SAFE WORKING WITH FORKLIFTS

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

FATIH EREL

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
OCCUPATIONAL HEALTH AND SAFETY

JUNE 2019

Approval of the thesis:

SAFE WORKING WITH FORKLIFTS

submitted by **FATIH EREL** in partial fulfillment of the requirements for the degree of **Master of Science in Occupational Health and Safety Department, Middle East Technical University** by,

Prof. Dr. Halil Kalıpçılar
Dean, Graduate School of **Natural and Applied Sciences** _____

Prof. Dr. Mahmut Parlaktuna
Head of Department, **Occupational Health and Safety** _____

Prof. Dr. Türker Özkan
Supervisor, **Occupational Health and Safety, METU** _____

Examining Committee Members:

Assoc. Prof. Dr. Bahar Öz
Psychology, METU _____

Prof. Dr. Türker Özkan
Occupational Health and Safety, METU _____

Dr. Pınar Bıçaksız
Psychology, Çankaya University _____

Date: 17.06.2019

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Surname: Fatih Erel

Signature:

ABSTRACT

SAFE WORKING WITH FORKLIFTS

Erel, Fatih
Master of Science, Occupational Health and Safety
Supervisor: Prof. Dr. Türker Özkan

June 2019, 78 pages

The importance of forklifts is undeniable in working life, especially when the stacking and internal transport system of a factory are considered. Taking note of this, high-income countries have developed lots of means to deal with forklifts until today. In Turkey, forklifts are dealt under the scope of work equipment which is far from guidance and promotion of positive driver behaviours and skills. In this study, human factors resulting in work accidents are investigated with Forklift Operator Behavior Questionnaire (FOBQ), Forklift Operator Skill Inventory (FOSI) and Effort-Reward Imbalance Model (ERI). This study is not limited to few cases where operator or mechanical failure that led to accident but instead provide forklift operators and their supervisors a reference, in other words guideline, for their work. FOBQ, FOSI and ERI, by which self-report driver behaviors and driver skills are investigated, provide a reference to every stakeholder in this manner. In the current study, no significant relationship found between age and study variables. In addition, there were positive and significant relationships between total number of work accidents and inattentiveness and similarly between total number of work accidents and effort-reward imbalance. When the relationship between effort-reward imbalance and two scales, namely driver behaviors and driver skills, positive and significant relationships were observed between effort-reward imbalance and inattentiveness, first factor of driver behaviors scale, and end-result violations, fourth factor of scale. No significant

relationship between effort-reward imbalance and driver skills was observed. Only inattentiveness, among other FOBQ and FOSI factors could predict forklift-related work accidents significantly. Unlike what was expected, there was no significant relationship between rule-based violations and forklift-related work accidents. The current study was limited to only a few sectors and counter-balanced forklifts. It is highly recommended that further studies should focus on different types of forklifts operated at different type of sectors.

Keywords: Forklift, Work Accident, Forklift Operator Behavior Questionnaire, Forklift Operator Skill Inventory, Effort- Reward Imbalance Model

ÖZ

FORKLİFTLERLE GÜVENLİ ÇALIŞMA

Erel, Fatih
Yüksek Lisans, İş Sağlığı ve Güvenliği
Tez Danışmanı: Prof. Dr. Türker Özkan

Haziran 2019, 78 sayfa

Forkliftler, özellikle fabrikalardaki istifleme ve iç nakliye işlemleri düşünüldüğünde iş hayatında vazgeçilmez bir yere sahiptir. Bunun farkında olan gelir düzeyi yüksek ülkeler günümüze kadar forkliftlerle çalışmada birçok yol ve yöntem geliştirmiştir. Türkiye'de forkliftler iş ekipmanı kapsamında ele alınmaktadır ve mevcut yaklaşım pozitif sürücü davranışları ve becerilerinin rehberliği ve teşvikinden oldukça uzaktır. Bu çalışmada iş kazalarına sebep olan insan faktörlerinin Forklift Operatörü Davranışları Anketi (FOBQ), Forklift Operatörü Beceri Envanteri (FOSI) ve Çaba-Ödül Dengesizliği Modeli (ERI) ile incelenmiştir. Bu çalışma, operatör veya mekanik bir arızanın kazaya sebep olduğu birkaç vaka ile sınırlı değildir, bilakis forklift operatörleri ve denetçilerine işlerinde bir kaynak, diğer bir deyimle rehber teşkil edecektir. Öz-beyana dayalı sürücü davranışları ve sürücü becerilerinin incelendiği FOBQ ve FOSI alandaki her paydaşa bu anlamda kaynak teşkil etmektedir. Mevcut çalışmada yaşla çalışma değişkenleri arasında anlamlı bir ilişki görülmemiştir. Bununla birlikte kaza sayıları ile dalgınlık arasında ve yine kaza sayıları ile çaba-ödül dengesizliği arasında pozitif ve anlamlı bir ilişki bulunmuştur. Çaba-ödül dengesizliği ile sürücü davranışları ile sürücü becerileri arasındaki ilişkiye bakıldığında ise çaba ödül dengesizliği ile sürücü davranışları ölçeğinin birinci faktör olan dalgınlık ve dördüncü faktörü olan zorunluluktan kaynaklanan ihlaller arasında pozitif ve anlamlı bir ilişki bulunmaktadır. Çaba-ödül dengesizliği ile sürücü becerileri arasında ise

anlamlı bir ilişki bulunmamaktadır. FOBQ ve FOSI faktörlerinden yalnızca dalgınlık forklift kaynaklı kazaları anlamlı bir şekilde yordamıştır. Beklenin aksine belirlenmiş prosedürlere uymamak ile forklift kaynaklı kazalar arasında anlamlı bir ilişki görülmemiştir. Mevcut çalışma sadece karşı ağırlıklı forklift operatörleriyle gerçekleştirilmiş olup sınırlı sayıda sektörde uygulanmıştır. Gelecek çalışmalarda, mevcut çalışmanın farklı sektörlerde kullanılan farklı forklift tipleriyle ve forklift operatörlerine gerekli zaman ayrılarak tekrarlanması tavsiye edilmektedir.

Anahtar Kelimeler: Forklift, İş Kazası, Forklift Operatör Davranışları Anketi, Forklift Operatör Becerileri Envanteri, Çaba-Ödül Dengesizliği Modeli

To my mom

ACKNOWLEDGEMENTS

Master studies have never been that easy. To be able to focus on study, one should get a sound support from his environment. I had had one more thesis at work when I started this thesis which also required extensive commitment. Time to time, I was exhausted and felt bitter; there I found the unabated support of my mom.

Coming back to study itself, working with forklift operators is really tiring. In this, I would like to thank my colleague, Ekin Karakaya Özkan for her advises to work together with Yücel Yetişkin, Senior Research and Training Expert in an association. With his help I had the chance to outreach my targets.

I also would like to offer my gratitude to my colleague Kaan Çoktu, also my superior in Work Equipment division at my workplace. In most of the preparatory steps of thesis he always offered his help.

I should also mention my main helper throughout analysis and writing the thesis. İbrahim Öztürk, was not only helping also encouraging me. I guess the word facilitator is designed for him. You are truly amazing.

Finally, I have to say a few words about Prof.Dr. Türker Özkan. He has a great impact on broadening our horizon in every aspect of life. Since the very first day of my entrance to METU in 2007, I had not seen someone like him. For the thesis, especially during preparation phases, when I saw him just for 5 minutes it corresponded to 1 month of study. I am a big fan of his approach to research, he sincerely increased my motivation whenever I felt down.

TABLE OF CONTENTS

LIST OF TABLES

TABLES

LIST OF FIGURES

FIGURES

LIST OF ABBREVIATIONS

ABBREVIATIONS

DBQ	Driver Behavior Questionnaire
DSI	Driver Skill Inventory
ERI	Effort Reward Imbalance Model
FOBQ	Forklift Operator Behavior Questionnaire
FOSI	Forklift Operator Skill Inventory
ILO	International Labor Organization
İSDER	İstif Makineleri Distribütörleri ve İmalatçıları Derneği
LPG	Liquefied Petroleum Gas
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
OC	Overcommitment
SSI	Social Security Institution
SOP	Standard Operating Procedure

CHAPTER 1

INTRODUCTION

1.1. Overview

Following Industrial Revolution, emerging industries have led more workers to be involved in working life. Indicating a positive sign in employment, on the other hand, it also resulted in increased number of work accidents and occupational diseases.

Work accidents and occupational diseases cause more than 6,300 workers die every day (ILO, 2017) and not only physical and financial but also mental burden follow these accidents. Every day, people are dying in Turkey as a result of work accidents and occupational diseases. Workplace safety and health practices are of high importance since increasing industrialization in Turkey is an indication of increasing number of Turkish labor force being exposed to workplace risk factors. According to Social Security Institution (SSI) 2015 figures, out of 241,547 work accidents occurred in 2015; 1252 workers died whereas 3596 workers suffered permanent incapacity in Turkey.

In the interest of ensuring protection of workers from work-related injuries and illnesses as well as preventing accidents in the industry, legal instruments including OSH Act numbered 6331 and secondary legislation have been introduced in all sectors excluding only a few exemptions. Numerous work-related injuries, illnesses and property damages occur at different workplaces but due to underreporting or misclassification as a result of lack of thorough standards, or unfamiliarity with the existing guidelines, people in the field are not normally aware of such events and their actual or potential consequences.

All organizations have a moral obligation to ensure that employees and all other people affected by the company's actions remain safe at all times (Miller & Haslam, 2009). Occupational safety and health in the workplace affects the daily lives of individuals. The aim of safety and health management is to improve working conditions and workers' health in the workplace. In the course of implementation of occupational safety and health management at workplaces, work equipment are of due importance. Work equipment is defined in the Regulation of Health and Safety Requirements for the use of Work Equipment as any machinery, tool or installation for use at work while the use of work equipment is defined as any activity concerning start, stop, use, handling, repair, modification, maintenance, commissioning and grooming of work equipment. Since forklift is fitting this description, it is dealt under the scope of this Regulation, as well.

1.2. Forklift

Forklift is a vehicle that is commonly used throughout industry which has forks to raise and lower the load carried. Having capability of moving along narrow aisles, versatility in material handling and ease of operation continued to increase the utilization of forklifts. Therefore, it is one of the most familiar types of powered machinery used in industry. Its ability to shift heavy loads efficiently has led to its universal application within manufacturing plants, warehouses, freight terminals and trade environments.

Almost all counterbalanced powered industrial trucks supported at three points. Even vehicles with four wheels have the same structure. Steer axle of the vehicle is attached to vehicle however there is a pivot pin in the center of the axle. When imaginary lines are drawn that is connected to this point, a triangle is formed and that is called the triangle of stability. The truck's stability lies on the fact that center of gravity is within the triangle of stability which means that the vehicle is stable and no tip over will occur.

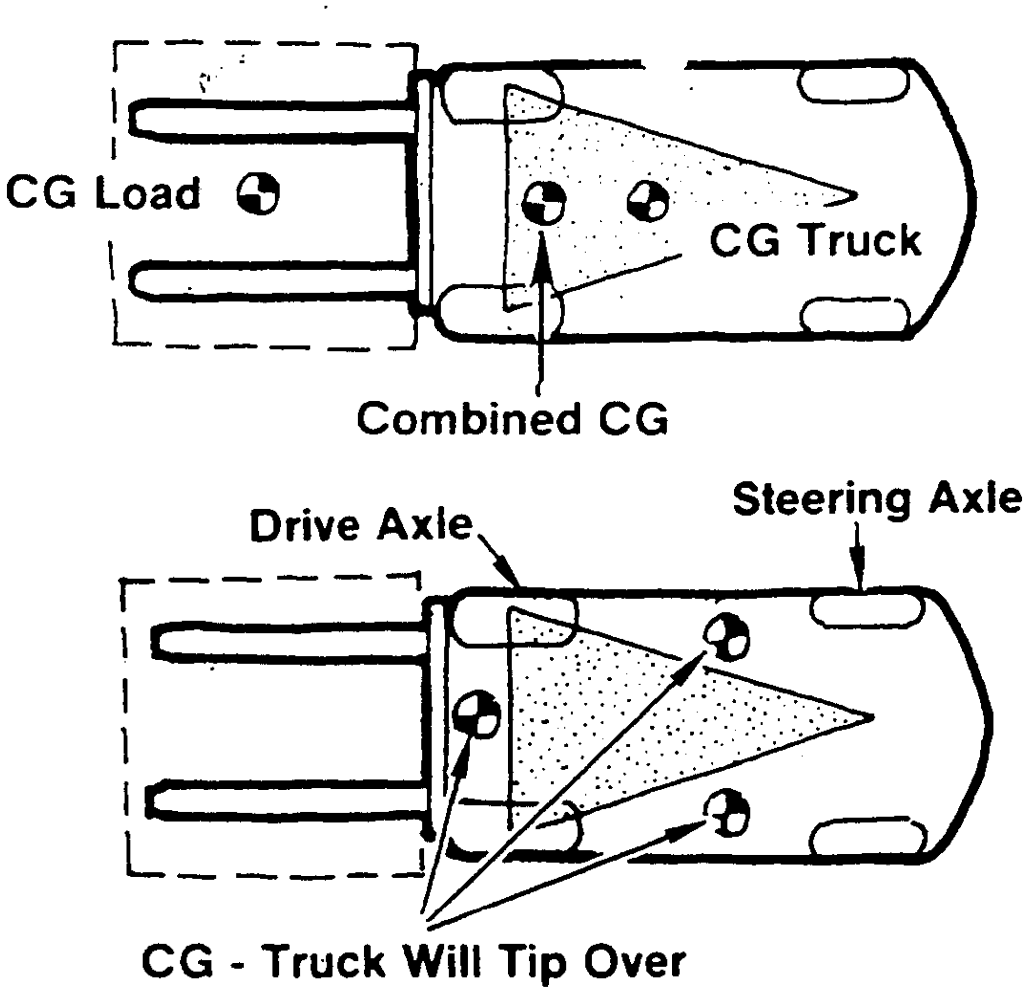

Figure 1.1 & 1.2: Forklift center of gravity

In 2012, 10,900 forklifts sold in Turkey while in 2013 this figure was 11,000 (İstif Makinaları Distribütörleri ve İmalatçıları Birliği [İSDER], 2013). Forklifts, when the incidents they took part in considered in addition to the advantages they provide, become an essential part of occupational safety and health. Almost every day, there occur near misses and minor accidents due to forklifts at workplaces. Unless necessary precautions are taken and/or implemented, major accidents and fatalities are inevitable. Forklifts often operate in confined spaces having to manoeuvre within narrow aisles, move in and out of crammed production line stations, ensure not to fall from tight loading ramps, etc. Most critically, pedestrians are often in the nearby

vicinity of working forklifts. The forklift operator has a lack of visibility due to blind spots caused by the forklift operator enclosure, forklift mast assembly and the forklift load carried. Such blind spots, as well as large forklift inertias and tight forklift operating areas, combine to make forklifts extremely accident prone. It should be well-noted that forklift operators have two tasks: to lift the load, carry it to the designated point and finally offload. This can be called as the main task. However, there is one more task they have to carry out which is driving. While carrying the load, they also have to keep track of the road and ensure a safe drive. Mostly due to rush, second part is underestimated.

1.2.1. Forklift Classification

According to Occupational Safety & Health Administration (OSHA) forklift classification:

- Class I: Electric Motor Rider Trucks
- Class II: Electric Motor Narrow Aisle Trucks
- Class III: Electric Motor Hand Trucks or Hand/Rider Trucks
- Class IV: Internal Combustion Engine Trucks (Solid/Cushion Tires)
- Class V: Internal Combustion Engine Trucks (Pneumatic Tires)
- Class VI: Electric and Internal Combustion Engine Tractors
- Class VII: Rough Terrain Forklift Trucks

While the classification above is globally accepted, there is also another one applied in Turkey. This is done based on power source. According to power source, forklifts are categorized into four groups which are diesel, gasoline-powered, LPG and battery powered. Both classifications are interchangeably used. In the current study, only forklift operators operating counter-weighted forklifts without specifying any of classifications above shall be used.

