Evaluating Disability Management in Construction using Maturity Modelling and Metrics and its Relation to Safety Performance

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DECLARATION

I, Rhoda Ansah Quaigrain, declare this document to be my own unaided work, and where published sources are used, they are acknowledged.

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Abstract

Despite the potential benefits of DM programs with respect to reducing costs and improving workplace morale, many organizations in the construction industry appear unable to develop and implement them. Inadequate support and practices at the organizational level affect the degree to which construction workplaces can accommodate disabled employees returning to the workplace with a disability, reinforcing the need to investigate the maturity of related practices. Moreover, there's little empirical evidence in the literature about the disability management performance of the construction industry in general.

This research aimed to investigate disability management in the Manitoban construction industry and its relation to safety performance. Specific objectives involved developing and validating a model to evaluate the maturity of construction organizations' disability management practices and a set of metrics to evaluate their disability management and safety performance. The research also aimed to evaluate the relationship between the maturity of construction organizations' disability management practices, their disability management performance and their safety performance. The research made use of maturity modelling to develop the required model. The developed model, called the Construction Disability Management Maturity Model, benchmarked construction companies' disability management performance using 12 disability management indicators. The weights of importance of these indicators was determined by eight construction experts using an analytical hierarchy process. The model was then applied to a sample of 10 general contractors in Manitoba using an assessment worksheet. The research also involved adopting three safety metrics and developing 12 new disability management metrics and using them to evaluate the safety and disability management performance of the same general contracting companies. The maturity

model results were correlated to the disability management and safety performance metric results to investigate the relationship between construction organizations' disability management maturity and their disability management and safety performance.

The analytical hierarchy process showed "Return to work and accommodation" and "Disability and injury management" practices were the most important disability management indicators whereas "Physical accessibility management" and "Claims management" practices were the least important. The results also showed after applying the CDM3 that the ten construction companies operated at the quantitatively managed maturity level. Smaller-sized companies were more mature on average with respect to disability management than larger companies. "Senior management support" and "Disability and injury prevention" were found to be the most mature disability management indicators whereas "Retention and recruitment" and "Communication" practices were the least mature. The findings also showed that companies with higher disability management maturity tended to record lower recordable injury rates, lower severity rates and lower lost time case rates, and thus have higher safety performance than companies with lower disability management maturity. Nevertheless, the relationships between various indicators of disability management performance and various indicators of safety performance were not statistically significant for the most part, most probably because of the small number of companies evaluated. This research is the first ever to deliver leading indicators of performance in the form of the Construction Disability Management Maturity Model that construction organizations can use to evaluate, benchmark and improve expected disability management performance. It is also the first to deliver lagging indicators of performance in the form of new metrics that they can use to evaluate, benchmark and improve actual disability management performance.

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List of Acronyms & Abbreviations

AHP	Analytical Hierarchy Process
CCIC	Canadian Council for International Co-operation
CEM	Construction Engineering and Management
CDM3	Construction Disability Management Maturity Model
CII	Construction Industry Institute
CLP	Claims Management Practices
CMM	Capability Maturity Model
CMMI	Capability Maturity Model Integration
CMP	Case Management Practices
CP	Communication Practices
CSAM	Construction Safety Association of Manitoba
DART	Days away, Job Restriction or Transfer
DIP	Disability and Injury prevention practices
DM	Disability Management
EP	Ergonomic Practices
EMR	Experience Modification Rating
FIMG	Fuzzy Industry Maturity Grid
ILO	International Labour Organization
IMG	Industry Maturity Grid
LTCR	Lost Time Case Rates
MB	Manitoba
MS	Maturity Score
MSI	Musculoskeletal
NIDMAR	Canadian National Institute for Disability Management and Research
OECD	Organization for Economic Cooperation and Development
OHS	Occupational Health and Safety
OHSHA	Occupational Health and Safety Agency for Healthcare
PAP	Physical Accessibility Management Practices
PEP	Program Evaluation Practices
PG	Potential Growth
PMI	Project Management Institute
RAP	Return to Work and Accommodation Practices
RCP	Regulatory and Compliance Policies
RIR	Recordable Injury Rates
RRP	Recruitment and Retention Policies
RTW	Return to Work
SEM	Safety Element Method

SMP	Senior Management Support Practices
SMS	Safety Management System
SPICE	Standardized Process Improvement for Construction Enterprises
SR	Severity Rates
TPM	Transitional Program Management Practices
UAI	Universal Assessment Instrument
UK	United Kingdom
UN	United Nations
UPIAS	Union of Physically Impaired Against Segregation
US	United States
WCA	Winnipeg Construction Association
WCB	Worker's Compensation Board
WHO	World Health Organization

CHAPTER 1: INTRODUCTION

This chapter provides background information about the research focusing in particular on the concepts of construction health and safety and disability management (DM). The chapter describes the problem that the research addresses. It also identifies the research goal, objectives and scope and reflects on its originality and significance to both industry and academia.

1.1 Health and Safety in Construction

The construction industry has traditionally had a poor safety record. A review of the literature reveals that the industry has a fatal and major injury rate that is three times higher than that of all other industries in industrialized nations such as the United Kingdom (UK) and the Netherlands (Clarke et al. 2009). In 2005, 7,509 construction injuries that lasted more than three days were recorded in the UK, with London recording the highest rate (i.e. 608 per 100,000 employees) (London Assembly, 2005, Clarke et al. 2009). Clarke et al. (2009) estimated the rate of unreported accidents in Britain at 50%, and estimated that 62% of construction workplaces in general had unsafe conditions and that only 46% of the construction workforce had the training required to do their jobs. Lingard and Saunders (2004) found that in Australia, only 57% of construction employees reached the age of 65 without having a permanent impairment.

In Canada, a review of the literature shows that the construction industry at large was responsible for 26,015 time-loss injuries in 2015 and was thus the industry with the third highest number of time-loss injuries for that year (Association of Employees' Compensation Boards of Canada 2017). It accounted for a total of 186 fatalities in 2015, representing 21.8% of all fatalities alone: the

highest rate of any industry in the country. In Manitoba (MB), the construction industry was responsible in 2016 for 1,717 time-loss injuries (Safe Work Manitoba 2016). Of those, the building industry accounted alone for 1,430 and was thus the industry with the highest number of time-loss injuries on that year whereas the heavy construction industry accounted for 287. Six fatalities related to the construction industry were reported in 2015 (Association of Employees' Compensation Boards of Canada 2017). These represented 31.5% of all fatalities in Manitoba even though the construction industry represented only 8.3% of the total workforce in Manitoba in 2016 (Safe Work Manitoba 2016). Despite a decrease in time loss injury rates from 6.9% and 8.7% in 2007 to 3.7% and 4.4% in 2016 for heavy and building construction respectively in MB, these rates were still higher than the overall average rate of 2.9% in 2016. Building and heavy construction's all injury rates were also a lot higher than the provincial averages in 2016 and amounted to 9.1% and 8.5% respectively.

1.2 Disability Management in Construction

The poor safety record of the construction industry reinforces the need to discuss the industry's management of disability since many construction injuries lead to temporary or permanent disability (Clarke et al. 2009). Early evidence in the literature (e.g. Newton and Ormerod 2005, Clarke et al. 2009, Lingard and Saunders 2004) suggests the exclusion of disabled employees from the construction industry may be due to the way the industry is organized rather than these employees' specific disabilities. Eppenberger and Haupt (2003), Clarke et al. (2009) and Tshobotlwane (2005) argued that construction employees are confronted with dangerous, life-threatening work conditions in construction sites that lead to serious accidents and injuries. These require the implementation of proactive and reactive measures to manage outcomes and

accommodate injured and disabled employees. The collection of these measures is what is known as Disability Management (DM). DM can therefore be defined as a workplace prevention and remediation strategy that seeks to prevent disability from occurring or, lacking that, to intervene early following the onset of disability. This usually happens using coordinated, cost-conscious, quality rehabilitation service that reflects an organizational commitment to continued employment of those experiencing functional work limitations. The goal of DM is therefore to ensure successful job maintenance or return to work (RTW) to people with disabilities (Akabas et al. 1992, Westmorland and Buys 2004).

Although DM in construction aims to address the industry's poor safety performance, the concept originally evolved out of a need to address discrimination against disabled people and their systematic under-representation in key areas of society, restricting their access to meaningful employment (Tshobotlwane 2005). The concept originated from that of older vocational rehabilitation programs for injured employees and gradually progressed to incorporate the RTW model. Comprehensive DM incorporates three key domains: prevention, early intervention and proactive RTW intervention to reduce the impact of injury and disability and to accommodate those experiencing functional work limitations (Rosenthal et al. 2007). Despite the benefits of RTW programs with respect to reducing costs and improving workplace morale (Shrey and Hursh 1999), many workplaces seem unwilling or unable to implement them (Brooker et al. 2012), citing the cost of workplace accommodations as an important barrier to their implementation (Tshobotlwane 2005, Rosenthal et al. 2005, Angeloni 2013). In Manitoba, DM programs implemented to manage disability involve reporting and documenting work injuries, offering alternate work, or modifying existing work (WCB, 2010). Modifications include altering aspects

related to employees' duties, responsibilities, work location, work hours or any combination of these. Although agencies like the WCB encourage and promote the implementation of workplace DM programs, many construction firms do not have formal DM and RTW programs in place (Ormerod and Newton 2004). This is because of the limited opportunities available in construction for alternate or modified work, the varying nature of construction work and the cost of implementing formal DM programs.

1.3 Problem Statement, Goal and Objectives

Inadequate support and practices at the organizational and managerial levels affect the degree to which construction workplaces can accommodate disabled employees returning to the workplace with a disability, reinforcing the need to investigate the maturity of existing related support and practices. Moreover, there's little empirical evidence about the maturity of these practices and the status of disability management (DM) in construction in general. Therefore, this research aimed to investigate DM in the Manitoban construction industry and its relation to safety performance. Specific objectives involved:

1. Developing and validating DM indicators that can be used to evaluate construction organizations' DM performance
2. Developing and implementing a model to evaluate the maturity of construction organizations' DM practices
3. Developing and implementing metrics (i.e. also known as performance metrics) to evaluate construction organizations' DM and safety performance
4. Evaluating the relationship between the maturity of construction organizations' DM practices, their DM performance and their safety performance

5. Making recommendations to improve the maturity of construction organizations' DM practices

1.4 Scope

The research focused on evaluating the status of DM in the Manitoban construction industry in particular. It also focused on developing and applying the model and metrics and evaluating the relationship between them within the local Manitoban industry. The model centers on evaluating DM at the organizational level rather than at the industry or project level. It aims to investigate the extent to which an organization's existing DM policies and practices compare against DM best practices. The metrics also aim to evaluate safety and DM performance at the organizational level. The research does not address specific physical retrofits or assistive technologies aimed at making workplaces more accessible. It also does not restrict itself to one type of physical or mental disability. The research focused on evaluating general contractor organizations from the building and heavy construction sectors in particular. The model and metrics developed evaluate DM using leading and lagging indicators of performance respectively and using qualitative and quantitative measures respectively.

1.5 Significance and Originality

The significance and originality of this research stem from it being the very first study to evaluate DM in the construction industry using leading and lagging indicators of performance. The research addresses the inability of construction companies to accommodate injured and disabled employees to ensure their timely RTW. It aims to provide practical and creative solutions that will allow

construction organizations to evaluate and benchmark their DM and RTW performance in order to support continuous improvement. This should lead in the long-term to the development of more robust organizational DM programs that would protect people with disabilities, ensure their prompt and safe RTW and provide them with the accommodations they need in the workplace. It should also help break cultural and attitudinal barriers in the industry by encouraging construction workplaces to hire employees with disabilities.

This research is the first to provide a tool in the form of a maturity model that construction organizations can use to evaluate the maturity of their existing DM practices. This is to address the lack of empirical evidence on the DM performance of the construction industry. There is little knowledge for example of the most mature DM practices implemented by construction workplaces or of ones in need of improvement. The maturity model developed in this research should enable construction organizations to evaluate and benchmark the maturity of their DM practices and thus predict related performance using leading indicators of performance. The research also defines as part of the model the DM best practices that these organizations should aim for. The model thus enables these organizations to evaluate their existing DM practices against those best practices and to identify and rectify deficiencies within their DM programs. Construction organizations should be able to use the model on a regular basis to assess their performance and address issues as they arise. The model can also be modified in the future to reflect changing legislation and changing best practices.

The research is also the first to develop a set of quantitative objective metrics to evaluate actual DM performance using lagging indicators of performance and address the lack of such measures

in the literature. There's little empirical evidence in the literature about how a company's quantitative data can be analyzed to measure its actual DM performance. The validated metrics should enable construction companies to evaluate and benchmark that performance quantitatively. These metrics can be compared to set benchmarks at the industry level to assess how a company is doing in comparison to others in the industry. Companies can use these metrics on a regular basis to assess actual performance, identify potential issues affecting it and develop solutions to address those issues. Additional metrics can be also added to those ones in the future to enable a more thorough evaluation of actual DM performance. The two tools developed (i.e. the model and metrics) can be used not only by construction companies but also by the Worker's Compensation Board of Manitoba, the Construction Safety Association of Manitoba and other regulatory bodies for auditing purposes. Should these best practices and benchmarks be enforced, the tools could be used in a regulatory capacity to evaluate compliance with them.

This research is expected to enable a better understanding of the relationship between improved DM practices evaluated using the model and improved DM performance evaluated using the metrics. It should also enable a better understanding of the relationship between these DM practices and safety performance. Should a relationship exist, the research would be making the case for the need to better integrate disabled employees in the workplace to ultimately improve everyone's safety. Employers who are serious about health and safety would therefore need to show that DM is a priority, that due diligence is exercised and that policies and practices in place are in accordance or exceed existing standards. The research could help justify further investments in DM to ensure related practices effectively accommodate disabled employees on site and in the field. It could also help make the case for the need to improve existing guidance (e.g. Workplace

Accessibility Act) and their enforcement to ensure greater accessibility to all.

CHAPTER 2: LITERATURE REVIEW

This chapter provides a detailed review of the relevant literature in the field. More specifically, this chapter includes a discussion of the concept of disability and the guidance in place to support the employment of disabled people. The chapter also discusses the concept of disability management (DM), in particular its history and theoretical foundations as it pertains to Canada specifically. This is followed by a review of the literature on DM in relation to the construction industry specifically. The chapter also describes the history, theoretical foundations and application of the concept of maturity modelling to the construction industry. It ends with a review of the methods used to benchmark construction safety and DM performance, focusing in particular on the use of leading and lagging indicators of performance.

2.1 Disability

This section delves into defining disability and describing its various paradigms. It also explores existing guidance in place in Canada to support disabled people and regulate their employment.

2.1.1 Origins and Theoretical Foundations

Until recently, the dominant paradigm regarding disability was the medical model (Pfeiffer 2001). The medical model contends that disability is a physical or mental impairment limiting one or more life activity. It argues that disability is linked to the individual and due to genetics or environmental conditions such as illnesses, accidents, war and pollution (Barnes 1999, Pfeiffer 2001). The model is primarily concerned with the avoidance, detection, categorization and elimination of impairment, and with rehabilitating people through medical and psychological

treatment. Despite its popularity, the model's assumption that disability is an individual problem is highly contested in the literature (Oliver 1983, Pfeiffer 1996:2001, Priestley 1999, Sapey and Hewitt 1991).

Even though most research relies on the medical model to define disability (Barnes 1991, Oliver 1997), the stigma model is still used sometimes and focuses on the perceptions, attitudes and biases related to disabled people in the workplace. The stigma model is based on Goffman's (1963) definition of disability as a social stigma because of disabled people's inability to meet the norms of society. But whereas Goffman (1963) was concerned with how disabled people interact with their social surroundings, DM research based on the stigma model is primarily concerned with how disabled people are perceived and treated (Thanem 2008). Although research (e.g. McCampbell 1995, Thanem 2008, Stone and Colella 1996) based on the stigma and medical models acknowledge the discrimination faced by disabled people in the workplace, it attributes it to the functional limitations of these people.

