willing to do that in the future either. However, there is a strong indication that people want to have look at course material before the course starts in order to be prepared and have well-grounded questions in mind, which might not pop up on the fly. Furthermore, people wish they were provided additional study material to deepen their

competence and understanding on topic and to have opportunity to reflect the studied subject in later occasion.

It is evident that the course material needs to be developed. Outdated materials require updating and material created by third party providers is better to be discarded. There are some courses, which do not even have a material framework, yet those courses are delivered continuously with course material below acceptable standard. Moreover, course material should be accessible to each stakeholder it may concern.

There are people, who would like to glance through the material before the course starts. Being familiar with the material is expected to help participants to be better prepared, when attending a course and therefore having a better ability to assimilate information imparted on the course. However, trainers are sceptical in terms of handing out of material prematurely, as they are afraid of people not following training if they had access to material prior to course. In the worst case scenario one may skip the course if material is provided beforehand, which would hurt the training services' business. Anyhow, there is strong evidence that in case the entire course material is not agreed to be provided, yet some detailed course information or material is wished to have beforehand unlike it has been done in the past. Some people are also keen to deepen their knowledge, so suggestions for further study is recommended. In addition, there are divergent opinions whether the course material should be available in laptop or printout. It would make sense to provide both, since electronic files are easier to be stored whereas having a printout allows people to jot down notes while listening to instruction.

4.1.3 Training delivery

The most essential contributor to a high quality of training delivery is the trainer's output, which was discussed in chapter 4.1.1. Yet there are things, which impact on training delivery, which are associated with trainer, but may be out of his or her leverage.

Training is very trainer-led in a classroom and therefore is lacking interaction, which occurs every now and then, but on the other hand that is what people want to have. It is legit to say that the most of people want to be trained and not to contribute by themselves. Trainers somewhat agree with customers, since they accept that the current mode of delivery is part of the job and has always been so. In addition to verbal delivery, information is currently conveyed by means of a slideshow and whiteboard spiced by

animations and videos from time to time. That is still considered to be the best and the most efficient way to give theoretical training and really get the subject across in both trainers' and customers' opinion. Yet people think that it would have been better to have more visual aids: videos, 3D-animations, explosion images, drawings and so on.

Both the trainers and the internal customers have conflicting views as regards to training delivery. The majority of people think that there has been enough interaction between trainers and participants and the current way to give a training is practical. Yet the most negative comments on training delivery urge to have more interaction and participant involvement. People seem to confuse the trainer's expertise and responsiveness to posed questions with interaction, which is not the case here. Anyway, the mode of delivery is very authoritarian.

When it comes to delivery of practical training, people are more than satisfied with the delivery. They value how it is conducted and that they are exposed to things, which are highly valuable and relevant to their work. However, there is no written or predefined process on training delivery for theoretical nor practical training. It is up to trainer's own preferences, in which way the training is delivered to customers as long as course objectives are met. That policy increases reliance on the trainer's competence, which is a double-edged sword; when the trainer is experienced, the adjustments can be made with ease to meet the target group's demands, on the other hand, in case of an inexperienced trainer, a lack of delivery process likely will have negative impact on training quality.

As regards the way of delivery in the current situation seems to be fine, therefore major adjustments are not needed. Yet people agree that interaction fosters learning and sharing of personal experiences is strongly recommended. Therefore, even people like to listen to the trainer's instruction and assimilate necessary information in that way, actions should be taken to provoke interaction. Especially, a separate time slot should be reserved for questions and answers, where people could talk through relevant issues to their work and installation.

One way to stimulate natural interaction between participants in a classroom is the arrangement of seats and tables. It is to be noted that majority of relevant interest groups are willing to retain current arrangement though. However, if alternative solutions are desired to be piloted, U-shape or auditorium arrangement could be the ones to go live.

4.1.4 Course planning

People are somewhat pleased with the current course schedule allocation. It is appreciated that there is a chance to go over things in the classroom before getting hands-on. However, a lack of sufficient amount of hands-on training is the most evident and criticized issue in training services currently. People urge to have more practical training, even at the expense of theoretical classroom training. Especially automation, electrical and sophisticated systems related training need to be trained more thoroughly. No one mentioned a mechanical training. Most of the employees being trained are field service engineers, whose job is to work hands on with the engines and associated systems. Occasionally simulator training is the preferred option and therefore can work as a substitute for actual equipment as it allows troubleshooting, which is blatantly desired by customers. Moreover, people wished that the training days would have been split to keep the interest up. The current way to have a full day of a certain type of training is not considered optimal, but for instance scheduling classroom training for the morning and practical training for afternoon session is suggested. Trainers are keen to be more involved in schedule planning than they have been in the past.

The majority of customers consider they have sufficient preliminary skills when attending a course, whereas trainers are not as unanimous concerning customers' competence. Customers tend to have very varying skill levels and many courses have people with unequal competences. There are requirements in order to be eligible to take particular courses, though that system is not watertight. Pre-assessment is applied on certain courses, especially with external customers. In order to attend to some courses, internal customers have to have done some preceding courses or modules, otherwise they can take courses to their liking. Course assessment is employed merely in internal courses and failing at the test will not have an impact on accomplishment of the course in some courses. All these things affect people's competence and have an effect, so there will be unqualified people in the courses in the future too, unless something is done about it.

The former is strongly associated with the course classification. People have indicated that courses are not corresponding to the level that they are meant to be. That has resulted in people taking part in courses beyond or below their competence. Trainers have also suggested that there is a need to reconsider the course classification. Furthermore, there are certificates, which people in certain positions need to have for their position. To obtain certificates, people have to do courses, however, the system allows courses to be fully

booked, which hampers people from getting the required certificates. Generalization of some courses have resulted in courses, which attract diverse people, who only gain very little from the course due to a wide spectrum of discussed topics.

Many people think that the courses are either under- or overscheduled. Courses that are perceived as too short are stemming from the need to have more hands-on training. The general perception is that the reserved time is not sufficient to acquire the expected level of knowledge on subject. Conversely, courses lasting too long are found to have a slow tempo, so that topics could be taught in fewer days. That is the case with courses lasting four to five working days, especially those courses, which do not include any practical training. In addition, people think that the less people are attending a course, the better it is for their learning. However, the perceived quality of training seems not to be associated with the number of participants, even though people have been asking for smaller study groups. The perceived quality is not contributing to actual learning though. The course assessment is basically used to find out how well the course content meets participants' competence.

There is not a system available to really follow up learning and people are basically not aware of how well their skills and knowledge correspond to the desired competence. Currently, the only way to define an individual's competence by means of courses are certificates. People are expected to master all information regarding certain subject once he or she has done a course and conversely, not being familiar with a topic if not accomplished the course. Moreover, any lifetime service or support is not provided for customers to retain acquired knowledge in addition to course material. At the moment the only way to enhance one's competence is to do more courses in addition to learning on the job.

Currently videos, still images and animations played on screen are the only visual aids to enhance training in classroom and none of them are used in practical training at all. IT-technology should be implemented to hands-on training, as majority of interest group want to have them to be employed, though it cannot replace the actual engine. Feasible applications could be a demonstration of inner parts of engine or customer specific installation on screen, when working on engine. People think that technology could definitely improve learning but may not speed up the training delivery process.

Pertaining to IT-technology, 3D-experience is considered beneficial for learning, at least to some extent. It is considered to be advantageous to visualize engine functionalities and therefore facilitate to assimilate new information, though incorporation of 3D is not as critical as having a sufficient amount of visual aids. It is to be noted that there is nothing, which could replace actual engine though. All support technologies are meant to enhance understanding of an engine in terms of its structure, functionality, operation and overhauling. The idea is to find a suitable technology or an application, which supports the aforementioned objective in the future.

When it comes to the course feedback form, it is considered sufficient allowing participants to provide constructive feedback. The only major disadvantage is that feedback has not been utilized for the training development. The present way of collecting feedback is found functional and does not require update. However, there are people, who are keen to devote their time to provide deeper and more insightful feedback, if they were allowed to. Hence, additional, a voluntary online feedback system could be launched for getting in-depth feedback without neglecting end of course assessment.

4.2 Disruptive approach

This subchapter presents the results of studied topics which are considered disruptive in their nature from training services' viewpoint: perception of hologram technology, available hologram technologies on the market and novel concepts to arrange the training services in the future.

4.2.1 Perception of holograms

The results show that people are onto hologram technology, at least to some extent. They can relate holograms to 3D-experience and light projection, which hold up and prove that relevant interest groups have an understanding on applied hologram technology, if it is implemented. Considering the benefits of technology in terms of training it is expected to support training by enhancing and simplifying understanding and to convey information more effectively, whereas some people would find its use redundant and not adding any value to training. It is to be noted that hologram related questions received more blank answers than other sections in the questionnaire, which tell on many people not being aware of holograms at the end of the day though.

If hologram technology was found applicable, it would be preferred to be used in classroom training to support following practical one. The trainers and customers agree, that the most useful application would be demonstration of inner parts of the engine, though many people cannot even find that advantage and find it either irrelevant or as a gimmick. Yet people would accept tentatively holograms as a part of the training, even though it is not considered a major breakthrough for training and learning because scepticism towards holograms is evident.

According to the results it is not imperative to have a 3D-experience without wearing any glasses or goggles, conversely wearable technology is accepted for that purpose by approximately half of the respondents. However, extensive use of wearables is found inconvenient, so the demonstrations requiring glasses could be applied for special cases and only for a limited period of time. Considering the learning curve it is not expected to have any impact on whether wearables are needed or not. Advanced technology is no substitute for a clear course material, thorough content, competent instructors and looking at, and teaching the real thing. The expected benefit is not so great that it could be considered worthwhile while the training services need new investments badly to actual equipment, which have guaranteed added-value to training delivery. Hologram technology asks a lot from the trainer and material creator, so its full utilization could be very hard to accomplish, therefore, incomplete use of technology might be rather a hindrance than a benefit.

4.2.2 Available hologram technologies

Frankly, there is not a suitable hologram technology available on the markets. Discussed technologies provide a desired 3D-experience for the naked eye, but have major constraints considering requirements. Varying from a technology to another, a field of view is limited and therefore cannot be used in most of the settings. That is an obvious disadvantage as the management team wishes to reduce the number of classroom instruction and wished that technology could be used in altering circumstances with ease. As technologies are fixed to a certain location, they set great requirements for venue in terms of illumination and space. That would also apply to hologram beamed to remote location. In addition, obviously a beamed image cannot see or hear anything by itself, which sets even higher standards for venue and required technology in the remote location.

Even though financial issues were excluded from this study, it is to be noted that technologies are way too expensive and expected cost-benefit is rather very low or non-existent. Considering approximated prices all technologies are too expensive and add very little or no value to training delivery. If they were implemented, they would be rather gimmicks than a teaching aid as few of respondents indicated so. In the worst case scenario, they even may become a burden. If alike cutting-edge technology was employed, augmented or virtual reality could be considered. As discussed earlier, unlike it was expected in the beginning of study, the majority of people are not against wearing goggles to have 3D-view, providing they were required to wear them only every now and then and they really offer an added-value to training delivery.