1.2.2. Forklift Operator

Forklift operator is any worker who is licensed and designated to perform following works within the frame of workplace:

- ✓ Before using forklift completes the daily routine checks including tail lights, fluid level for hydraulic systems, any leakage etc.
- ✓ Loads containers, boxes etc. efficiently from storage areas or trailers.
- ✓ Having completed loading procedures carries the load to the specified location following a pre-designated route. In the course of moving a load, obeys the safety rules. Complies with the regulations and standards.
- ✓ Maintains a neat work area.
- ✓ Ensures shipments are accurate and free of damage.

1.2.2.1. Pre-requirements for being a forklift operator

- ✓ To be regarded as a successful forklift operator, one must have a strong spatial awareness, a dedication to workplace safety and the ability to organize and sort with detail. Strong communication and technical skills are highly valuable.
- ✓ To be recruited, operator must have operator certificate and if he is to use the vehicle on the road then has to obtain Class G driver's license.

1.2.2.2. Stacking with forklift

Stacking is a term widely used for defining arrangement in a pile, typically a properly formed one. Though it is well-known, due to time and other constraints, it can be ignored or its importance can be underestimated. For proper and safe stacking, there are a few leading guidelines which defines safe stacking heights for various materials. Some of the guidelines are:

1. 1917.14 (OSHA standard) indicates while stacking cargo, pallets and other material stability against sliding and collapse should be provided.

2. NFPA standard states empty pallet stacking shall be restricted to 15 feet concerning fire risk.

3. The Civil Aviation Authority of Singapore puts a limit of 6 meters in height for stacking goods

4. The Asia Food Journal is more concerned with the integrity of a stored package and it can end up with erosion so they propose two solutions which are reducing stacking height or using possible means for extra strength.

Seeing some implementations from the world, it is better to check what safe stacking height depends on. There, one should get these info before determining such a safe height; what is being stacked, in what type of container is being used, what the total weight of package is, the loading capacity of floor, deck and shelving (there one should check static calculation), temperature and humidity conditions, the means the products will be lifted and carried. At this point, all the questions should be addressed in a risk assessment and severity of possible risks should be evaluated. In Turkey, the rules related with safe stacking are given in the Regulation of Safety and Health Requirements for the use of Work Equipment. Further details are given in a guidelines issued by the Occupational Safety and Health Research and Development Institute.

1.2.2.3. Workplace Traffic

Today's competitive world is putting pressure on employers as they need to deliver products on time. This triggers the pressure exerted on operators and sometimes leads them to overlook safety concerns. Forklifts were sixth major contributor in safety violations with regards to OSHA's ranking and in 2016, OSHA reported more than 2,800 violations related to forklifts. Although there are still employers who view forklift as an automobile, more basic problems like workplace arrangements to handle traffic and forklift-pedestrian intersections still remain. Taking into account the fact that in approximately 45% of forklift accidents pedestrians are involved according to the study conducted by Larsson and Rechnitzer (1994), forklifts should adjust their speed accordingly whenever there is a pedestrian nearby. Since pedestrian forklift

interactions at workplaces have not been dealt sufficiently, lots of major and fatal accidents took place. Assuming operators do not make any mistakes is not proper; professionals in this field state that engineering and administrative controls should be used altogether in combating risks. Janicak (1999) states that these interventions should include advanced logistics, traffic engineering and in-vehicle technologies.

1.2.3. Forklift accidents in the world

In Regulatory Impact Analysis conducted by Occupational Safety and Health Administration (OSHA) in 1995, it was stated that powered industrial truck accidents result in 85 fatalities and almost 35,000 serious injuries every year and 20 to 25 percent of these accidents were found to be caused by insufficient training. A study conducted in the Netherlands (2016), it was found that in 2016, there occurred around 1700 accidents where forklifts were involved, 150 accidents resulted in serious injury and these accidents leaded to 7 fatalities. Larsson and Rechnitzer (1994), only distinct safety focused forklift research, listed down the forklift accident types as; hit by forklift, fall from/by forklift, other forklift injury, overexertion. This causation is expected to be very similar in Turkey considering the fact that forklifts being used have same parts and used in similar work environments.

1.2.4. Forklift accidents in Turkey

In Turkey, Social Security Institution (SSI) publishes work accident data annually. Accidents registered through a scheme defined by the Institution are evaluated and listed in the website as yearbooks. However, since the classification in accident notification is risk based rather than a style that includes equipment type, the number of forklift involved in accidents is not announced officially.

1.2.5. Forklift in Turkish OSH Legislation

Within the scope of Turkish OSH Legislation, forklifts are dealt under regulation of Safety and Health Requirements for the use of Work Equipment. In this regulation, basic requirements for safe use of forklifts and periodic inspection criteria are stated in details. It should also be noted that Turkish legislation system switched to a new phase of legislation focusing more on consultation and rather drawing some borders for a framework rather than being restrictive.

In Turkey, work accidents are classified according to titles designated by Social Security Institution (SSI). As these titles not including forklifts directly, there is no specific data published in Turkey related with forklift accidents so far. Forklift accidents find place under the titles of injuries getting stuck under an object fell, injuries by motor vehicle roll over, hitting moving objects, getting stuck between moving objects and motor vehicle crashing a pedestrian.

1.2.6. Differences between Forklifts and Automobiles

In daily lives, people think that forklifts and automobiles have similar operating structure and are driven in the same manner. However, forklifts have some basic differences than automobiles. It should not be forgot that forklifts are equipment that stability is sacrificed for the sake of mobility. Some of the basic differences between forklifts and automobiles are listed in Table 1-1 below:

Table 1.1: Differences between forklifts and automobiles

Forklift	Automobile
Steers from rear	Most of the steers from front
Carries heavy loads	Only limited load in the baggage
Main task is to carry load	Main task is to keep the lane
Lower visibility due to load	High visibility
Low stability	High stability
Tip-over is highly possible	Tip-over is almost impossible

1.3. Human Factors

1.3.1. Introduction

Forklifts, whose use is almost inevitable for stacking, have been highly involved in workplace accidents since their first use in the industry. So far, there have been so many factors discussed for the root cause of forklift accidents yet sufficient focus has not been given to human factor. Not limited with forklift accidents, various accident causation theories have been developed to better analyze the accidents. Domino Theory, Human Factors Theory, Accident/Incident Theory, Epidemiological Theory, System Theory, Combination Theory and Behavioral Theory are the most widely used theories in the field. Domino Theory developed by Heinrich (1931), stating that accidents result from a couple of successive events, forming a line of dominoes, which are social environment, carelessness, unsafe conditions and acts.

Reason (1993) classified failures in two; active and latent failures. Classification is made with respect to who committed the failures and time needed to have a serious impact. Unlike latent failures, the active failures are more evident and unwanted consequences which emerge right after. Reason defines active failures as unsafe acts to the sharp end of the system.

Organizational accidents model of Reason (1993) showed that the chain of accident starts with administrative decisions and organizational process included political and economic climates of organization. Latent failures formed in this stage transferred by functional and departmental paths, and then reached the end of system. Although there were many unsafe acts, only a couple of them can pass behind the defenses.

Deliberate deviations from the controlled or organized practice were named as violations. The sharp end of the system intentionally went beyond the rules. Violations were divided into four respectively routine, reasonable, exceptional and deliberate violations. Routine violations comprised short cut of between task related points. The type of violations is not sufficient or in other words effective to analyze relationship between violations, work accident, and the safety culture. The all types of

violations included deliberately deviation from the task or plan. Therefore, in practice type of violations was not effective to determine effect on safety consequences. Instead of trying to make a distinct classification, the first and main differentiation between errors and violations makes more sense.

Errors, categorized into three in terms of prior intention and the way aimed and succeeded. For classifying errors, Reason (1990) proposed an algorithm consisting three questions including whether prior intention was included and whether action reached a success. Slips and lapses were errors when prior intention exists; yet, actions did not end up as planned. The slip and lapses are unintentional deviations from what was planned. Lapses were consequences of memory failures; whereas, the slips were related with attention deficits (Özkan & Lajunen, 2005). Mistakes were types of error where actions comply with a plan, but the plan does not go as it was intended. Mistakes come across when the end of system have not enough information or competency to structure their decisions. The errors and violations differed from each other by motivation. Informational processing failures were the reasoning of errors, while violation included willfulness, based on motivation. The errors could be avoided by training or memory aids and so on; whereas, in order to prevent violations, attitude changes were needed (Reason, 1993).

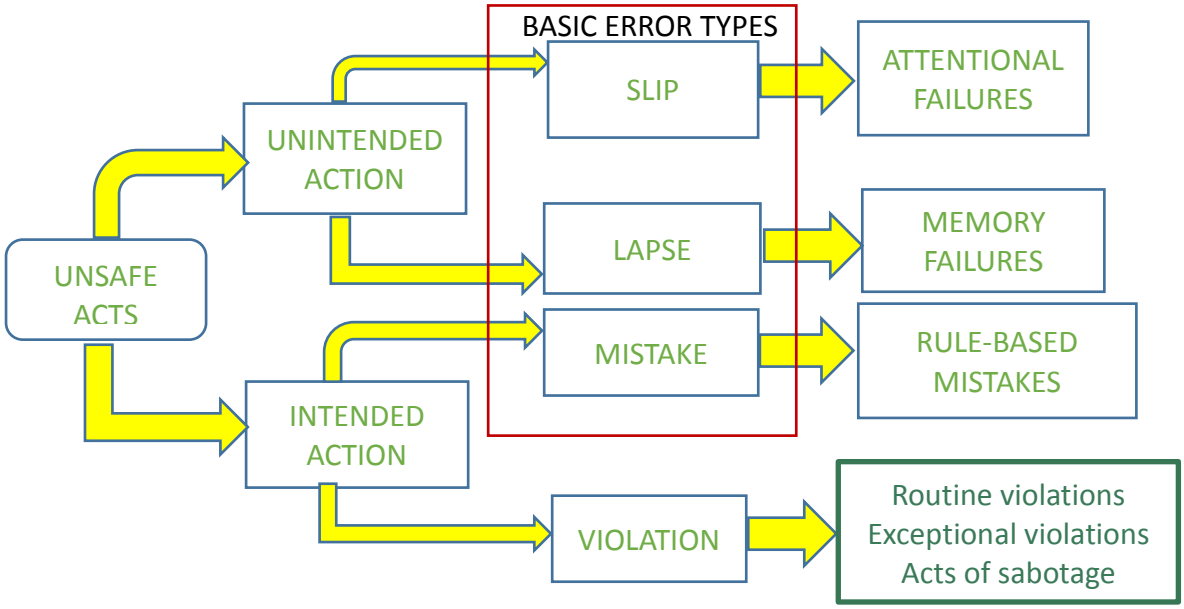

Figure 1.3: Reason's unsafe acts algorithm

Embrey (2005) states that in skill based failure recovery is rapid as the driver receives instant feedback and feedback system is emphasized. Feedback system there can be auditory and/or visual warnings. For skill-based failures, feedback system is evaluated more beneficial than training. When it comes to slips, lapses and skill-based errors, tasks and responsibilities, information flow in forms of instructions, safe operation procedures etc. need to be improved. In rule-based decision errors, instructive and informative training is considered functional. In addition, as procedural aids, checklists can be utilized. In case of decision errors that encourage risk taking, especially in high-risk tasks for operators to correctly identify the hazards, the training programme should include scenario based parts with illustration of potential hazards turning into risks. Standard operating procedures (SOP) are reported to be beneficial in identifying and alleviation of decision errors but, these procedures are not sufficient, safety culture should also be implemented. In Turkey, forklift operators are recruited mostly with an operator licenses. Unless the company is institutional, SOPs are not taken into force or not set up at all and operators are expected to show their experience while operating the forklifts.

Safe driving can be divided into two components, driving skills and driver behaviors. Cognitive and motor skills including maximum performance capabilities, do not always predict accident involvement, but it should be noted that motivational factors determine what drivers are doing or must do with their skills (Näätänen & Summala, 1974; Summala, 1985; Summala & Näätänen, 1988). This distinction corresponds to that between driver performance and driver behavior (Evans, 1991) and driving skills and driver style (Elander, West, & French, 1993).

1.3.2. Driver Behaviors

Two main types of drivers can be described: professional and non-professional drivers. While non-professional drivers are the ones using the vehicles without any commercial purposes, professional ones have a defined profession where they drive for working purposes. Due to the nature of their work, professional drivers spend more

time than non-professional drivers while driving and eventually have higher mileage. Yet, not much known about the differences between professional and non-professional drivers in terms of crash involvement and risky driving behaviours. Some researchers have shown that self-reported driving behavior and observed driving behavior have correlations (Helman & Reed, 2015; Zhao et al, 2012). Reason, Manstead, Stradling, Baxter, and Campbell (1990) showed errors, lapses and violations were three main risky driving behaviors factors. Afterwards, Lawton, Parker, Stradling, and Manstead (1997) added aggressive violations into these three factors.

In order to prevent forklift accidents caused by operators, risky behaviors and unsafe acts should be eliminated if possible, if not should be alleviated as much as it is possible. In this sense, reasoning behind unsafe acts and risky behaviors during driving should be investigated. Some of the accident predictors were reported as sensation seeking, personality, aggressive driving. To evaluate these various methods have been used including Neo Five Factor Inventory, Brief Sensation Seeking Scale, Zimbardo Time Perspective Inventory and Driver Behavior Questionnaire (DBQ). DBQ was originally developed by Reason et al. (1990) to evaluate driver behaviors affiliated to accident involvement. Originally, DBQ is made up of sub-scales determining driver errors, deliberate violations and rule-based violations. DBQ, widely used in traffic and transportation psychology, was developed based on Reason's human error algorithm. DBQ has been translated into many languages and almost two hundred studies used original DBQ or different versions (De Winter & Dodou, 2010) and (af Wåhlberg, Dorn, & Kline, 2011) state that DBQ is one of the most widely used driving behavior measurement instrument.

Several studies showed different factor structure for DBQ for professional drivers. In researches conducted by Davey, Wishart, Freeman & Watson (2007) and Sullman, Meadows, & Paio (2002), only ordinary violations were positively correlated to accidents. Maslac´, Antic, Lipovac, Pesic´, & Milutinovic (2018) found out that only lapses were positively associated with accidents, where professional drivers were involved, among five DBQ factors. Mehdizadeh, Shariat-Mohaymany, & Nordfjaern

(2019) stated that background variables including age, income and annual driving mileage and risky driving behaviors have been the most investigated variables on accident record and professional driving behaviors. Safe driving has been influenced by driver inattention. Some studies including the ones, Qu, Ge, Zhang, Zhao, & Zhang (2015) and Farner, Braitman, & Lund (2010) indicated that inattention is negatively affecting driver performance and a risk factor for accidents. In United States, a research made by Qu et al. (2015) showed that 10 to 33% of accidents were caused by inattention.

Maslac et al. (2018) states that depending on the research area and applied DBQ version greatly changes the results of studies. In this sense, so many cross cultural studies supporting the distinction between errors and violations have been conducted including the ones, Stanojevic, Lajunen, Jovanovic, Sârbescu, & Kostadinov (2018), Üzümcüoğlu, Özkan, & Lajunen (2018) and de Winter & Dodou (2016). Üzümcüoğlu et al. (2018) stated that individualism was negatively and significantly associated with non-speeding violations factor. In French example of DBQ, Guého, Granié & Abric (2014), in line with the literature, found out that younger drivers commit more violations. In their cross-cultural study with 41 countries, de Winter & Dodou (2016) also stated that countries with lower developmental indexes are corresponding to more aggressive violations.