Another model, the social model stands in direct contrast with the medical model. The model originated in the 1970s in the United Kingdom (Campbell and Oliver 1996) and was later formalized by Oliver (1983), Corker (2000) and Finkelstein (1980). The social model views "society's failure to provide appropriate services and adequately ensure the needs of disabled people" as the main problem rather than disabled people's functional limitations as viewed by the medical model (Oliver 1996). It explains disability in social terms focusing on the ways in which the physical, cultural and social environments exclude or disadvantage disabled people (Pfeiffer 2001) and thus equates disabled people to other oppressed groups. Nevertheless, feminist

approaches argue that disability is not just in the external social world (Thomas 2007) but also in people's embodied experience of impairment: an aspect usually overlooked by the social model. Crow (1996) argues that disabled people are "frustrated and disenchanted by pain, fatigue, depression and chronic illness", criticizing the social model for its focus on socio-political and institutional issues and its neglect of personal issues.

Recent years have witnessed a move to apply the theory of social constructionism to disability (Borden 1992, Brzuzy 1997, Ringma and Brown 1991). Witkin (1990) described constructionism as a theory that seeks to "elucidate the socio-historical context and ongoing social dynamic of descriptions, explanations, and accountings of reality". Social constructionism thus assumes that knowledge is not an objective entity or reality but a social creation (Levine 1997). According to Hiranandani (2005), social constructionism offers significant insight to disability because most individualistic accounts of disability fail to recognize that even the most objective of disorders such as visual impairment varies across cultures and societies. For instance, Edgerton (1985) showed that attitudes towards people with impairments in non-western cultures ranged from negative discrimination to acceptance and even positive attribution of supernatural powers. This understanding of disability as a social and cultural phenomenon rather than an inherent objective reality calls into question the assumptions made by the medical model and that form the foundation of disability research and practice (Hiranandani 2005).

Another approach: the emancipatory paradigm put forward by Oliver (1992) and Barnes (1992) provides an alternative to the non-partisan, objective research model long accused of having compounded disabled people's oppression (Barnes 1996, Stone and Priestley 1996). The

emancipatory paradigm emphasizes emancipatory goals and commits to open partisan support and empowerment of research subjects in order to overcome the traditional asymmetrical relationship between researchers and research subjects (Oliver 1997). The paradigm also aims to change the role of funding bodies and the relationship between research findings and policy responses (Oliver 1997, Barnes 2003).

2.1.2 Relevant Guidance in Canada

Internationally, enacted legislation to protect the rights of disabled employees includes the Americans with Disabilities Act in the United States (1990) (Rush 2012) and the UK Disability Discrimination Act (1995). Germany enacted the Law of Severely Disabled People (Thornton 1998), compelling public and private companies with more than 16 employees to set aside 6% of their positions to disabled persons or pay a compensatory levy for each unfilled compulsory position (Thornton 1998). Similarly, Greece introduced a compulsory employment law in the public sector, assigning the Manpower Employment Organization to oversee the employment of disabled persons in that sector (Strati and Evangelinou 2007).

Although Canada does not have separate legislation or regulations to protect the rights of disabled employees (Shrey and Hursh 1999), the Canadian Charter of Human Rights and the Duty to Accommodate principle (Government of Canada 1985) have been introduced at the federal level for that purpose. These require employers to provide reasonable accommodation to employees to enable them to do their jobs. However, these regulations also have “undue hardship” clauses that can allow employers to circumvent this obligation. Additionally, Canada has invested heavily at the federal and provincial levels to develop DM training programs, with the goal of creating safer

work environments that accommodate employees with disabilities (OECD 2010). An example includes the Targeted Wage Subsidies Programme (OECD 2010) designed to encourage the hiring of employees with disabilities by temporarily subsidizing up to 100% of their wages to address their workplace accommodation needs (OECD 2010). Unlike other countries, Canada does not have a federal disability act (Burns and Gordon 2010). Only three out of ten provinces have their own disability legislation: Ontario's Accessibility for Ontarians with Disabilities Act (Government of Ontario, 2001 (revised 2005), Nova Scotia's Community ACCESS-Ability Program (Government of Nova Scotia 2005) and Manitoba's Accessibility Act (2013). The Council of Canadians with Disabilities (2005) stressed the need for a federal disability act and for integrated services for people with disabilities. There is in particular a need for federal and provincial legislations that work in parallel rather than against each other (Burns and Gordon 2010).

Another major piece of legislation enacted in every province includes the Employees Compensation Acts (Burns and Gordon 2010). Federal employees who are not under provincial jurisdiction are covered by the Federal Government Employees Compensation Act (Burns and Gordon 2010). Under the Employees Compensation Act and Occupational Health and Safety Regulations (Burns and Gordon 2010), employers are responsible for paying disability benefits to employees experiencing work-related injuries and illnesses, with the process managed by the relevant employees' compensation board or commission. Employers also have a duty to report and accommodate employees' RTW. Premiums are paid by employers to an "Accident Fund" and rated according to industry classes, occupations and individual employers' experiences. The more work injuries in a workplace, the higher the premium paid by the employer for that workplace. Premiums accumulated are used to provide medical and rehabilitation aid, supplement lost wages to injured

employees and pay for board administration fees (WCB 2010). Figure 1 below summarizes these existing legislations at the federal and provincial levels. Although these exist, there are no obligations for companies to comply with them and no penalties in place for failures to comply.

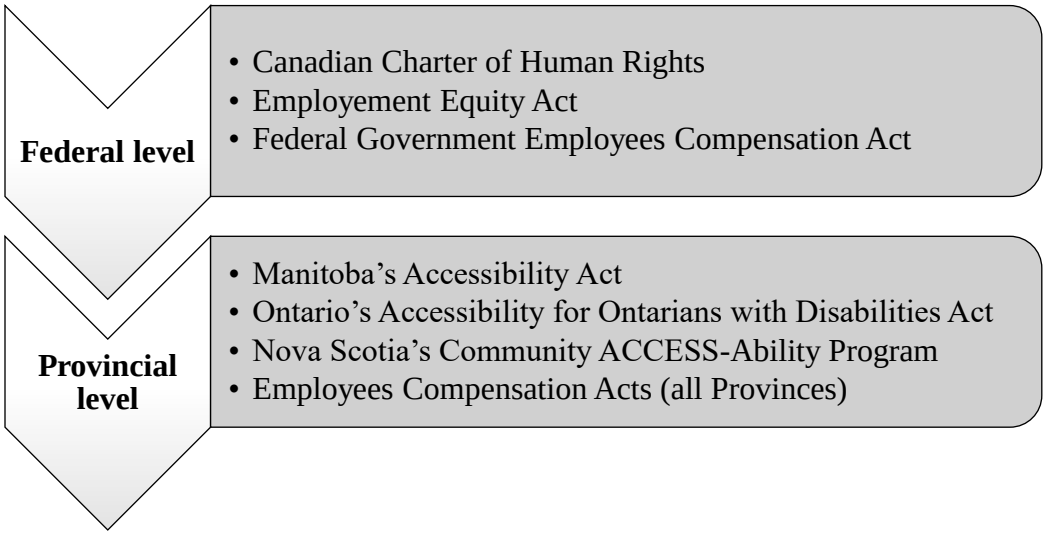


Figure 1: Existing Disability Legislations in Canada

A key milestone in Canada involved the establishment of the Canadian National Institute for Disability Management and Research (NIDMAR) in October 1994 in British Columbia with the aim of facilitating the implementation of workplace-based reintegration programs. The institute expanded internationally through partnering with local people in other countries (Tate et al. 1989, Schwartz et al. 1989, Shrey and Hursh 1999, Hunt 2009), helping enact relevant guidance in those countries. For example, the International Labour Organization (ILO) in Geneva adopted the ILO Code of Practice on Managing Disability in the Workplace in 2002 based on the foundation provided by NIDMAR, with research and development contributions from Australia, Europe, New Zealand, and the United States (Hunt 2009). Within Canada, the NIDMAR program's standards were also adopted in whole or in part by employees compensation boards (WCB) in Newfoundland

and Labrador, Ontario and Saskatchewan in 2004, 2005 and 2006 respectively. The WCB of Manitoba also adopted the Consensus Based Disability Management Audit tool developed by NIDMAR to evaluate, monitor and improve organizations' DM performance (Hunt 2009).

2.2 Disability Management

This section provides an overview of the history and origins of DM and its theoretical foundations in general and as it relates to Canada in particular. It also provides a review of the literature on disability and DM as it pertains to the construction industry specifically.

2.2.1 Origins and Theoretical Foundations

Disability management (DM) first arose in Finland in the 1970s but did not gain prominence until the 1980s in the United States as an approach that can be used by large employers to reduce their employees' compensation costs and rising health care costs (Tate et al. 1986, Schwartz et al. 1989, Dyck 2006, Hunt 2009). It was thus conceived by employers as a concept to control disability costs beginning in the mid-1980's (Galvin et al. 1986). It built on older vocational rehabilitation programs for injured employees and gradually evolved to incorporate the return to work (RTW) model. As regulations became more stringent, aspects such as safety, ergonomics, ecological assessment and specialized case management strategies were integrated to it (Hursh 1997, Rosenthal et al. 2005). The concept found its way to employees' compensation public policy in the 1990s. Although DM as a concept did not reach Canada until the 1990's, the movement to recognize people with disabilities in Canada began in the 1980's (Westmorland and Buys 2004). Over time, the service-based approach evolved into a workplace-based one and took into account aspects such as organizational development, safety, risk management, and case management

(Rosenthal et al. 2007). These aspects became the foundations of DM policies and programs. The concept gradually evolved from a cost controlling approach to an employer-based one that aims to prevent and manage injury, taking into consideration aspects such as organizational development, safety, risk and case management (Rosenthal et al. 2007).

DM can be defined as a workplace prevention and remediation strategy that seeks to prevent disability from occurring (Hursh 1997). Lacking that, it aims to intervene following the onset of a disability to ensure the continued employment of those experiencing functional work limitations (Akabas et al. 1992, Rosenthal et al. 2007). According to Tate et al. (1986) and Smith (1997), DM is a cohesive, systematic, and goal-oriented process that incorporates three key domains: prevention, early intervention and proactive RTW interventions to reduce the impact of injury and disability and accommodate those experiencing functional work limitations. The sphere of DM encompasses a wide range of other interventions such as claims and benefits management as well as vocational and industrial rehabilitation (Angeloni 2013). According to Lingard and Saunders (2004), firms pursue DM in response to the globalization of their activities, the growing multiculturalism of their workforce and as a competitive necessity.

Current models of DM incorporate elements of the systems theory, whereby employees' disabilities are seen as impacting the health and functional integrity of the whole organization (Rogers 1993). An extension of that theory and an important premise of every effective DM program is the notion that employees are not just "hued hands" but full members of the organization who contribute to achieving its goals (Cowan 1995, Galvin 1986, Shamie 1994, Tate et al. 1986). This is because disability does not only implicate the individual worker but also co-

employees and supervisors who take on increased workloads to compensate for the absent worker (Smith 1997). As shown in Figure 2 which was adapted from Rondinelli et al. (1997), an employee who sustains an on the-job injury typically receives an initial medical assessment by an approved provider, more often a general practitioner who lacks formal occupational training. This practitioner must decide whether to authorize the employee's RTW and whether to refer him or her to a physiatrist or other medical, therapeutic, and educational care before revaluation. This is followed by the development of a customized RTW strategy for the employee by the employer.

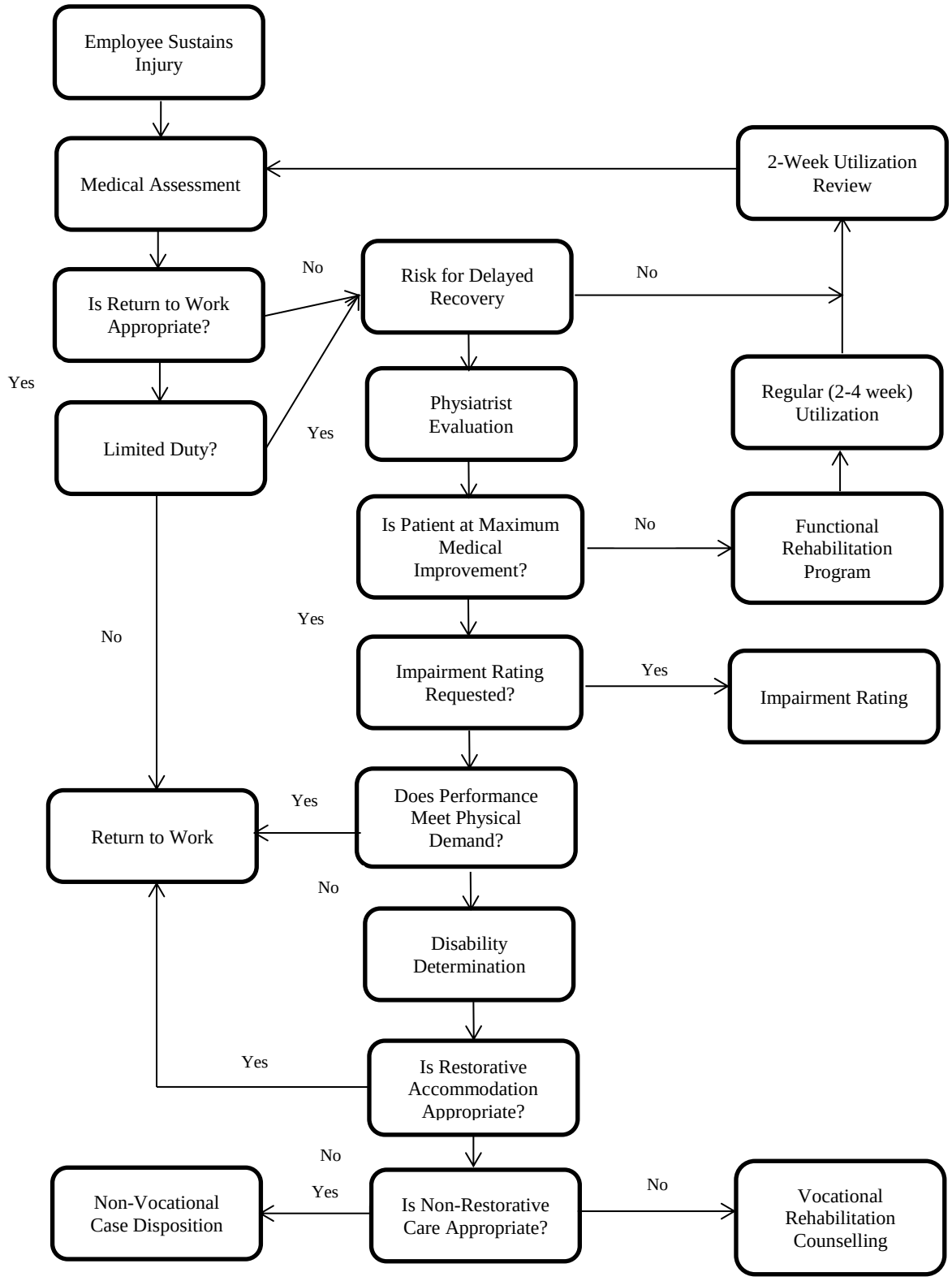


Figure 2: Generic Rehabilitation Process for Injured Employees (adapted from Rondinelli et al. 1997)

Return to work (RTW) is an essential component of disability management (DM). RTW is an evolving process, comprising four key phases: off work, work re-entry, work retention, and work advancement (Young et al. 2005). RTW intervention is successful if it was able to help a person stay at work, decrease work absence or help employees return to productivity. A review of the literature found senior management support to be an important determinant of RTW interventions (Franche et al. 2005, Hunt and Habeck 1999, Main and Shaw 2016, White 2011, Gambatese 2005). Employer responses to employees returning to work after an injury were classified as one of three: "welcome back", "business as usual" and "you're out" (Strunin and Boden 2000). In the former response, employers encouraged employees' return to pre-injury employment and provided accommodations to enable this return. In the second and third responses, employers showed some neglect of employees' needs or found reasons to terminate them respectively. Active collaboration between disability managers and union representatives should include: 1) explicit contract language with respect to RTW, 2) awareness of disability and accommodation issues within the workforce, 3) accommodation and RTW plans that have organizational support, and 4) data monitoring systems that facilitate alternative RTW placements and track injuries and illnesses (Bruyere and Shrey 1991, White 2011). Provision of workplace accommodations and regular contact between healthcare providers and the workplace significantly reduced time away from work (Franche et al. 2005). Other important factors included early contact between the workplace and the worker, the presence of a RTW coordinator and ergonomic work site visits by the RTW coordinator (Shrey and Lacerte 1995). This is because active participation from labour and management improved RTW rates (Shrey et al. 2007). Several studies (e.g., Rosenthal et al. 2005, Krause et al. 1998, Krause et al. 2001, Rogers 1993) emphasized the importance of injury

prevention programs because of how expensive medical care for injured employees is in comparison with injury prevention efforts.