As a representative of Trade Show Hologram stated, required attributes are not realistic. The hologram technology, which the case company is after, is out of reach considering current human competence and technology. Therefore, it is reasonable to focus on the ones, which are realistic, support training delivery and maximizes learning output.

4.2.3 Novel concepts

All six concepts studied provide a disruptive approach to training services, some more than the others. Each of them has their pros and cons, some of them are greater than others. Some disadvantages are such that they could be overcame with particular actions and adjustments, but not everything.

The first concept has been piloted recently and has gained primarily positive feedback from participants. It reduces time spent at the training centre and therefore cost, which benefit both the training services and customers. Furthermore, it allows trainers to train more groups, if training can be sold, or to be better prepared for courses. Increased time off from training delivery can be allocated to personal development as well. However, this concept is not as disruptive as preferred and its main problem is rigidity, because only a form of training delivery is renewed compared to traditional training. Training is still designed to be identical to everyone and the only option to get training is to select courses from a course portfolio according to one’s liking.

Technical training days would rationalise internal training and leave approximately two thirds of a calendar year open to focus just on external customers, which are a source of money for the training business. Increased networking opportunities, reaching more

employees and enhanced training awareness coupled possibly with the field services' technical days are appealing expected advantages. However, constantly altering business circumstances may erase all the pictured benefits, then the concept would not gain any foothold among the target group. In addition to that, people logistics makes this concept inoperable in the raw.

The mentoring-concept would make many of the desired attributes possible: individuality, relevancy, increased operational efficiency and flexibility. All of these things are such that cannot be achieved by means of sustaining training. Even though the concept looks very simple and clear on a paper, it is anything but that. There are two major barriers, which, at least today, cannot be overcome: technology and information flow. There has to be a fool-proof platform and an internet connection to make this concept feasible as the information has to travel to both directions in real-time without considerable delays and disruptions. That is not possible with the connections available today, but can probably be overcome as time goes by. Though educational material, which is available offline, can be done, but that covers only the other half of the concept, when the trainer proactively delivers information to the field service, not the other way around. Another barrier, information flow is related to the training services' position within the case company. The training services' are a very small unit in a company and its primary role is to support major units, in this case the field services. Unless its internal position and image is not improved, its agenda in terms of training internal customers will always be devalued. Though that is a good way from company's business perspective, as a whole, but actions shall be taken to enhance training's appreciation among the field service engineers, since the training services enhance their competence, and therefore profitability as well.

The agenda of tailored training is good, but its execution seems to be too high a mountain to climb. First of all it is not expected that by means of intensive induction a time required of person being competent to operate alone at a customer's site could be shortened down. Possibly a basic understanding of a company's equipment portfolio could be provided, but the majority of relevant professional skills are gained learning on the job. However, a lesson from the concept is that rationalisation of course schedule could allow newcomers to gain necessary skills quicker as today completion of necessary courses may take over a year, as certain courses are delivered every now and then, therefore requirements of individual person cannot be met from time to time.

The fifth concept, training support, has traits of future learning methods by allowing people to study at their own pace and being independent of time and place, but as such is not feasible. It is a doomed idea to let training centres, thus hands-on training go away. Competent field service engineers are the core of the entire company's business, therefore retaining and enhancement of their professional aptitude shall be a top priority. However, not offering a hands-on nor face-to-face theoretical training for employee profiles, who do not need it in their daily work should be reflected further. Currently, such training has a bit of a sense of "nice to have" for them and cannot be deemed worthwhile, especially considering opportunity for cost of such training.

The final concept, outsourcing of training to dealers, offers too low reward proportioned to high risks. Even though in many businesses outsourcing of functions is a viable option, such as spare part sales in mechanical engineering industry or manufacturing in mobile phones, in training business, at least in this particular, training delivery cannot be outsourced. Although this concept would allow training services to cut down costs and to generate rather constant positive cash flow by charging fee from dealers, they do not outweigh related risks. The two main reasons are the intellectual property rights and the brand, actually both of them are the ones the entire case company's business is built on. Being a technology forerunner and having a high quality brand are the company's business pillars and both of them would be put in jeopardy, if classified information was signed over to non-company quarter.

As a conclusion it can legitimately be stated that none of the sketched concepts is not fully disruptive in a greater scope, though they are in the case of the studied company. Some of them are feasible, whereas some are not. Which is the one to put resources on depends on management's preferences and multiple other factors, which are not covered in this study, therefore stand has not been taken. However, no matter which one of the outlined concepts was selected, it would be either outdated or non-optimal in a few years' time. There are two obvious reasons to that. First one is that e-learning possibilities would not be fully capitalized or the effectiveness of training delivery would still not be maximized as the training still relied on more or less non-tailored approach. It is to be noted that training probably never can be completely individual and tailored in training services. Based on the acquired information a disruptive approach to training services is a combination of attributes from different concepts.

5 DISCUSSION

This chapter discusses managerial implications in chapter 5.1. Based on the acquired results the most remarkable findings are highlighted and two alternative approaches to develop training are presented: sustaining and disruptive. Chapter 5.2 reflects limitations of the study whereas chapter 5.3 discusses other possible technologies, which could be used in training services in the future.

5.1 Managerial implications

Generally speaking, as long as training is regarded as a business the goal of which is to make profit, internal and external training should be treated separately in reporting. Currently they have common KPIs, which distorts the measurement of training services profitability, since they do not take into account a fact that the company's policy does not allow making profit by internal training. It is to be noted that it only concerns reporting, not the organization and delivery themselves. Dividing external and internal training into separate units within training services is not suggested.

Unless training services did not have to, it would not train internal personnel at all, as it does not make sense considering training services' business. However, training of internal personnel, especially the field service engineers, is vital for the entire company and therefore has to be conducted at least as well as the training of external customers. That is why approaches presented below are primarily to be implemented to concern internal customers in order to meet the study objectives: to improve quality of training, speed up the training process and to reduce time involved in travelling. Approaches could be leveraged to external training as well if it is feasible and reasonable businesswise, though internal training is the one to pilot it and possibly implement later on.

One critical aspect of internal training is to offer training, which benefits employees. Currently the training portfolio does not meet the requirements completely. Communications channels are open between the training services' management and line managers, but everything is based on personal relations. There is not coordination nor structured system in that regard. Having such would be a win-win situation for both parties: departments would have a chance to get relevant training and training services could cut down redundant training offering, therefore streamline operations and increase

cost-effectiveness. No matter whether training is taking sustaining or disruptive approach, the aforementioned ones will apply.

5.1.1 Sustaining approach

As stated earlier in this study, sustaining innovations are the ones, which slightly improve existing operations, in this case training services. All arisen issues are to be solved and existing attributes developed a bit further, but the core, a way to deliver training remain unchanged. That means, notable changes in a great scope shall not be expected, even though by fixing the flaws presented below, training can be developed in a sustaining way.

The importance of the trainer is evident. Their competence and expertise are vital for successful training delivery, hence there are a few things to do to secure them. They should have more time to prepare for coming courses and develop their own expertise, especially in terms of novel and advanced technologies. The development of trainers' pedagogical and technological skills should be coordinated by the training services and appropriate support to be organized. Furthermore, an organized approach to involve trainers in material creation process shall be implemented. Currently that is based solely on personal relations and has resulted in, among other things, subpar material from time to time. That is associated with the fact that there are courses, which do not have a material framework and designated material at all. In terms of material delivery, it should be accessible to participants well before coming to the training centre in order to achieve an enhanced learning and smoother training delivery process.

The findings reveal that the majority of the training delivery is up to mark. Actions, which foster interaction between course participants and trainer are more than welcome though. Such tacit knowledge exchange alongside networking opportunities is one of the greatest advantages in classroom instruction. Moreover, predefined training delivery process could also even out differences between the trainers. Such process is considered beneficial especially for newcomers, who are relatively much due to a high turnover of trainers.

There is one glaring point in course planning: more time should be allocated to hands-on training. That is a considerable dilemma, as a practical training delivery process cannot be sped up to have more topics covered over a few days nor can theoretical training time be shortened down either. Considering the objective to speed up the entire training

delivery process things are getting tough. Basically there is no solution to that problem as long as the theoretical training is delivered in classroom. Moreover, unclear course classification disturbs training delivery as either trainers' or participants' competences are not at the expected level.

It is to be said that all sustaining improvements are such, which should have been done a long time ago. Nevertheless, they are better to be implemented sooner than later, if training, and especially its delivery is to be kept up to mark. However, by means of sustaining innovations training services will fall behind from the market standard eventually and most of the demand and requirements remain unmet. If all strategical and operational goals were met, it would require an implementation of totally novel approach to training, in other words, disruptive.

It is to be noted too, that the training services' are doing their best as they are listening to their customers and act accordingly. However, this usually, as theory suggest, leads to performance oversupply, of which no one is willing to pay and eventually their favour will switch to disruptive one. It is vital to recognize whether performance oversupply applies to training services in any domain. For instance, it can be discussed whether an entire equipment portfolio needs to be available at training centres to train people to pull out a piston or to remove a cylinder head in terms of a certain engine model. If so, it shall be eliminated in order not to fall to a trap of disruptive innovation set by a competitor.

5.1.2 Disruptive approach

It is obvious that in the future training will be taking place online in increasing proportions. It is legitimated assumption, because both academic researches and the case company's aspirations and strategic objectives support that approach. Learning results in e-learning are at least as good, or even better compared to taking training in a classroom according to multiple studies. The training services' aspirations to disconnect training from time and physical location are to be achieved by transferring theoretical training online. That will reduce travelling and speed up the training process as early pilot findings reveal that studying theory at one's own pace online takes considerably less time compared to classroom instruction in the case company's training. Learning results are still to be confirmed, but initial experiences are rather positive. It is to be noted that hands-on training cannot be taken remotely as study results suggest that it is the most important

single factor in training and to have competent personnel they need to be trained with real equipment.

No classroom-concept is currently in its early stages of disruptive trajectory, therefore way below an imaginary line depicting a current performance of training delivery. Currently it is only applied to relatively low share of training and study results still remain unverified. It requires a lot in terms of technology, material creation and participants. Due to its novelty, people are still not used to study in such a way. Learning material still has to be created individually for each course, but it is getting more convenient and handy to do as time goes by and an increasing amount of material is stored to database. The material creation team is applying a modular structure, which is a major advantage in that regard.

However, that method does not fully utilize available advantages and therefore, may never surpass that current performance line or does it only by a small margin. That is because, it is still a course, which is designed for a large group of people and have to be taken within certain, usually short, timeline. For being a part of course, it does not allow people to gain desired competence by means of training any quicker than today, therefore it capitalizes on existing opportunities just partly. That leads to the fundamental issue of the entire training services: offering training in form of courses, which include both theoretical and hands-on training and are accessible only in fixed times and locations.