1.3.3. Driving Skills

Combining sub-tasks including guidance, navigation and control makes driving a vehicle a complex task. After getting training from relevant institution, there comes a licensure. With the knowledge and practice gained at the training program and experiences in daily traffic in post-licensure period shapes the driver's driving skills. In traffic researches two human factors; namely driving skills and driving styles, are believed to explain a big part of individual differences in driving (Elander et al., 1993; Taubman-Ben-Ari, Mikulincer, & Gillath, 2004). For the driving skills; Lajunen (1997) states that driver skills which is accepted as another dimension of driving, has

the potential to determine the behavior of having a traffic accident either directly or by affecting driving style. Driving skills consist of both perceptual motor skills to control the vehicle and safety skills including risk evaluation and decision making. These two components in combination lead to respond in complex traffic cases. There are some basic skills for driving safely including using mirrors and signals properly, speed control and wearing seat belt throughout the journey. For example, according to a study carried out by Crundall, Underwood, & Chapman (1999) found out that while experienced drivers is keeping an eye on a wider range of road, relatively inexperienced drivers tend to keep track of a narrower area. Also Borowsky (2006) and Sagberg & Bjornskau (2006) indicated that experience on the road is improving driver's risk perception and hazard awareness. Similarly, Upahita, Wong, & Lum (2018) showed in their study that driving training and experience on the road is affecting the driver's ability to handle hazardous circumstances while driving. Active drivers were better performing in hazard detection and response.

Evaluation of driving skills by the individual does not always reflect the reality (McKenna, Stanier, & Lewis, 1991). For better illustration, in a study conducted in Finland, %90 of drivers indicated that they consider themselves better than an average driver (Näätänen & Summala, 1974). Perception that having high driving skills is known to give artificial being safe feeling even if the person has low safe driving skill. Because, it causes the driver to think having better control than actual case increases the artificial safety feeling by assuming other drivers have higher possibility of having an accident than the person. Bandura (1997) states that underestimation and overestimation are both risky because while first one can lead to unnecessary restriction, the other one can end up take part in activities beyond the driver's competence. As Freydier, Berthelon, and Bastien-Toniazzo (2016) indicated, higher experience leads to higher perceptual and cognitive skills. However, this is a slow process and attentional allocation and alignment with driving skills and task demands is included.

Although self-reports can sometimes be deceptive especially for novice driver, there have been several self-report instruments available for a standardized assessment of skills (Spolander (1983), Lajunen & Summala, 1995, Hatakka, Keskinen, Katila, and Laapotti's, 1991). Driver Skill Inventory (DSI), developed by Lajunen and Summala (1995), has been most frequently validated self-report instrument in this context in different countries, including United Kingdom (Lajunen, Parker, & Stradling, 1998b), Australia and Finland (Lajunen, Corry, Summala, & Hartley, 1998), Iran, Greece, Turkey (Warner, Özkan, Lajunen, and Tzamaloukas, 2013; Özkan, Lajunen, Chliaoutakis, Parker, and Summala, 2006) and China (Xu et al., 2018). Original DSI developed by Lajunen and Summala (1995) was with 29 items. Like the original DSI, DSI applied later for validation in different countries showed a two-factor structure: perceptual motor skills (PMS) and safety skills (SS). While safety skills imply necessary skills for drivers to refrain from possible accidents, perceptual motor skills are related to how to handle a vehicle. Driving skill perception changes from country to country. Zhang, Huang, Roetting, Wang, and Wei (2006) made a comparison between US drivers and Chinese drivers and found out that Chinese drivers perceived skill, age, gender and prompt reaction important for safe driving while US drivers stressed being aware of limitations and abilities, utilizing driving devices appropriately and friendly interaction with other drivers. Özkan et al. (2006), made a cross-cultural study on the differences between PMS and SS in accident involvement. Results showed a negative correlation in the Netherlands and Finland with regards to accident involvement, where PMS found to be positively correlated to accident involvement in Iran. Finally it is remarkable that Martinussen, Møller, Prato, and Haustein (2017) showed that DBQ and DSI were successful in predicting traffic accidents. Also as validated by Xu et al. (2018) is a valid tool that is used to measure driving skill and two factor structure of DSI showed cross-cultural reliability. It should also be noted that DSI or other self-reports are not the only option to measure driving skills, driving simulators are also being used (e.g. Martinussen et al., 2017). Although use of self-reports for measuring driving skills is still debatable, DSI, a reliable and the most used driver skill measurement tool, is thought to be beneficial.

1.3.4. Effort-Reward Imbalance Model (ERI)

Till today, researches have focused more on driver behaviors and driving skills. There are so many reasons behind leading drivers to different behaviors. One of those reasons for operators considered to be the relationship between job and operator. To assess this relationship there are several methods to be used. The ERI model, developed by Siegrist (1996), focuses on the effort and the reward gained at work at the same time. Model relies on the assumption that work related benefits or satisfaction and its effect on health depend on the reciprocal relationship between effort and reward. Effort is linked with work demands and liabilities and responsibilities the person has. On the other hand reward, reflects what employee gets out of what he did. Payment and appreciation may be given as examples to reward. The model concentrates rather on imbalance, where work is characterized by high effort spent and no or low reward. When the effort made and reward got at work are not equal, this can end up with negative stress among workers. Recent studies using ERI revealed that work stress is affecting workers' health like cellular immunity (Nakata, Takahashi, and Irie, 2011) and coronary diseases (Xu, Zhao, Guo, Guo, and Gao, 2010) In addition, it was shown that the relationship between effort and reward have impact on workers' work related attitudes, in particular job satisfaction (Li, Yang, Cheng, Siegrist, and Cho, 2005). Between 1997 and 2016, there have been 22 papers published researching the association between ERI and physiological indices of the cardiovascular system (Eddy, Wertheim, Kingsley, and Wright, 2017). In those studies ERI found to be affecting workers' health directly. ERI model is made up of three elements, respectively effort, reward, and overcommitment. While overcommitment is intrinsic, effort and reward are extrinsic constructs. Employees spend different levels of effort which can be observed through their job demands, work interruptions, responsibility, workload, time pressure and overtimes. Normally the level of effort spent is expected to be equal to rewards received by workers including job security and payment. Mismatch between effort and reward is called high cost-low gain (Bakker, Killmer, Siegrist, and Schaufeli, 2000). This is linked with high

turnover intentions and job dissatisfaction because of workers' emotional distress. Finally, OC is moderating the relation between ERI and the other study variables.

Last element; overcommitment is an intrinsic construct that is characterized by committing excessively such as to obligate beyond the ability for fulfillment and high need for approval. People more prone to overcommitment react more strongly when there is an existing effort-reward imbalance. According to Mark and Smith (2012) and Kinman and Jones (2008), overcommitment is a strong predictor for depression and anxiety.

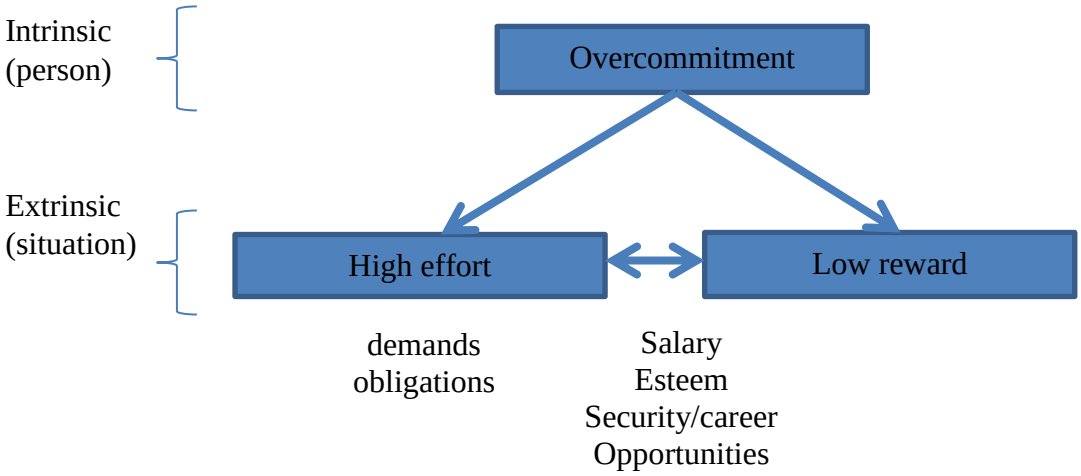

Figure 1.4: The ERI-Model: Relationship between Effort, Reward and Overcommitment (according to Siegrist 1996)

In Siegrist's model, overcommitment is assessed with six items which were utilized in the course of this study. In a study conducted by Mc Linton & Dollard (2010), they found out participants in Japan reported higher ERI scores than western samples which corresponded to higher aggression on road.

Forklift operators, do race with time. They always have to catch the planned schedule, both their workload is high and time allocated for the tasks are relatively low. While

evaluating the reasons directing forklift operators to aberrant behaviors, effort-reward imbalance consisting effort, reward and overcommitment should also be considered.

CHAPTER 2

STUDY 1: INVESTIGATION OF FORKLIFT ACCIDENTS IN TURKEY

2.1. Purpose

The aim of the study was to evaluate the underlying reasons for forklift accidents. Considering that every year around 10,000 forklifts are sold and put into service and every year forklift operators are dying because of lack of safety measures, the importance of issue can easily be seen.

2.2. Methods

SSI of Turkey, which is the public authority to issue work accident and occupational diseases statistics annually, does not publish equipment based work accident figures. This is due to the fact that European Statistics on Accidents at Work (ESAW) methodology is risk-based. However, for better operation of the studies, the reasoning of accidents in Turkey was needed. On this purpose, 2017 SSI yearbook, including work accident and occupational diseases data, was taken and forklift accidents were investigated manually by using keywords including "forklift, forklif, fortip, forlif" because of the fact that employers or employer representatives or the persons responsible for notifying work accidents do not have technical background or knowledge. Yet there were still missing accident notifications, so filters were made use however although several filters had been applied there were still some accidents missing in the final table. Therefore, manual scanning for 1633 forklift-related fatalities was benefited for double-check.

2.3. Results

In the scope this study, forklift accidents in Turkey only in 2017 were investigated. As stated above, in Turkey SSI, does not have a specific categorization for forklift

accidents rather risk based specification. With a specific permission taken from SSI, all raw accident data regarding 2017 was taken and all fatal accidents were read thoroughly. In 2017, 5167 forklift accidents were recorded. İstanbul leaded with 868 accidents, while in Kocaeli there have been 615 accidents and 475 in Bursa. 4828 male and 339 female worker have been injured or died in these accidents. Although there were no female operators involved in these accidents, female workers injured due to getting stuck between a surface and forklift or getting hit by a forklift. Yet not all of forklift accidents ended up with fatality. While some of these resulted in fatalities, the others led to injuries and absenteeism.

17 forklift accidents resulting in fatality were recorded and one more accident was accidentally recorded as a forklift accident although it was not. 5 of the accidents occurred in Istanbul while 2 in Adana and 1 in Bursa, Elazığ, Kocaeli, Gaziantep, Tekirdağ, Mersin, Ankara, İzmir, Balıkesir, Ordu and Malatya. It is remarkable that most of the accidents were concentrated on afternoon. 4 accidents were recorded between 07:00-11:00, while this figure is 7 for 11:00-16:00 and 6 for 16:00-19:00. Not a single accident reported after 7 PM.

Reasons for these accidents were;

- five cases forklift overturning and operator dying
- three cases getting stuck between forklift and the good to be loaded
- two cases collision (one in-house traffic and the other one road traffic)
- two cases inclined surface
- two cases forklift forks getting stabbed and killing the employees
- two cases raising employees and result fall from height

Three accidents happened outside workplace which means road traffic and fifteen accidents occurred inside the workplace. In five cases employees died had taken OSH training while thirteen had not taken them. All the operators died in these accidents

were male. 11 of them were at the level of primary school while 1 of them was literate, 3 of them high school and 3 of them graduated from a university. Finally, 6 of the accidents occurred in production sector, while 4 in construction sector, 4 in transportation and warehousing sector, 2 in wholesale and retail sector, 1 in agriculture and forestry and 1 in administrative and support sector.

2.4. Discussion

Looking at the reasons behind the forklift accidents in 2017, two fatal accidents were caused by the operation on the inclined surface. Working on inclined surface requires extra skills and proper training and also it should be noted that only theoretical training is not enough because unless an operator feels the instability operation on inclined surface with load, he will not be able to comprehend the possible risks ahead. 2017 forklift accident figures in Turkey say that three fatalities occurred due to collision, three cases due to getting stuck between forklift and the good to be loaded and two cases due to forklift forks getting stabbed. Briefly, the reason behind these accidents was either lacking procedures for those cases or not following the procedures. Two fatalities in 2017 occurred in Turkey due to cases raising employees and result fall from height. Normally, raising employees with forklift is prohibited by the Regulation of Safety and Health Requirements for the use of Work Equipment. However, since the employers do not want to spend for mobile elevating work platforms or other suitable means, forklift operators find themselves makeshift solutions. Findings of forklift accidents in 2017 in Turkey were utilized in Study 2 for development of instruments.

CHAPTER 3

STUDY 2: INSTRUMENT DEVELOPMENT FOR FORKLIFT OPERATORS

3.1. Purpose

In the literature, there have not been much documents and researches related with safety aspects of forklift and the way forklift operators are working. Other than a few countries presenting national data, forklift accidents have not been investigated thoroughly. In addition, researches are so limited when it comes to occupational safety and health, and the most distinct one conducted by Larsson and Rechnitzer (1994) was concentrated on segregation which is a term commonly used for separation of in-bounds traffic of pedestrians and forklifts. Similarly so far, to our best knowledge, since human behaviors on this issue have been ignored but technical specifications were time to time highlighted, there have been no studies in the world focusing on the relationship between human factor and forklift accidents. In this sense, main focus in current study was to develop DBQ & DSI designed specifically for forklift operators and to evaluate the underlying reasons for forklift related work accidents and secondary objective was to see how operators perceive effort-reward imbalance at work and this is linked with accidents.

3.2. Methods

3.2.1. Interviews

Following literature survey, as a second step to form up questionnaire statements, operators were asked about their opinions on underlying reasons for forklift accidents.

3.2.1.1. Demographics

In total ten operators were interviewed. All the operators were working in paint production sector, their ages ranged between 30 and 52. 8 operators were graduated from secondary school while other 2 were graduated from high school. All the operators got OSH training at their workplaces.

3.2.1.2. Context

Interviewees first asked about how many years they had been working as an operator, whether they had operator license or not, the skills they gained during those training programmes. Secondly, they were asked about the main causes of forklift accidents. All the operators stressed speed factor. According to them, high speed or sudden acceleration or deceleration could lead to serious accident.

Listing the reasons one by one, they were also asked their ideas about some precautions and their efficiencies like load diagram, loading ramps, what to do in a case of overturn. All replies recorded. Some examples given below:

Q: What about loading? Is it somehow related with accidents?

A: How come? It is our duty, an experienced operator can never make an accident.

Q: Assume that forklifts started to overturn. What would you do?

A: Immediately I get out of forklift.

Q: What is the hardest part of your job?

A: To catch up with the program. Most of the time, we are staying overtime.

Q: Do you think that rules are being implemented and followed everywhere?

A: To be honest even here (he thinks his workplace doing perfect in occupational safety and health) there were no rules 10 years before, yet with the time being, working conditions are getting better and better.

At first point, some of operators replied promptly: “I have never had accidents.” considering anything told can be a nightmare for their job. Therefore, after operators finish telling reasons for forklift accidents they were asked following questions:

- For a second, please forget about yourself, we see so many operators doing serious mistakes through completing their duties, if you think about other forklift operators, what are the main reasons for forklift accidents?
- For those reasons what safety measures can be taken? Are they being implemented?

When forklift operators were convinced that aim was not to investigate them but to get to know what the problems of forklift operators are, they started to respond. For example, at first glance, when they were asked “What do you think about lifting personnel with forklift?” they refrained from answering. However as explained above, after getting convinced about the research, some of them started explaining:

“Normally, personnel should not be lifted with forklift. However, the boss wants it like this. We told him so many times not to do so, yet he does not accept.”

One of the problematic areas is operating outdoors. Normally, according to Turkish Legislation, if an operator is to drive on roads, he has to have a Class G license showing that he is eligible to operate a forklift on roads. However, sometimes employers neglect this fact and send his operators outside. This Class G license necessity comes from the fact indoor and outdoor operation differs a lot. If segregation is done at workplace to some extent, then operator’s priority is load not the road. However, while driving outside he always have to take care of the road. Also, the companies have their rules while operating forklifts on the roads. While some of the operators were aware of the situation, the others were not. Therefore, an item related with outdoor use added to questionnaires.