The success of DM programs is measured in terms of cost efficiency, administrative efficiency, and reduced complexity of the claim and benefit systems (Angeloni 2013). The advantages of implementing them include improved employee health and safety and improved employee morale (Calkins et al. 2000, Harder et al. 2006). Companies that implement DM programs should benefit from savings in direct and indirect costs. Indirect cost savings include lower disability insurance premiums due to a reduction in overall disability claims (Hargrave et al. 2008, Kuhnen et al. 2009). Comprehensive DM programs that take into account the physical and organizational work environment as well as the personal health of individuals are more effective than those that consider each separately (Angeloni 2013).

2.2.2 Application in Construction

Historically, disabled persons were discriminated against in various forms, fueling prejudice against them and systematic under-representation in key areas of society (Tshobotlwane 2005). This also restricted their access to employment, resulting in widespread poverty and illness (Schwellnus 2001). Unfortunately, discrimination against disabled people still persists today in many countries (Napier 2003). Disabled people continue to experience many barriers, including the negative attitudes of employers and other employees, inadequate workplace accommodations and discriminatory recruitment and employment practices (Lagadien 1996, Meager 1998).

The medical model is the most used disability model in the construction industry today (Brzuzy

1997, Finkelstein 1991). The model views disability as a functional limitation and an individual problem, pathology, dysfunction, or deviance. The construction industry is perceived as one with harsh physical conditions that are not suited to disabled people (Tshobotlwane 2005). This is because construction employees are confronted with dangerous, life-threatening work conditions on a daily basis, leading to serious accidents and injuries (Eppenberger and Haupt 2003). There is also little understanding of the design requirements needed to accommodate disabled people because the main stakeholders (i.e. disabled people) are not involved in the building process: from design to construction and ultimately occupation. (Clarke et al. 2009). The nature of the industry is such that many construction employees do not have a long-term relationship with their employers, compounding the unwillingness of employers to accommodate them should they get injured (Welch et al. 1999, Lingard and Saunders 2004).

Research on DM in construction is still in its very early stages, with very few journal papers published on the topic. A study by Clarke et al. (2009) analyzed the British and Dutch approaches to DM in the construction industry and found the Dutch model to be more skewed to the social model and to be considerably more regulated than the British one. The study draws on research carried out for the Norwegian Work Research Institute and uses their statistical data, literature reviews and interviews with key actors to develop questionnaires aimed at investigating sector-specific factors that facilitate labor market participation of disabled employees in the two countries. The study found that the Dutch construction sector required construction employees entering it to be more qualified than the British sector. The authors also found the construction sectors in both countries to be highly disabling and exclusive. The Dutch sector was more regulated through collective agreements and greater trade union involvement than the British sector.

Nevertheless, although the study brings to light the disabling nature of the construction industries in both countries, it does not provide strategies for addressing it.

Lingard and Saunders (2004) investigated the DM practices of 62 construction companies in Victoria, Australia using a web-based survey. The study showed that small construction firms were less likely than medium-to-large ones to have formal DM practices in place. Responding firms found it difficult to provide appropriate alternate or light duties for employees following an injury. Secondary DM activities such as the provision of modified work and the coordination of rehabilitation were not universally implemented and in many cases were lacking. There was a general perception that RTW practices were difficult to implement and were costly, with little benefits in terms of reducing lost workdays. Evidence to support these claims were not substantiated, with the authors calling on further research to challenge them. The authors also found that small construction firms were less able to accommodate injured employees than larger ones because they were less likely to have the resources to do so. This made employees in small firms more likely to suffer if injured than employees in larger ones (Kenny 1999, Lingard and Saunders 2004, Cheadle et al. 1994). Similar to Clarke et al. (2009), the study did not provide a quantitative framework or indicators which companies can use to evaluate the effectiveness of their DM programs.

Newton and Ormerod (2005) surveyed the top 100 construction organizations in the UK and found little to no formal practices in place to support construction employees with disabilities. Many of the employers surveyed believed that people with disabilities do not have a place in the construction industry, with new entrants facing more challenges than returning ones. The authors

also analyzed 20 case study construction by interviewing and auditing them. The results showed that only 27% of organizations had a disability employment policy. Of those, only a quarter went beyond the general recruitment policies and provided policies on how to effectively support its disabled employees. The study attributed these issues to the narrow view the industry has of the term “disabled person” which limits disability to physical and sensory impairment. The study found that although organizations recognized that there were health and safety issues that affected both disabled and non-disabled employees, construction organizations did not for the most part recognize the importance of employing disabled persons. Most companies however, expressed their willingness to comply with existing disability legislation provided adjustments to do so were minor and inexpensive. Employers were also less likely to hire people with disabilities than to take back ones disabled because of an injury on the job (Newton and Ormerod 2005).

A follow-up study by Ormerod and Newton (2013) investigated barriers faced by young disabled people entering the construction industry using interviews and mini focus groups with 49 participants from the North West of UK. The study revealed that the participants (i.e. young disabled people) were unlikely to think about a career in construction without proactive encouragement and support. Employees with disabilities were automatically excluded from jobs such as “ladder climbing, walking on rough ground, tunneling, working at height, working in confined spaces, [and] working on the railways”. The research revealed the need for an inclusive approach that would treat employees with disabilities equally rather than favourably. The industry including both employers and professional institutions also needed to raise awareness about the range of job opportunities available for young employees with disabilities to dispel the myth that construction work is only for able-bodied, fit men.

Tshobotlwane (2005) investigated the employment of physically disabled people in the construction industry in Western Cape, South Africa by surveying 52 employers, 35 employees and 20 employees with disabilities. The study found that the majority of employers were ignorant of the Employment Equity Act provisions. Disabled people had limited movement around project sites which hindered their on-site productivity. The study also revealed that even though many employers did not hire disabled people and were thus non-compliant with the Employment Equity Act, they had not faced any claims or penalties because of it. Employers who had complied with the act found the cost to do so negligible. This is in contrast to employers surveyed by Lingard and Saunders (2004) who believed that DM practices increased operating costs but provided little to no return in terms of reducing lost workdays. These employers were reluctant to adopt formal rehabilitation and RTW programs because of the difficulty with providing suitable alternate work for disabled employees. Lingard and Saunders (2004) also found that construction injuries usually led to long-term disability: a disturbing fact given the lack of formal polices in place to prevent this. Smallwood and Haupt (2008) found physically impaired employees more suited to administrative work. In their survey of 71 skills development facilitators in South Africa, they concluded that disabled people have a role to play and can substantially contribute to the construction process. Most respondents to the survey (i.e. the skills development facilitators) supported the employment of disabled people, reinforcing the need for programs and guidelines that would address the underemployment of disabled employees and provide incentives to promote their widespread adoption.

The most recent study by Winter et al. (2015) assessed DM within the Manitoban construction

industry using a web-based survey of 88 construction organizations, and represents the only Canadian work to date about the topic. The study showed that only 4% of surveyed organizations employed 5% or more disabled employees. Musculoskeletal injuries were the most common disability encountered, followed by physical mobility and hearing impairments. Approximately, 56% of responding organizations saw retaining valued and experienced employees and maintaining employee morale as the main reasons for implementing a DM program. They also identified the lack of suitable modified or alternate work to be the most important barrier to DM yet identified the provision of this work as the most common practice implemented by them, raising questions about this work's suitability to disabled employees. Additionally, only a small proportion of responding companies provided additional accommodations to their disabled employees such as accessible washrooms, and accessible workstations. The study concluded that although a large portion of construction companies in Manitoba recognized the importance of implementing DM, only a small proportion actually implemented it. This reinforces the need for tools that can help these companies evaluate and benchmark their existing DM practices if any in order to develop, implement and improve their DM programs in the long-term. A key limitation of the study was that it failed to provide a framework or tools that construction organizations can use to implement and benchmark DM in their workplaces. The study did not also evaluate the perceptions of construction employees themselves but limited the survey to employers only.

2.3 Maturity Modelling

This section discusses the concept of maturity modelling: its history, theoretical foundations and application within the construction industry in particular.

2.3.1 Origins and Theoretical Foundations

Maturity modeling emanated from the software manufacturing industry (Finnemore et al. 2000) in response to the poor performance of software manufacturers working on US Department of Defense Projects (Paulk et al. 1995). It is based on the earlier concepts of process improvements such as Philip Crosby's quality management maturity grid describing "five evolutionary stages in adopting quality practices" (Crosby 1979) and the Shewhart plan-do-check-act cycle (Paulk et al. 1995). Process maturity modeling consists of various stages of progression which, when adhered to increase the effectiveness of a process. One of the earlier models developed to enable maturity modelling is the Capability Maturity Model (CMM) developed by researchers at Carnegie Mellon University (Paulk et al. 1995). CMM defines five thresholds or levels of maturity for a given process (Paulk et al. 1995). At the first level, a process is primarily chaotic or ad-hoc. It is made repeatable at the second level, after which it becomes defined or standardized. At the fourth level, a process is usually measured or controlled, before it is optimized at its highest level by subjecting it to continuous improvement and feedback cycles.

Assessing the maturity of a process involves investigating the degree to which the process is defined, managed, measured and controlled (Dorfman and Thayer 1997). This is usually accomplished by analyzing the policies and practices existing within the process (Paulk et al. 1995). Process maturity modelling can therefore act as a diagnostic and prescriptive tool that would allow internal and external stakeholders to identify thresholds of optimal performance, areas where performance is not optimal and thus measures that would improve that performance (De Bruin et al. 2005, Maier et al. 2009). This is all so that the process being assessed can advance to the next

level of maturity. Process maturity modelling was found to reduce the overall software development cycle in the field of software development (Harter et al. 2000) and improve project performance in the field of project management (Ibbs and Kwak 2000). It also improved the forecasting and meeting of goals, costs and performance (Lockamy and McCormack 2004).

2.3.2 Application in Construction

In construction, the concept has been applied to develop a number of maturity models. The Standardized Process Improvement for Construction Enterprises Model (SPICE) (Sarshar et al. 1998) was developed by researchers at Salford University to improve the management of construction processes, as called for in the Latham report on the performance of the UK construction industry (Sarshar et al. 1998). The model consists of five maturity levels. It involves testing an organization's key processes against five process enablers (Finnemore et al. 2000, Sarantakos 2005). These five process enablers provide guidelines and consist of activities that are preconditions for implementing the construction processes (Finnemore et al. 2000). The testing of each key process against the five process enablers allows organizations to better understand the capability of their key processes before they are implemented. A key strength of the model is that its assessment is based on facts rather than perceptions (Finnemore et al. 2000, Amaratunga et al. 2002). The model also identifies process strengths as well as weaknesses, and enables thus the development of process improvement plans. Nevertheless, the model does not account for the multi-organizational nature of construction work because it treats all organizational processes equally (Vaidyanathan and Howell 2007).

Another model: the Construction Supply Chain Maturity Model aims to remove inefficiencies in

the construction supply chain and improve operational excellence (Vaidyanathan and Howell 2007). It does so along three dimensions: functional, project and firm. It is based on the concept of process maturity as used in the CMM and consists of four levels of maturity. Although the model addresses the multi-enterprise supply chain aspect of construction, it does not take into account other aspects such as building information modelling. Another maturity model: the Construction Industry Macro Maturity Model (Willis and Rankin 2011) is based on an adaptation of the concept of process improvement used in the CMM. It assesses the maturity of the construction industry at the macro level, providing leading indicators of project performance. There are three possible maturity levels associated with each key practice with the evaluation based on the presence of specific outcomes or indicators. While the model is very effective at the macro level given the industry's characteristics, it is less effective at the organizational level given it's oversimplification of the growth process at that level (Willis and Rankin 2011).

A number of maturity models have been developed for project management specifically, with the Project Management Maturity Model (PM3) being the most notable of all (PMI 2005). The PM3 includes a "directory of best practices", which lists over 500 organizational project management best practices. It assesses organizational project management maturity along three domains, i.e. project, portfolio and program, and four stages of process improvement. Despite its strengths, the model does not use a hierarchical scale or levels of maturity, which makes quantifying organizational project management maturity difficult. Another model: the Fuzzy Industry Maturity Grid (FIMG) is mostly used at the macro level. The FIMG is a modification of the Industry Maturity Grid (IMG), first developed by University of Cambridge as "a qualitative model offering diagnostic and prescriptive analysis of a subject industry" (Tay and Low 1994). The IMG operates

under three dimensions: markets, technologies and structures, with each having its own set of characteristics. A weakness of the IMG according to Tay and Low (1994) is that an industry is assumed to belong to one of only eight possible sub-cubes. There also appears to be a disconnect between maturity and performance since unlike other maturity models, the FIMG does not presume a relationship between improved maturity and improved performance.

Only one maturity model has so far been developed to evaluate health and safety in construction: the Health and safety Maturity Model (Goggin and Rankin 2010). The model assesses maturity based on six key safety factors and three maturity levels. The six factors assessed are "Policy and standards, Management commitment, Worker involvement and commitment, Equipment, materials, and resources, Working environment, and Hazard management". The model comprises three maturity levels. On one end, a score of less than 1 demonstrates inadequate safety performance where a practice or procedure does not exist or does not conform to legislative requirements. On the other, a score of 3 demonstrates standardized practices that are continuously improved. The maturity model is based on the hypothesis that greater maturity in an organization's practices will result in improved performance. This was assessed by collecting data from four New Brunswick construction companies and comparing the model's findings to their historical safety performance measured using lagging indicators. The research demonstrated the ability of the model to measure a company's current practices and thus serve as a proactive tool for health and safety. The study highlighted areas in need of improvement, such as allowing greater worker participation in planning construction companies' health and safety program, which would lead to improved health and safety. Nevertheless, the model did not cover safety aspects such as safety planning, controlling, and communication. Given its focus on health and safety, the model did not

also adequately cover explicit DM aspects such as injury management and prevention and RTW practices.

Other than this one maturity model focusing on health and safety, the literature review did not reveal any other maturity models evaluating DM in the construction industry in Canada or elsewhere, thus the importance and significance of this research.

2.4 Benchmarking Safety Performance

According to Cambon et al. (2005), there are three main approaches to measure safety performance: (1) the result-based approach, (2) the compliance-based approach, and (3) the process-based approach. In the result-based approach, lagging indicators, also referred to as outcome or negative indicators, are used to measure performance whereas in the two remaining approaches, leading indicators, also referred to as pro-active, positive or predictive indicators are used instead. This section reviews safety performance benchmarking using leading and lagging indicators of performance.

2.4.1 Using Leading Indicators

A number of studies have focused on safety performance evaluation (SPE) as an essential part of safety management since this evaluation provides information on a safety system's quality (Sgourou et al. 2010). For instance, Sawacha et al. (1999) investigated the impact of historical, economical, psychological, technical, procedural and organizational factors as well as the working environment on construction safety performance. The research found an organization's policy towards safety to be the most influential factor driving safety performance. This reinforces the

need for SPE frameworks that help companies identify potential hazards early on (Ng et al. 2005, Crocker 1995). Ng et al. (2005) proposed a SPE framework that is more comprehensive, structured and organized than previous frameworks (e.g. Mohamed 1999) and that relies on the administration of two questionnaires. The first focused on identifying the main factors affecting safety performance at the organizational and project levels and the second on identifying organization-level and project-level sub-factors (Ng et al. 2005). The results of the first questionnaire contributed to developing the framework used to analyze contractors' safety performance at the organizational and project levels. A total of 13 organizational and 18 project-level factors were identified. The study found the most important SPE factors at the organizational level to be the ''implementation of safety management system in accordance with legislation'' and ''compliance with occupational safety and health legislation, codes and standards''. At the project level, the most important SPE factor was the ''provision of safe working environment". The study also found the "performance of frontline employees" to always be a critical factor in promoting workplace safety. Despite its strengths, the framework does not measure the continuous performance of employees after the implementation of corrective actions.