To fully capitalize the available technology and resources, the most disruptive and efficient method to arrange training is expected to be achieved by deploying following actions:

- Delivery of theoretical training as a part of course is to be terminated, no matter even if it was delivered in e-learning. There are lot of topics, which are taught in various courses. Such overlapping topics cause redundant work and lower efficiency. Instead of courses it is suggested to offer just modules, which are to be selected and studied individually online. Real-time support, platform to clear doubts and mandatory assessment are essential to make that fully functional. A customer could select topics according to one’s own preferences whenever they want to. In this way, theoretical training would get as tailored as possible considering a large volume of trained people since individual theoretical

competence is acquired by means of accomplishing different modules. Such arrangement would also decrease the number of required material tremendously.

- Hands-on training still requires travelling to training centres to work on real equipment. Therefore it is suggested to offer only hands-on courses, which are tailored either with line managers or to meet customer specific installations. When, where and how often hands-on courses are delivered, shall be discussed on separate occasion. Anyway it is essential that offering is organized in such manner that it allows a quick induction for a newcomer. Furthermore, it is advisable to centralize most of the real equipment only in a few training centres and put more resources on simulators as proportion of hands-on training is increasingly operational in nature instead of traditional engine dismantling.
- When it comes to applied training technology, studied hologram technologies would provide preferred 3D-experience in a very controlled environment, but it is not expected to be applicable in the company's training and not adding any value to training. To beam a trainer as a hologram to a remote location to give training is not feasible, since it requires too much in terms of technology, internet connection, expenses and environment in the receiving location. It could even be considered disturbing, as it is considered a gimmick and taking a focus away from the fundamental activity, learning itself. However, a 3D-view is the one which shall be worked on. More it can be incorporated in training, the better it is for people to assimilate new information. Especially demonstration of internal parts of equipment shall be a top priority, when creating new training material. To increase operational training availability flash based simulators are to be implemented increasingly.

Suggested actions will secure individual training, making it accessible regardless of time and location and allow people to study at one's own pace topics relevant to their own work. Decreased travelling and time spent in the training location are obvious advantages. The entire training and learning process is streamlined by eliminating redundant training, thus all training delivered is essential to whoever takes it. Moreover, training attractiveness will increase and more training could be sold, especially to internal customers, as benefits of training would be better recognized. Whether the aforementioned actions should cover external training too, is a subject of further discussion.

It is to be noted that the proposed actions cannot be implemented in one go. Disruptive innovation is not about breakthroughs, but about honing processes constantly and developing process as unexpected issues arise. No one can know, how long it takes that disruptive approach in the training services could displace the current method of training delivery. However, once it does, expected benefits, therefore operational efficiency and profitability are to be maximized.

5.2 Limitations of the study

The research has studied only the case company specific features and factors impacted by those challenges, therefore research findings cannot be generalized in a greater scope. It is also to be noted, despite of analysing course feedbacks providing some sense of longitudinal study, the study is primarily cross-sectional so it describes at one specific point in time. Therefore, study results might be very different, if the same study is conducted in, say, two years. Furthermore, the study is conducted by one researcher and guided and supervised only by one company's representative, therefore the acquired findings may be affected by personal traits. If respondents were chosen differently, the results of the study might differ significantly from the ones gained.

The research had some remarkable limitations in terms of studied topics too. First of all, desired hologram technology had to be visible for the naked eye, which restricted a number of possible solutions in terms of 3D-view tremendously. Therefore any wearable technology, augmented nor virtual reality were not considered, when mapping out the corresponding technology market. The financial aspect was largely excluded from the study and covered only on the face of it here and there. The acquired findings only deal with the greater picture and do not go into details. Hence, the study does not take a stand on how they shall be designed and eventually implemented in practice. If the aforementioned topics wanted to be examined in the context of training services, a separate individual study is needed.

5.3 Other possible technologies

The findings prove that relevant interest groups would accept a use of wearable technology to gain a 3D-view, if it added value to training and learning and not being just a trick, which pulls attention away from learning itself. A value-adding feature is a strict requirement and cannot be yielded. Utilization of such technology should not be employed extensively but only to serve a specific purpose in carefully selected topics. Hence, noteworthy technologies could be everything, which meet the aforementioned requirements, such next-generation virtual reality glasses, Oculus Rift, or Microsoft Hololens, which enables an overlap of holographic images into a real world image, just to name a few. The expected commercial release is to take place in 2016. Yet, they should not be implemented for the sake of technology itself, but for enhanced learning outcomes and training delivery.

6 CONCLUSION

A demand for hologram technology to be utilized in training activities marked a starting point for the thesis. The goal was to investigate, define and select the best equipment for such a purpose. Based on the given statement and research objectives a major research question and three subquestions were created to steer the research process. However, it became evident very early on that the desired hologram technology might be non-existent. Therefore, a more holistic approach to develop training services was taken and the fourth subquestion was attached to reflect the entire training services from the perspective of sustaining and disruptive innovation.

It was clear from the outset that there is not a theory, which is suitable as such to support empirical study. Therefore, topics relevant to the research were discussed to provide theoretical foundation for the thesis. By combining relevant theories empirical research were able to carry out. Topics were presented thoroughly, because such a study had not earlier been conducted in the case company's training services. Furthermore, if further study is to be taken, it is beneficial to have a relevant theory and research methods already presented extensively. For the majority of time there were no difficulties to find applicable theory, though in terms of holograms there were such, since all available studies tend to address technology itself, not its applications and what does it enable.

Empirical data collection methods were adjusted to contemporary situations. Summer vacations, among other things, made getting people to contribute more difficult than it would have been maybe during a different time of year. Nevertheless, a sufficient number of people contributed and provided pivotal relevancy, depth and insight for the research. Eventually, respondents represented very wide range of nationalities, experience levels and various positions.

Concerning question on how hologram technology can be applied to training, it can be stated, that it can be utilized, if the technology itself is imperative instead of actual learning. That is obviously not sought. A desired 3D-view and demonstration of internal parts of the equipment by means of hologram technology can be achieved, but it is better to be done in alternative ways, which are expected to be more convenient to use, affordable, convey information more effectively and people accept them without reservation. A lot of prejudice is associated with hologram technology. Considering all

the constraints related to available hologram technology, there is not an argument to prefer it to high quality 3D-animations, virtual or augmented reality.

As the great deal of empirical section of the research addressed sustaining and disruptive innovations in terms of training services, corresponding dataset, results and managerial implications are the greatest lesson of the research project. It is up to the management's preferences, whether to develop training in sustaining or disruptive way. The sustaining way is easier to accomplish and that is the one, where established companies and departments are good at, like training services. Possibly carried out improvements would be valued by trainers and customers and therefore probably increase satisfaction among the relevant interest groups. However, that is exactly the point, where a disruptive innovation will usually take over, if the training services kept improving the established training offering and other relevant factors. Early signs of disruptiveness in customers' preference can be recognized already. Moreover, considering the objectives presented in the first chapter, improving the quality of training, speeding up of training delivery process and reducing time involved in travelling in addition to a need to increase the amount of hands-on training, disconnecting it from time and place, making training more individual and relevant to participants, there is no chance to achieve them by applying a sustaining approach. That holds true, even though the case company' situation is unique as in such a way that no other company can provide training on its equipment. Yet there is a significant threat of lost sales, if demand cannot be met. Therefore the presented disruptive approach as such or with certain modifications is the one, which can be expected to fulfil all the aforementioned objectives and resolve current challenges of the training services in the future as well.

In a greater scope, this research proved that disruptive innovation as a theory is applicable to the service business, which has unique characteristic like having a monopoly to provide a training on its products. The theory was proven to be able to show that by improving the established features, both strategic objectives and customer demand cannot be met. By identifying the trajectory of disruptive innovation the training services management can reflect operations from a new perspective and make sure they are among the forerunners in terms of corporate training, thus to ensure business profitability, relevancy and competent workforce within the case company in the future as well.

The research opens up a door for further research. First of all, as training services is a profit organization, thus any development action and implementation requires a study

addressing its profit and cost impact on training services. As the study disclosed, a use of wearable technology is accepted and corresponding further study is needed, if such application is to be deployed. Furthermore, if any of the proposed approaches were considered feasible, the analytical approach to implement it has to be studied from a process perspective. That would provide a practical handbook for training services and enable them to take training to the next decade.

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APPENDICES

APPENDIX 1. Complete list of customer feedback

Respondent ID	Offering ID	Customer type	Course name	Course type	Length (in days)	# of participants	Feedback 1	Feedback 2	Feedback 3	Feedback 4	Feedback 5
1	72669	Internal	control system mv, lv, dc operation and practical intermediate internal	ELC	4,67	9	More hands-on (general)	Invest in training equipment	More than coffee and lunch		
2	72669	Internal	control system mv, lv, dc operation and practical intermediate internal	ELC	4,67	9	More hands-on (general)				
3	72669	Internal	control system mv, lv, dc operation and practical intermediate internal	ELC	4,67	9	More hands-on (electric)	More design concepts			
4	72669	Internal	control system mv, lv, dc operation and practical intermediate internal	ELC	4,67	9	More hands-on (general)	More accurate schedule	More information to be given before course	Material to be provided before the course starts	Arrange a joint dinner for course members
5	72669	Internal	control system mv, lv, dc operation and practical intermediate internal	ELC	4,67	9	More hands-on (general)	Better communication	Better coordination	Shorter course preferred	
6	72669	Internal	control system mv, lv, dc operation and practical	ELC	4,67	9	Shorter course preferred				

			intermediate internal								
7	67817	Internal	propulsion condition monitoring service (pcms) for sales and project personnel	PRO	2,13	4	Split the course considering target group	Use digital sales tool			
8	74657	External	unified controls (unic c3)	PRX	2,00	8	Hard to follow demonstrations at the screen				
9	74657	External	unified controls (unic c3)	PRX	2,00	8	Excess of information considering course length				
10	74657	External	unified controls (unic c3)	PRX	2,00	8	Lack of customer specificity				
11	68718	undefined	undefined	undefined	undefined	undefined	Longer course preferred				
12	68718	undefined	undefined	undefined	undefined	undefined	Material to be provided before the course starts				
13	71665	Common	engine rt-flex operation & practical advanced	PR2	4,67	3	Combine component presentation to be done in hands-on				
14	71665	Common	engine rt-flex operation & practical advanced	PR2	4,67	3	Material to be provided before the course starts	Detailed schedule to be provided before course starts			
15	71665	Common	engine rt-flex operation & practical advanced	PR2	4,67	3	Shorter course preferred				
16	67818	Internal	propulsion condition	PRO	3,20	5	Split the course considerin	Shorter course preferred			

			monitoring service (pcms) for service engineers				g target group				
17	72813	External	customised course	EXT	3,60	12	More hands-on (general)				
18	72813	External	customised course	EXT	3,60	12	More hands-on (general)	Longer course preferred			
19	72813	External	customised course	EXT	3,60	12	More hands-on (general)	To do course in case company's facility instead of customer site			
20	72813	External	customised course	EXT	3,60	12	To do course in case company's facility instead of customer site				
21	72813	External	customised course	EXT	3,60	12	More hands-on (general)				
22	68738	Internal	gasfastrak 50df package for internal personnel	PR4	25,60	19	Excess of repetition	Course is too expensive, even though it's for free online			
23	68738	Internal	gasfastrak 50df package for internal personnel	PR4	25,60	19	Too large group size	Excess of repetition	Too many instructors		
24	74573	Common	customised course	EXT	4,67	8	Too much hands-on	More theoretical training preferred			
25	74573	Common	customised course	EXT	4,67	8	Deeper information preferred on the gas process				