Another problematic area forklift operators stressed is inclined surfaces. This requires extra skills like in which director to go, how to stack, knowing what to do and what not to do in these areas. Regarding this issue, some other items were also added.

3.2.1.3. Procedure

Forklift operators were interviewed for the first step as described in previous parts. Outputs of the interviews, literature survey and accident data were used for the first draft for DBQ and DSI for forklift operators. For the interviews, consent of both OSH responsibles and operators were taken.

3.3. Instruments for Forklift Operators

3.3.1. Forklift Operator Behavior Questionnaire (FOBQ)

In this study, DBQ developed by Reason, Manstead, Stradling, Baxter, & Campbell (1990) and later adapted to Turkish by Sümer, Lajunen, & Özkan (2002) was used as basis. Accident reports, literature and interviews were used as auxiliary sources. Briefly, in the first draft 9 articles were derived from accident reports, 11 articles from interviews and 51 articles from literature. While new articles valid for forklifts were added, articles not applicable for forklifts were excluded and some items were revised for forklift. In the final form 4 articles were derived from accident reports, 7 articles from interviews and 20 articles from literature, 1 item from original DBQ and 6 items from DBQ and revised for forklifts. Final form is given in Table 3-1.

Table 3-1: Forklift Operator Behavior Questionnaire Developed

Item no	Item	Source
1	Fail to wear safety belt while operating the forklift	Accident Reports
2	Overload although knowing the load capacity before lifting the load	Accident Reports
3	Try to jump off the vehicle although knowing what to do in case of a tip-over	Literature
4	Use improper attachment with the concern of getting job done in time	Literature
5	Fail to ensure audible and visual warning devices on forklift are working while going in reverse direction	Original DBQ item revised for forklift
6	Improper stacking although having the knowledge	Literature
7	Try to turn while dreamy at a risky place	Literature
8	Proceed on his way at pedestrian-forklift intersection without taking necessary precautions	Original DBQ item revised for forklift
9	Fail to use PPE (helmet, mask, gloves etc.)when necessary although provided	Interviews
10	Fail to follow the rules at noisy places	Interviews
11	Sudden brake involuntarily	Original DBQ item revised for forklift
12	Unncessarily accelerate	Literature
13	Sudden brake at rises and falls on inclined surfaces	Literature
14	Turn at inclined areas	Literature
15	Leave forklift at inclined area	Literature
16	Fail to take necessary precautions to avoid unauthorized access	Literature
17	Fail to carry the load at a possibly low level (10-15 cm) that load would not hit the ground	Literature
18	Turn while the load is lifted	Literature
19	Operate forklift while sleepy	Literature
20	Drive vehicle while dreamy	Interviews
21	Operate while tired	Interviews
22	Avoid blowing horn when necessary	Literature
23	Unnecessarily blow the horn	Original DBQ item revised for forklift
24	Respond cell phone while operating forklift	Interviews
25	Overload due to shipping concerns	Literature
26	Use forklift to push and pull any object	Literature
27	Blow horn only when necessary	Literature
28	Lift personnel with forklift	Interviews
29	Horse play	Interviews
30	Load that will block sight	Literature
31	Drive so close to the vehicle in front that it would be difficult to stop in an emergency	Original DBQ item
32	Fail to utilize banksman or convex mirror or blue light upon availability at blind spots	Original DBQ item revised for forklift
33	Fail to draw in loading ramp	Literature
34	Intervene accumulator or counter-weight and change	Literature
35	Keep up working with the concern of getting job done although there is a problem like leakage etc.	Literature
36	Fail to obey traffic rules at the road	Accident reports
37	Operate forklift while drunk or unconscious	Original DBQ item revised for forklift
38	Sudden movement since the operator seat is uncomfortable	Accident reports

3.3.2. Forklift Operator Skill Inventory (FOSI)

DSI with 20 items, developed by Lajunen & Summala (1995), which was later adapted to Turkish by Lajunen & Özkan (2004), was used as basis. According to the differences between forklifts and cars, all items were revised and final version with 21 items was formed up. Final form is given in Table 3-2. 3 items were taken from accident reports, 8 items from literature, 2 items from interviews, 5 items from original DSI and 3 items taken from original DSI and revised for forklift.

Table 3-2: Forklift Operator Skill Inventory Developed

Item no	Item	Source
1	Know the factors affecting forklift balance	Accident reports
2	Work in job definition	Literature
3	See in-factory risks	Literature
4	Predicting traffic situation ahead	Original DSI item
5	Making firm decisions	Original DSI item
6	Fast decision-making	Interviews
7	Load suitable with data plate and load chart	Literature
8	Proper stacking	Literature
9	Stay calm in irritating situations	Original DSI item
10	Control forklift	Original DSI item revised for forklift
11	Slow down at blind spots, use convex mirrors or banksman if available, if not blow horn	Interviews
12	Safe drive at inclined areas	Original DSI item revised for forklift
13	Adjust speed according to the conditions	Original DSI item
14	Wear safety belt while driving	Literature
15	Follow in-factory operating procedures	Literature
16	Follow outside-factory operating procedures	Literature
17	Conforming to the speed limits	Original DSI item
18	Avoid unnecessary and/or sudden brake	Original DSI item revised for forklift
19	Operate at a narrow aisle	Accident reports
20	Know what to do in case to tip-over	Accident reports
21	Safely work with loading ramp	Literature

3.4. Discussion

Forklifts have distinct differences than automobiles as stated in introduction section. Instability sacrificed for mobility is the crucial one and unless necessary precautions taken it can lead to fatalities. Most of the time, these fatalities occur in the form of tipover. As expressed in Study 1, 5 of the forklift fatalities in 2017 resulted from tipover. Secondly, forklifts have lower visibility. Sometimes this can be due to high stacking or lack of visual warnings. Since main task of forklifts is to carry the load, it can lead producers to neglect such safety elements. These differences between forklifts and automobiles required revision in DBQ&DSI developed for automobiles that was based on Reason's taxonomy differentiating unsafe acts as errors and violations. In addition to different parts in two types of equipment, the fact that main task for forklifts is to lift and carry loads is definitely resulting in different behaviors and also demands different skills. In this sense, altogether the data acquired in interviews, 2017 forklift accidents' analysis and information taken from literature, a Forklift Operator Behavior Questionnaire (FOBQ) and Forklift Operator Skill Inventory (FOSI) formed up. In the following chapter, FOBQ, FOSI and original ERI Model, found unnecessary to be updated considering the content, shall be used to investigate how operator behaviors, operator skills and operator effort-reward imbalance affect forklift accidents. FOBQ is expected to have a bit different factor structure than the factor structure offered widely in the literature. ERI model, which has not been studied for forklifts so far, is thought to have relationship with total number of accidents.

CHAPTER 4

STUDY 3: FORKLIFT OPERATORS DRIVING ANALYSIS AND EFFECT OF EFFORT-REWARD IMBALANCE IN DRIVING

4.1. Purpose

The aim of present study was to investigate the effect of human factors on forklift accidents. Human factors, here, were taken as two branches; namely driver behaviors and driver skills since the study was carried out about forklift operators. At this point, it should be taken into consideration that so far all human factor researches focused on vehicles on the road but not on indoor traffic. Forklifts look alike vehicles in terms of the driving power and general structure however they have certain differences including steering axle, stability and a few other factors. Basic modification required for forklifts applied to two questionnaires, namely FOBQ and FOSI, ERI was used without any amendment, and three questionnaires were made use. During application, operators were informed that neither their name nor their company information would be shared in the research. Despite informing, there were some reluctant operators to give information about their accident data. In the following section, summary of the results are discussed in same order with the analyses including factor structure of FOBQ & FOSI, correlations between study variables and hierarchical regression analyses. Following these, contributions of the study, limitations of the study and suggestions for future studies were also given.

4.2. Method

4.2.1. Forklift Operator Behavior Questionnaire (FOBQ)

In this study, FOBQ developed in Section 3.5.1. was used. Final evaluation form consisted of 38 items with 5 point Likert type scale. Item score differs from 0 (Never)

to 4 (Always) indicating how often the forklift operator does the behavior stated in the article. Higher scores imply higher frequency for the behavior indicated in the item.

4.2.2. Forklift Operator Skill Inventory (FOSI)

FOSI developed in Section 3.5.2. was used. Final version of evaluation form consisted of 21 items with 5 point Likert type scale. Item score differs from 0 (Too weak) to 4 (Very strong) indicating how skilled forklift operator is on the stated task.

4.2.3. Effort-Reward Imbalance Model

In interviews mentioned in Section 3.1.3, operators stressed out that time constraints, obligation to catch up with the schedule are main difficulties of forklift operators. Also some of the operators indicated that although so much effort is put, operators are not earning well. Evaluation form consisted of 23 items with 5 point Likert type scale. Item score differs from 0 (Totally disagree) to 4 (Totally agree) indicating to what extent operator agrees on the statement given. Forklift operation is characterized by high levels of stress, therefore ERI thought to be useful while assessing forklift accidents and forklift operator's stress. ERI ratio was calculated according to Siegrist et al. (2004) formula $e / (r \times c)$, where effort (e) = total effort, r = total reward and c = correction factor (6/11). Correction factor was taken as 6/11 since all 6 items including the item "Over the past few years, my job has become more and more demanding." in the original article were used in the questionnaire.

Effort is evaluated mostly using five items. In the original questionnaire there is also a sixth item which is about physical exertion, in researches focusing more on white collars do not include this sixth item. Reward is evaluated with 11 items which covers 2 items for appreciation, 4 items for support and financial aspects and 2 items for employment security. For each scale answers are summed and ERI ratio which stands for the relation between effort and reward is calculated. While making the calculation a correction factor is used to account for different number of items in effort and reward scales. For the interpretation; higher ERI ratio reveals a higher level of imbalance between effort and reward.

4.2.4. Procedure

All the questionnaires were submitted to Middle East Technical University Ethical Committee for ethical approval and necessary approval was taken. Ethical Approval was attached to Annex A. To check for conceptual errors, typos and semantic ambiguities, questionnaires were revised by three occupational safety and health experts that have basic knowledge on human factors. Later, before applying the questionnaires, all questionnaires read by three active forklift operators and final revision has been applied. Statistical analyses were performed with IBM SPSS 22.0.

4.3. Participants

10 operators working at a textile factory, 52 operators working at 6 different chemical production factories and 165 operators operating counter balanced forklifts and working at 21 different cement factories took part in. All the participants (100%) were male operators. The age range was between 22 and 56. For the whole sample, the mean age was 39.14 (*SD* = 6.73). The average of forklift operating experience in years was 9.89 (*SD* = 6.13). Table regarding education level of forklift operators and sample characteristics for demographic variables in the study are given below.

Table 4-1. Demographics for Study 3

Parameter	Value
N	227
Primary school	29
Secondary school	39
High school	139
University	20
Age	
M	39.14
SD	6.73
Forklift Operating Experience	
M	9.89
SD	6.13
Total Accident	
M	0.53
SD	1.65

4.4. Results of Study 3

4.4.1. Item Descriptives

4.4.1.1. FOBQ Descriptives

Forklift Operator Behavior Questionnaire items with highest means were, respectively, “Blowing horn only when necessary” (*M* = 2.58), “Not Wearing safety belt while operating forklift” (*M* = 1.38), “Fail to ensure audible and visual warning devices on forklift are working while going in reverse direction” (*M* = 1.17), “Fail to carry the load at a possibly low level (10-15 cm) that load would not hit the ground (*M* = .94), “Fail to keep the distance with the vehicle in front” (*M* = .91).

4.4.1.2. FOSI Descriptives

Forklift Operator Skill Inventory Questionnaire items with highest means were, respectively, “Control the forklift” (*M* = 3.56), “Safe drive on inclined surfaces” (*M* = 3.51), “Follow in-factory operating procedures” (*M* = 3.51), “Obey speed regulations” (*M* = 3.51), “Avoid unnecessary and/or sudden brake” (*M* = 3.49).

4.4.1.3. ERI Descriptives

The mean effort was 1.90 out of 4 (*SD* = 1.01) while responding mean reward for all operators was 2.55 (*SD* = 0.68). Mean overcommitment results came out as 1.63 (*SD* = 1.03). Results are given in Table 4.2.

Table 4-2. Effort-Reward Imbalance Model Descriptive Statistics

	Minimum	Maximum	*M* ± *SD*
Effort	0	4	1.90 ± 1.01
Reward	0.73	4	2.55 ± 0.68
ERI	0	6.72	1.55 ± 1.10
Overcommitment	0	4	1.63 ± 1.03

Table 4-3. Effort-Reward Imbalance Model Items Descriptive Statistics

Item		*M*	*SD*
1	I have constant time pressure due to a heavy work load.	3.26	0.84
2	I have many interruptions and disturbances while performing my job.	3.35	0.84
3	I have a lot of responsibility in my job.	3.42	0.68
4	I am often pressured to work overtime.	3.21	0.78
5	My job is physically demanding.	3.45	0.71
6	Over the past few years, my job has become more and more demanding.	3.15	0.90
7	I receive the respect I deserve from my superior or a respective relevant person.	3.27	0.83
8	I receive the respect I deserve from my colleagues.	3.45	0.69
9	I experience adequate support in difficult situations.	3.04	0.91
10	I am treated unfairly at work.	3.56	0.70
11	My job promotion prospects are poor.	3.44	0.80
12	I have experienced or I expect to experience an undesirable change in my work situation.	3.51	0.65
13	My job security is poor.	3.42	0.73
14	My current occupational position adequately reflects my education and training.	2.60	1.38
15	Considering all my efforts and achievements, I receive the respect and prestige I deserve at work.	3.51	0.71
16	Considering all my efforts and achievements, my job promotion prospects are adequate.	3.30	0.97
17	Considering all my efforts and achievements, my salary / income is adequate.	3.51	0.73
18	I get easily overwhelmed by time pressures at work.	3.49	0.73
19	As soon as I get up in the morning I start thinking about work problems.	3.02	1.04
20	When I get home, I can easily relax and ‘switch off' work.	3.24	0.92
21	People close to me say I sacrifice too much for my job.	3.34	0.76
22	Work rarely lets me go, it is still on my mind when I go to bed.	2.98	0.86
23	If I postpone something that I was supposed to do today I'll have trouble sleeping at night.	3.12	0.74

4.4.2. Factor Analyses

4.4.2.1. Forklift Operator Behavior Questionnaire (FOBQ)

Principal component analysis utilizing Promax rotation technique was used. The Kaiser-Meyer Olkin Measure showing the sample adequacy came out .751 and the Barlett’s test of sphericity revealing correlation matrix is factorable, was significant ($df = 703$, $p < .001$). The number of factors was checked for three, four and five, and

number of factor was selected as four. This decision was based on scree plot and the factor structure of FOBQ. The cut-off value for different loadings was taken as .40.

Among 38 items, 6 items were eliminated. The reason for eliminating items "1, 3, 7, 16, 28 and 29" was the item loadings were below cut off value, which is .40. Principal Component Analysis ran a four-factor solution with promax rotation for FOBQ with remaining 32 items

First factor consisted of 9 items. Most of the items were about inattentiveness, not being able to settle down to work. Therefore, this factor was named as "inattentiveness". It can also be interpreted as an attentional failure which is a typical type of error in Reason's taxonomy. The communalities ranged between .287 and .593. Item having the highest communality value was "Not stacking properly while having the required safety information". The initial eigenvalue of the first factor was 7.14 and explained 18.78% of the variance. Reliability of the first factor with 9 items was .80.

Second factor consisted of 11 items. Items were all about not following the rules and procedures that were established for forklift operators. So, the name of factor was determined as "Rule-based violations". The communalities ranged between .205 and .527. The initial eigenvalue of the second factor was 2.98 and explained 7.84% of the variance. Reliability of the second factor with 11 items was .79.

Third factor consisted of 7 items. Most of the items were related with unusual situations or cases and unexpected reactions of operators to these situations. The factor named as "Contextual Violations". It is mostly related with complicated issues like working on an inclined surface. Item having the highest communality was "Drive so close to the vehicle in front that it would be difficult to stop in an emergency." The communalities ranged between .305 and .579. The initial eigenvalue of the second factor was 2.26 and explained 5.95% of the variance. Reliability of the third factor with 7 items was .71.