Teo et al. (2005) proposed a framework for managing construction safety using factor analysis, which considered four main criteria (i.e. policy, process, personnel (3Ps) and incentive) and a number of inherent sub-criteria. Using factor analysis based on the four criteria, the study identified four main factors (i.e. company safety policy; construction process; personnel management with regard to safety; and incentives) that affected site safety. The study argued that understanding the 3Ps alone does not guarantee a reduction in construction accidents. It recommended that project managers pay more attention to the four main factors identified to improve safety performance. A

further study by Teo and Ling (2006) developed a model to measure the effectiveness of construction safety management systems (SMS) using a safety index. The study used the analytic hierarchy process (AHP) and factor analysis to identify the most important factors affecting safety performance and that would need to be incorporated into the model. The actual model was developed by means of the multi-attribute value model approach, which enabled the calculation of the Construction Safety Index to evaluate the effectiveness of a company's SMS. A key limitation of the model is that it is not intended as a safety performance evaluation tool but rather an auditing tool that can objectively assess the strength and weaknesses of the SMS. The model does not also provide recommendations to solve safety problems on site. To address these limitations, Mahmoudi et al. (2014) proposed a framework for the continuous monitoring and improvement of construction companies' safety. The framework evaluated seven main factors and 120 related sub-factors and was used to evaluate the safety performance of three construction companies. The study identified "Leadership and commitment" and "Risk management" as the most important factors of safety performance at the organizational and project levels respectively. Despite the framework's ability to measure the performance of a construction company with respect to health and safety and to identify corrective actions, it does not take into account project and organizational-level factors such as communication, behaviour and substance abuse.

Similarly, Podgórski (2015) used an AHP-based method to identify 20 leading indicators measuring the operational performance of occupational health and safety (OHS) management systems. The study concluded that monitoring these indicators would allow managers to respond more effectively to the earliest indication of irregularities in the management of safety. They study used five existing safety performance measurement tools to develop their own model. These tools

included the Safety Element Method (SEM), the Universal Assessment Instrument (UAI), the Self-Diagnostic OHS tool, the Tripod Delta, and the Safety Climate Assessment Questionnaires. The first three tools were used in the analysis conducted by Sgouru et al. (2010). The Safety Element Method (SEM) developed by Alteren and Hovden (1998) evaluated safety performance based on six elements and 12 sub-elements and using a five-level scale. Despite its consideration of safety behaviour as part of its assessment, the SEM does not consider the impact of hazard assessment on safety performance. The UAI was developed at the University of Michigan (Redinger and Levine 1998) to evaluate safety performance and began to be widely distributed in 1998 in the United States (US) and other countries (Podgórski 2015). The Self-Diagnostic OHS tool developed by Roy et al. (2005) at the University of Sherbrooke in Canada was intended to subjectively evaluate safety performance using a questionnaire. The tool consisted of 67 statements or indicators divided into nine subject areas. A team of French and Dutch experts proposed a comprehensive questionnaire-based tool: the Tripod Delta to measure safety performance (Cambon et al., 2005). The tool consists of 230 structural performance indicators and 90 operational performance indicators categorized under 14 defined components of safety management. The Methodological foundations of the Safety Climate Assessment Questionnaires was proposed by Zohar (1980) to evaluate safety culture, with subsequent researchers (e.g. Mearns et al. 2003) using it to explore employees' perceptions of safety-related problems.

A recent study by Lingard et al. (2017) used both traditional lagging indicators, as well as expected leading indicators of safety performance to uncover time dependent relationships and explore causal relationships between safety indicators. Using data collected as part of a routine reporting process implemented on a large infrastructure project in Melbourne, the study uncovered the

problematic use of the terms leading and lagging to describe safety indicators. Their findings about the use of leading indicators challenge the assumption that leading indicators measured at one point in time can predict safety outcomes at a subsequent point in time. This is significant being that their study makes the argument for better measures safety. The study also revealed complex links between measures of safety management activity (leading indicators) and incident/injury rates (lagging indicators). Based on their finding, it was recommended measures of safety management activity are better posited as positive performance indicators rather than leading indicators as they can behave as lagging indicators in relation to the frequency of incidents/injuries (Lingard et al. 2017).

2.4.2 Using Lagging Indicators

Safety performance has traditionally been measured using lagging indicators such as metrics (Ng et al. 2005, Hinze et al. 2013, Lingard et al. 2017). Examples of such metrics include the "Recordable injury rate" (RIR), the "Lost time", "Days away", "Transfer injury rate" or "Experience modification rating" (Ng et al. 2005, Hinze et al. 2013, Grabowski et al. 2007). The "Recordable injury rate" (RIR) is also referred to as the "Accident" or "Incident rate" according to the Occupational Safety and Health Administration (OSHA). The rate covers injuries that result in death, days away from work, restricted work or transfer to another job, medical treatment beyond first aid or loss of consciousness (OHSHA, 2010). It is defined as the number of "all work injuries" per million work hours and remains the primary metric used by construction organizations to track their safety performance. It was used by Wanberg et al. (2013) to quantify the safety performance of 32 projects. Cha and Kim (2011) used the metric as one of their measures to quantify overall construction safety performance. Rankin et al. (2008) also used it as part of a

research project initiated by the Canadian Construction Innovation Council to quantify project performance in 37 construction projects from seven provinces in Canada. More recently, Yun et al. (2016) reviewed over 23 metrics for quantifying project performance in general and adopted the metric as one of two to benchmark construction safety. Despite its advantages, the metric is still less desirable than a proactive approach that can predict incidents before they occur (Rud 2011, Hinze et al. 2013). To be more useful in the industry, it should be made project-type specific (e.g. residential projects, commercial projects, industrial projects) to enable comparative assessments of performance (Hopkins 2009). This is because the safety performance of a specific type of projects can be accurately measured when the characteristics are disseminated down into performance measurement. Moreover, RIRs reflect recent experience with their reliability solely dependent on the accurate reporting of the organization tracking it.

Another metric that construction companies use as their primary measure of safety performance is "Lost time" (Nassar and AbouRizk 2014). The metric is defined as the number of lost time injury events that resulted in a fatality, permanent disability or time lost per 200 000 work hours. Jaselskis et al (1996) conducted a quantitative and qualitative analysis of data related to companies and projects in the US and found "Lost time" and OSHA's "RIR" to be useful in evaluating a company's safety performance over time. The study confirmed the findings of Levitt and Samuelson (1987) on the value of "Lost time" and "recordable injuries" as they reflect actual costs paid for employees' compensation. Rankin et al. (2008) used the "lost time" metric to evaluate safety in 37 projects as one of two indicators of safety performance. The metric was found to provide valuable, easily understood information that could be used to compare safety performance across multiple projects. A follow-up study by Nasir et al. (2012) further validated the two metrics

proposed by Rankin et al. (2008) (i.e. RIR and Lost time) on a sample of 19 projects across Canada. Nassar and AbouRizk (2014) also found that the metric was easy to implement and achieved practical results, enabling the company using it to implement strategies that minimized time lost to injuries. In determining what counts as lost-time injuries, different countries adopt different criteria. For instance, England counts lost-time injuries after three days, Australia after five, and most Canadian provinces after one day only (Nassar and AbouRizk 2014). Despite its usefulness, the metric fails to account for occupational diseases with prolonged latent periods. It also measures injury severity and not necessarily the potential seriousness of the accident leading to that injury (Amis and Booth 1992, Kletz 1993, Krause and Finley, 1993, Hopkins, 1994). Hopkins (1994) also found the metric not to be related to injury frequency and thus to safety performance but rather to changes in claims management behaviour.

The "Days away, job restriction or transfer (DART) rate" is a relatively newer metric and describes the number of recordable injuries and illnesses per 100 full time employees that resulted in days away from work, restricted activity or job transfer at any given time frame (OHSHA 2010, Rud 2011). The metric was adopted by the Construction Industry Institute (CII) Performance Assessment, formerly known as CII Benchmarking & Metrics using OSHA's definition of the metric (Dai et al. 2012). The metric has since been used as one measure to quantify safety performance. For example, Yun et al. (2016) used the DART rate as one of two measures to quantify the safety performance of phase-based capital projects and found it to be effective at that.

Experience Modification Rating (EMR) is often used to evaluate a company's safety performance. However, EMR does not reflect actual safety performance since the metric is based on an

employer's claim history over the past three years. Everett and Thompson (1995) pointed out that EMR does not fairly represent the safety records of different employers because EMR also considers wage rates (Dai et al. 2012). Like EMR, both RIR and DART also measure past performance and focus on results rather than the process (Fang et al. 2004).

Another metric also used is the "First-aid injury" rate which assesses injuries that require one-time treatment and subsequent observation of them. This treatment can include cleaning wounds on the skin surface, applying bandages, flushing an eye or drinking fluids to relieve heat stress (Wanberg et al. 2013). Wanberg et al. (2013) used OSHA's definition of the metric and of RIR to evaluate 32 construction projects' safety performance and validate the metric's use. Similarly, Cha and Kim (2011) defined and used the metric as one of three measures of safety performance. The study reported that there was general consensus among participating organizations that the metric provided a consistent measure of safety performance across them.

Additional metrics used include the number of injuries and their severity as well as accidents' frequency and related costs (Sgourou et al. 2010). Cha and Kim (2011) proposed and used the "Safety cost ratio" in additional to the "RIR" and the "first-aid injury rate" to evaluate the safety performance of 22 construction projects from seven constructions organizations. The ratio involved dividing total safety costs by total revenue. These safety costs take into account direct and indirect costs. Direct costs refer to the cost of worker's compensation whereas indirect costs includes costs associated with the loss of productivity of the crew and injured individuals, transportation costs to medical facilities, and the costs to complete the required paperwork.

Metrics used less regularly include the loss ratio (i.e. the ratio of the cost of claims to the cost of premiums) and the number of liability claims related to worksite injuries (i.e. the ratio of the cost of claims to the cost of premiums) (Hinze et al. 2013). Extreme caution must be used when interpreting the loss ratio. This is because this interpretation must consider the period over which the ratio will be effective, sometimes referred to as the "pricing horizon" (Grabowski et al. 2007). Comparing the loss ratio of one organization to another also requires taking into account the nature and mix of projects completed by each and their impact on the ratio. Although this metric has been used less frequently than others, it is a useful measure of disability and injury management performance (Grabowski et al. 2007) and can improve safety performance considerably (Hinze et al. 2013, Cox et al. 2003). Almahmoud et al. (2012) found it be very useful when examining the relationship between project safety performance and overall project performance in multiple case studies of construction projects in Saudi Arabia. However, the study noted that the ratio should be used in conjunction with other measures to give a broader more complete assessment of safety performance.

2.4.3 Using Leading and Lagging Indicators

Given that metrics provide historical information about past safety performance, they are known as lagging indicators of performance (Hinze et al. 2013, Toellner 2001). The distinction between leading and lagging performance indicators is not always clear-cut (Reiman and Pietikäinen 2012), with some researchers describing them as a continuum rather than two separate entities (Hopkins 2009, Hale 2009, Wreathall 2009). Typically, leading and lagging indicators are considered on a time scale where leading indicators precede harm and lagging indicators follow it. A key limitation of lagging indicators is that they are based on historical data (Podgorski 2015) and have a

statistically low probability of occurrence over short time frames (Lingard, et al. 2017). These metrics are usually easy to calculate and can provide information on the effectiveness of actions performed in the past; however, they do not enable their current monitoring and correction (Lingard et al. 2017). Nevertheless, their timely and accurate analysis is essential to successful prevention (Podgorski 2015). In contrast, leading indicators are considered superior to lagging indicators because they evaluate proactive, preventative approaches to safety rather than reactive ones. They enable earlier and more efficient intervention and give a good picture of how a given system operates. As such, when tracked over time, such indicators provide information on changes in a safety management system and assist in planning future changes (Podgorski 2015). Therefore, there is value in having tools that consider both types of indicators and that account thus for subjective feedback in addition to objective metrics to assess safety performance (Hinze et al. 2013, Rozenfeld et al. 2010, Toellner 2001).

2.5 Benchmarking Disability Management Performance

The main goal of DM is to support injured employees and enable them to successfully return to work (RTW). A DM program includes policies and practices that aim to minimize production loss, reduce the magnitude of work disability, and prevent injuries or illnesses from becoming chronically disabling (Williams and Westmorland 2002, Krause et al. 2001, Habeck and Kirchner 1999, Gensby et al. 2012). Though most employers are well versed in traditional methods to eliminate workplace safety risks, there's growing interest in reducing their impact should they occur by tracking work absences, facilitating early RTW, and proactively communicating with injured employees and their healthcare providers (Shaw et al. 2008).

Construction is a high-risk industry that can be managed through primary and secondary management strategies. Primary strategies, the focus of the construction industry are those designed to prevent work-related injuries and illnesses. They include safety programs, pre-placement screening, ergonomic services, safety education, loss prevention programs, health promotion, employee assistance programs and wellness services (Habeck and Kirchner 1999, Tate et al. 1987). Within construction, these strategies are traditionally integrated to the core of project management. Secondary DM strategies focus on managing disability after an injury or illness has occurred. These practices include case management, RTW, and rehabilitation practices as well as workplace modifications and DM program reviews and evaluations. There is little formalization and standardization of these practices in construction as demonstrated earlier in the chapter.

Like most programs, DM programs require ongoing evaluation to ensure that they operate effectively and that any issues are identified and addressed effectively (Gensby et al. 2012). These evaluations have focused primarily on ensuring the existence of specific policies and practices, with the use of metrics almost non-existent. This evaluation of the existence of specific policies and practices has proven insufficient. This is because identifying whether a RTW intervention has occurred or not does not evaluate how well people are doing after that intervention, what type of work they can perform, and their future employment prospects (Krause et al. 2001, Gensby et al. 2012). Therefore, there is a need to use metrics that would measure aspects such as the length of time these people were away from work for, related operational and administrative costs and potential cost savings.

Few studies used such metrics. Some used metrics such as “time away from work due to sickness

or injury", "the cost of compensations for employees" (e.g. Tate et al. 1987, Badii et al. 2006), "days lost per work related injury", "the number of occupational diseases" (Breslin and Olsheski 1996, Burton and Conti 2000, Bunn et al. 2006), "total work lost days" (Bernacki et al. 2000), and "injury claims" (Wood 1987). Breslin and Olsheski (1996) evaluated a transitional RTW program in Cincinnati based on time away from work. Lemstra and Olszynski (2003) investigated an occupational management program for a private meat manufacturing company in Saskatchewan based on employees' compensation injury claims. Only a few studies used measures related to the modification or change of a job function and sustained job retention (Gensby et al. 2012). Skisak et al. (2006) measured work absence using the percentage change in average days of absence per employee in managed and non-managed business units. Yassi et al. (1995) measured time losses in total hours lost and time loss per 100,000 paid hours. A criticism of these metrics is that they essentially benchmark safety performance rather than DM (Hinze et al. 2013). This reinforces the need to develop new metrics that would measure DM exclusively, and ones that would measure DM in construction in particular as those are currently missing in the literature.

CHAPTER 3: RESEARCH METHODS

This chapter provides an overview of the overall methodology adopted for this research. This is followed by a detailed description of the methods used to accomplish each of the five research objectives.