26	74573	Common	customised course	EXT	4,67	8	More failure issues	More "what if" - scenarios			
27	66481	Internal	unified controls (unic c3) internal	PRX	2,00	8	Split the course considering target group				
28	66481	Internal	unified controls (unic c3) internal	PRX	2,00	8	Longer course preferred	More hands-on (simulator)			
29	66481	Internal	unified controls (unic c3) internal	PRX	2,00	8	Provide material in memory sticks				
30	66481	Internal	unified controls (unic c3) internal	PRX	2,00	8	More hands-on (simulator)				
31	69996	Internal	unified controls (unic c1 and c2) internal	PRX	2,13	9	Combine UNIC courses into one course				
32	69996	Internal	unified controls (unic c1 and c2) internal	PRX	2,13	9	Longer course preferred	More physical systems	Less software systems		
33	PPELS Bali Pesanggaran	undefined	undefined	undefined	undefined	undefined	Poor location	More hands-on (general)			
34	PPELS Bali Pesanggaran	undefined	undefined	undefined	undefined	undefined	More hands-on (general)				
35	69610	Internal	customised course	EXT	2,80	5	Feedback adjustment missing				
36	69610	Internal	customised course	EXT	2,80	5	Repair beamers				
37	74368	External	power plant (diesel) electrification at site	POW	4,67	20	More troubleshooting	Practical introduction to equipments	Emphasis on sensors and maintenance	More hands-on (general)	
38	74368	External	power plant (diesel) electrification at site	POW	4,67	20	More hands-on (general)				
39	74368	External	power plant (diesel) electrification at site	POW	4,67	20	More hands-on (general)				

40	74368	External	power plant (diesel) electrification at site	POW	4,67	20	More hands-on (general)	Better material preferred	More videos		
41	74368	External	power plant (diesel) electrification at site	POW	4,67	20	More hands-on (general)				
42	74368	External	power plant (diesel) electrification at site	POW	4,67	20	More hands-on (general)				
43	74368	External	power plant (diesel) electrification at site	POW	4,67	20	More hands-on (general)				
44	74368	External	power plant (diesel) electrification at site	POW	4,67	20	Utilize available equipments at the site				
45	74368	External	power plant (diesel) electrification at site	POW	4,67	20	More hands-on (general)				
46	74368	External	power plant (diesel) electrification at site	POW	4,67	20	More hands-on (general)	More detailed information about electrical devices	More troubleshooting	More advanced information preferred	
47	74368	External	power plant (diesel) electrification at site	POW	4,67	20	More hands-on (general)				
48	72798	undefined	undefined	undefined	undefined	undefined	More hands-on (general)				
49	72798	undefined	undefined	undefined	undefined	undefined	More hands-on (general)				
50	72798	undefined	undefined	undefined	undefined	undefined	More hands-on (general)	Use service engineers as a instructor	Instructor lacking field experience		
51	72798	undefined	undefined	undefined	undefined	undefined	More hands-on (general)	Less theory			

52	73405	Common	customised course	EXT	3,20	8	More training on electrical systems				
53	73405	Common	customised course	EXT	3,20	8	Provide printouts for jotting down notes				
54	73405	Common	customised course	EXT	3,20	8	More exercises after the relevant topic				
55	70585	External	power plant w32 maintenance	POW	4,67	6	Deeper information preferred on fuel, lube oil and water systems	Experience errors at the site	Longer course preferred		
56	70585	External	power plant w32 maintenance	POW	4,67	6	Longer course preferred				
57	70585	External	power plant w32 maintenance	POW	4,67	6	Longer course preferred	More hands-on (general)			
58	70585	External	power plant w32 maintenance	POW	4,67	6	Longer course preferred	More hands-on (general)			
59	70585	External	power plant w32 maintenance	POW	4,67	6	Longer course preferred	More hands-on (general)	Better scheduling	Have binders with compass for prayers	
60	70096	Internal	control system unic/wecs 8000 commissioning advanced internal	PR4	8,53	8	Material to be provided before the course starts				
61	70096	Internal	control system unic/wecs 8000 commissioning advanced internal	PR4	8,53	8	More hands-on (general)				
62	70096	Internal	control system unic/wecs 8000	PR4	8,53	8	Split the course considerin				

			commissioning advanced internal				g target group				
63	70623	External	lngpac operation advanced	PRX	3,20	6	Shorter course preferred				
64	70623	External	lngpac operation advanced	PRX	3,20	6	Shorter course preferred				
65	70623	External	lngpac operation advanced	PRX	3,20	6	More hands-on (general)				
66	70391	Internal	zero injury training workshop	HES	0,53	17	Use more real our company cases as an example				
67	73712	External	power plant management	POW	4,67	4	More focus on customer specific products				
68	70768	Internal	propulsion control system, protouch	PRO	2,80	5	More hands-on (VAF torque meter)				
69	70768	Internal	propulsion control system, protouch	PRO	2,80	5	More hands-on (VAF torque meter)	More hands-on (torsion vibration meters)			
70	70121	External	w unified controls (unic c2)	PRX	2,00	6	Customer specific drawings preferred	Software preferred			
71	70121	External	unified controls (unic c2)	PRX	2,00	6	Customer specific drawings preferred				
72	68759	Internal	gasfastrak 50df package for internal personnel	PR4	21,33	11	All relevant issues were not covered enough	Work with the components relevant to this course			
73	68759	Internal	gasfastrak 50df package for internal personnel	PR4	21,33	11	More hands-on (general)				

74	68759	Internal	gasfastrak 50df package for internal personnel	PR4	21,33	11	More hands-on (gas systems)				
75	69915	Internal	unified controls (unic c1 and c2) internal	PRX	1,87	7	More thorought training on UNIC 3 software				
76	69915	Internal	unified controls (unic c1 and c2) internal	PRX	1,87	7	More software training				
77	73779	Common	customised course	EXT	1,00	30	Case studies preferred				
78	73779	Common	customised course	EXT	1,00	30	Live training preferred				
79	73779	Common	customised course	EXT	1,00	30	Live training preferred	More discussion about relevant topics	RD vs field experiences		
80	73779	Common	customised course	EXT	1,00	30	Live training preferred				
81	73779	Common	customised course	EXT	1,00	30	Mathematical models preferred if applicable				
82	73779	Common	customised course	EXT	1,00	30	Live training preferred				
83	73779	Common	customised course	EXT	1,00	30	Live training preferred				
84	74227	External	customised course	EXT	4,67	12	More theoretical training (mechanical process and systems)	Apply tests during the course			
85	74227	External	customised course	EXT	4,67	12	Apply tests during the course				
86	74227	External	customised course	EXT	4,67	12	Translator lacking relevant vocabulary				
87	74227	External	customised course	EXT	4,67	12	More hands-on (general)				
88	69983	Internal	engine w34df operation intermed	PR4	4,67	5	More troubleshooting	Address common errors			

			iate internal								
89	69983	Internal	engine w34df operation intermediate internal	PR4	4,67	5	Less hands-on for service engineer	More trouble shooting	More functional information		
90	69983	Internal	engine w34df operation intermediate internal	PR4	4,67	5	More troubleshooting	More simulations			
91	73765	External	engine w32 operation advanced	PR4	5,20	5	More hands-on (fuel pump and valve)				
92	73765	External	engine w32 operation advanced	PR4	5,20	5	More troubleshooting				
93	70856	External	power plant (gas) electrification at site	POW	4,67	15	More hands-on (general)				
94	70856	External	power plant (gas) electrification at site	POW	4,67	15	Lack of plant specific	Arrive at site a day earlier to know plant-specific details			
95	70856	External	power plant (gas) electrification at site	POW	4,67	15	More hands-on (general)				
96	64505	Internal	engine w50df operation intermediate internal	PR4	4,67	11	More simulator training (automation)				
97	68373	Internal	zero injury training workshop	HES	0,53	15	More customer specific examples				
98	74109	External	engine w50df practical	PR4	4,67	6	Better safety equipment needed				

99	74109	External	engine w50df practical	PR4	4,67	6	Better safety equipment needed				
100	74109	External	engine w50df practical	PR4	4,67	6	Better safety equipment needed				
101	70498	External	controllable pitch propellers	PRO	1,87	6	More hands-on (general)				
102	70515	External	power plant management	POW	4,67	6	More information to be given before course	Course was for beginners			
103	74721	External	engine w-x52/62/72 basic	PR2	3,20	10	Longer course preferred				
104	74721	External	engine w-x52/62/72 basic	PR2	3,20	10	More simulator training				
105	74721	External	engine w-x52/62/72 basic	PR2	3,20	10	More hands-on (general)	Longer course preferred			
106	74721	External	engine w-x52/62/72 basic	PR2	3,20	10	More troubleshooting	Real-life cases			
107	74721	External	engine w-x52/62/72 basic	PR2	3,20	10	More simulator training				
108	74721	External	engine w-x52/62/72 basic	PR2	3,20	10	More on-site training				
109	74721	External	engine w-x52/62/72 basic	PR2	3,20	10	Longer course preferred	More hands-on (general)	More simulator training		
110	65110	Internal	commissioning mechanical advanced internal	WOW	4,67	6	Power Plant specific course needed				
111	69966	Internal	engine w50df operation intermediate internal	PR4	4,67	5	Less slides preferred				
112	64836	Internal	engine w34sg operation intermed	PR4	4,67	10	Split the course considering target group				

			iate internal								
113	64836	Internal	engine w34sg operation intermediate internal	PR4	4,67	10	Split the course considering target group				
114	64836	Internal	engine w34sg operation intermediate internal	PR4	4,67	10	Outdated course materials				
115	64836	Internal	engine w34sg operation intermediate internal	PR4	4,67	10	Outdated course materials	Course material was sent to wrong e-mail address prior to course			
116	64836	Internal	engine w34sg operation intermediate internal	PR4	4,67	10	Split the course considering target group				
117	64836	Internal	engine w34sg operation intermediate internal	PR4	4,67	10	Instructor's proficiency in English wasn't satisfying				
118	70002	Internal	engine w34sg operation intermediate internal	PR4	4,67	7	Smaller groups in practical training				
119	69997	Internal	unified controls (unic c3) internal	PRX	2,00	10	In the beginning of the course the general system functioning is preferred				
120	69997	Internal	unified controls (unic c3) internal	PRX	2,00	10	More troubleshooting in simulators				
121	68663	Internal	fundamentals of ship propulsion	PRO	2,80	13	Detailed schedule to be provided before course starts	Provide material in memory sticks			