Fourth factor consisted of 5 items. Most of the items were related with the reactions given in the case of necessity where the job demands the behavior stated in the relative item. Therefore, name of the factor was set as “End-result violations”. These violations are the cases where due to the obligations, operators have to skip safety measures and carry out the task given as it is. Item having the highest communality was “To continue work while there is a leakage to catch up with the plan” The communalities ranged between .350 and .432. The initial eigenvalue of the second factor was 1.85 and explained 4.86% of the variance. Reliability of the fourth factor with 5 items was .61.

Four factors explained 37.44% of the total variance. Details are given in Table 4-4 in the following page.

Table 4-4. Factor loading of items in Forklift Operator Behavior Questionnaire

	Items	Components				Communality	*M*	*SD*
		1	2	3	4			
8	Proceed on his way at pedestrian-forklift intersection without taking necessary precautions	.801				.576	0.50	0.83
6	Improper stacking although having the knowledge	.744				.593	0.38	0.70
24	Respond cell phone while operating forklift	.670				.403	0.85	1.06
19	Operate forklift while sleepy	.648				.448	0.22	0.56
20	Drive vehicle while dreamy	.607				.499	0.31	0.61
25	Overload due to shipping concerns	.598				.396	0.70	1.11
2	Overload although knowing the load capacity before lifting the load	.581				.359	0.44	0.83
23	Unnecessarily blow the horn	.500				.383	0.34	0.65
4	Use improper attachment with the concern of getting job done in time	.432				.287	0.52	0.84
31	Fail to keep up the following distance with the vehicle in front		.727			.527	0.91	1.43
33	Fail to draw in loading ramp		.695			.457	0.43	1.01
32	Fail to utilize banksman or convex mirror or blue light upon availability at blind spots		.662			.469	0.78	1.20
36	Fail to obey traffic rules at the road		.645			.379	0.31	0.94
18	Turn while the load is lifted		.594			.364	0.57	0.89
17	Fail to carry the load at a possibly low level (10-15 cm) that load would not hit the ground		.575			.481	0.94	1.36
5	Fail to ensure audible and visual warning devices on forklift are working while going in reverse direction		.569			.347	1.17	1.54
10	Fail to follow the rules at noisy places		.523			.381	0.63	1.12
27	Blow horn only when necessary		.459			.228	2.58	1.65
34	Intervene accumulator or counter-weight and change		.449			.205	0.23	0.67
9	Fail to use PPE (helmet, mask, gloves etc.)when necessary although provided		.418			.362	0.49	1.03
22	Avoid blowing horn when necessary		.407			.309	0.51	0.93

Table 4-4. (continued)

	Items	Components				Communality	*M*	*SD*
		1	2	3	4			
13	Sudden brake at rises and falls on inclined surfaces			.830		.579	0.28	0.53
14	Turn at inclined areas			.713		.432	0.39	0.62
11	Sudden brake involuntarily			.637		.435	0.65	0.79
12	Unncessarily accelerate			.583		.484	0.37	0.66
26	Use forklift to push and pull any object			.546		.400	0.92	0.96
15	Leave forklift at inclined area			.403		.227	0.24	0.52
35	Keep up working with the concern of getting job done although there is a problem like leakage etc.				.634	.432	0.29	0.69
37	Operate forklift while drunk or unconscious				.592	.350	0.02	0.15
38	Sudden movement since the operator seat is uncomfortable				.511	.399	0.45	0.78
21	Operate while tired				.481	.386	0.85	0.95
30	Load that will block sight				.472	.421	0.51	0.74

Note: The cut-off value for factor loadings taken as .40

4.4.2.2. Forklift Operator Skill Inventory (FOSI)

Principal component analysis utilizing Promax rotation technique was used. The Kaiser-Meyer Olkin Measure showing the sample adequacy came out .928 and the Barlett's test of sphericity revealing correlation matrix is factorable, was significant ($df = 190$, $p < .001$). The number of factors was taken as two. This decision was based on scree plot and the factor structure of FOSI. The cut-off value for different loadings was taken as .40.

Table 4-5. Factor loadings of items in Forklift Operator Skill Inventory

	Items	Component		Communality	*M*	*SD*
		1 SS	2 PMS			
14	Wear safety belt while driving	.926	-.525	.469	2.60	1.38
15	Follow in-factory operating procedures	.905		.661	3.51	0.71
17	Obey speed regulations	.843		.603	3.51	0.73
18	Avoid unnecessary and/or sudden brake	.741		.603	3.49	0.73
2	Work in job definition	.600		.462	3.35	0.84
9	Stay calm in annoying situations	.583		.494	3.04	0.91
13	Adjust speed according to the conditions	.558		.549	3.42	0.73
21	Safely work with loading ramp	.543		.553	3.34	0.76
8	Proper stacking	.503		.580	3.45	0.69
11	Slow down at blind spots, use convex mirrors or banksman if available, if not blow horn	.497		.492	3.44	0.80
7	Load suitable for data plate and load chart	.462		.564	3.27	0.83
12	Safe drive at inclined areas	.423	.428	.609	3.51	0.65
6	Making decision fast		.914	.524	3.15	0.90
1	Know the factors affecting forklift balance		.775	.588	3.26	0.84
5	Know how to react at specific traffic conditions		.656	.592	3.45	0.71
19	Operate at a narrow aisle		.621	.261	3.02	1.04
4	Foresee the upcoming traffic conditions		.540	.453	3.21	0.78
20	Know what to do in case to tip-over		.492	.503	3.24	0.92
3	See in-factory risks		.410	.506	3.42	0.68

Note: The cut-off value for factor loadings taken as .40

During the factor analysis, 16th item of DSI, "Follow outside-factory operating procedures" was not taken into account due to the fact that it is not valid for all workplaces, while some workplaces may need forklifts in external traffic in addition to indoor use, the others may not need them outdoors.

First factor consisted of 11 items. Most of the items were about following rules and SOPs, implementing what is taught to be safe. Therefore this factor was named as "safety skills". The communalities ranged between .462 and .661. Item having the highest communality value was "Following internal traffic forklift operating

procedures". The initial eigenvalue of the first factor was 9.248 and explained 46.24% of the variance. Reliability of the first factor, safety skills, with 11 items was .89.

Second factor consisted of 10 items and factor was named as "perceptual motor skills". The communalities ranged between .261 and .609. The initial eigenvalue of the second factor was 1.317 and explained 6.59% of the variance. Reliability of the second factor, perceptual motor skills, with 11 items was .79.

4.4.3. Correlations between study variables

Correlations between the study variables, respectively, age, exposure, total number of accidents, education, effort, reward, effort-reward imbalance, overcommitment, safety skills, perceptual motor skills and violations were presented in Table 3.5. Age was significantly negatively related to education (r = -.203 p < .01). Exposure or in other words, years operating forklifts was negatively related to education (r = -.164 p < .05) and positively related to effort (r = .137 p < .05). Total number of accidents was significantly positively related to effort-reward imbalance (r = .160 p < .05) and negatively related to inattentiveness (r = -.217 p < .01). Effort was negatively related to reward (r = -.285 p < .01) and positively related to ERI (r = .835 p < .01), OC (r = .345 p < .01), inattentiveness (r = .174 p < .01) and end-result violations (r = .170 p < .05). Reward was negatively related to ERI (r = -.634 p < .01), OC (r = -.353 p < .01), inattentiveness (r = -.228 p < .01), contextual violations (r = -.148 p < .05), end-result violations (r = -.168 p < .05) and positively related to SS (r = .172 p < .05). ERI was significantly positively related to OC (r = .404 p < .01), inattentiveness (r = .220 p < .01) and end-result violations (r = .144 p < .05).

SS were significantly positively related to PMS (r = .742 p < .01) and were negatively related to inattentiveness (r = .367 p < .01), contextual violations (r = .247 p < .01) and end-result violations (r = .295 p < .01). PMS were significantly negatively related to inattentiveness (r = .238 p < .01), rule-based violations (r = .200 p < .01), contextual violations (r = .144 p < .05) and end-result violations (r = .247 p < .01). Inattentiveness was positively related to rule-based violations (r = .314 p < .01), contextual violations

(r = .363 p < .01) and end-result violations (r = .435 p < .01). Rule-based violations was positively related to contextual violations (r = .318 p < .01) and end-result violations (r = .252 p < .01). Finally, contextual violations was positively related to end-result violations (r = .403 p < .01).

Table 4-6. Correlations between study variables

Correlations Between Study Variables

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Age	1													
2	Exposure	.643**	1												
3	Totalaccident	.110	.108	1											
4	Education	-.203**	-.164*	-.112	1										
5	EF	.117	.137*	.112	.006	1									
6	RW	.025	.055	-.067	-.092	-.285**	1								
7	ERI	.039	.051	.160*	.051	.835**	-.634**	1							
8	OC	.010	-.047	-.008	.101	.345**	-.353**	.404**	1						
9	SS	.003	.035	-.084	.009	.027	.172*	-.038	-.083	1					
10	PMS	.033	.091	-.042	.054	.089	.085	.045	-.087	.742**	1				
11	Inattentiveness	.025	.066	.217**	-.127	.174**	-.228**	.220**	.045	-.367**	-.238**	1			
12	Not following the rules established	-.038	-.067	-.056	-.128	.103	-.077	.095	-.005	-.080	-.200**	.314**	1		
13	Contextual Violations	-.062	-.030	.009	.066	.045	-.148*	.058	.125	-.247**	-.144*	.363**	.318**	1	
14	End-result Violations	-.049	-.005	.045	.014	.170*	-.168*	.140*	.123	-.295**	-.247**	.435**	.252**	.403**	1

EF: Effort; RW: Reward; ERI: Effort-Reward Imbalance, OC: Overcommitment; SS:Safety Skills; PMS: Perceptual Motor Skills

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4.4.4. Regression Analysis

4.4.4.1. The relationships between driver behaviors and total number of accidents

To test relationships between total number of accidents and driver behaviors, two hierarchical regression analyses were carried out. In all analyses, exposure which stands for driving experience of operators, and age were entered in the first step as the control variables. Four factors of Forklift Operator Behavior Questionnaires (FOBQ) were entered in the second step as can be seen below in Table 3.6.

In hierarchical regression analysis, total number of accidents was entered as the dependent variable. In the first step, age and exposure were entered as control variables and four factors of FOBQ were entered in the second step and the model was significant ($F(6, 223) = 2.99$, $p = .008$). Among the four factors of FOBQ, only inattentiveness (95% CI [.265, .902]), was significantly positive related to total accidents ($\beta = .028$, $p < .001$).

Table 4-7. The relationships between total number of accidents and operator behaviors

	1. Total accident				
Variables	R^2	ΔR^2	F	β	p
	.015	.015	1.63		.198
Age				.069	.430
Exposure				.064	.463
	.076	.061	3.64		.007
Inattentiveness				.275	.000
Rule-based Violations				-.119	.097
Contextual Violations				-.037	.619
End-result Violations				-.026	.733

*Df*s for F-tests: 1. Step = 2, 221; 2. Step = 4, 217 for Total Accident.

4.4.4.2. The relationships between driver skills and total number of accidents

To test relationships between total number of accidents and driver skills, two hierarchical regression analyses were carried out. In all analyses, exposure and age were entered in the first step as the control variables. Four factors of Forklift Operator Skill Inventory (FOSI) were entered in the second step, given in Table 3.7. In

hierarchical regression analysis, total number of accidents was entered as the dependent variable. In the first step, age and exposure were entered as control variables and two factors of FOSI were entered in the second step and the model was insignificant ($F(4, 222) = 1.265$, $p = .285$). No factor of DSI was significantly positive related to total accidents.

Table 4-8. The relationships between total number of accidents and operator skills

	1. Total accident				
Variables	R^2	ΔR^2	F	β	p
	.015	.015	1.63		.197
Age				.071	.420
Exposure				.063	.472
	.023	.008	.89		.411
SS				-.11	.252
PMS				.031	.756

Note: FOSI; SS: Safety Skills; PMS: Perceptual Motor Skills
*Df*s for F-tests: 1. Step = 2, 220; 2. Step = 2, 218 for Total Accident

4.4.4.3. The relationships between inattentiveness and effort-reward imbalance

To test relationships between inattentiveness and effort-reward imbalance, two hierarchical regression analyses were carried out. In all analyses, exposure and age were entered in the first step as the control variables. Three factors of Effort-Reward Imbalance (ERI) were entered in the second step, given in Table 3.8. In hierarchical regression analysis, inattentiveness was entered as the dependent variable. In the first step, age and exposure were entered as control variables and three factors of ERI were entered in the second step and the model was significant ($F(5, 221) = 3.232$, $p = .008$). Only reward (95% CI [-.309, .001]) was significantly negatively related to inattentiveness ($\beta = -.206$, $p = .049$).

Table 4-9. The relationships between inattentiveness and effort-reward imbalance

	1. Inattentiveness				
Variables	R^2	ΔR^2	F	β	p
	.005	.005	.545		.581
Age				-.030	.733
Exposure				.086	.331
	.070	.065	5		.002
ERI				-.011	.953
RW				-.206	.049
EF				.116	.429

Note: ERI; ERI: Effort Reward Imbalance; RW: Reward; EF: Effort
*Df*s for F-tests: 1. Step = 2, 219; 2. Step = 3, 216 for Inattentiveness.

4.4.4.4. The relationships between rule-based violations and effort-reward imbalance

To test relationships between rule-based violations and effort-reward imbalance, two hierarchical regression analyses were carried out. In all analyses, exposure and age were entered in the first step as the control variables. Three factors of Effort-Reward Imbalance (ERI) were entered in the second step, given in Table 3.9. In hierarchical regression analysis, rule-based violations were entered as the dependent variable. In the first step, age and exposure were entered as control variables and three factors of ERI were entered in the second step and the model was insignificant ($F(5, 221) = .908$, $p = .477$). No factor was significantly related to rule-based violations.

Table 4-10. The relationships between rule-based violations and effort-reward imbalance

	2. Rule-based violations				
Variables	R^2	ΔR^2	F	β	p
	.005	.005	.509		.602
Age				.003	.896
Exposure				-.075	.396
	.021	.016	1.173		.321
ERI				-.101	.588
RW				-.087	.413
EF				.173	.252

Note: ERI; ERI: Effort Reward Imbalance; RW: Reward; EF: Effort
*Df*s for F-tests: 1. Step = 2, 219; 2. Step = 3, 216 for rule-based violations.

4.4.4.5. The relationships between contextual violations and effort-reward imbalance and overcommitment

To test relationships between contextual violations and effort-reward imbalance, two hierarchical regression analyses were carried out. In all analyses, exposure and age were entered in the first step as the control variables. Three factors of Effort-Reward Imbalance (ERI) were entered in the second step, given in Table 3.10. In hierarchical regression analysis, contextual violations were entered as the dependent variable. In the first step, age and exposure were entered as control variables and three factors of ERI were entered in the second step and the model was insignificant ($F(5, 221) = 1.708$, $p = .134$). Only reward (95% CI [-.317, -.044]) was significantly related to contextual violations ($\beta = -.302$, $p = .010$).

Table 4-11. The relationships between contextual violations and effort-reward imbalance

	3. Contextual Violations				
Variables	R^2	ΔR^2	F	β	p
	.004	.004	.473		.624
Age				-.088	.313
Exposure				.026	.764
	.038	.034	2.525		.059
ERI				-.302	.102
RW				-.274	.010
EF				.225	.133

Note: ERI; ERI: Effort Reward Imbalance; RW: Reward; EF: Effort
*Df*s for F-tests: 1. Step = 2, 219; 2. Step = 3, 216 for contextual violations.

4.4.4.6. The relationships between end-result violations and effort-reward imbalance and overcommitment

To test relationships between end-result violations and effort-reward imbalance, two hierarchical regression analyses were carried out. In all analyses, exposure and age were entered in the first step as the control variables. Three factors of Effort-Reward Imbalance (ERI) were entered in the second step, given in Table 3.11.