3.1 Overall Research Approach and Methods

Research on disability management (DM) in construction used a number of methods, including surveys (e.g. Lingard and Saunders 2004, Smallwood and Haupt 2008, Newton and Omerod 2005, Tshoboltwane 2005), case studies (e.g. Clark et al. 2009) and interviews (e.g. Ormerod and Newton 2013). This research used a mixed-method approach based on triangulation as recommended by Bryman (1992:2006) and Dainty (2007) for construction management research. Triangulation involves using qualitative and quantitative research methods to elicit the relevant data from research participants. In this research, it aims to analyze the complex interactions between various DM practices as recommended by Campbell and Fiske (1959), Webb et al. (1966), Burgess (1982) and Brannen (1992). Qualitative research explores the meaning that "individuals or groups ascribe to a social or human problem" (Creswell 2014). Related methods are usually described as inductive, with the underlying assumption that reality is a social construct (Creswell 2014). In this research, qualitative methods are used on the first and second objectives of the research, which seek to define and validate DM indicators and use the defined indicators to develop and implement a model to evaluate the maturity of construction organizations' DM practices. Quantitative methods of inquiry are used on the third objective which seeks to develop and implement metrics to evaluate the DM and safety performance of organizations. The fourth and

fifth objectives merge the data from the first, second and third objectives to evaluate the relationship between leading and lagging indicators of DM performance and make recommendations to improve construction organizations' DM practices. Integrating both methods achieves the best possible results and leads to a far greater understanding of the problems investigated (Greene 2007, Bryman 1992). Campbell and Fiske (1959), Webb et al. (1966), Burgess (1982) and Brannen (1992) described this integration as the most appropriate way in which problems are conceptualized and studied.

Table 1 shows the specific types of studies reviewed for this research and the contribution of each to the research whereas Figure 3 outlines the research methodology.

Table 1: Contributions of Existing Relevant Studies to Research

Research Type	**Contribution**	**Authors**
Studies on DM	Provide insight into the implementation of DM and an understanding of the various aspects of DM. Inform the development of relevant best practices.	Colella (1994), Corker (2000), Dibben et al (2000),Galvin et al (1986), Harder et al (2006), Hursh (1997), Krause et al (1998), OHSAH (2010), OECD (2010), Rieth et al (1995), Rogers (1993), Rosenthal et al (2007),Shrey, (1995), Tate et al (1989), Angeloni, (2013)
Studies on DM in construction	Enable focus on the peculiarities of DM in construction and on the latest research in the field.	Clarke et al, (2009), Lingard and Saunders (2004), Newton and Ormerod (2005) (2013), Smallwood and Haupt (2008), Tshobotlwane (2005)
Studies on maturity modelling	Provide the theoretical foundations for maturity modelling. Enable model development.	Crosby (1979), Dorfman (2000), Finnemore et al (2000), Lockamy and McCormack (2004), Vaidyanathan and Howell (2007), Willis and Rankin (2009)
Studies on DM implementation	Enable the identification of key practice areas of DM and DM metrics. Inform the development of leading and lagging indicators of DM.	Cheadle et al (1994), Stone and Colella (1996), Shrey and Hursh (1999), Brooker et al (2012), National Institute of Disability Management and Research (2003), The Conference Board of Canada (2013), Lingard and Saunders (2004)
Studies on construction safety performance	Enable the identification of safety performance metrics.	Hinze et al. 2013, Sgourou et al. 2010; Ng et al., 2005, Reiman and Pietikäinen 2012

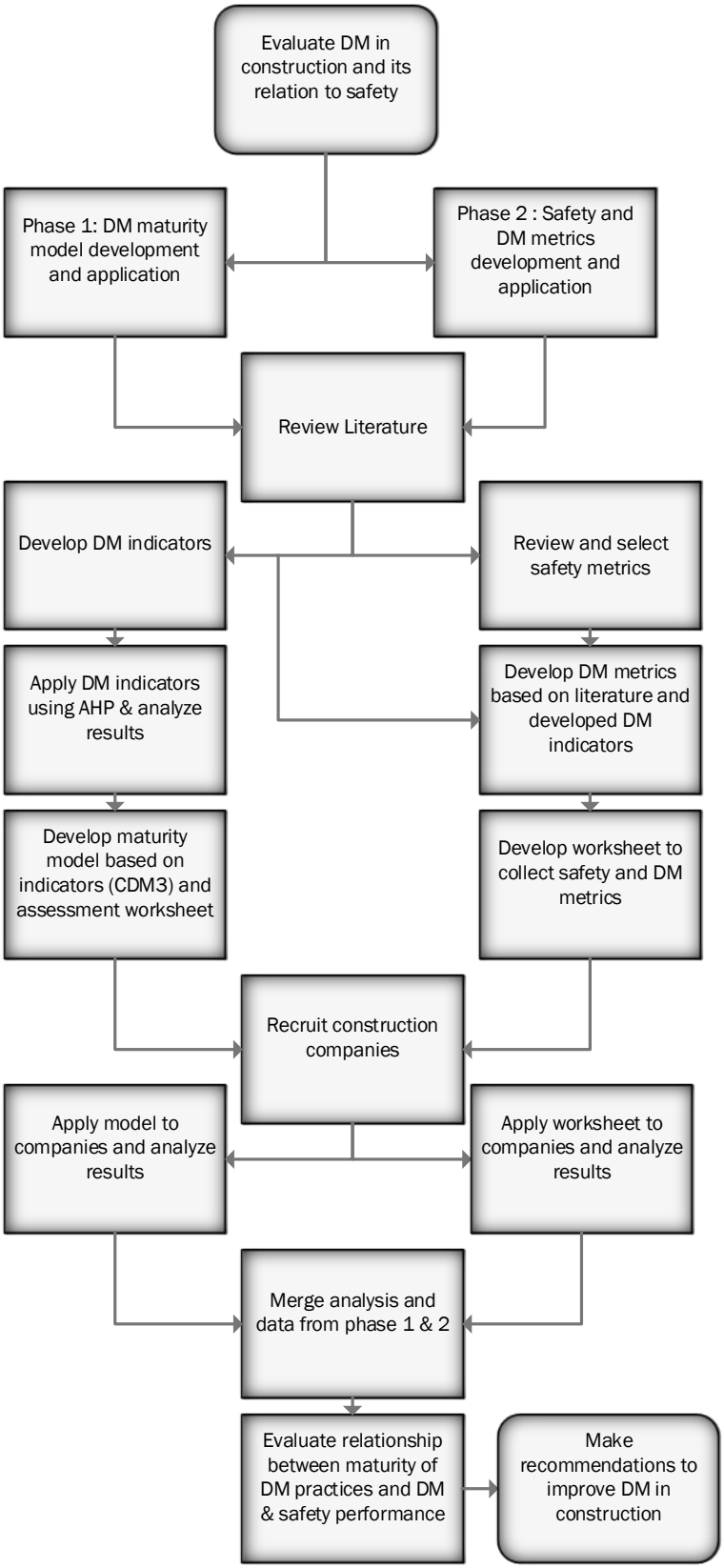


Figure 3: Research Methodology

3.2 Objective #1: Developing and Validating Disability Management Indicators for Construction Organizations

This section presents the methods used to develop and validate DM indicators for the construction industry. It also includes a list of those indicators, their definitions and key inherent best practices within each. This is followed by a description of the analytical hierarchy process (AHP) used to validate them.

3.2.1 Indicators Development

The research involved developing 12 main DM indicators that can be used to assess construction organizations' policies and practices and forecast how well a company is expected to perform with respect to DM. Each indicator represents "a quantitative or qualitative factor or variable that provides a reliable means to measure achievement, to reflect changes connected to an intervention, or to help assess the performance of a development actor" (OECD/DAC 2010). Developing the indicators involved identifying existing DM practices using an extensive literature review, and then formulating the DM indicators relevant to construction using the process outlined below:

- Literature selected for review: The literature review entailed searching the University of Manitoba library and the online research databases of Scopus, Compendex, and ScienceDirect for relevant documents using the terms: "DM, DM practices, DM performance measurement, DM indicators, DM assessment framework, DM assessment model, DM performance evaluation, construction injury management, and construction DM".

- Literature breakdown: The literature search identified a total of 97 relevant documents: 69 journal papers, 11 DM standards, nine books and eight conference papers. Of the 69 journal papers found, only eight investigated DM in construction in particular, with only one research conducted in Canada. The remaining journal papers (i.e. 61) studied DM in relation to other industries such as the services industry, medical field and business management, with the majority being more generic in focus. The majority of the papers were published in journals focusing on disability rehabilitation, such as Safety Science, Journal of Vocational Rehabilitation, Rehabilitation Counselling Bulletin and Psychiatric Rehabilitation Journal. Five of the DM standards were published in Canada, while the remaining six were from other countries such as the United Kingdom, United States and Australia. All of the 97 documents were reviewed to identify the relevant existing DM best practices in the literature.
- Literature review: The full 97 documents were reviewed using an iterative process to identify the DM practices inherent in them and the DM characteristics and issues that can be translated to DM practices. These practices formed the basis of the developed indicators. Only practices that had been implemented and validated in a workplace or community-based environment were included. These practices were categorized under 15 different themes. These themes included: 1) Early contact interventions, 2) Workplace assessment, 3) Case management/coordination, 4) RTW policies, 5) Workplace accommodations, 6) Modified work, 7) Transitional work opportunities, 8) Alternative placements, 9) Revision of workplace roles, 10) Employee participation, 11) Labour-management commitment, 12) Education of employees, 13) Rehabilitation services, 14) Information systems and 15) Preventative strategies. In doing so, practices with similar outcomes and procedures were

grouped and coded. These themes provided the basis for sorting the practices while also providing a framework by which the indicators were constructed and defined.

- DM indicators and practices definitions: Only practices that were relevant to the construction industry were included in the final version of the indicators and practices. The relevance and appropriateness of the practices were assessed against the nature and characteristics of construction projects, project outcomes and health and safety best practices. The indicators were then formulated using a constant comparative analysis based on Grounded theory (Glaser and Strauss 1967, Strauss and Corbin, 1990). The goal of the Grounded theory approach is to generate theories that explain how some aspect of the social world works, in this case DM. This involved analyzing which practices assessed and encompassed similar characteristics, narrowing them down and merging them where appropriate. This process resulted in 12 different categories of practices or indicators. These categories were then named according to the dominant characteristic that ran through the practices making up each.

The 12 indicators were divided into two main categories based on their applicability: organizational-level indicators and individual-level indicators. Organizational indicators encompassed those practices that do not target the individual worker in particular but cut across the entire organization. Individual indicators focused on the individual worker without necessarily targeting every worker within the organization. For instance, case management practices were classified as an individual-level indicator because they apply only to employees injured on site and thus require specific rehabilitation and RTW accommodations. Table 2 identifies and defines these 12 indicators, their associated key practices and references to these practices in the DM literature.

Table 2: Proposed DM Indicators, Associated Key Practices and Relevant Literature

Indicators	Definition	Key Practices	References
Communication practices (CP)	These practices aim to provide information to all employees on disability, injury and safety in the workplace, along with specific information about the strategy of the organization with respect to health and safety.	- Information routes - Policy change communications - Open communication management with employees - Early intervention communication - Employee knowledge assessment	Brooker et al. 2000, Westmorland et al. 2005, Muriel et al, 2005, Loisel et al., 2013, The Conference Board of Canada, 2013; Habeck et al. 1991, Dyck 2006; Tate et al. 1986, Shrey 1995
Case management practices (CMP)	These practices aim to plan, implement, coordinate, monitor and evaluate the options and services required to meet employee health and rehabilitation needs.	- Post-RTW monitoring and coordination - Initial assessment of physical and functional rehabilitation - Occupational rehabilitation counseling and job skill retraining	Brooker et al. 2000, Marek et al. 2010, Kong et al. 2012, Salazar et al 1999, Hunt and Habeck 1999, Shrey and Olsheski 1992, OHSAH 2010, The Conference Board of Canada 2013, Welch et al. 1999
Return to work and accommodation practices (RAP)	These practices aim to integrate employees who have been injured or have a disability back to the workplace by providing services such as job needs assessment and modified work.	- Job needs assessment - Job analysis - Functional assessment - Job and workstation modification - Vocational assessment and job placement for employees unable to return to original positions - Intermediate evaluation of progress	Lidwall 2015, OHSAH 2010, Westmorland et al. 2005, Grace et al. 2013, The Conference Board of Canada, 2013, Habeck et al. 1991, Dyck 2006, Tate et al. 1986, Shrey 1995, Krause et al. 1998, Schwartz et al. 1989, Hunt and Habeck 1999, Shrey and Olsheski 1992, He et al. 2010, OHSAH 2010, Harder and Scott 2003, Winter et al. 2015
Claims management practices (CLP)	These practices aim to manage claims related to occupational and non-occupational injuries or illnesses that may entitle individual employees to long-term disability benefits.	- Claims management from initial injury to claim resolution - Evaluation of long-duration claims	Hughes and Barber 1992, Amr and Nemr 2008, Irving 2010, Habeck et al. 1991, Dyck 2006, Tate et al. 1986, Shrey 1995, Thomason et al. 2001, Hassanein and Nemr 2008, OHSAH, 2010
Disability and	These practices aim to provide	- Workplace safety programs	Maiwald 2011, Davis 2004, Badii 2006,

injury prevention practices (DIP)	preventative measures to alleviate injuries and educate employees on these aspects before the occurrence of disabling injuries.	- Hazard management - Health and welfare programs - Project site safety - First aid - Educational safety awareness programs - Mental health and stress management programs	Feldstein et al. 1998, Habeck et al. 1991, Dyck 2006; Tate et al. 1986, Shrey 1995, Krause et al. 1998, Harder and Scott 2003, Hansen 1997, Intracorp 1999, Kochaniec 1999, Rogers 1995, Shrey and Lacerte 1995, OHSAH 2010, Johnson et al. 1996
Transitional program management practices (TPM)	These practices aim to provide generic DM programs for injured employees, which will be customized to individual employees during case management.	- Workplace job accommodation - Transitional jobs breakdown - Organizational level modified duties - Organizational level occupational training	Radey and Wilkins 2010, The Conference Board of Canada 2013, Habeck et al. 1991, Dyck 2006, Tate et al. 1986, Shrey 1995, Krause et al. 1998, Shrey and Hursh 1999, Schwartz 1989, Westmorland et al. 2005
Physical accessibility management practices (PAP)	These practices aim to improve the physical accessibility of construction workplaces to people with disabilities and as such cover physical workplace accessibility requirements.	- Workplace and project site accessibility - Training for staff on physical implications of disability - Workstation accessibility	Barnes and Mercer 2005, Wilton and Schuer 2006, Newton et al. 2007, Hunt and Habeck 1999, Shrey and Olsheski 1992, Newton et al. 2007, McCampbell 1995
Senior management support practices (SMP)	These practices aim to provide continuous and consistent support from senior management to ensure the effective implementation of DM programs.	- Senior management role - Management and financial support of safety programs - Management support of RTW, modified work and related financial commitments	Dibben et al. 2001, Westmorland et al. 2005, Caveen, et al. 2006, Tortarolo and Polakoff 1995, Lipold 2000, Storrer 2000, Polakoff 1993, Westmorland and Buys 2004, Habeck et al. 1991, Dyck 2006, Tate et al. 1986, Shrey 1995
Program evaluation practices (PEP)	These practices aim to assess DM procedures, regulations and practices within the organization.	- Workplace incidents data collection - Case management evaluation - RTW evaluation - Injury and illness statistics analysis - Program modifications and improvements	OHSAH 2010, Jacobson et al. 2013, The Conference Board of Canada 2013; Hunt and Habeck 1999, Shrey and Olsheski 1992, Robinson et al. 2014

Regulatory and compliance policies (RCP)	These policies aim to ensure the compliance of practices developed by an organization to accommodate injured and disabled employees with existing guidance at the federal and provincial levels.	- Salary replacement policies - Job accommodation and transitional policies - Employment and budgetary responsibility policies - Vocational training policies	OHSAH 2010, The Conference Board of Canada 2013, Westmorland et al. 2005, Smallwood and Haupt 2008, Habeck and Kirchner 1999
Recruitment and retention policies (RRP)	These policies aim to assess the recruitment process of employees by a construction organization as well as the procedures in place to ensure the retention of injured employees. The principle of non-discrimination should be respected throughout the process.	-Recruitment polices (diversity management) - Pre-employment tests and selection criteria - Retention and gradual resumption of work measures - Support and technical advice to identify any opportunities and adjustments	OHSAH 2010, IRS 1996, Dibben, et al. 2000, Thomason et al. 1989, Harder and Scott 2005, Westmorland et al. 2005, Habeck and Kirchner 1999
Ergonomic practices (EP)	These practices aim to ensure the design of work processes and spaces that minimize injuries, complaints, staff turnover and work absenteeism.	- Jobs designed to reduce heavy lifting - Ergonomic strategies for workstations and work areas - Ergonomic considerations in purchasing new tools, equipment, or furniture - Ergonomic approaches to assist disabled employees	Johansson and Rubenowitz 1992, Johansson 1994, Thompson el al. 2003, Westmorland et al. 2005, Udosen 2006, Westmorland and Buys 2004; Winter et al. 2015

3.2.2 Indicators Application

As part of applying the developed indicators, an Analytical Hierarchy Process (AHP) was used to determine their relative weights of importance in relation to overall DM performance. The Analytic Hierarchy Process (AHP) is a structured, multi-attribute decision-making method that is used to determine the weights of importance of different criteria, assuming a problem is divided into a hierarchy of criteria (Saaty 1987). Numerical scales are attributed by making pairwise comparisons of these criteria with respect to their impact on an element placed in a superior level in the hierarchy (Aminbakhsh et al. 2013). AHP has a number of advantages. It can be used to solve complex problems that are difficult to quantify. The method is used in maturity modelling and in construction management for purposes such as contractor selection (e.g. Lin et al. 2008), safety management (e.g. Aminbakhsh et al. 2013), and technology, equipment, and material selection (e.g. Lin et al. 2008). AHP uses the geometric means of individual respondents, thus reducing the inconsistency of expert judgments and bias in the decision-making process. It derives scales of values from pairwise comparisons in conjunction with ratings, making it suitable for multi-objective, multi-criterion, and multi-actor decisions (Aminbakhsh et al. 2013). It represents a trade-off between experts' objective and subjective judgments (Saaty 1987), making it more reliable to use than other multi-criteria decision-making methods (Sambasivan and Fei 2008). The method provides a more controlled and systematic way for determining the weights of importance of different indicators. The twelve indicators were therefore prioritized by determining their relative weights of importance in relation to overall DM performance using pairwise comparisons (Saaty 1987, Saaty and Vargas 2001).