122	68663	Internal	fundamentals of ship propulsion	PRO	2,80	13	Use more parts to support theory				
123	72769	External	controllable pitch propellers	PRO	4,53	8	Longer course preferred				
124	72769	External	controllable pitch propellers	PRO	4,53	8	More troubleshooting				
125	72769	External	controllable pitch propellers	PRO	4,53	8	Instructor needed more preparation time with the specific software				
126	72769	External	controllable pitch propellers	PRO	4,53	8	Software drawings were too hard to follow				
127	72769	External	controllable pitch propellers	PRO	4,53	8	Course material needs to be improved	Wiring diagrams were incorrect and too complicated	Too short course considering addressed material		
128	69999	Internal	engine room auxiliary systems operation intermediate internal	EAX	4,67	8	Material to be provided before the course starts	Presurvey before the course which topics people want to discuss about			
129	69999	Internal	engine room auxiliary systems operation intermediate internal	EAX	4,67	8	Too short course considering addressed material	Course information to be provided before the course starts			
130	69999	Internal	engine room auxiliary systems operation intermediate internal	EAX	4,67	8	More hands-on (general)				

131	73579	External	engine w50df operation advanced	PR4	4,67	8	More troubleshooting				
132	72569	Common	engine rt-flex operation & practical advanced	PR2	4,67	4	More individual hands-on training				
133	70204	External	engine w46 common rail operation advanced	PR4	4,67	5	Provide material in memory sticks				
134	70204	External	engine w46 common rail operation advanced	PR4	4,67	5	Longer course preferred				
135	70204	External	engine w46 common rail operation advanced	PR4	4,67	5	Longer course preferred				
136	72219	External	engine w50df operation advanced	PR4	4,67	8	More hands-on (general)				
137	72219	External	engine w50df operation advanced	PR4	4,67	8	More hands-on (general)				
138	72219	External	engine w50df operation advanced	PR4	4,67	8	More hands-on (general)				
139	69483	External	engine w50df operation advanced	PR4	4,67	8	More hands-on (general)				
140	69483	External	engine w50df operation	PR4	4,67	8	More hands-on (general)				

			advanced								
141	69483	External	engine w50df operation advanced	PR4	4,67	8	More hands-on (general)				
142	69483	External	engine w50df operation advanced	PR4	4,67	8	More simulator training				
143	73058	Common	engine rt-flex operation	PR2	4,27	15	More equipment parts on hand for demonstration				
144	73058	Common	engine rt-flex operation	PR2	4,27	15	More simulator training				
145	73058	Common	engine rt-flex operation	PR2	4,27	15	More equipment parts on hand for demonstration				
146	73058	Common	engine rt-flex operation	PR2	4,27	15	More simulator training	Course should be kept on vessel			
147	72573	External	customised course	EXT	3,33	13	Poor facility, too noisy as other trainings are going in adjacent rooms and poor projectors				
148	72573	External	customised course	EXT	3,33	13	More hands-on (general)				
149	72573	External	customised course	EXT	3,33	13	Poor projectors				
150	72573	External	customised course	EXT	3,33	13	More 3D images of parts	Have actual parts on hand	Training onboard could be better	Customer specific topics preferred	
151	69898	Internal	engine w50df operation intermediate internal	PR4	4,67	2	Instructor's proficiency in English wasn't satisfying				

152	64960	Internal	gas program module 2 internal	ENR	4,67	9	I/P converter not needed in every course				
153	64960	Internal	gas program module 2 internal	ENR	4,67	9	Participants had too different skills coming to course	More focus on new technologies and processes			
154	64960	Internal	gas program module 2 internal	ENR	4,67	9	More focus on gas process	More focus on UNIC C3 software tree structure			
155	68760	Internal	gasfastrak 50df package for internal personnel	PR4	21,33	10	Participants had too different skills coming to course				
156	68760	Internal	gasfastrak 50df package for internal personnel	PR4	21,33	10	PID-training too engineering style	Course topics were treated in illogical sequence	PID-training to be given at the end of course		
157	68760	Internal	gasfastrak 50df package for internal personnel	PR4	21,33	10	More examples preferred	More exercises preferred			
158	67814	Internal	propulsion hydraulics basic	PRO	2,13	3	More hands-on (general)				
159	73318	Internal	engine w50sg operation intermediate internal	PR4	4,87	6	Less UNIC things	More troubleshooting			
160	73318	Internal	engine w50sg operation intermediate internal	PR4	4,87	6	Course assessment was not that good				
161	73792	External	engine rt-flex operatio	PR2	4,67	4	Control systems to be				

			n & practical advanced				explained by means of videos				
162	73792	External	engine rt-flex operation & practical advanced	PR2	4,67	4	More hands-on (general)	More trouble shooting (electronics controls)	More simulator training		
163	72357	External	unified controls (unic c2)	PRX	2,00	5	More troubleho oting on UNIC	If had a better understanding of course, could've taken some info from home			
164	72566	External	engine w50df operation advanced	PR4	4,67	5	The course material is needed before the lectures	The first part of course was dealt too fast			
165	70916	External	engine w46 common rail operation advanced	PR4	4,67	4	Risk assessment and isolations to be part of hands-on training				
166	70409	Common	engine rt-flex operation & practical advanced	PR2	4,67	5	More hands-on (general)	Longer course preferred			
167	70409	Common	engine rt-flex operation & practical advanced	PR2	4,67	5	Wanted to see a novel engine component before starting the lecture				
168	70409	Common	engine rt-flex operation & practical advanced	PR2	4,67	5	More hands-on (general)	More trouble shooting			
169	71986	Internal	zero injury training worksho p	HES	0,53	5	More exercices preferred				

170	72773	External	engine w32 operation advanced	PR4	4,67	4	More hands-on (general)				
171	72773	External	engine w32 operation advanced	PR4	4,67	4	Too long breaks				
172	70765	Internal	fundamentals of ship propulsion	PRO	2,80	10	Simulator demonstration desired				
173	70765	Internal	fundamentals of ship propulsion	PRO	2,80	10	More hands-on (general)	Lectures to be held in training room			
174	70765	Internal	fundamentals of ship propulsion	PRO	2,80	10	More simulator training				
175	70013	Internal	unified controls (unic c3) internal	PRX	2,00	9	Longer course preferred				
176	66480	Internal	unified controls (unic c1 and c2) internal	PRX	2,13	8	Include UNIC C3 to C1 and C2				
177	66480	Internal	unified controls (unic c1 and c2) internal	PRX	2,13	8	Train each module at a time				
178	72917	Common	customised course	EXT	4,67	9	More hands-on (general)	Too much information cosidering the schedule			
179	72917	Common	customised course	EXT	4,67	9	Ask a lot of theoretical and applied the quota shares				
180	72917	Common	customised course	EXT	4,67	9	Better to operate systems onboard	Wish to had a representative of the yard present to answer questions			

181	72770	External	unified controls (unic c2)	PRX	1,87	7	Classroom hot and stuffy				
182	70012	External	engine w20 operation advanced	PR4	4,67	5	Shorter course preferred				
183	70012	External	engine w20 operation advanced	PR4	4,67	5	Provide written step-by-step guide to commence hands-on training				
184	70012	External	engine w20 operation advanced	PR4	4,67	5	More hands-on (general)	Longer course preferred			
185	70012	External	engine w20 operation advanced	PR4	4,67	5	Shorter course preferred				
186	71131	External	engine w50df operation advanced	PR4	4,67	8	Longer course preferred				
187	65097	Internal	gas program module 1 internal	ENR	4,67	16	Use engine simulator for PID training				
188	65097	Internal	gas program module 1 internal	ENR	4,67	16	Arrange a separate course on PID	Would have benefitted information on how the PID affects to engine performance and emissions			
189	65097	Internal	gas program module 1 internal	ENR	4,67	16	Shorter course preferred	Too much PID training			
190	65097	Internal	gas program module 1 internal	ENR	4,67	16	Too much PID training				

191	65097	Internal	gas program module 1 internal	ENR	4,67	16	More hands-on (general)				
192	66008	External	engine wn25 operation advanced	PR4	5,33	5	More questions asked while booking so material and content is relevant to requirements. That would reduce time involved in training delivery				
193	69865	Internal	cbm/dmp competence audit for field service site survey internal	WOW	1,87	6	Longer course preferred				
194	69865	Internal	cbm/dmp competence audit for field service site survey internal	WOW	1,87	6	More theoretical training and techniques to be discussed	Longer course preferred			
195	69865	Internal	cbm/dmp competence audit for field service site survey internal	WOW	1,87	6	Focus more on training than to how write a report				
196	71568	Common	engine rt-flex basic	PR2	2,80	4	Longer course preferred				
197	71568	Common	engine rt-flex basic	PR2	2,80	4	Longer course preferred				
198	72563	External	engine w50df operation advanced	PR4	4,67	8	Longer course preferred				
199	71208	External	engine w50df operation	PR4	4,67	6	Include a session on electric diagrams in course	More simulator training	More troubleshooting		

			advanced								
200	71208	External	engine w50df operation advanced	PR4	4,67	6	More hands-on (general)	More pictures and videos			
201	71208	External	engine w50df operation advanced	PR4	4,67	6	Unclear electrical drawings				
202	71208	External	engine w50df operation advanced	PR4	4,67	6	Play real videos to demonstrate engine knocking				
203	71208	External	engine w50df operation advanced	PR4	4,67	6	Add a comment or page number for the sake of reference in drawings				
204	65346	Internal	power plant operation and maintenance internal	OMP	4,67	5	More hands-on (electric)				
205	70589	External	unified controls (unic c2)	PRX	1,87	7	More hands-on (general)				
206	70589	External	unified controls (unic c2)	PRX	1,87	7	More hands-on (general)				
207	70589	External	unified controls (unic c2)	PRX	1,87	7	More hands-on (general)	Longer course preferred			
208	70589	External	unified controls (unic c2)	PRX	1,87	7	More real-life examples				
209	70589	External	unified controls (unic c2)	PRX	1,87	7	More hands-on (general)	More simulator training	Complete every day with a hands-on training related to theoretical part conveyed		
210	68637	Internal	unified controls (unic c3) internal	PRX	3,20	8	Every student better to have WECS				

							installed on their own laptop				
211	68637	Internal	unified controls (unic c3) internal	PRX	3,20	8	Be aware of different backgrounds of participants in terms of field experience				
212	68637	Internal	unified controls (unic c3) internal	PRX	3,20	8	Arrange a joint dinner for course members				
213	69519	Internal	fundamentals of ship propulsion	PRO	1,87	20	Take participants' background into account				
214	69519	Internal	fundamentals of ship propulsion	PRO	1,87	20	More practical examples of combinator curves could have been prepared earlier				
215	69519	Internal	fundamentals of ship propulsion	PRO	1,87	20	Visit where the parts have been produced				
216	69519	Internal	fundamentals of ship propulsion	PRO	1,87	20	Visit at thruster department				
217	69519	Internal	fundamentals of ship propulsion	PRO	1,87	20	Visit at site to see presented items				
218	69519	Internal	fundamentals of ship propulsion	PRO	1,87	20	Visit at site to see presented items				
219	69519	Internal	fundamentals of ship propulsion	PRO	1,87	20	Visit at site to see presented items				
220	69519	Internal	fundamentals of ship propulsion	PRO	1,87	20	More time for questions, exercises and answers	Arrange this course in Trieste	Provide advanced course for this subject too		