In hierarchical regression analysis, end-result violations were entered as the dependent variable. In the first step, age and exposure were entered as control variables and three factors of ERI were entered in the second step and the model was significant (F(5, 221) = 3.357, p = .006). All ERI factors were significantly related to end-result violations, respectively effort (95% CI [.064, .312]), (β = .438, p = .003), reward (95% CI [-.328, -.067]) (β = -.308, p = .003), ERI (95% CI [-.305, -.025]), (β = -.418, p = .022).

Table 4-12. The relationships between end-result violations and effort-reward imbalance

	4. End-result violations				
Variables	R^2	ΔR^2	F	β	p
	.004	.004	.397		.673
Age				-.078	.376
Exposure				.045	.609
	.072	.068	5.315		.001
ERI				-.418	.022
RW				-.308	.003
EF				.438	.003

Note: ERI; ERI: Effort Reward Imbalance; RW: Reward; EF: Effort
*Df*s for F-tests: 1. Step = 2, 219; 2. Step = 3, 216 for end result violations.

4.5. Discussion

4.5.1. Discussion of Descriptives of the Instruments

Forklift, due to its own characteristics carries its own risks. Therefore FOBQ and FOSI that were adapted to Turkish were needed to be updated to the risks forklift carry and forklift operators have to face. At first glance, "Blow horn only when necessary" item in Forklift Operator Behavior Questionnaire is the one with highest mean (M = 2.58) among others. Blowing horn without any need causes conflict and disrupts the coherence in the traffic and finally results in operational blindness. In this case, when an operator really needs to blow the horn, he will not be able to make use of it since no one will be aware of it. The second item with high mean was "Not wearing safety belt while driving" (M = 1.38), which is very vital in a case of work accident, especially overturn. Third item: "Fail to utilize banksman or convex mirror or blue light upon availability at blind spots" (M = 1.17) is crucial in workplace traffic. This finding shows that either workplace arrangements in case of visual and audible warning systems not work or error-free systems should be used. A few examples for workplace arrangements can be given as utilizing banksman or convex mirror. Error-free systems have just emerged in recent years. In such systems, forklifts can stop immediately after they recognize an obstacle or live body.

Forklift operators perceive their forklift controlling skills at high levels (*M* = 3.56) which is quite controversial. This can be interpreted as two ways, it is because either they are really highly skilled or they perceive themselves skilled yet they are not. Second option results in not seeing necessity to themselves and maybe accident in the end. Safe driving in inclined areas (*M* = 3.51), obeying in-house driving procedures (*M* = 3.51), following speed limits (*M* = 3.51) and avoiding unnecessary and/or sudden brake (*M* = 3.49) were items with highest means in Forklift Operator Skill Inventory. Considering that skills stated above are one of the main reasons of forklift related casualties, higher perceived skills should be questioned.

For ERI questionnaire it should be noted in most of the researches, effort part consists of 5 articles not 6. The reason behind that the sixth item is on physical effort which is not suitable for white collar employees therefore in those studies this item was removed from the questionnaire. However, for forklift operators physical strain is one of the most important aspects, during the course of this study, sixth item was also included. In effort part of ERI, item with highest mean was "I have a lot of responsibility in my job." *(M* = 2.43) while it was "I receive the respect I deserve from my colleagues." *(M* = 2.93) in reward part and "When I get home, I can easily relax and 'switch off' work." *(M* = 2.24). As can be seen from the item with highest mean in effort part of ERI, forklift operators are overwhelmed with the amount of responsibilities they are carrying.

4.5.2. Factor Analyses of FOBQ and FOSI

4.5.2.1. Factor Analyses of FOBQ

In their study (2010), where deWinter & Dodou did a meta-analysis for DBQ, deducted that after the seminal article of Reason in 1990, DBQ has been widely known and DBQ factors are significant predictors of self-reported accidents. Bearing af Wahlberg's study (2011) in mind, stating DBQ shows various factor structure in various studies, and that this study is based on forklifts rather than automobiles in mind, this study yielded a different factor structure. At first glance one without deep information about forklifts could have thought that rule-based violations would be the

most distinct factor however the study showed that it was one of the four factors leading forklift accidents yet did not come out significant.

Current study showed that only inattentiveness was directly explaining the total number of accidents significantly which also fits with the findings of Rimmö & Hakamies-Blomqvist (2002), Regan, Lee, & Victor (2013), Stanislaw (2012), Cordazzo, Scialfa, & Ross (2016) stating inattentiveness is a factor increasing risk of collision and also the finding of Klauer, Guo, Sudweeks, & Dingus (2010) showing approximately 25 to 30% of traffic conflicts are caused by inattention. In addition, traffic safety researchers have focused increasingly on the importance of inattention generally and distraction more specifically as causal to collisions (McKnight & McKnight, 2003; Redelmeier and Tibshirani, 1997).

In his study, Embrey (2005) stated that for skill-based failure recovery, instant feedback, which can be in terms of auditory and/or visual warnings, is so essential that feedback system is more beneficial than training. In Minimum Requirements for Work Equipment part of Regulation of Safety and Health Requirements for the use of Work Equipment states that unless the operator can ensure there is no one at the hazard area, the vehicle shall be equipped with visual and audible warning systems. Embrey (2005) also states that when it comes to slips, lapses and skill-based errors, tasks and responsibilities, information flow in forms of instructions, safe operation procedures etc. need to be improved. However in this study, although the item "Rule-based violations" was one of four factors of FOBQ, it was not significant. Recently, Cordazzo, Scialfa, Bubric, & Ross (2014) carried out a study with the original DBQ, in a North American life-span sample of adult drivers. The results revealed a three-component structure of lapses, errors and violations however these had limited ability to predict collisions. The authors stressed the importance to incorporate new items. In the course of this study, difference between forklifts and automobiles were taken into account, and items were either revised or new items added upon research on forklift accidents in Turkey, literature research and interviews made with forklift operators.

4.5.2.2. Factor Analyses of FOSI

In the current study, although the items were revised according to counter-balanced forklifts, two factors were same; namely, perceptual motor and safety skills, with the original DSI form composed by Lajunen & Summala (1995) including two factors. Present study indicated that the FOSI had a clear two factor structure with high item loadings and high internal consistency. Bearing in mind that 16th item "Follow outside-factory operating procedures" was excluded considering in some workplaces there were no out-of-workplace traffic, only two items, "Wear safety belt while driving" and "Safe drive at inclined areas" were cross-loaded. This was due to the fact that items can be perceived as perceptual motor skills and safety skills at the same time. It should also be noted that only one item "Control the forklift" was below cut-off value (.40) so could not be categorized into factor structure. In two-factor structure, this highest loaded item was "Safe drive at inclined areas". This item shows that operator took part in the study thinks that they wear safety belt while moving. Here, as Ehrlinger, Johnson, Banner, Dunning, & Kruger (2008) found out it can be seen that less skilled individuals are less accurate in their self-reports than highly skilled operators since in reality most of the forklift operators during the study were not wearing safety belt before they were called for interviews. Two factor structure made up of PMS and SS, is same with the literature however the content is different due to the risks forklift operating carry. "Obey speed regulations" item was loaded to safety skills in this study while it was the same in Finnish study (Lajunen & Summala, 1995) and another study for Australian and Finnish drivers conducted by Lajunen et al. (1998), it was loaded on PMS in a study conducted by Xu et al. (2018). In the original study, there were no items like "Wear safety belt while driving", which was loaded both on SS (.926) and PMS (.525) or "Follow in-factory operating procedures", highly loaded on SS (.905). This is solely coming from the fact that forklift operation and driving a car have some basic differences. While one is focused on road only, in the other one first aim is to raise and move the loads.

4.5.3. Correlation Results

Unlike the findings of Cordazzo et al. (2016), age was not significantly correlated to any of study variables. However, here, it should be noted that due to the fact that forklift operating includes high level of physical exertion, oldest operator was at the age of 56 which could have affected the difference between two studies. There were only two significant correlations between total accidents and the other study variables. The correlations between total number of accidents and inattentiveness show that as the inattentiveness increases, the total number of accidents increases, as well. In literature there are different findings about these. For example, in their study Blockey & Hartley (1995) stated that neither errors nor violations were significant accident predictors, while Freeman, Wishart, Davey, Rowland, & William (2009) and Sümer (2003) found out positive correlations between errors and accidents. On the other hand, Stradling, Parker, & Lajunen (1998) stated that errors were not accident predictors but violations were. More recently, af Wåhlberg et al. (2011) observed that in the literature "errors and lapses, taken together, have been significant predictors of accidents as the various violation factors".

Secondly, total accident was also significantly positively related to effort-reward imbalance which stands for the fact that higher ERI results in higher number of accidents. As it is known, forklift operators are against time. When this time limitation is combined with high ERI, it leads to higher number of accidents. Effort and ERI, which is the function of effort and reward, were significantly positively correlated to overcommitment, inattentiveness and end-result violations. This shows that as effort and ERI increase, operators feel more overwhelmed, they are getting more distracted and they tend to act unsafely more when the situation requires. Only reward was positively correlated to one of FOSI factors, which was the factor, safety skills. More forklift operators are rewarded, higher safety skills they think they have. This can be more related with the fact that where forklift operators are being rewarded, they are getting required and proper training so this leads operators to perceive their safety skills higher. ERI was not significantly correlated to any of FOSI factors. However,

ERI was positively significantly correlated to inattentiveness and end-result violations. Although the correlation was not high, they were both correlated to ERI which means higher effort-reward imbalance leading to higher levels of inattentiveness and end-result violations. Safety skills, one of two factors of FOSI, were highly and significantly correlated to perceptual motor skills ($r = .742$). All FOBQ factors were positively and significantly correlated to each other. This means higher inattentiveness leads to higher levels of rule-based violations, contextual and end-result violations.

4.5.4. Discussion of Hierarchical Regression Analyses

Two hierarchical regression analyses to test relationships between number of accidents and driver behaviors were conducted. In the first phase, age and experience were the control variables. Vahedi, Shariat Mohaymany, Tabibi, & Mehdizadeh (2018), where they showed a higher annual mileage and more hours of driving were positively related to crash involvement among taxi drivers. On the contrary, Sullman et al. (2002) showed that older truck or professional fleet drivers were less involved in accidents. In the course of this study, age and experience of operators could not predict accidents. For age, the reason may be the fact that oldest operator in the study was at the age of 56 and secondly due to the nature of the work, mean of the driving experience was 9.89. This is not a significant figure to explain the relationship between experience and accidents. Thirdly, while driving a car only focus is to keep track of the road and traffic, operating a forklift requires extra task where the operators need to keep track of the load and take goods from starting point to off-load point. Sullman et al. (2002), Davey et al. (2007) & Maslac´ et al. (2018) showed in their studies that among five DBQ factors, only the lapses factor was positively associated with accident involvement of truck and professional fleet drivers.

Among four factors of FOBQ, only inattentiveness significantly predicted total accidents. In literature driver inattention was found to be influencing safe driving (Qu et al., 2015). Previous studies (Qu et al., 2015; Farmer et al., 2010; Klauer et al., 2006)

has shown that inattention is negatively influencing driver performance and therefore it is an important risk factor for accidents. Meanwhile none of two factors of FOSI could predict total accidents. This may have happened due to the fact that age mean of the participants was relatively low and as Martinussen et al. (2017) suggested novice drivers are inconsistent while assessing their driving skills compared to their driving performance.

For the first time in literature, relationship between effort-reward imbalance and driver behaviors was investigated and for counter-balanced forklifts, only reward predicted inattentiveness and contextual violations. This finding is matching with the finding of Öz, Özkan, & Lajunen (2013) stating only time and work pressure among study variables could be related to errors and violations. None of factors in FOBQ could predict rule-based violations. This is an important finding since all the attention and occupational safety and health measures in the field are being concentrated just on getting proper measures. However, in this study all ERI factors predicted end-result violations. This means effort-reward imbalance is directly affection end-result violations which is also one of the important reasonings of accidents.

4.6. Implication of the Results

Prior to this study, at the instrument development phase, all operators and occupational safety experts at respective workplaces were asked the most important thing leading to forklift related accidents in this area. The answer was pretty straight: Rules. So everyone involved in the research totally believed that following the rules would solve all the problems. The results highlighted something else. Second factor of FOBQ, rule-based violations include many important points including blind spot arrangements, what to do at pedestrian-forklift intersection and not using cell phone. However, in the study this factor was not a significant predictor of forklift accidents. This does not mean that rules should not be followed. Instead, findings of the study reveals that all necessary precautions should be taken however, most of the accidents occur due to momentarily deviation from those involuntarily.

Fourth factor of FOBQ was end-result violations which is an inevitable necessity to continue work although the situation is not convenient and safe. According to findings,

In terms of Reason's taxonomy, current study has differentiated a bit; while in Reason's taxonomy unsafe acts were divided into two, respectively errors and violations and later errors divide into three: slips, lapses and mistakes, in current study unsafe acts or behaviors were divided into four: namely, inattentiveness (inattention errors), rule-based violations, contextual and end-result violations (violations). Although the main division, errors and violations is the same, sub-branches were a bit different. This is based on the main differences between forklift and automobiles. At first glance, it may be thought that procedures should have been the main reason behind forklift accidents; one with an experience in the field can easily confirm the outcome of the study which is also stated in some other researches mentioned above.

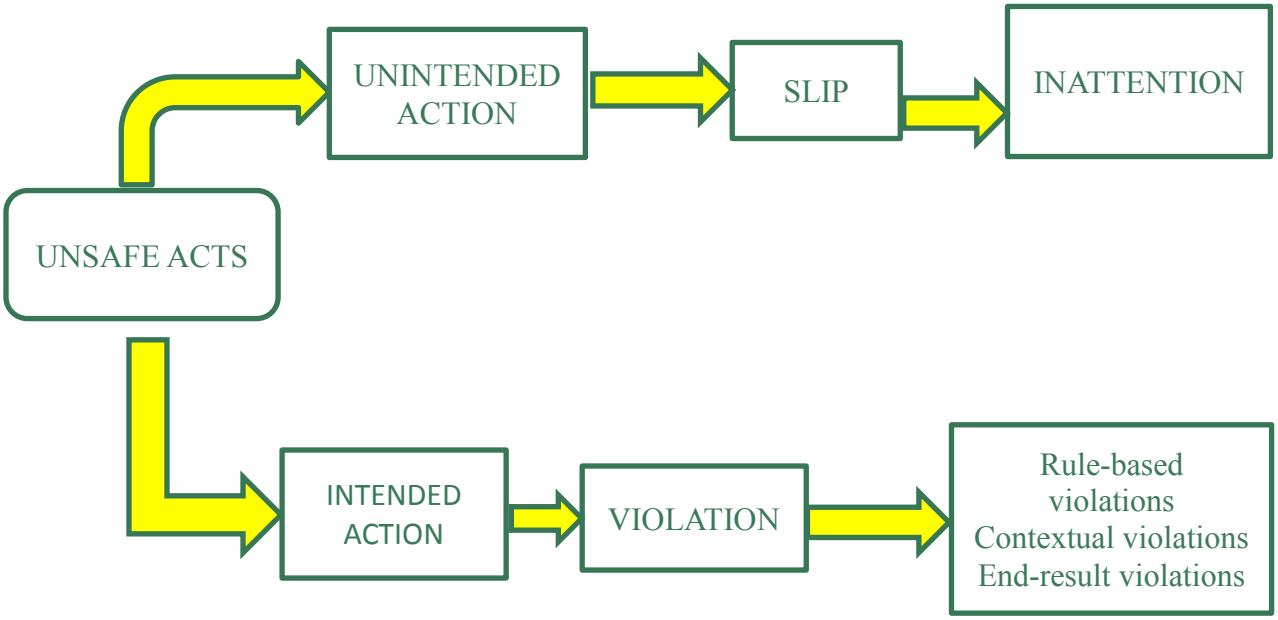

Figure 4.1: Unsafe act algorithm found in the study

In this study, safety skills and perceptual motor skills were not significant predictors of accidents not fitting with the findings of Sümer et al. (2006) and Martinussen et al. (2014) where they showed that Turkish drivers reporting high levels of perceptual-motor skills and low levels of safety skills reported higher numbers of accidents and also in this study SS and PMS were positively correlated though it was the opposite in the abovementioned studies. However, it should be noted that DSI may not be sufficient to reveal the phenomenon. That comes from the fact that operators may be biased and can significantly deviate from their real performance either intentionally or unintentionally. As stated above, male drivers more prone to overestimate their driving skills

For the first time ERI was included in a study focusing on accident reasoning. This was based on the fact that so far ERI has commonly been researched for occupations or jobs that have high working load and time pressure. Forklift operators have limited time to carry out their job, they are going under high level of musculoskeletal strain and not being overpaid. When these facts are combined with the previous ERI studies, it has been found that ERI should also be investigated during the course study. In line with the findings of Öz et al. (2013) stating time and work pressure is related to errors and violations and taking heavy workload of forklift operators into consideration, inattentiveness, only significant predictor of work accidents in this study, could be predicted only by reward among three ERI factors, respectively, effort, reward and ERI which means operators think that only reward is affecting inattentiveness. End-result violations consisting items like “Keep up working with the concern of getting job done although there is a problem like leakage etc.” and Operate forklift while drunk or unconscious” was predicted by all ERI factors which means effort-reward imbalance directly leads operators to act unsafely and commit violations.