3.2.2.1 Data Collection

The research involved recruiting eight DM, construction, and health and safety experts from Manitoba for the purpose of conducting the AHP. These experts were required to have extensive knowledge and experience on DM and construction health and safety in Manitoba. Therefore, they were selected using chain-referral sampling. This sampling method involved contacting a known expert in construction DM and health and safety who then recommends other experts who have the knowledge base to undertake the analysis. It was used until all eight experts were recruited. Table 3 shows these experts' main attributes.

Table 3: Main Attributes of AHP Experts

Expert	Educational Level	Years of Experience	Position/ Field of Expertise
1	MSc (Civil Engineering)	26	Project Manager/ Case Management Specialist
2	PhD (Disability Studies)	20	Researcher
3	BSc (Civil Engineering)	18	Safety Officer
4	MSc (Project Management)	19	Project Manager/Contractor
5	MSc (Civil Engineering)	14	Safety Manager
6	BSc (Civil Engineering)	15	Project Manager/Contractor
7	MSc (Civil Engineering)	13	Project Manager/safety officer
8	BSc (Civil Engineering)	12	Safety Officer

Because of ethical considerations brought forward by the University of Manitoba Research Ethics Board, the AHP was conducted separately with each expert. Separate meetings were scheduled with six of the eight experts, with each expert briefed during that meeting about the process. The two other experts participated in the process via email and phone due to conflicting schedules. Each expert was tasked with carrying out pairwise comparisons of the 12 indicators by determining the level of importance of one indicator versus another to construction organizations' DM performance. Appendix A shows a copy of the instructional sheet provided to each expert and that

described the process in detail to them, including what is expected of them. The comparisons were made using the nine-point fundamental scale develop by Saaty (1987), and ranging from “equal importance” (1) of the two indicators to “extreme importance” (9) of one indicator versus another. This nine-point scale was preferred over an abbreviated five-point scale to reduce the level of fuzziness associated with experts’ judgements. The process also allowed for experts to justify their respective ratings. Before the start of the AHP, each expert was required to sign a consent form, a copy of which can be found in Appendix B. The whole AHP was also reviewed and approved by the University of Manitoba Research Ethics Board prior to its implementation. Appendix C shows the relevant ethics approval certificate.

3.2.2.2 Data Analysis

The pairwise comparisons conducted by each expert produced a pairwise comparison matrix. The values in the matrix within each column were known as pairwise comparison judgments and reflected the relative importance of each indicator for each expert. These values were normalized, producing ratio scales in the form of principal eigenvectors or Eigen functions (Saaty 1987). The normalization entailed dividing each value for each indicator in a column by the sum of values within the same column such that the sum of each column’s values is 1. The consistency ratio of the pairwise judgments for each expert was calculated to determine the reliability of the pairwise comparisons and the potential for rank reversal. The final sets of weights of importance representing the consensus of the expert group were then determined using the aggregation of individual judgments approach. Fundamentally, for each set of indicators compared, the pairwise judgments provided by each expert were aggregated using geometric means to produce a single set of pairwise comparison judgments (Forman and Peniwati 1998). These were then normalized

in the same manner described earlier to produce a final set of weights of importance. Once this was done, the indicators were ranked from the most important to the least important based on their weights of importance.

The analysis focused first on calculating the consistency ratio of the pairwise judgements for the experts, then on reviewing the highest ranked and lowest ranked indicators. These rankings were discussed in relation to the literature in the field focusing in particular on the research conducted on DM in Manitoba (i.e. Winter et al. 2015). The analysis goes on to review the ranking of organizational versus individual-level indicators and to discuss the relevance of these rankings in the context of the existing DM literature. Finally, a discussion of the relevance of the newly developed indicators is conducted.

3.3 Objective #2: Developing and Implementing Construction Disability Management Maturity Model

This section presents the methods used to develop and implement the DM maturity model, also known as the Construction Disability Management Maturity Model (CDM3) and that was based in part on the indicators developed in the previous section. A comprehensive overview of the model is also included in this section.

3.3.1 Maturity Model Development

The development of the CDM3 was based on the 12 DM indicators defined as part of the previous objective. These indicators formed the foundation of the model with the practices inherent in them

forming the best practices that represent the performance benchmarks against which a construction organization's practices are compared. In its final form, the CDM3 aims to define key DM best practices in the literature, and evaluate the maturity of construction organizations' DM practices against these best practices, providing guidance for improving these organizations' overall DM. The CDM3 divides the twelve indicators into two different categories based on their level of implementation and applicability: organizational-level indicators versus individual-level indicators. These indicators represent clusters of related activities, which when adhered to enable the achievement of performance goals. They represent the independent variables of the model, with the dependent variable being DM performance. The model assumes that higher maturity of each indicator will translate to higher levels of DM performance. Figure 4 depicts the structure of the proposed model graphically. A detailed description of these indicators and the inherent practices within each can be found in Table 2.

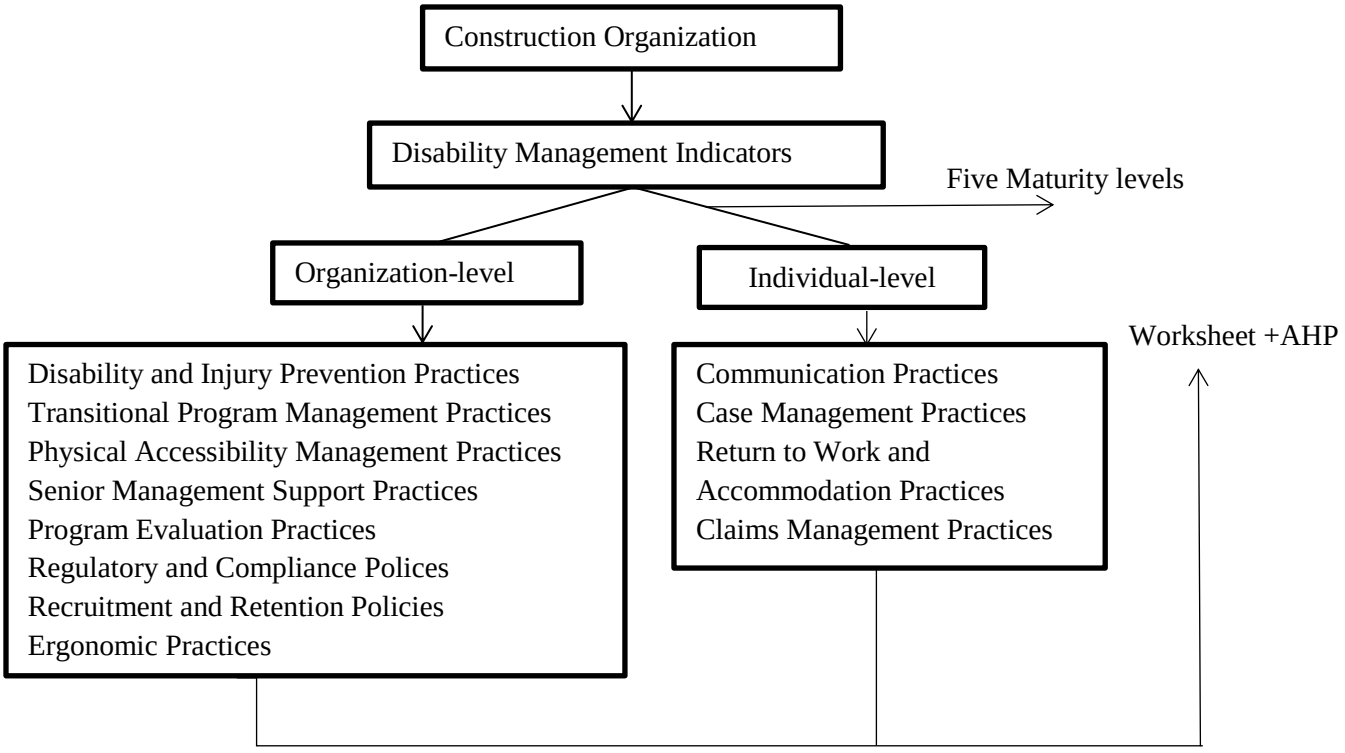


Figure 4: Structure of CDM3

Individual-level indicators focus on the individual employee without necessarily targeting every employee within the organization. They include:

- *Communication practices (CP)*: These practices cover information provided to all employees about the organization's DM strategy, and accommodations provided at all levels in support of those with disabilities.
- *Case management practices (CMP)*: These practices deal with the individual employee following an injury with the aim of managing the injury and rehabilitating the employee. Case management is a term used to describe a variety of strategies aiming to manage the health and social services provided to every injured employee individually and to his or her family (Habeck and Kirchner 1999).

- *Return to work and accommodation practices (RAP)*: These practices involve the completion of a job needs assessment to determine how the DM program can best meet the needs of returning employees with disabilities. A comprehensive analysis of employees' skills is also conducted to modify their original jobs or identify alternate jobs for which they would be more suited.
- *Claims management practices (CLP)*: These practices entail managing claims related to occupational and non-occupational injuries or illnesses that may entitle the individual employee to long-term disability benefits.

Organizational-level indicators encompass practices that cut across the entire organization rather than focus on the individual employee. They include:

- *Disability and Injury prevention practices (DIP)*: These practices cover the preventative aspects of DM. DM programs should educate employees on them to avoid disabling injuries.
- *Transitional program management practices (TPM)*: These practices cover the development of a generic DM program for injured employees, which can be customized to the individual employee as part of CMP.
- *Physical accessibility management practices (PAP)*: These practices aim to improve the physical accessibility of construction workplaces and as such cover physical workplace accessibility issues.
- *Senior management support practices (SMP)*: These practices aim to garner support at the senior management level to ensure the effective implementation of DM programs.

- *Program evaluation practices (PEP)*: These practices aim to continuously evaluate DM programs, customized individual RTW programs and injury and illness statistics to determine required program modifications and improvements.
- *Regulatory and compliance policies (RCP)*: These practices aim to ensure compliance with existing legislation with respect to issues such as salary replacement, job accommodation, transitional employment, budgetary responsibility and vocational training.
- *Recruitment and retention policies (RRP)*: These practices cover the recruitment of new employees and the retention of injured ones, emphasizing throughout the principle of non-discrimination and equitable opportunities to all.
- *Ergonomic practices (EP)*: These practices entail designing work processes and spaces that minimize injuries, complaints, staff turnover and work absenteeism in order to meet employers' social and legal obligations and improve employees' health and safety.

The research adopted for the CDM3 the maturity scales used by the Capability Maturity Model Integration and SPICE (Sarshar et al. 1998). The CDM3 has five distinct maturity levels to enable continuous improvement of organizational practices and the attainment of the highest level of process maturity. As shown in Figure 5, each level represents a well-defined stage, the characteristics of which are described below.

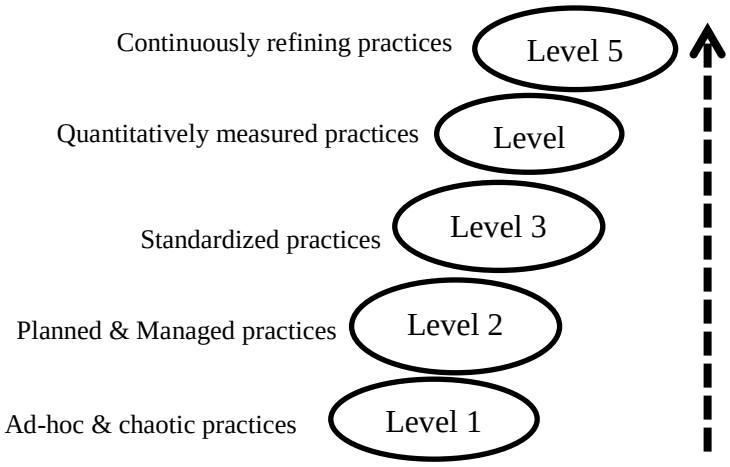


Figure 5: CDM3 Maturity Scale

- *At maturity level 1*: Organizational processes are ad hoc and chaotic (CMMI Product Team, 2002). No procedures or policies are defined or implemented. Organizations' DM performance usually depends on the competence of organizational members rather than the application of specific DM practices.
- *At maturity level 2*: Organizational processes are planned, implemented, measured, and controlled to a degree although not standardized. This level implies that DM requirements practices and results are visible but not wholly synergized.

- At maturity level 3: Organizational processes are standardized with respect to DM practices, that is, they are defined, implemented, managed and used consistently across the organization.

- At maturity level 4: Organizational processes are implemented accurately and efficiently in accordance with quality control standards and performance measurement. Performance data is collected and evaluated against internal and external benchmarks to identify causes of process variation.

- At maturity level 5: Organizational processes are continually improved upon to address process variation and achieve optimal efficiency by establishing new quantitative objectives and benchmarks (Sarshar et al. 1998).

3.3.2 Maturity Model Implementation

This section describes the implementation of the developed model as well as the analysis of the data collected as part of that implementation.

3.3.2.1 Data Collection

An assessment questionnaire, a copy of which can be found in Appendix D was developed to implement the CDM3 and evaluate the extent to which each organization implemented each indicator and each best practice inherent within it. The assessment worksheet assessed the 12 indicators making up the CDM3 using a total of 134 close-ended, Likert scale questions, with each indicator assessed using a specific number of questions. Each question represents a specific practice, which each responding organization required to rate the extent to which it implemented that practice using a range of responses ranging from “Strongly Disagree” (1) to “Strongly Agree” (5). These practices represent best practices when operating at the optimal level (i.e. level 5). The worksheet was designed so that it could be completed by more than one individual within the organization. Random verifications of the responses provided were conducted to ensure their accuracy and improve the validity and rigour of the assessment. These verifications involved checking project and organizational documents and conducting direct observations when appropriate. The worksheet was reviewed and approved by the University of Manitoba Research Ethics Board prior to its eventual deployment. Appendix E shows the relevant ethics approval

certificate whereas Table 4 shows the breakdown of the questions making up the assessment worksheet. Table 5 shows the selective verifications conducted to determine the reliability and accuracy of the responses to each assessment question (i.e. practice). The acronyms used to refer to the questions are based on the indicator they belong to (e.g. CP, CMP, and RAP) and their sequence and number (e.g. 1, 2, and 3) in the model's assessment worksheet in Appendix D.