221	69773	Internal	commissioning mechanical advanced internal	WOW	4,67	6	Longer course preferred				
222	69773	Internal	commissioning mechanical advanced internal	WOW	4,67	6	Longer course preferred				
223	69773	Internal	commissioning mechanical advanced internal	WOW	4,67	6	Longer course preferred				
224	69600	External	engine w46f operation advanced	PR4	4,67	8	More hands-on (general)	Provide pre-reading material			
225	69600	External	engine w46f operation advanced	PR4	4,67	8	Should be a full-day course	Have a newer equipment			
226	69600	External	engine w46f operation advanced	PR4	4,67	8	Training of electrical content could be shrinked to 1/2 day				
227	69734	Internal	transverse thruster control system, tt7000	PRO	4,67	2	Longer course preferred				
228	70352	Internal	controllable pitch propeller (cpp) control system, lipstronic 7000 basic	PRO	5,60	6	Needs to new building product				
229	70352	Internal	controllable pitch propeller (cpp) control system, lipstronic 7000 basic	PRO	5,60	6	Longer course preferred				
230	70352	Internal	controllable pitch propeller	PRO	5,60	6	More troubleshooting				

			(cpp) control system, lipstronic 7000 basic								
231	71176	Internal	vessel automation, power distribution, commissioning basic	ELC	4,67	9	Longer course preferred	More hands-on (general)			
232	71176	Internal	vessel automation, power distribution, commissioning basic	ELC	4,67	9	AVR bench for training				
233	72219	External	engine w50df operation advanced	PR4	4,67	8	More hands-on (general)				
234	72219	External	engine w50df operation advanced	PR4	4,67	8	More hands-on (general)				
235	72219	External	engine w50df operation advanced	PR4	4,67	8	More hands-on (general)				
236	71046	Internal	propulsion control system, protouch	PRO	2,80	4	A general introduction for start/finish of pro touch commissioning				
237	66411	External	engine w32 operation advanced	PR4	4,67	7	More hands-on (general)				
238	66412	Internal	engine w32 operation intermediate internal	PR4	4,67	4	Longer course preferred				
239	70104	Internal	maintenance & measure	ENR	4,67	6	More hands-on (general)				

			ment techniques for field service								
240	69907	Internal	engine w-x52/62/72 operation & practical	PR2	4,67	3	Give more suggestions before training				
241	69974	Internal	commissioning mechanical advanced internal	WOW	4,67	5	Longer course preferred				
242	69974	Internal	commissioning mechanical advanced internal	WOW	4,67	5	More hands-on (general)				
243	74419	Common	engine rt-flex operation & practical advanced	PR2	4,67	6	Longer course preferred	Include routine overhauls			
244	74419	Common	engine rt-flex operation & practical advanced	PR2	4,67	6	More hands-on (general)				
245	67816	Internal	transverse thruster overhaul	PRO	10,67	3	Too slow-paced course	Present cases with examples from the field	Instructor had insufficient proficiency in grammar	More theoretical training could expedite hands-on training	
246	67816	Internal	transverse thruster overhaul	PRO	10,67	3	Too slow-paced course	Too repetitive presentation	Was familiar with most of the practical things due to academic studies		
247	70624	External	engine control system	PRX	2,00	5	Longer course preferred	More hands-on			

			(wecs 7500)					(general)			
248	70624	External	engine control system (wecs 7500)	PRX	2,00	5	Longer course preferred				
249	70624	External	engine control system (wecs 7500)	PRX	2,00	5	More info about C-tank manufacturing process				
250	70624	External	engine control system (wecs 7500)	PRX	2,00	5	Cover some other in addition to Viking Grace				
251	70624	External	engine control system (wecs 7500)	PRX	2,00	5	More info about C-tank manufacturing process				
252	74158	External	engine w50df operation advanced	PR4	4,67	5	Electricians and 3rd engineers need more hands-on and electrical training				
253	74158	External	engine w50df operation advanced	PR4	4,67	5	Move practical sessions to afternoon				
254	64880	Internal	engine w20 operation intermediate internal	PR4	4,67	5	More info about product updates	Bulletins			
255	70310	Common	engine rt-flex operation & practical advanced	PR2	4,67	4	Simulator differs from the real engine	Implement comments from operating staff to training delivery			
256	71787	External	engine w32 operation advanced	PR4	4,67	5	Would be nice to have 32 block to work on				
257	69719	External	engine w46f operation	PR4	4,67	5	More hands-on (general)				

			advanced								
258	69719	External	engine w46f operation advanced	PR4	4,67	5	Would be great to see a working engine and see what issues it has had				
259	69719	External	engine w46f operation advanced	PR4	4,67	5	More hands-on (general)				
260	69719	External	engine w46f operation advanced	PR4	4,67	5	One day training on electrical systems is not enough for mechanical engineers				
261	73034	External	engine wv32 practical	PR4	4,67	11	More hands-on (general)				
262	73034	External	engine wv32 practical	PR4	4,67	11	Longer course preferred				
263	64961	Internal	engine room performance evaluation and troubleshooting internal	ENR	4,67	4	Similar courses for power plant too				
264	64961	Internal	engine room performance evaluation and troubleshooting internal	ENR	4,67	4	More component evaluation				
265	64961	Internal	engine room performance evaluation and troubleshooting internal	ENR	4,67	4	More simulator training				
266	69995	Internal	engine w46f operation intermediate internal	PR4	4,67	9	Wois presentation hard to follow because of assistant's english proficiency				

267	69995	Internal	engine w46f operation intermediate internal	PR4	4,67	9	Simulator training in shorter assignments				
268	69995	Internal	engine w46f operation intermediate internal	PR4	4,67	9	Smaller groups in practical training				
269	70771	Internal	propulsion hydraulics basic	PRO	1,87	4	More hands-on (general)				
270	74607	External	engine w50df practical	PR4	4,67	9	Show videos				
271	74607	External	engine w50df practical	PR4	4,67	9	More simulations				
272	70376	External	engine w46 common rail operation advanced	PR4	4,67	4	More troubleshooting				
273	70376	External	engine w46 common rail operation advanced	PR4	4,67	4	More troubleshooting				
274	72123	External	engine w34sg operation advanced	PR4	4,67	5	Instructor's accent and background noise hampered the understanding				
275	69900	Internal	unified controls (unic c1 and c2) internal	PRX	1,87	3	Material to be provided before the course starts, especially them which can be done outside of the classroom				
276	72412	External	controllable pitch propellers	PRO	2,80	6	Maximum number of participant				

							s better to be 6				
277	72412	External	controllable pitch propellers	PRO	2,80	6	Material to be provided before the course starts	Limit number of participants in a course			
278	71118	Common	engine rt-flex operation & practical advanced	PR2	4,67	4	Cover more detailed information about remote control engineering components, circuits etc. Needed for electro-tech-officers onboard ships				
279	71118	Common	engine rt-flex operation & practical advanced	PR2	4,67	4	More hands-on (general)	Keep theory unchanged without reducing time devoted for hands-on			
280	71118	Common	engine rt-flex operation & practical advanced	PR2	4,67	4	More simulator training				
281	70735	Common	engine rt-flex operation & practical advanced	PR2	4,67	6	More practical examples				
282	69986	Internal	engine room performance evaluation and troubleshooting internal	ENR	4,67	9	Update simulator to WOIS style control room	Add more examples of problems/create real solutions to problems found on			

								service jobs			
283	69986	Internal	engine room performance evaluation and troubleshooting internal	ENR	4,67	9	EIR simulator to be updated				
284	69986	Internal	engine room performance evaluation and troubleshooting internal	ENR	4,67	9	EIR simulator to be updated				
285	69986	Internal	engine room performance evaluation and troubleshooting internal	ENR	4,67	9	Add gas system materials into this course				
286	71792	Internal	customised course	EXT	4,67	3	Timetable to be provided beforehand	Explain the differences regarding engines in training and real circumstances			
287	71792	Internal	customised course	EXT	4,67	3	More Integrated systems				
288	71792	Internal	customised course	EXT	4,67	3	Want to get updated information				
289	70514	External	engine w34sg operation advanced	PR4	4,67	6	More hands-on (general)	More simulations			
290	73100	Common	customised course	EXT	2,80	7	False information provided. Ended up in a tailored customer course, which had				

							a level of advanced instead of basic				
291	73100	Common	customised course	EXT	2,80	7	Wrong information about course was provided				
292	74685	External	engine w50df operation advanced	PR4	4,67	9	More in-depth information and flowcharts to be provided on complex control system				
293	72062	Internal	propac control system, wichmatic ii, retrofit	PRO	0,93	4	Specific loading instructions preferred				
294	73201	Common	engine rt-flex practical & operation advanced	PR2	4,67	4	Use adjustable chairs				
295	70502	External	engine w200 basic	PR4	4,67	5	Conduct training on rig with specific rig equipments				
296	70502	External	engine w200 basic	PR4	4,67	5	Conduct training on rig	Present manufacturing site			
297	70502	External	engine w200 basic	PR4	4,67	5	Technicians to train specific practical skills				
298	73333	Common	engine rt-flex operation & practical advanced	PR2	4,67	4	Hard to understand mechanical movement without a picture or image				
299	73333	Common	engine rt-flex operation & practical advanced	PR2	4,67	4	Material to be provided before the course starts				

300	74254	External	engine w-x52/62/72 operation & practical	PR2	4,67	5	Videos about engine maintenance				
301	70625	External	engine w32 practical	PR4	4,67	6	Siesta room desired				
302	70625	External	engine w32 practical	PR4	4,67	6	More hands-on (general)				
303	68850	Internal	engine w50df practical internal	PR4	4,67	9	Practical hands-on components to be included more extensively				
304	70759	Internal	ambassador for service engineers	WOW	0,93	1	More participants				
305	69010	Internal	sealing system, lip and face type, theoretical and practical	PRO	4,67	6	ACU needed to get more information				
306	71181	Internal	vessel automation, variable speed drives, commissioning basic	ELC	4,67	7	More hands-on (VSD)				
307	71181	Internal	vessel automation, variable speed drives, commissioning basic	ELC	4,67	7	More time devoted for programming				
308	64541	Internal	technical fundamentals for non-technical persons internal	WOW	2,80	11	Longer course preferred	Outdated engines	Windows in classrooms	Area for fresh air	
309	64541	Internal	technical fundamentals for non-technical persons internal	WOW	2,80	11	Provide material in memory sticks	Name one toilet ladies only			