4.7. Contributions of the Study

Firstly, it should be noted that, to our best knowledge, this was the first study on effects of human factors in forklift accidents. Also, for the first time in literature, Effort and Reward Imbalance Model was applied to forklift operators and its relationship with FOBQ and FOSI was investigated. Last but not least, maybe the most important contribution is this study is the first one that applied DBQ and DSI which were modified for counter-balanced forklift operators.

4.8. Limitations and Suggestions for Future Studies

Current study was limited to counter-weighted forklift operators which does not give full information about all forklift accidents considering the fact that although all forklift types work in similar principle, they have slight differences in use with respect to their classifications yielding different risks. For other types of forklifts, FOBQ and FOSI items should be revised. Also for driving skills methods other than DSI should be used to confirm the findings of the study, which are different from the literature. For the future studies, it should be ensured that forklift operators have time constraints so proper arrangements for research should be fixed in advance. Operators that have to catch up with a schedule tend to give random answers to questions without reading. In current study, mostly forklift operators working at relatively developed or in other words institutional workplaces were included. A further study to be conducted with forklift operators working at small and medium sized enterprises can state whether current study can be generalized or not. Lastly, various sectors including logistics and warehouses where forklift operators sometimes exceed the maximum working hours should also be researched in terms of FOBQ, FOSI and ERI.

REFERENCES

af Wåhlberg A., Dorn, L., & Kline, T. (2011). The Manchester Driver Behaviour Questionnaire as a predictor of road traffic accidents. *Theoretical Issues in Ergonomics Science*, 12(1), 66–86.

Bakker, A. B., Killmer, C. H., Siegrist, J., & Schaufeli, W. B. (2000). Effort–reward imbalance and burnout among nurses. *Journal of Advanced Nursing,31(4),* 884-891.

Bandura, A. (1997). Self-efficacy. The exercise of control. *New York: W. H. Freeman and Company*.

Blockey, P. N., & Hartley L. R. (1995). Aberrant driving behaviour: errors and violations. *Ergonomics, 38:9,* 1759-1771.

Borowsky, A. (2006). Age skills and hazard perception in driving *[Master of Science]*. *Israel: Ben-Gurion University of the Negev*.

Civil Aviation Authority of Singapore. *Workplace Safety and Health Guidelines Safe Loading.*

Cordazzo, S.T.D., Scialfa C.T., Bubric K., & Ross R.J. (2014) The Driver Behaviour Questionnaire: A North American analysis. *Journal of Safety Research, Volume 50,* 2014, 99-107,

Cordazzo, S.T.D., Scialfa C.T., & Ross R. J. (2016). Modernization of the Driver Behaviour Questionnaire. *Accident Analysis & Prevention, 87,* 83-91.

Crundall, D., Underwood, G., & Chapman, P. (1999). Driving experience and the functional field of view. *Perception, 28,* 1075–1087.

Davey, J., Wishart, D., Freeman, J., & Watson, B. (2007). An application of the driver behaviour questionnaire in an Australian organisational fleet setting.

Transportation Research Part F: Traffic Psychology and Behaviour, 10(1), 11–21.

Department of Labor, United States (1995). *Stacking of Cargo and Pallets.* Retrieved from https://www.osha.gov/laws-regs/regulations/standardnumber/1917/1917.14

Department of Labor, United States (1995). *Powered Industrial Truck Operator Training.* Retrieved from https://www.osha.gov/laws-regs/federalregister/1995-03-14

de Winter, J. C. F., & Dodou, D. (2010). The Driver Behaviour Questionnaire as a predictor of accidents: A meta-analysis. *Journal of Safety Research, 41*, 463–470.

de Winter, J. C. F., & Dodou, D. (2016). National correlates of self-reported traffic violations across 41 countries. *Personality and Individual Differences, 98,* 145–152

Eddy P., Wertheim E.H., Kingsley M., & Wright B.J. (2017). Associations between the effort-reward imbalance model of workplace stress and indices of cardiovascular health: A systematic review and meta-analysis. *Neuroscience & Biobehavioral Reviews, 83*, 252-266.

Ehrlinger J., Johnson K., Banner M., Dunning D., & Kruger J. (2008). Why the unskilled are unaware: Further explorations of (absent) self-insight among the incompetent. *Organizational Behavior and Human Decision Processes, 105 (1)*, 98-121.

Elander, J., West, R. & French, D. (1993). Behavioral correlates of individual differences in road-traffic crash risk: An examination of methods and findings. *Psychological Bulletin, 113*, 279-294.

Embrey, David. (2005). Human Error Understanding Human Behaviour and Error. *Hum. Reliab. Associates. 1*.

Evans, L. (1991). Traffic safetv and the driver. *New York: Van Nostrand Reinhold*.

Farmer, C. M., Braitman, K. A., & Lund, A. K. (2010). Cell phone use while driving and attributable crash risk. *Traffic Inj. Prev., 11(5),* 466–470

Freeman, J., Wishart, D., Davey, J., Rowland, B., & Williams, R. (2009). Utilising the driver behaviour questionnaire in an Australian organisational fleet setting: Can it identify risky drivers? *Journal of the Australasian College of Road Safety, 20,* 38−45.

Chloé Freydier, Catherine Berthelon, Mireille Bastien-Toniazzo. (2016). Does early training improve driving skills of young novice French drivers? *Accident Analysis & Prevention, 96,* 228-236,

Guého, L., Granié, M-A., & Abric, J-C. (2014). French validation of a new version of the Driver Behavior Questionnaire (DBQ) for drivers of all ages and level of experiences. *Accident Analysis & Prevention. 63,* 41-48.

Hatakka M., Keskinen E., Katila A., & Laapotti S. (1991). New drivers versus light traffic (Abstract). Supplement: International Conference on Traffic Safety, New Delhi, India, 1991. *J Traffic Med 1990, 18(4),* 290.

Heftruck Nederland, A New Record Year in Fatal Forklift Accidents? (2016). Retrieved, from https://www.heftrucknederland.nl/nieuws/2016-forkliftaccidents-infographic

Heinrich, H.W. (1941). Industrial accident prevention. *A scientific approach (2nd ed.)*

Helman, S., & Reed, N. (2015). Validation of the driver behaviour questionnaire using behavioural data from an instrumented vehicle and high-fidelity driving simulator. *Accident Analysis & Prevention, 75,* 245–251.

İstif Makinaları Distribütörleri ve İmalatçıları Derneği (2013). *İSDER*

Janicak, C.A., & Deal, G.A. (1999). Occupational fatalities involving forklifts. *J. Trauma 47 (6),* 1084–10 87.

Kinman G, & Jones F. (2008). Effort-reward imbalance, over-commitment and work-life conflict: testing an expanded model. *J Manag Psychol. 23(3*),236-251.

Klauer, S.G., Guo, F., Sudweeks, & J., Dingus, T.A., (2010). An analysis of driver inattention using a case-crossover approach on 100-car data: Final report. *National Highway Traffic Safety Administration, USA,* 334.

Lajunen T., & Summala H., (1995). Driving experience, personality, and skill and safety-motive dimensions in drivers' self-assessments. *Personality and Individual Differences, 19, 3,* 307-318.

Lajunen, T., (1997). Personality Factors, Driving Style, and Traffic Safety. *Traffic Research Unit, Department of Psychology, University of Helsinki.*

Lajunen, T., Corry, A., Summala, H., & Hartley, L. (1998). Cross-cultural differences in drivers' self-assessments of their perceptual-motor and safety skills: Australians and Finns. *Personality and Individual Differences, 24*, 539–550.

Lajunen, T., & Özkan, T. (2004). Culture, safety culture, and traffic safety in Turkey and in Europe. The Turkish Driver Behaviour Questionnaire (T-DBQ): Validity and norms. Report no: SBB-3023. The Scientific and Technical Research Council of Turkey (TUBITAK), June 2004, Ankara, Turkey.

Lajunen T., Parker D., & Stradling S.G. (1998). Dimensions of driver anger, aggressive and highway code violations and their mediation by safety orientation in UK drivers, *Transportation Research Part F: Traffic Psychology and Behaviour, 1(2)*, 107-121.

Lajunen, T., Parker, D., & Summala, H. (2004). The Manchester driver behavior questionnaire: a cross-cultural study. *Accident Analysis & Prevention, 36(2),* 231–238.

Larsson, T.J., & Rechnitzer, G., (1994). Forklift trucks: analysis of severe and fatal occupational injuries, critical incidents and priorities for prevention. *Journal of Safety Science, 17*, 275–289.

Lawton, R., Parker, D., Stradling, S. G., & Manstead, A. S. (1997). Predicting road traffic accidents: The role of social deviance and violations. *British Journal of Psychology, 88(2),* 249–262.

Li, J., Yang W., Cheng Y., Siegrist J., & Cho S. (2005). Effort-reward imbalance at work and job dissatisfaction in Chinese healthcare workers: A validation study. *International Archives of Occupational and Environmental Health, 2005. 78(3*), 198-204.

Mark G., & Smith A.P. (2012). Effects of occupational stress, job characteristics, coping, and attributional style on the mental health and job satisfaction of university employees. *Anxiety Stress Coping, 25(1),* 63-78.

Martinussen, L.M., Møller, M., Prato, C.G., Haustein, S. (2017). How indicative is a self reported driving behaviour profile of police registered traffic law offences? *Accid.Anal. Prev. 99 (Pt A),* 1–5.

Maslac´, M., Antic´, B., Lipovac, K., Pešic´, D., & Milutinovic´, N. (2018). Behaviours of drivers in Serbia: Non-professional versus professional drivers. *Transportation Research Part F: Traffic Psychology and Behaviour, 52*, 101–111.

McKenna, F.P., Stainer, R.A., & Lewis, C. (1991). Factors Underlying Illusory Self-Assessment of Driving Skills in Males and Females. *Accident Analysis Prevention, 23*, 45-52.

McKnight, A.J. & McKnight, A.S. (2003). Young novice drivers: Careless or clueless? *Accident Analysis and Prevention,* 35(6), 921-25.

McLinton, S.S. & Dollard, M.F. (2010). Work stress and driving anger in Japan, *Accident Analysis & Prevention, 42 (1),* 174-181.

Mehdizadeh M., Shariat-Mohaymany A., & Nordfjaern T. (2019). Driver behaviour and crash involvement among professional taxi and truck drivers: Light

passenger cars versus heavy goods vehicles, *Transportation Research Part F: Traffic Psychology and Behaviour, 62*, 86-98.

Miller, P., & Haslam, C. (2009). Why employers spend money on employee health: interviews with occupational health and safety professionals from British Industry. *Saf. Sci., 47*, 163–169.

Ministry of Labour (1999). *Guideline for the Safe Operation and Maintenance of Powered Lift Trucks.* Ontario, Canada: Publication Section of Ministry of Labour.

Näätänen, R., & Summala, H. (1974). A Model for the Role of Motivational Factors in Drivers' Decision-making. *Accident Analysis and Prevention, 6 (3-4),* 243-261.

Nakata, A., M. Takahashi, & M. Irie. (2011). Effort-reward imbalance, overcommitment, and cellular immune measures among white-collar employees. *Biological Psychology, 88(2-3),* 270-279.

National Fire Protection Association (2016). *National Fire Protection Report*. Retrieved from https://www.nfpa.org/assets/files/AboutTheCodes/13/13_A2018_AUT__PI Responses.pdf

Occupational Safety & Health Administration (n.d.). *Powered Industrial Trucks eTool: Types & Fundamentals - Types: Forklift Classifications.* Retrieved from https://www.osha.gov/SLTC/etools/pit/forklift/types/classes.html

Öz, B., Özkan, T., & Lajunen, T. (2013). An investigation of professional drivers: Organizational safety climate, driver behaviours and performance, *Transportation Research Part F: Traffic Psychology and Behaviour, 16,* 81-91.

Özkan, T., & Lajunen, T. (2005). A new addition to DBQ: Positive driver behaviours scale. *Transportation Research Part F: Traffic Psychology and Behaviour, 8(4),* 355–368.

Özkan, T., Lajunen, T., Chliaoutakis, J. E., Parker, D., & Summala, H. (2006). Cross-cultural differences in driving skills: A comparison of six countries. *Accident Analysis and Prevention, 38,* 1011–1018.

Qu, W., Ge, Y., Zhang, Q., Zhao, W., & Zhang, K. (2015). Assessing dangerous driving behavior during driving inattention: psychometric adaption and validation of the attention-related driving errors scale in China. *Accid. Anal. Prev., 80*, 172–177.

Reason, J.T. (1990). *Human Error.* Cambridge University Press: New York.

Reason, J. T., Manstead, A. S. R., Stradling, S., Baxter, J., & Campbell, K. (1990) Errors and Violations on the Road: A Real Distinction? *Ergonomics, 33*, 1351-1332.

Reason, J.T. (1993). Promoting safety in the oil industry. The Ergonomics Society Lecture Presented at the Ergonomics Society Annual Conference, Edinburgh, 13-16 April 1993. *Ergonomics. 37*, 12, 1999-2013.

Redelmeier D.A., & Tibshirani R.J. (1997). Association between cellular-telephone calls and motor vehicle collisions. *The New England Journal of Medicine, 1997,* 336:453-458.

Regan M., Lee J.D., & Victor T. (2013). Driver distraction and inattention: Advances in research and countermeasures. Washington: SAE International.

Rimmö, P.-A., & Hakamies-Blomqvist, L. (2002). Older drivers' aberrant driving behavior, impaired activity, and health as reasons for self-imposed driving limitations. *Transp. Res. F 5*, 47–62.

Sagberg, F., & Bjornskau, T. (2006). Hazard perception and driving experience among novice drivers. *Accident Analysis & Prevention, 38(2),* 407–414.

Siegrist, J. (1996). Adverse health effects of high-effort/low-reward conditions. *J Occup Health Psychol. 1996, 1(1),* 27.

Sosyal Güvenlik Kurumu (2015). *SGK YILLIKLARI – 2015*, Retrieved from http://www.sgk.gov.tr/wps/portal/sgk/tr/kurumsal/istatistik/sgk_istatistik_yilliklari

Spolander, K. (1983). Accident risks of drivers – a model tested on man and woman (in Swedish) *Swedish Road and Traffic Research Institute (VTI), Rapport 260.*

Stanislaw, H. (2012). Personality and demographic predictors of aggressive and distracted driving, *Advances in Traffic Psychology*, 63-75.

Stanojević, P., Lajunen, T., Jovanović, D., Sârbescu, P., & Kostadinov, S. (2018). The driver behaviour questionnaire in South-East Europe countries: Bulgaria, Romania and Serbia, *Transportation Research Part F: Traffic Psychology and Behaviour, 53*, 24-33.

Stored Package. (2018). *Asia Food Journal*. Retrieved April 20, 2018.