Table 4: Breakdown of Assessment Worksheet

Assessment Questions/ Best Practices Numbers	Indicator
1-11	Communication practices
12-29	Case management practices
30-39	Return to work and accommodation practices
40-44	Claims management practices
45-69	Disability and injury prevention practices
70-83	Transitional program management practices
84-88	Physical accessibility management practices
89-101	Program evaluation practices
102-105	Senior management support practices
106-110	Regulatory and compliance policies
111-124	Recruitment and retention policies
125-134	Ergonomic practices

Table 5: Selective Verifications of Practices

Practices	Method of Verification
Communication Practices (CP)	
CP1, CP2, CP3, CP4, CP5	Interviews to determine the prevalence of practices and follow-up questions Review DM policies
CP6, CP7	Review evidence of injury management training of employees
CP8	Review evidence of health and safety training of employees
CP9-CP11	Interviews to determine the prevalence of practices and follow-up questions Review DM policies
Case Management Practices (CMP)	
CMP1, CMP2, CMP3, CMP6, CMP8, CMP9, CMP10	Interviews to determine the prevalence of practices and follow-up questions Review DM policies
CMP4, CMP5	Review existence of functional abilities form Review assessment process for determining the physical and functional capability of injured employees.
CMP7	Review existence of functional abilities form given to treating physician and procedures to ensure they are filled and submitted
CMP 11	Review existence of a case manager role in the organization
CMP12	Review existence of formal training obtained by case manager or DM coordinator
CMP13	Review hiring process and requisite skills required by the DM coordinator
CMP14, CMP15	Review job description of DM coordinator
CMP16, CMP17, CMP18	Interviews to determine the prevalence of practices and follow-up questions Review DM policies
Return to Work and Accommodation Practices (RAP)	
RAP1, RAP2, RAP3, RAP7	Interviews to determine the prevalence of practices and follow-up questions Review DM policies
RAP 4	Review job analysis process, determine its existence and if it is periodically updated
RAP5, RAP6	Review functional assessment process, determine its existence and if it is periodically updated
RAP8	Review job modification processes and the criteria for providing modified jobs for employees. Check examples within the organization.
RAP 9	Review process used to determine when an employee cannot return to original job and would need retraining. Review existence of process to retrain such employees to ensure job retention.
RAP10	Review examples of individualized RTW plans and templates for developing them.
Claims Management Practices (CLP)	
CLP 1, CLP2, CLP3, CP4, CLP5	Interviews to determine the prevalence of practices and follow-up questions.

	Review DM policies
Disability and Injury Prevention Practices (DIP)	
DIP1, DIP2, DIP3	Interviews to determine the prevalence of practices and follow-up questions. Review DM policies
DIP4	Review hazard prevention program
DIP5, DIP6	Review evidence of first aid training provided to workers, presence of kits and qualified attendants.
DIP7, DIP8, DIP9	Review evidence of health and wellness programs, examples of incentives to ensure employee participation
DIP10, DIP11, DIP12, DIP13, DIP14, DIP15, D1P16, DIP18, DIP19, DIP20, DIP20, DIP21,DIP22, DIP23 DIP24, DIP25	Interviews to determine the prevalence of practices and follow-up questions. Review safety management system and policies, review safety databases, safety training for employees, safety reporting procedures
Transitional Program Management Practices (TPM)	
TPM1, TPM2, TPM3, TPM7, TPM8, TPM9, TPM10, TPM11, TPM14	Interviews to determine the prevalence of practices and follow-up questions. Review DM policies
TPM4	Review evidence of collaborative process used in developing transitional work for employees
TPM5, TPM6	Review evidence of formal training provided to RTW coordinator
TPM12, TPM13	Review evidence of the provision of transitional work and monitoring processes
Physical Accessibility Management Practices (PAP)	
PAP1, PAP2, PAP3, PAP4, PAP5	Interviews to determine the prevalence of practices and follow up-questions Review DM policies, and accessibility of workplace
Program Evaluation Practices (PEP)	
PEP1, PEP2, PEP3, PEP4, PEP6, PEP7, PEP8, PEP11, PEP13	Interviews to determine the prevalence of practices and follow up-questions Review evidence of tracking records for illness or injury, participation in wellness programs, cost associated with DM, workers in RTW programs and evaluation of these records
PEP5, PEP9, PEP12	Review evidence tracked data is reviewed, e.g. review samples of reports using the tracked data
PEP10	Review evidence that worker representatives in the workplace have access to the evaluation data
Senior Management Support Practices (SMP)	
SMP1, SMP2, SMP3, SMP4	Interviews to determine the prevalence of practices and follow-up questions Review DM policies
Regulatory and Compliance Policies (RCP)	
RCP1, RCP3, RCP4. RCP5	Interviews to determine the prevalence of practices and follow-up questions Review DM policies
RCP2	Review evidence that DM strategy is formulated in accordance with national legislation
Recruitment and Retention Policies (RRP)	

RRP1, RRP2, RRP3, RRP4, RRP5, RRP6, RRP9, RRP10, RRP11, RRP12, RRP13, RRP14	Interviews to determine the prevalence of practices and follow-up questions Review recruitment policies, hiring procedures, testing criteria and accommodations to persons with disability
RRP7	Review evidence that recruitment staff and selection panel members are trained to handle issues involving equal opportunity, diversity and disability
RRP8	Review evidence that disabled employee or disability expert is part of the recruitment panel
Ergonomic Practices (EP)	
EP1, EP2, EP3, EP4, EP5, EP6, EP8, EP9, EP10	Interviews to determine the prevalence of practices and follow-up questions Review DM policies
EP7	Review evidence that ergonomic factors are used in purchasing new tools, equipment, or furniture

The model was used to evaluate ten building and civil construction companies in Manitoba. The participating companies, the characteristics of which are shown in Table 6 were recruited through the Winnipeg Construction Association (WCA) using a stratified sampling technique. The WCA included 108 general construction member companies which formed the total population of general construction companies for this research. These companies were divided into different strata or categories depending on their size, with random sampling used to select a sufficient number of companies from within each stratum. Companies were divided into small (S), medium (M) and large (L) based on the number of employees working for them as defined by Industry Canada's (2014). This is to enable comparisons between small, medium and large-sized companies using these terms rather than using the number of employees. Therefore, Table 6 makes reference to both the number of employees within each company and their size. A sample size of 85 companies was required to ensure a confidence level of 95% and at 10% margin of error (Krejcie and Morgan 1970). However due to time and human resource limitations, the sample size was limited to a maximum of 10 companies. Although this means that the results cannot be generalized to the entire population of general construction firms in Manitoba, the sample produced a body of knowledge that provides a rigorous foundation upon which further studies can be built.

Table 6: Characteristics of Participating Companies

Company	Area of Operation	Number of Employees	Size	Annual Revenue (in millions of $)	Respondents
Company 1	Building	100-499	Medium	13.80	2
Company 2	Building	0-99	Small	13.70	2
Company 3	Building	0-99	Small	6.88	2
Company 4	Building	0-99	Small	2.54	2
Company 5	Building/Civil	≥ 500	Large	50.00	3
Company 6	Building/Civil	100-499	Medium	13.30	3
Company 7	Building	0-99	Small	2.66	1
Company 8	Building/Civil	100-499	Medium	15.10	1
Company 9	Building/Civil	100-499	Medium	12.50	2
Company 10	Building	100-499	Medium	15.66	1

On the actual interview day, each company that agreed to participate in the research was required to sign the consent form shown in Appendix F. The interview involved going through the assessment worksheet with the health and safety or DM coordinator of the company one indicator and one best practice at a time and took on average an hour. The companies were categorized based on the number of their employees as defined by Industry Canada (2014). Companies with less than 100 employees were classified as small. The ones employing between 100 and less than 500 employees were considered medium, and the ones with 500 employees or more were categorized as large companies. The companies sampled are in no way related to the expert group who conducted the AHP.

3.3.2.2 Data Analysis

Cronbach's alpha was calculated to measure the validity and reliability of the assessment worksheet, which is the extent to which the items in the worksheet provided consistent information with regards to the data (Cortina 1993). The alpha value ranges in value between 0 and 1, with values close to 1 indicating high consistency (Cortina 1993). Values of 0.70 or higher generally

indicate an acceptable level of reliability, although the interpretation of alpha values in specific contexts can be more complex (Schmitt 1996).

Each indicator is made up of a number of practices. The maturity of each practice was rated on a Likert scale from 1 to 5 and referred to as *MS Practice*. The maturity scores of the practices (i.e. *MS Practice*) within every indicator were then summed up to produce the *Actual Score Indicator* (AS). That score was divided by the optimal score for the indicator (i.e. *Optimal Score (OS) Indicator*) which assumed a rating of 5 for each practice and was multiplied by the number of practices within that indicator. This value was multiplied by the highest maturity level of 5 to derive the initial maturity score for each indicator (i.e. *MS Indicator*) as per Equation 1. To obtain *MS Indicator %*, the value was multiplied by 100 instead of the 5, as per Equation 2. The *MS Indicator* score aimed to quantify the relative contribution of each indicator to the overall maturity of the company and thus determine the practices that make the greatest contribution to it without taking into account the weight of importance of every indicator. A comparison of the *MS Indicator* for different indicators within the same company can also determine the extent to which every indicator is prioritized within the company. The *MS indicator* for each indicator was then summed, and divided by the optimal score for all the indicators (i.e. *Optimal Score (OS),* which is 5 multiplied by the number of indicators) and multiplied by 5 as per Equation 3 to calculate the overall maturity score for each company without taking into account the AHP weights of importance (i.e. *MS Company unweighted*). Another maturity score that took the AHP weights of importance into consideration (i.e. *MS Company*) was calculated for each company by multiplying the *MS Indicator* for each indicator by its weight of importance (i.e. *AHP weight*) and summing up the resulting product for all indicators as per Equation 4, dividing it by the optimal score (i.e.

Optimal Score (OS)) and multiplying it by 5. A comparison of these maturity scores (i.e. *MS Indicator*, *MS Company unweighted* and *MS Company)* across different companies can help determine the level of influence of key indicators on overall DM performance.

The analysis considered both weighted and unweighted maturity scores. This is because the analysis of both weighted and unweighted maturity scores show whether companies have focused on the most important DM indicators or not. These maturity scores also do change when the weights of importance stemming from the AHP are taken into account. Moreover, these weights are not universal and are based strictly on the group of experts conducting the AHP as part of this research. These experts are not representative of the whole province of Manitoba, and as such, these weights do not represent the overall construction industry in Manitoba. There are also no accepted validated industry weights of importance for these DM indicators that can be used in all cases. These weights of importance can therefore differ from one study to the other depending on the people conducting the AHP.

The potential maturity growth for each company at the indicator (i.e. *PG Indicator*) and company (i.e. *PG Company*) levels were also calculated using Equations 5 and 7 respectively by finding the difference between the optimal maturity score of 5 and the *MS Indicator* and *MS Company* respectively. Similarly, the potential maturity growth percentages for each company at the indicator (i.e. *PG Indicator %*) and company (i.e. *PG Company %*) levels were also calculated by dividing the *PG Indicator* and *PG Company* values respectively by 5 and multiplying them by 100 as shown in Equations 6 and 8 respectively. This potential growth represented the amount of development and growth required to reach the highest level of performance (i.e. level 5). It also

help determine the extent to which the objectives associated with each key indicator were achieved and the level at which an indicator operated. While the sample size does not allow for the generalization of the results, it provides key insights into how companies approach DM and where improvements in their DM indicators are possible. Based on the model assumptions, as companies implement more improvements to their DM practices, their assessed DM maturity should improve when practices are diligently implemented. Actual follow-up data would need to be collected to ascertain how companies implement recommendations based on the maturity scores received.

$$MS\ Indicator = \frac{\sum (MS\ Practice)}{OS\ Indicator}\ x\ X \quad \text{Equation 1}$$

$$MS\ Indicator\ \% = \frac{\sum (MS\ Practice)}{OS\ Indicator}\ x\ 100 \quad \text{Equation 2}$$

$$MS\ Company\ unweighted\ = \frac{\sum (MS\ Indicator)}{OS}\ x\ X \quad \text{Equation 3}$$

$$MS\ Company = \frac{\sum (MS\ Indicator\ x\ AHP\ weights)}{OS}\ x\ X \quad \text{Equation 4}$$

$$PG\ Indicator\ = (X - MS\ Indicator) \quad \text{Equation 5}$$

$$PG\ Indicator\ \% = \frac{PG\ Indicator}{5} x100 \quad \text{Equation 6}$$

$$PG\ Company\ = (X - MS\ Company) \quad \text{Equation 7}$$

$$PG\ Company\ \% = \frac{PG\ Company}{5} x100 \quad \text{Equation 8}$$

Where X stands for highest maturity scale, which for this study is 5.

The analysis involved evaluating the maturity of the participating companies and investigating the most mature and least mature companies with their most mature and least mature indicators. This was followed by an evaluation of the maturity of these companies in relation to their weights of importance. The research also involved evaluating the maturity of these companies as a function

of their size and the maturity of the different indicators across these companies and in relation to their weights of importance. The maturity of every individual indicator and of its key practices was also analyzed across these companies. A sample case study of the maturity of Company 1 in particular and of its indicators is also presented to demonstrate how the CDM3 can be applied to evaluate the DM practices of an individual construction organization. The research identified the opportunities for improvement for this specific company based on its performance and the maturity of its practices before discussing the applicability and relevance of the model in general. This discussion was based on the administration of the model's assessment questionnaire by the research team, the maturity model's findings, and the implementation of the random verifications by the research team and all interactions with the samples companies throughout these activities.

3.4 Objective #3: Developing and Implementing Disability Management and Safety Metrics for Construction Organizations

This section describes the methods used to review, develop and collect safety and DM metrics to evaluate the safety and DM performance of the construction industry respectively. The section includes a full list of these developed metrics, their definitions and the formulas used to calculate them.

3.4.1 Metrics Review and Development

This research involved reviewing the construction DM and safety literature to identify the metrics used to evaluate construction organizations' safety and DM performance in the literature. The

literature was not only limited to the scientific journal and conference publications found in databases such as SCOPUS and ScienceDirect. It extended to public and government agencies such as the Occupational Safety and Health Administration (OSHA) and the Employees Compensation Boards in the different provinces in Canada. While the literature review could not identify any explicit DM metric, the following process was used to identify relevant metrics used in the literature:

- Literature selected for review: A systematic literature review was conducted to identify peer-reviewed papers that focused on evaluating DM and health and safety performance using lagging indicators of performance. The papers were extracted from the University of Manitoba library and the online research databases of Scopus, Compendex, and ScienceDirect. The search and screening of articles followed a two-step process. The initial key terms used to search for them were “construction health and safety”, “construction disability management” and “construction injury management”. The resulting papers were narrowed down using a second set of terms that included: “metrics”, “lagging indicators”, “performance assessment” and “performance measures”.
- Literature review: A total of 55 safety-relevant documents were identified using the process outlined above. These documents consisted of 45 journal papers, 4 conference papers and 6 health and safety guidelines. All 55 documents were reviewed using an iterative process to identify published safety metrics in them. Table 6 lists the pre-existing metrics found in the literature and used extensively within the industry. If the metric cited in an article was drawn from another source, the original article was also examined. Many of the identified metrics had different names but were essentially similar. A definition of each metric is provided in Table 6 as well as the formula used to calculate it. Although these metrics can

also measure aspects of DM given the overlap between safety and DM, none of these metrics focused exclusively on DM, thus the need to develop a new set of metrics to measure DM performance exclusively.