310	64541	Internal	technical fundamentals for non-technical persons internal	WOW	2,80	11	Provide accurate schedule beforehand				
311	64541	Internal	technical fundamentals for non-technical persons internal	WOW	2,80	11	Arrange a joint dinner for course members				
312	64541	Internal	technical fundamentals for non-technical persons internal	WOW	2,80	11	Longer course preferred				
313	64541	Internal	technical fundamentals for non-technical persons internal	WOW	2,80	11	Arrange this course in other locations too i.e. Americas				
314	64541	Internal	technical fundamentals for non-technical persons internal	WOW	2,80	11	Introduce some other parts too	Reduce theory on day 2			
315	70102	External	customised course	EXT	4,67	6	More troubleshooting				
316	70102	External	customised course	EXT	4,67	6	More hands-on (automation)	More automation related discussion			
317	70102	External	customised course	EXT	4,67	6	More automation				
318	70051	Internal	gas program module 2 internal	ENR	4,67	7	Split the course considering target group				
319	70051	Internal	gas program module 2 internal	ENR	4,67	7	More hands-on (general)				
320	74574	External	engine w46 common rail operation advanced	PR4	4,67	3	More training with WECSplorer				

321	74574	External	engine w46 common rail operation advanced	PR4	4,67	3	Bring some components to classroom for discussion				
322	74574	External	engine w46 common rail operation advanced	PR4	4,67	3	More hands-on (general)	More simulations			
323	69421	External	engine wv32 practical	PR4	4,67	5	Elaborate detailed causalities for specific malfunctions	Improve simulator	How to foresee and prevent major failures		
324	69421	External	engine wv32 practical	PR4	4,67	5	Improve simulator	More hands-on (general)	Theory to be related to real life situations		
325	71445	External	power plant (gas) electrification	POW	4,67	4	More practice on site				
326	67764	Internal	engine w50df operation intermediate internal	PR4	4,67	10	Would have good to have a one day UNIC - introduction with the use of simulator				
327	67764	Internal	engine w50df operation intermediate internal	PR4	4,67	10	Should have a course "UNIC C3 with control and commissioning with custom design"				
328	67764	Internal	engine w50df operation intermediate internal	PR4	4,67	10	There should be pre-assessment to know the capability of trainee				
329	73482	External	engine w50df operation	PR4	4,67	8	Reduce training on electronics	Increase hands-on			

			advanced					training on overhaul of additional items such as various bearings			
330	73482	External	engine w50df operation advanced	PR4	4,67	8	More hands-on (general)	A good balance 1,5 days of theory and 3,5 of hands-on			
331	65908	Internal	sulzer engine al20, s20, s20u theoretical internal	PR4	2,27	5	Include hands-on training in course				
332	65908	Internal	sulzer engine al20, s20, s20u theoretical internal	PR4	2,27	5	Include hands-on training in course				
333	71664	Common	engine rt-flex operation & practical advanced	PR2	4,67	9	Have a theory part in the morning and corresponding hands-on in the afternoon				
334	71664	Common	engine rt-flex operation & practical advanced	PR2	4,67	9	Have a theory part in the morning and corresponding hands-on in the afternoon				
335	71664	Common	engine rt-flex operation & practical advanced	PR2	4,67	9	Have a theory part in the morning and corresponding hands-on in the afternoon				
336	71664	Common	engine rt-flex	PR2	4,67	9	Have a theory				

			operation & practical advanced				part in the morning and corresponding hands-on in the afternoon				
337	71664	Common	engine rt-flex operation & practical advanced	PR2	4,67	9	Have a theory part in the morning and corresponding hands-on in the afternoon				
338	73611	External	engine rt-flex operation & practical advanced	PR2	4,67	8	Longer course preferred				
339	71666	Common	engine rt-flex operation	PR2	4,27	5	More simulator training				
340	72976	Common	customised course	EXT	4,67	4	More hands-on (automation)	More hands-on (sensors)			
341	72976	Common	customised course	EXT	4,67	4	More hands-on (general)	Accurate schedule to be provided beforehand	Material to be provided before the course starts		
342	74139	Common	customised course	EXT	4,67	9	Modify slides to correspond customer specific installations				
343	74139	Common	customised course	EXT	4,67	9	More hands-on (overhauling of main end bearing)				
344	70235	Internal	field service engineers (fse) reporting	WOW	0,93	15	More interaction to ensure understanding				
345	69617	External	engine w50df operation	PR4	4,67	6	More hands-on (general)				

			advanced								
346	69617	External	engine w50df operation advanced	PR4	4,67	6	More hands-on (general)				
347	69617	External	engine w50df operation advanced	PR4	4,67	6	More hands-on (general)				
348	70739	External	engine w50df operation advanced	PR4	4,67	3	Include DF engine failure statistics				
349	71235	External	engine w32 practical	PR4	4,67	5	Longer course preferred				
350	71235	External	engine w32 practical	PR4	4,67	5	Longer course preferred				
351	71235	External	engine w32 practical	PR4	4,67	5	Longer course preferred				
352	70233	Internal	zero injury training workshop	HES	0,47	15	Provide possible solutions to hazards				
353	74461	External	engine w32 operation advanced	PR4	4,67	2	Shorter course preferred	Smaller group sizes			
354	74461	External	engine w32 operation advanced	PR4	4,67	2	Do not grow group size				
355	73989	External	engine w46f operation advanced	PR4	4,67	3	Shorter course preferred	Reduce number of breaks or increase training hours per day			
356	73989	External	engine w46f operation advanced	PR4	4,67	3	More hands-on (automation & control)				
357	71175	Internal	vessel automation, integrate	ELC	9,33	9	Facilities were not prepared				

			d automation system (ias) & power management system (pms), commissioning basic								
358	71175	Internal	vessel automation, integrated automation system (ias) & power management system (pms), commissioning basic	ELC	9,33	9	More training equipment are needed for exercises				
359	71175	Internal	vessel automation, integrated automation system (ias) & power management system (pms), commissioning basic	ELC	9,33	9	Server was a old version and didn't work properly with configured system				
360	71175	Internal	vessel automation, integrated automation system (ias) & power management system (pms), commissioning basic	ELC	9,33	9	More simulator training				
361	71175	Internal	vessel automation,	ELC	9,33	9	Equipments should be ready	Divide such a long			

			integrated automation system (ias) & power management system (pms), commissioning basic				and up-to-date when course commences	course into two or three parts over the year, learn -> work -> learn			
362	71106	External	unified controls (unic c2)	PRX	1,87	2	More troubleshooting				
363	71207	External	engine w50df practical	PR4	4,67	5	Maintenance troubleshooting				
364	71207	External	engine w50df practical	PR4	4,67	5	More hands-on (general)	1 day of theory & 4 days of hands-on suggested			
365	69988	Internal	engine w50df practical internal	PR4	4,67	5	More topics of electronics to be discussed				
366	72413	External	controllable pitch propellers	PRO	2,80	6	Longer course preferred	CPP system hard to understand			
367	72413	External	controllable pitch propellers	PRO	2,80	6	More work benches				
368	69946	Internal	oily water separation (ows) and oily water treatment (owt) operation intermediate internal	PRX	2,80	4	Longer course preferred	Include videos			
369	70737	External	engine w32 operation advanced	PR4	4,67	5	More hands-on (general)	Less theory			
370	74655	External	engine rt-flex operation &	PR2	4,67	7	Arrange theory in the morning				

			practical advanced				and hands-on in the afternoon				
371	74655	External	engine rt-flex operation & practical advanced	PR2	4,67	7	Afternoon sessions to be about hands-on				
372	72739	Internal	controllable pitch propeller (cpp) and steerable thruster (stt) hydraulics advanced	PRO	4,27	4	Provide suggestions for self-study				
373	70783	Internal	ambassador for service engineers	WOW	1,87	2	More office people to attend on courses				

APPENDIX 2. Observations: Technical fundamentals

Classroom

- Pre-study material and training might not be enough for taking a course.
- As far as I know, there is no extra optional or recommended study material available for those people, who might be interested in studying them.
- The most effective way to get people's attention was to run 3D-animations on engines, that really "ignited" atmosphere → could classroom training be based on those? (To be noted, animations need to be improved in terms of functionality, applicability and ductility)
- It is recommended to get rid of boards (bad handwriting, blurry drawings etc.)
- Currently training is conducted by applying 1st) Power Point, 2nd) Board and 3rd) other supportive material i.e. 3D-animations.
- People are craving for explosion photos.
- The training today is very trainer-centred → should we consider moving the focus from trainer to studied product and interaction?
- Print outs are mere provided support material.
- People were interested in option to have look at the training material beforehand. They told it may have improved their insight on subject and speeding up absorbing new information in classroom setting.
- People need to get involved in training. Some of them are struggling to follow the lecture → how could the interaction be enhanced? Seat-table positioning? Different lecturing strategies?
- Some of the slides were very tedious, contained too much information and were hard to follow.
- There were few 2D-videos/animations, they were not enough to illustrate filter in operation though.
- Quality of animated photos more or less poor.
- People told that it would be appreciated to have a list of links etc. for deepening and broadening their knowledge on certain systems, components etc.
-Engine ignition was delivered smoothly; a great mix of verbal presentation and visual aids (animation, even though quality was poor).
-Should course feedback be collected before the end of course?

Hands-on

-Very unpractical to provide support material for hands-on training in form of brochures → get rid of those.
- Incorporate technology into presentation. Consider utilizing displays mounted next to engines for demonstrating functionality, show customer specific drawings etc. Displays and/or Ipads?
- Verbal presentation is lacking illustration and impressiveness. In addition, it is very time consuming, boring and clumsy.
- There are not any visual aids to follow training in hands-on excluding the engines.
- Should simulation be part of every course?
- Illogical policy not to wear protective glasses and a helmet.
- Shall we consider providing instructions for hands-on training in addition to supervisor's guidance? (Electronic drawings, manuals, animations etc.) Basically people had no idea of what they were doing in hands-on training.
- Is it common policy to let people operate without trainer's presence and guidance?
- Especially technicians could find it handy to have instructions downloaded to their Ipads while operating.

Other

- Course classification needs to be checked and re-evaluated
- External consultant to evaluate training processes and methods (pedagogically).
- Some courses are overscheduled, on the contrary some of them are under-scheduled → consider revising course schedules. Generalization: More automation is involved in training, more time is consumed.
- Study, how many trainers have received pedagogic training or wish to receive such training?

APPENDIX 3. Observations: Electrical and automation systems

- It is good to give a shot for participants to express their wishes on topics to be addressed in a coming week, at least I thought in the first place. Reconsidering it, may this lead to not fulfilling all course objectives and getting sideways from the topic?
- Should hands-on training be accommodated to every single course?
- A lot of outdated products in hands-on facility
-We are utilizing occasionally material created by supplier (in this case ABB and Vamp) to present systems which are relevant for use our products. It cannot be that way, or at least should not be.
- Material in electrical systems courses (at least in this one, reportedly in others in this area too) is insufficient, therefore material needs to be compiled by trainer himself. -> We have to start creating material for those courses, which trainer could use as a foundation and complement it with his/her own slides, right? If we are lacking expertise in a certain area, could we consult RD or product support?
-Moreover, electrical systems material is outdated very often as technology evolves faster over the time compared to mechanical systems. Shall we revise material validity i.e. in every 4 years, even if there is not input from trainer or by new product launch?
- I think we should listen more carefully to trainers in terms of material creation.
- Do we want to allow speaking any other language than English for question & answer, if all the participants are not speaking the same language?
- Some slides contained animations running constantly to support PP bullets, which was definitely positive.
- The way of thinking: A person has not done a course, he/she knows nothing about it and other way around. -> Improve ongoing learning.
- It would be handy to have a brief summary of addressed issues at the end of each slideshow.
- In the worst case, we train people to understand our supplier's product, but we are not providing information of how they function with our products.
- Do we sell e-learning to external customers?
- Could the company's trainers go to secondment? Especially those who do not have experience from the field.
- Are we or should we assess trainers expertise, aptitude and his/her learning on constant basis?