Stradling, S., Parker, D., Lajunen, T., Meadows, M., & Xie, C. (1998). Normal behaviour and traffic safety: Violations, errors, lapses and crashes. *4th Annual Conference on Transportation*, 637-644.

Sullman, M. J., Meadows, M. L., & Pajo, K. B. (2002). Aberrant driving behaviours amongst New Zealand truck drivers. *Transportation Research Part F: Traffic Psychology and Behaviour, 5(3),* 217–232.

Summala, H. (1985). Modeling driver task: A pessimistic prediction? *Human behavior and traffic safety,* 43-65.

Summala, H., & Näätänen, R. (1988). *The zero-risk theory and overtaking decisions*. Assen, Netherlands: Van Gorcum & Co.

Summala, H. (1996). Accident Risk and Driver Behaviour. *Safety Science, 22,* 103-117.

Sümer, N. (2003). Personality and Behavioral predictors of traffic accidents: Testing a contextual mediated model. *Accident Analysis and Prevention, 35 (6),* 949-964.

Sümer, N., Özkan, T., & Lajunen, T. (2006). Asymmetric relationship between driving and safety skills. *Accident Analysis and Prevention, 3*8, 703–711.

Taubman-Ben-Ari, O., Mikulincer, M., & Gillath, O. (2004). The multidimensional driving style inventory – scale construct and validation. *Accident Analysis and Prevention, 36,* 323–332.

Upahita, D.P., Wong, Y.D., & Lum, K.M. (2018). Effect of driving experience and driving inactivity on young driver's hazard mitigation skills, *Transportation Research Part F: Traffic Psychology and Behaviour, 59,* 286-297.

Üzümcüoğlu, Y., Özkan, T., Lajunen, T. (2018). The relationships between cultural variables, law enforcements and driver behaviours across 37 nations, *Transportation Research Part F: Traffic Psychology and Behaviour, 58,* 743-753.

Vahedi, J.; Shariat Mohaymany, A.; Tabibi, Z.; Mehdizadeh, M. (2018). Aberrant Driving Behaviour, Risk Involvement, and Their Related Factors Among Taxi Drivers. *Int. J. Environ. Res. Public Health 2018, 15,* 1626.

Valent Group (2018). *Ten Most Common Osha Violations Cited in 2016,* Retrieved from https://www.valentgroup.com/osha-violations/

Warner, H.W., Özkan T., Lajunen T., Tzamaloukas G.S. (2013). Cross-cultural comparison of driving skills among students in four different countries, *Safety Science, 57,* 69-74.

Xu J., Liu J., Sun X., Zhang K., Qu W., & Ge Y. (2018). The relationship between driving skill and driving behavior: Psychometric adaptation of the Driver Skill Inventory in China, *Accident Analysis & Prevention, 120*, 92-100.

Xu, W., Zhao Y., Guo L., Guo Y., & Gao W. (2010). The association between effort-reward imbalance and coronary atherosclerosis in a Chinese sample. *American Journal of Industrial Medicine, 53(7),* 655-661.

Zhang, W., Huang, Y.H., Roetting, M., Wang, Y., Wei, H. (2006). Driver's views and behaviors about safety in china–what do they not know about driving? *Accid. Anal. Prev. 38 (1),* 22.

Zhao, N., Mehler, B., Reimer, B., D'Ambrosio, L. A., Mehler, A., & Coughlin, J. F. (2012). An investigation of the relationship between the driving behavior questionnaire and objective measures of highway driving behavior. *Transportation Research Part F: Traffic Psychology and Behaviour, 15(6),* 676–685.

APPENDICES

A. Ethical Permission

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

DUMLUPINAR BULVARI 06800
ÇANKAYA ANKARA/TÜRKEY

Sayı: 28620516/495

08 AĞUSTOS 2018

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Prof. Dr. Türker ÖZKAN

Danışmanlığını yaptığınız; yüksek lisans öğrencisi Fatih EREL'in "**Safeworkingwithforklifts**" başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek gerekli onay **2018-SOS-162** protokol numarası ile **08.08.2018 - 30.08.2019** tarihleri arasında geçerli olmak üzere verilmiştir.

Bilgilerinize saygılarımla sunarım.

Prof. Dr. Ş. Halil TURAN
Başkan V

Prof. Dr. Ayhan SOL
Üye

Prof. Dr. Ayhan Gürbüz DEMİR
Üye

Doç. Dr. Yaşar KONDAKÇI
Üye

Doç. Dr. Zana ÇITAK
Üye

Doç. Dr. Emre SELÇUK
Üye

Dr. Öğr. Üyesi Pınar KAYGAN
Üye

B. Demographic Information Form

Forklift, işyerlerinde en önemli kaldırma ve iletme ekipmanlarından biridir. Her yıl onlarca kişi forklift kullanımı sırasında hayatını kaybetmekte ya da yaralanmaktadır. Bu önemli sorunun insani boyutunu daha iyi anlayabilmek için bir araştırma yapmaktayım. Bu nedenle, elinizdeki ankette sürücü davranışları, becerileri ve stres ile ilgili konularda bazı sorular ve ifadeler yer almaktadır. Anketteki hiçbir maddenin tam olarak doğru veya yanlış cevabı yoktur. Burada, önemli olan bu konularda sizin gerçekten ne yaptığınız, neye inandığınız ve ne düşündüğünüzdür. Lütfen, soruları sizi tam olarak yansıtacak şekilde ve içtenlikle cevaplayınız. Anketi doldurmadan önce her soru grubunun başındaki açıklamaları dikkatle okuyunuz ve soruları bu açıklamalara uygun olacak şekilde boş soru bırakmadan cevaplayınız, eksik doldurulmuş anketleri araştırmada kullanmak mümkün değildir. Araştırmada kişi bazında değerlendirmeler yapılmayacaktır. Bu nedenle anket üzerine isminizi yazmanız istenmemektedir. Katkınızdan dolayı teşekkür ederim.

Her türlü sorunuz için Fatih.erel@metu.edu.tr adresinden ulaşabilirsiniz.

1. Yaşınız: _____ 2. Cinsiyetiniz: ❑ Kadın ❑ Erkek

3. Eğitim durumunuz: _4. Ne kadar süredir forklift kullanıyorsunuz? _____ Yıl

5. G tipi forklift ehliyetiniz var mı? ❑ Evet ❑ Hayır

6. Son üç yıl içerisinde **küçük ya da büyüklüğüne bakmaksızın, nedeni ne olursa olsun,** başınızdan geçen **kaza sayısı kaçtır?**

Bu kazaların kaç tanesinde hatalı taraftınız?

Bu kazaların kaç tanesi yaralanma ile sonuçlandı?

C. Driver Behavior Questionnaire

Aşağıda verilen durumları ne sıklıkta yaparsınız ?

Lütfen her bir madde için verilen durumun ne sıklıkta başınızdan geçtiğini belirtiniz. Soruları, nasıl araç kullandığınızı düşünerek cevaplandırınız ve her bir soru için sizi tam olarak yansıtan cevabı, yanındaki kutudaki uygun rakamı daire içine alarak belirtiniz.

0= HİÇ BİR ZAMAN 1= NADİREN 2= BAZEN 3= SIK SIK 4= HER ZAMAN

1.	Forklift kullanırken emniyet kemeri takmamak	0	1	2	3	4
2.	Yük kaldırmadan önce aracın kapasitesini bilmesine rağmen kapasitesini aşan yükleme yapmak	0	1	2	3	4
3.	Forkliftin acil bir durumda devrilmesi durumunda yapılması gerekenleri bilmesine rağmen araçtan atlamaya çalışmak	0	1	2	3	4
4.	İş yetiştirme kaygısıyla uygun olmayan ataşman kullanmak	0	1	2	3	4
5.	Geri giderken forkliftteki görsel ve sesli ikazların çalışıyor durumda olmasına dikkat etmemek	0	1	2	3	4
6.	Bilgi sahibi olmasına rağmen uygun olmayan istif yapmak	0	1	2	3	4
7.	Dalgınlıkla dönülmeyecek yerde dönmeye çalışmak	0	1	2	3	4
8.	Yaya-forklift kesişim noktalarında gerekli önlemleri almayı unutarak yoluna devam etmek	0	1	2	3	4
9.	Gerektiği durumlarda kendisine verilmesine rağmen kişisel	0	1	2	3	4

	koruyucu donanımlarını(baret, maske, eldiven vs.) kullanmamak					
10.	Gürültü seviyesinin yüksek olduğu yerlerde kuralları takip etmemek	0	1	2	3	4
11.	Gayri ihtiyari ani fren yapmak	0	1	2	3	4
12.	Gereksiz ani hızlanmak	0	1	2	3	4
13.	Eğimli alanda iniş ve çıkışlarda ani fren yapmak	0	1	2	3	4
14.	Eğimli alanda dönüş yapmak	0	1	2	3	4
15.	Forklifti eğimli alanda bırakmak	0	1	2	3	4
16.	Forklifti yetkisi olmayan kişilerin kullanmaması için araçtan inerken gerekli tedbirleri almamak	0	1	2	3	4
17.	Yükün çatallar yere çarpmayacak şekilde mümkün olduğu kadar alçakta(10-15 cm) taşımamak	0	1	2	3	4
18.	Yük havadayken dönüş yapmak	0	1	2	3	4
19.	Uykuluyken forklifti kullanmak	0	1	2	3	4
20.	Dalgınken araç kullanmak	0	1	2	3	4
21.	Yorgunken çalışmak	0	1	2	3	4
22.	Çalması gerektiği halde kornayı kullanmaktan kaçınmak	0	1	2	3	4
23.	Gereksiz yerde korna kullanmak	0	1	2	3	4
24.	Forklift kullanırken cep telefonuna cevap vermek	0	1	2	3	4
25.	Sevkiyat yetiştirme kaygısı ile aşırı yükleme yapmak	0	1	2	3	4
26.	Forklifti herhangi bir nesneyi itme ve çekme için kullanmak	0	1	2	3	4

27.	Kornayı sadece gerektiğinde kullanmak	0	1	2	3	4
28.	Forkliftte insan taşımak	0	1	2	3	4
29.	Forkliftle şakalaşmak	0	1	2	3	4
30.	Görüş alanını engelleyecek yükleme yapmak	0	1	2	3	4
31.	Öndeki araçla takip mesafesini korumamak (fren mesafesi)	0	1	2	3	4
32.	Kör noktalarda varsa mavi ışık ve tümsek ayna ile işaretçi kullanmamak	0	1	2	3	4
33.	Araç yükleme rampasına uygun yanaşmamak	0	1	2	3	4
34.	Akü veya karşı ağırlığa müdahale edip değiştirmek	0	1	2	3	4
35.	Ekipmanda sızıntı vb. bir sorun olmasına rağmen görevi yetiştirme telaşıyla çalışmaya devam etmek	0	1	2	3	4
36.	Karayolunda trafik kurallarına uymamak (ters şerit vb.)	0	1	2	3	4
37.	Sarhoş veya bilinci açık değilken forklift kullanmak	0	1	2	3	4
38.	Forklift koltuğu rahatsız olduğu için ani hareket yapmak	0	1	2	3	4

D. Driver Skills Inventory

Forklift kullanırken güçlü ve zayıf yönleriniz nelerdir?

Her forklift operatörünün güçlü ve zayıf sürücü yönleri vardır. Lütfen sizin, bir operatör olarak güçlü ve zayıf yönlerinizin neler olduğunu her bir madde için aşağıdaki uygun seçeneği işaretleyerek belirtiniz.

0= ÇOK ZAYIF 1= ZAYIF 2= NE ZAYIF NE GÜÇLÜ 3=GÜÇLÜ 4= ÇOK GÜÇLÜ

1.	Forkliftin dengesine etki eden unsurları bilmek	0	1	2	3	4
2.	Görev tanımı içerisinde çalışmak	0	1	2	3	4
3.	Fabrika içinde tehlikeleri görme	0	1	2	3	4
4.	İlerideki trafik durumlarını önceden kestirme	0	1	2	3	4
5.	Belirli trafik ortamlarında nasıl hareket edileceğini bilme	0	1	2	3	4
6.	Hızlı karar alma	0	1	2	3	4
7.	Tip etiketi(kapasite bilgileri) ve yük çizelgesine uygun yükleme yapmak	0	1	2	3	4
8.	Uygun istif yapmak	0	1	2	3	4
9.	Sinir bozucu durumlarda sakin davranma	0	1	2	3	4
10.	Forklifti kontrol etme	0	1	2	3	4
11.	Kör noktalarda yavaşlamak, varsa tümsek aynaları ve işaretçi yoksa korna kullanmak	0	1	2	3	4
12.	Eğimli alanlarda güvenli sürüş	0	1	2	3	4
13.	Koşullara göre hızı ayarlama	0	1	2	3	4
14.	Araç seyir halindeyken emniyet kemerini takmak	0	1	2	3	4
15.	Fabrika içi kullanım prosedürlerine uymak	0	1	2	3	4
16.	Fabrika dışı kullanım prosedürlerine uymak	0	1	2	3	4
17.	Hız sınırlarına uyma	0	1	2	3	4
18.	Gereksiz ve/veya ani frenden kaçınma	0	1	2	3	4
19.	Dar bir hol/koridorda araç kullanmak	0	1	2	3	4
20.	Devrilme halinde yapılacakları bilmek	0	1	2	3	4
21.	Araç yükleme rampası ile güvenli çalışma yapmak	0	1	2	3	4

E. Effort-Reward Imbalance Model

Aşağıda yer alan ifadeler için

Hiç katılmıyorum, Kısmen katılmıyorum, Kararsızım, Kısmen katılıyorum, Tamamen katılıyorum

seçeneklerinden **birini** işaretleyiniz.

	Kesinlikle katılmıyo rum	Kısmen katılmıyorum	Kararsızım	Kısmen katılıyorum	Tamamen katılıyorum
ÇÖ 1 Yoğun çalışma temposundan dolayı sürekli zaman baskısı altındayım.					
ÇÖ 2 İşimde sürekli kesilmeler ve müdahalelerle karşılaşıyorum.					
ÇÖ 3 İşimde çok fazla sorumluluğum var.					
ÇÖ 4 Çoğu zaman mesaiye kalmam gerekiyor.					
ÇÖ 5 Geçtiğimiz birkaç yıl içerisinde işim daha çok çaba gerektirecek.					
ÇÖ 6 İşim fiziksel olarak zorlayıcı.					
ÇÖ 7Amirlerimden hak ettiğim saygıyı görüyorum.					
ÇÖ 8 İş arkadaşlarımdan hak ettiğim saygıyı görüyorum.					
ÇÖ 9 Zor durumlarda yeterli desteği alıyorum.					

ÇÖ 10 İşte bana haksız muamele yapılıyor.					
ÇÖ 11 Geleceğe dair işte yükselme ihtimalim pek yok.					
ÇÖ 12 İş durumumda istenmeyen bir değişiklik yaşadım veya yaşamayı bekliyorum.					
ÇÖ 13 İş güvenliğim yetersiz.					
ÇÖ 14 Mevcut iş pozisyonum eğitim durumumu ve aldığım eğitimlerimi yeterince yansıtmaktadır.					
ÇÖ 15 Tüm çaba ve başardıklarım düşünülürse, işte hak ettiğim saygı ve prestiji görüyorum.					
ÇÖ 16 Tüm çaba ve başardıklarım düşünülürse, iş beklentilerim yeterlidir.					
ÇÖ 17 Tüm çaba ve başardıklarım düşünülürse, maaşım/gelirim yeterlidir.					
ÇÖ 18 İşteki baskıdan kolaylıkla etkileniyorum.					
ÇÖ 19 Gündüz kalkar kalkmaz iş problemlerimi düşünmeye başlıyorum.					
ÇÖ 20 Eve geldiğimde kolaylıkla rahatlayıp kendimi					

işten soyutlayabiliyorum.					
ÇÖ 21 Bana yakın kişiler işim için kendimi çok harap ettiğimi söylüyorlar.					
ÇÖ 22 İş yakamı bırakmıyor, yatağa girdiğimde bile aklımda.					
ÇÖ 23 Bugün yapmam gereken bir şeyi yarına ertelersem, gece yatağımda uyuyamam.					