- For those people who do not speaking English as their first language or are lacking vocabulary in a certain area of expertise, might appreciate to have a list of relevant terms and their meaning for following the instruction
- As previously discussed include links to slides for further study.
- One cannot basically have too much explosion photos.
- Lack of interaction was obvious. It only occurred when someone had to pose a question for further information / elaboration.
- Some slides have some irrelevant information
- Is it appropriate to have supplier arranged training?
- Conversation rarely catches fire.
- Very monolithic training delivery method -> Diversify training.
- Sometimes we have training oversupply/undersupply
- 100 % classroom-based training for a whole week make people fed up
- We have products based our design, but we are not able to train people to use them properly
- People's involvement and enthusiasm vary a lot in hands-on
- Course assessment: Who is drawing up exams? Are we tracking people's performance? -> If not, develop a system. That way we could assess how a course matches to people skills, their learning etc.
- Is it possible not to pass a course?
- Discussion with participants concerning the need of classroom:
    - People value a possibility to ask questions, get further explanation etc. in other words, attributes enabled by physical presence
    - People really would like to have preliminary course material
    - People cannot find courses which are useful for them considering their position
    - People want to have more training material, especially they who are working in the field and have a lot of spare time on flights and evenings.
    - As already stated, the material of electrical systems is insufficient

-In addition, there are courses which do not have a proper course material framework available, therefore the trainer has to compile material himself, which may lead to failure in terms of meeting course specification.

APPENDIX 4. Questionnaire: Trainers

Interviewee:

Job title:

A brief job description:

Country:

Years in current position:

Years at the company:

Number of courses conducted (approximately):

CURRENT STATE OF TRAINING

1) What are the most positive things in training at the moment (schedule, technology, structure, material, participants' motivation etc.)?

2) What are the easiest and the least time-consuming things to train in courses?

3) Please explain in your own words, why they have been such?

4) What are the most difficult and time-consuming things to train?

5) Please explain in your own words, why they have been such?

6) Do you think course schedule is allocated wisely (classroom/hands-on)? If not, how would you allocate it?

7) In general, do you think, people have required set of preliminary skills and knowledge when they're participating in course?

8) Have people asked for additional study material for deepening and broadening their knowledge on studied topic? Please explain.

9) Are you happy with the quality of support material i.e. print outs? Do you think, they are informative enough for course participants?

10) Are you utilizing visual aids (animations, videos, explosion images etc.) in training? If yes, what kind of and how extensively?

11) Is there enough interaction between trainer and course participants? Please explain.

12) Are you happy with the training, where trainer is a centre of attention? Please explain.

13) Currently training is conducted with verbal presentation, power point and board in classroom. Is that the most efficient and informative way to do it? Please explain.

14) Have you received any pedagogic training? If yes, please explain. Please let me know, if you wish company to arrange you pedagogic training.

15) Do you think, that the learning objectives can be met, no matter in which location the training is taking place or who's the instructor? Please explain why / why not.

16) Do you think your language proficiency has had any impact on the quality of training?

17) Occasionally translator is needed in training. Please explain in your own words, what sort of impacts it had on training. Can you suggest any corrective actions what it comes to translator?

18) Is there anything else you'd like to say about current state of training (positive/negative)? Please explain.

DEVELOPMENT OF TRAINING

19) Please list three things from the trainer's point of view, which you wish not to be altered in training.

20) Please list three things from the trainer point of view, which you wish to be altered in training.

21) Would you like to provide course material in advance for course participants so they could have a look on it before the course?

22) Do you think it would be better for course participants to have all course material on their laptops or Ipads instead of printouts?

23) Would you like to have more interactive training? If yes, how would you accomplish it?

24) Are you happy with current seat-table positioning, which resembles the one in high school? If not, please propose your idea.

25) Today training is very trainer-centred, especially in classroom. Do you wish the focus was more on products and interaction?

26) In hands-on training, would you apply IT-technology, if it was available? For instance, demonstrating piston functionality on TV display/Ipad with top-quality animation while standing next to actual component, showing customer specific drawings etc.

27) Do you think such technology would improve quality of training and speed up training process?

28) If we could apply 3D-technology in training, would you consider it as a major improvement for training quality and study results? Please explain how and why.

29) Do you think course participants would provide deeper and more constructive feedback, if it was collected, for instance, after the lunch break on the last day of course (Please note question 31)?

30) Do you think current course feedback form provides an opportunity for course participants to express themselves so comprehensively, that their feedback can be utilized to develop training? Please explain.

31) What do you think, should we develop our course feedback form further? If yes, what's your opinion on collecting course feedback online after course and grant a course certificate upon feedback? This applies in such cases where customer has e-mail address. Please explain.

32) Any other suggestions on training development?

HOLOGRAM TECHNOLOGY

33) How do you understand a concept of hologram? Please explain in your own words. Please note there's no right correct answer and a textbook-like answer is not sought.

34) How do you conceive holograms regarding training?

35) If we had a hologram technology available in training, how would you apply it?

36) Do you think hologram technology could be utilized in training? How?

37) Do you think it's necessary that hologram is visible to naked eye? That means glasses or headset are not needed. Please motivate your answer.

38) Would you like to train people by means of such technology, if the wearables e.g. glasses or headset were required for 3D-experience? You can consider a 3D-movie in cinema as a reference.

39) Generally speaking, do you think we need 3D-experience in order to enhance and quicken people's learning process, hence improve the quality of training services and shorten working hours elapsed on one course?

40) Is there anything you'd like to let me know what it comes to 3D-experience and holograms in training? Please express yourself freely.

APPENDIX 5. Questionnaire: Internal Customers

Interviewee:

Job title:

A brief job description:

Country:

Years in current position:

Years at the company:

Number of courses attended: a) 0-1 b) 2-5 c) 6-10 d) 10+

CURRENT STATE OF TRAINING

1) Which things you have considered the most positive in courses (schedule, technology, material, structure, trainers' expertise etc.)?

2) What have been easiest and the least time-consuming things to learn in courses?

3) Please explain in your own words, why they have been such?

4) What have been the most difficult things to learn in courses?

5) Please explain in your own words, why they have been such?

6) Do you think course schedule is allocated wisely (classroom/hands-on)? If not, how would you allocate it as a customer?

7) In general, have you had sufficient preliminary skills and knowledge, when participating in course?

8) Did you wish that you were provided additional study material for deepening and widening your knowledge on topic?

9) Are you happy with the quality of support material e.g. print outs? Do you think, they contain all relevant information?

10) Have there been enough visual aids (animations, videos, explosion images etc.) to follow training and to enhance your learning? If not, what kind of aids you wished to have?

11) Have there been enough interaction between trainer and course participants? Please explain.

12) Are you happy with the training, where trainer is a centre of attention? Please explain.

13) Currently training is conducted with verbal presentation, power point and board in classroom. Is that the most efficient and informative way to do it? Please explain.

14) Are trainers' pedagogic skills on sufficient level in your opinion?

15) Do you think that course location or instructor has any impact on your learning outcomes?

16) Has instructor's language proficiency had impact on the quality of training?

17) Have you participated in any course where translator has been involved? If yes, please explain in your own words, how it affected to quality of training?

18) Is there anything else you'd like to say about current state of training (positive/negative)? Please explain.

DEVELOPMENT OF TRAINING

19) Please list three things from your point of view in training, which you wish not to be altered in training.

20) Please list three things from your point of view, which you wish to be altered in training.

21) If course material were provided you in advance, would you have a look on it before the course?

22) Do you wish to have all course material on your laptop/Ipad instead of printouts?

23) Would you like to have more interactive training? If yes, how would you accomplish it?

24) Are you happy with current seat-table positioning, which resembles the one in high school? If not, please propose your idea.

25) Today training is very trainer-centred, especially in classroom. Do you wish the focus was more on products and interaction?

26) In hands-on training, would you like to have IT-technology applied? For instance, watching top-quality animation about piston functionality on TV display/Ipad while standing next to actual component, seeing your customer specific drawings while working with the engine etc.

27) Do you think such technology would improve your learning and speed up absorbing information?

28) If we could apply 3D –technology in training, would you consider it a major advantage for your learning? Could it assist you to understand i.e. engine technology more thoroughly and quicker? Please explain how and why.

29) Would you provide deeper and more constructive course feedback, if you had opportunity to fill out feedback form, for instance, after the lunch break on the last day of course (Please note question 31)?

30) Do you think that current feedback form provides you an opportunity to express yourself comprehensively enough, so your feedback could be utilized for training development? Please explain.

31) If we developed our course feedback further, collected it after course online and granted you a course certificate upon feedback, providing you have e-mail address, what would you think about it? Would you engage to it? Do you think it would help us to improve quality of training? Please explain.

32) Any other suggestions on training development?

HOLOGRAM TECHNOLOGY

33) How do you understand a concept of hologram? Please explain in your own words. Please note there's no right answer and a textbook-like answer is not sought.

34) How do you conceive holograms regarding training?

35) If we had a hologram technology available, how do you wish and/or expect us to apply it?

36) Do you wish us to utilize hologram technology for your learning?

37) Do you think it's necessary that hologram is visible to naked eye? That means glasses or headset are not needed. Please motivate your answer.

38) Would you like to have training being conducted by means of technology, which requires wearables e.g. glasses or headset enabling 3D-experience? You can consider a 3D-movie in cinema as a reference.

39) Generally speaking, do you think having 3D-experience would enhance and quicken your learning process? That means you would get more out of course in shorter period of time than you've done previously.

40) Is there anything you'd like to let me know what it comes to 3D-experience and holograms in training? Please express yourself freely.

APPENDIX 6. Questionnaire: Hologram technology companies

1. Does your product provide 3D-experience for viewers?

2. If yes, can we move around an object and still retain 3D-view or do we just see a flat image instead?

3. Are 3D-glasses or any other wearable technology required?

4. Is the hologram live or pre-recorded? For instance, can we demonstrate features of, in this case engine, in a real-time which are not pre-recorded?

5. Could we use your technology in a classroom setting? Is it possible to be used in meeting room too?

6. If not, in what sort of fixed setting could we use it?

7. What are the requirements for the use of your technology? (room, lighting, etc.)

8. Does your technology allow us to beam a product or an instructor to another location?

9. Please provide us approximate price estimation. (i.e. 1.000€ / 10.000-50.000€ / 50.000-200.000€ / 200.000€+)