Table 7: Safety Metrics in Literature

Metric	Definition	Formula	Sources
Reportable incidents/Accident Rate/ Recordable Injury Rate (RIR) /Total Recordable Injuries Frequency	The number of reported incidents per 200,000 work hours.	Number of reported incidents *200,000/ Total work hours	Rankin et al. 2008, Cha and Kim 2011, Hinze et al. 2013, Yun et al. 2016, Wanberg et al. 2013, Nasir et al. 2012, COAA 2011, OHSAH, 2010
Lost Time/ Lost Time Case Rate Frequency (LTCR)	The number of incidents that resulted in lost time per 200,000 work hours	Number of time lost incidents/cases*200,000/ Total work hours	Rankin et al. 2008, Nassar and AbouRizk 2014, Nasir et al. 2012, OHSAH, 2010
First-aid Injury Rate/ Total Injury Frequency (TIF)	The amount of first-aid injuries per 200,000 work hours.	Number of accident*200,000/Total work hours	Wanberg et al. 2013, Cha and Kim 2011, Yun et. al. 2016
Total Recordable Occupational Illnesses Frequency (TROIF)	The number of occupational illnesses (as defined in by the U.S. Occupational Safety and Health Administration and the Bureau of Labour Statistics), divided by the total on-site hours worked, converted to standardized frequency based on 200,000 person-hours.	Number of occupational Illnesses *200,000/ Total work hours	Hinze et al. 2013
Number of Near Misses	The number of near misses generated by 200,000 worker-hours exposure and divided by the total work hours worked on the project.	Number of near misses *200,000/ Total work hours	Salas and Hallowell 2016
Number of Safety Observations	The number of safety observations conducted in the year by 200,000 worker-hours exposure and divided by the total work hours worked in the year.	Number of safety observations *200,000/ Total work hours	Salas and Hallowell 2016
Number of Close Calls	The number of close calls reported per 200,000 hours of worker exposure.	Number of close calls *200,000/ Total work hours	Hinze et al. 2013
Number of Sickness Absence	The number of sickness absence days per 200,000 work hours.	Number of sickness absence days *200,000/ Total work hours	Hinze et al. 2013
Safety Cost Ratio	The amount spent on safety issues against total revenue.	Safety Cost /Revenue	Cha and Kim 2011

Safety Education	The amount of training of employees per gross area.	Number of Training hours of employees/Gross area of company	Cha and Kim 2011
Days Away/Restricted or Transfer (DART) Rate	The number of recordable incidents that occur among a given number of full-time employees over a given period of time.	Number of recordable incidents that resulted in days away from work, restricted activity and/or job transfer *200000/ Total work hours	Hinze et al. 2013, Cha and Kim 2011, Grabowski et al., 2007, Yun et al. 2016, OHSAH, 2010
Experience Modification Rating	The base premium is calculated by dividing a company's payroll in a given job classification by 100 and then by a "class rate".	Company's payroll in a given job classification/ 100 "class rate".	Hinze et al. 2013, Yun et al. 2016
Severity Rate (SR)	The number of days lost to incidents per 200,000 work hours.	Number of days lost to incidents * 200,000/ Total work hours	Hinze et al. 2013, Yun et al. 2016
Loss Ratio	The cost of claims against the cost of premiums.	Cost of claims/Cost of premiums	Hinze et al. 2013,Grabowski et al. 2007
Number of Liability Claims	The number of liability claims associated with worksite injuries.	Number of claims	Hinze et al. 2013, Cox et al. 2003, Grabowski et al. 2007

The research involved developing new DM metrics based on the 12 DM indicators identified and weighed as part of the first research objective. These indicators were defined based on an extensive review of the DM literature and the identification of specific DM practices. The research entailed determining whenever possible which of these practices could be measured, quantified and tracked, and developing for every one that could the metric that would best measure the performance aspect of these practices. Informal feedback received from experts involved in the AHP and in implementing the CDM3 and the metrics as part of the first and second research objectives also helped the research team develop these metrics. Nevertheless, these experts were not directly involved in developing them. The metrics were not also formally validated which is a major limitation of this research. Instead, the people within each company that were responsible for applying them informally validated them as part of the application. Therefore, future research should formally validate these 12 metrics and develop additional ones.

Table 8 shows the 12 resulting DM metrics developed for this research and that can be tracked on a monthly, quarterly or annual basis to benchmark DM performance at the organizational level. The table defines each metric, presents the formula used to measure it and identifies the specific DM indicator it relates to. Although a number of metrics could be developed for DM indicators such as “Communication”, “Program evaluation”, “Return to work and accommodation”, “Case management” and “Disability and injury prevention” practices, metrics measuring “Regulatory and compliance” policies, “Recruitment and retention” policies and “Senior management support” practices were noticeably absent. This is because these indicators and their inherent practices were more qualitative and subjective in nature and thus were more difficult to quantify and convert into metrics.

Table 8: New DM Metrics Proposed

Metric	Definition	Formula	Relevance	Practices
DM1	Percentage of employees and their safety representatives involved in the planning of DM.	(Total number of employees and their safety representatives involved in the planning of DM / Total number of employees) *100	This metric seeks to measure the overall involvement of employees within an organization's DM program. Clear and timely communication is key in creating more responsible and empowered employees and in cutting down costs. The higher the percentage, potentially the higher the level of integration and communication lines between management and employees.	Communication, Disability and injury prevention, Program evaluation
DM2	Percentage of employees provided with health and safety training.	(Total number of employees provided with health and safety training/ Total number of employees)*100	This metric seeks to measure to extent to which organizations train their employees on health and safety issues within the workplace, thereby preventing accidents due to ignorance of safety procedures. The higher the percentage, potentially the higher the level of training and awareness of employees of such issues.	Communication, Disability and injury prevention, Program evaluation
DM3	Percentage of employees participating in site safety meetings.	(Total number of employees participating in site safety meetings / Total number of employees)*100	This metric seeks to measure the level of integration of employees in their organization's safety management. Every project has its unique characteristics in terms of potential hazards and employees must be involved in managing them to prevent accidents on site. The higher the percentage, potentially the higher employees' involvement in managing safety.	Communication, Disability and injury prevention, Program evaluation
DM4	Percentage of injured employees who were provided with physical accommodation.	(Total number of injured employees who were provided with physical accommodation/ Total number of injured employees requiring physical accommodation)*100	This metric seeks to measure the extent to which employees who required physical accommodation were actually accommodated. It is essential for organizations to accommodate employees physically in a timely manner to ensure quick adjustment back to the workplace. This physical accommodation can include workstation modifications and more. The higher the percentage, potentially the higher the level of accommodation.	Physical accessibility management, Program evaluation,
DM5	Percentage of employees who returned back to work.	(Total number of employees who returned from injury leave /Total number of	This metric seeks to measure the extent to which injured employees were actually able to return back to work in the same or in an alternate capacity. The aim is to assess whether existing practices foster early return to work,	Return to work and accommodation, Case management, Program

		injuries that resulted (required) in days away, modified or restricted work) *100	although the length of absence can also be due to the severity of injuries. The length of time has economic consequences for the organization so the shorter the time, the lesser the economic impact on productivity, thus the need for a strong return to work program. By bringing disabled employees quickly and safely back to work, employers can greatly minimize the costs of disability. The higher the percentage, potentially the higher the ability of the organization to bring injured employees back to work.	Evaluation
DM6	Percentage of injuries that required case management.	(Total number of injuries that required case management/Total number of injuries) *100	This metric seeks to measure the extent to which injuries required case management. One of the main aims of DM is to support injured employees on a case-by-case basis. This metric seeks to calculate how often this is conducted so that measures can be put in place to ensure employees get the accommodations required. The higher the percentage, the potentially higher the level of individual injuries and employees accommodated. A lower percentage doesn't necessarily imply lower performance. It may imply that the organization had a lower number of severe injuries that required case management.	Return to work and accommodation, Case management, Program evaluation
DM7	Percentage of employees off due to injury.	(Total number of employees off due to injury/ Total number of employees) *100	This metric seeks to measure the extent to which injured employees took a leave of absence due to their injuries. This metric seeks to calculate the level of absence of employees so that measures can be put in place to ensure their return back to the workplace. The higher the percentage, potentially the higher the number of employees who took a leave of absence because of their injuries. The percentage can also be an indication of the severity of the injuries. A high percentage could therefore prompt the organization to investigate its safety practices.	Return to work and accommodation, Case management, Program evaluation
DM8	The cost of claims against the number of claims.	Total cost of claims/Total number of claims	This metric seeks to measure the average cost of a claim in order to assess and forecast actual and future safety and DM costs. This is to reduce the organization's	Claims management, Program evaluation

			overall expenditure on claims. The higher the ratio, potentially the higher the amount of money spent on claims.	
DM9	Percentage of employees who were placed on modified work.	(Total number of employees placed on modified duties / Total number of injuries that resulted (required) in days away, modified or restricted work)*100	This metric seeks to measure the effectiveness of the transitional program. Equally important are processes that help keep employees on the job once they return to the workplace. Transitional work assignments are necessary in a good DM program. The goal is to move employees from part-time or transitional employment to full-time employment, as they recover and are able to take on more responsibilities. The higher the percentage, potentially the higher the level of integration and thus the number of employees who were provided with modified work.	Transitional program management, Program evaluation,
DM10	Percentage of employees who transitioned from temporary work to their original work.	(Total number of employees who transitioned from temporary work to their original work / Total number of employees placed on transitional work) *100	This metric seeks to measure the effectiveness of the transitional program. The goal is to successfully manage the transition of employees on modified duties to their original work. By tracking the number of employees who successfully transitioned from their modified work to their original work, organizations are able to assess the transition rate and how to better accommodate employees. The higher the percentage, potentially the higher the transition rate. This is an indication that proactive measures are being taken to ensure employees return to their original jobs or jobs that suit their abilities as their rehabilitation progresses.	Transitional program management, Program Evaluation
DM11	Percentage of jobs designed to reduce heavy lifting and repetitive movement.	(Total number of jobs designed to reduce heavy lifting and repetitive movement/ Total number of jobs)*100	This metric seeks to measure the extent to which jobs are designed to ergonomic principles. Ideally, organizations should introduce prevention programs that eliminate or minimize heavy lifting and other straining on the body. The higher the percentage, potentially the higher the number of jobs that are designed to reduce heavy lifting and repetitive movements.	Ergonomics, Disability and injury prevention, Program evaluation
DM12	Percentage of new tools, equipment, or	Total amount of money spent on new tools,	This metric seeks to measure the extent to which new tools and equipment purchased take into account	Ergonomics and Disability and

	furniture purchased taking into account ergonomic factors.	equipment, or furniture purchased taking into account ergonomic factors/ Total amount of money spent on new tools, equipment, or furniture purchased) *100	ergonomic factors. Research shows that implementing an ergonomic intervention program decreases work-related health costs. The higher the percentage, the higher the extent to which tools, equipment, or furniture purchased take into account ergonomic principles.	injury prevention, Program evaluation

3.4.2 Metrics Implementation

This subsection describes the data collection and analysis methods used to implement and evaluate the safety and DM metrics defined as part of this research. The metrics were not formally validated.

3.4.2.1 Data Collection

The research aimed to apply all of the safety and DM metrics defined in the previous subsection to the sample of companies recruited as part of the second objective. Of the ten companies that participated in the research, only eight agreed to participate in this metrics implementation phase. The last two companies (i.e. Company 9 and 10) opted out of it due to confidentiality reasons despite efforts to assure them that their identities will not be disclosed. Companies that took part in this phase are shown in Table 6.

To collect the safety and DM data that would enable the calculation of those metrics, the Excel worksheet shown in Appendix H was developed and sent out electronically to these eight companies. Follow-up calls were then made a day later to confirm companies had received the email with the excel worksheet and to answer questions about the data requested. Although companies were encouraged to send the completed worksheet within two weeks, most could not. This is because many did not have a central database that stored all of their safety and injury data. Three companies in particular did not store this data electronically and therefore had to manually look for it in their paper records. Others were simply too busy to respond in time. A third group collected and tracked only some of the data required, which meant that not all safety and DM metrics could be calculated.

Information required from the companies included but were not limited to: “the number of injuries/ illnesses, the number of incidents/injuries that resulted in days away from work, the number of restricted activities and/or job transfers, the number of employees placed on modified or transitional work duties, the number of accidents requiring immediate first aid, the total number of employees employed, the amount of time lost to incidents (days), the number of work hours, the number of employees off due to injury, the number of employees who returned back from injury leave (in less than three months), the number of employees who returned back from injury leave (in more than three months), the number of injuries that required case management, the number of employees who transitioned from temporary work to their original work, the cost of claims, the number of claims and the cost of insurance premiums”. Safety and DM data was collected on a monthly basis from 2012 to 2015 for each of those companies to enable related performance to be assessed over that four-year time period. Although the intent was to collect all of the data shown in Appendix G, realistically, most companies only tracked a few of them. Moreover, although utmost confidentiality was assured, most companies were hesitant to provide data such as the cost of claims. This limited the data that could be collected, and thus the number of metrics that could be calculated and applied as part of this research. As a result, only data for 3 of the 15 safety metrics identified as part of this research (i.e. RIR, SR and LTCR) were actually collected. The DM data was the most difficult to collect given that only four of the eight evaluated companies tracked it (i.e. Company 1, 3, 4 and 7). Due to this limitation, only data for 5 of the 12 developed DM metrics (i.e. DM5, DM6, DM7, DM9 and DM10) could be collected.

3.4.2.2 Data Analysis

The research involved using descriptive statistics and graphs to analyze the safety metrics collected

and evaluate relevant trends. The graphs for the safety metrics: RIR, SR and LTCR were calculated per 100 workers, and respective values were plotted for each of the eight companies over the four-year study period. Although the safety metrics defined in the literature and shown in Table 7 were based on 200k hours, all construction companies evaluated used a 100 workers basis for all metrics collected. The province of Manitoba's injury and illness statistics (Safe Work Manitoba 2016) were also all expressed per 100 workers. Therefore, the data analysis was conducted per 100 workers so that no assumptions would need to be made when trying to convert the figures expressed per 100 workers to 200k hours. This also made the comparison with provincial injury statistics easier. The research also entailed analyzed the correlations between the three safety metrics using Spearman's non-parametric correlation test due to the small sample of companies assessed. Future research should ensure that more data is collected so that more rigorous analysis could be conducted.

The research also involved using descriptive statistics and graphs to analyze the five DM metrics: DM5, DM6, DM7, DM9 and DM10 for four of the eight companies. In the same way, the graphs for these DM metrics were derived using the formulas in Table 7, and respective values were plotted for each of the four companies. Finally, the research entailed assessing the relationships between every DM performance metric and every safety performance metric using Spearman's non-parametric correlation test to investigate possible correlations between them. This is to investigate whether companies with better DM performance had a higher safety performance record and vice-versa. The analysis also involved assessing the safety and DM metrics of Company 1 in particular as a continuation of the same case study started as part of the previous objective. This is followed by a discussion of the relevance and applicability of these metrics.

3.5 Objective #4: Evaluating Construction Organizations' Disability Management and Safety Performance

This objective involved evaluating the relationship between companies' leading indicators of performance as evidenced by their maturity model scores (i.e. Objective #2) and their lagging indicators of performance as evidenced by their safety and DM metrics (i.e. Objective #3). Therefore, the research relied on using the maturity modelling data stemming from the achievement of objective #2 and the DM and safety metrics data stemming from the achievement of objective #3.

The data analysis focused in particular on investigating the relationship between companies' overall DM maturity measured using the CDM3 and their DM performance metrics (i.e. also known as metrics) using both descriptive statistics such as graphs and Spearman's non-parametric correlation. It also entailed investigating the relationship between companies' overall maturity scores and their safety performance metrics. The research also involved assessing the relationship between the maturity of individual indicators and DM performance metrics using bar charts, lines and boxplots and also Spearman's non-parametric correlation. It also investigated the relationship between the maturity of the individual indicators measured and the safety performance metrics using Spearman's non-parametric correlation. The interrelationships between the maturities of the different indicators themselves were also analyzed using Spearman's non-parametric correlation. As with the second and third objectives, Company 1's DM maturity measured using the CDM3 was analyzed in relation to its safety and DM performance metrics. This is followed by a discussion of the implications of the findings. The analysis of the metrics also uses the average of the 4 years

data was collected and analyzed for when discussing the performance of companies. Due to small number of companies evaluated, more rigorous statistical analysis such as regression analysis using the leading (i.e., MS scores of the CDM3) and lagging indicators (i.e., metrics) of performance could not be conducted. Future research should focus on evaluating more companies that collect most if not all of the data related to the 15 safety metrics and 12 DM metrics considered in this research. This may help establish new relationships between the CDM3 and the DM metrics and between the safety and DM metrics that could not be detected using only three safety metrics and five DM metrics.

3.6 Objective #5: Making Recommendations to Improve Construction Organizations' Disability Management Performance

The research involved developing recommendations to improve the DM performance of the construction industry based on the findings of the research as a whole. These recommendations provide guidance to those looking to implement DM by helping them assess current practices, compare them to best practices and identify opportunities for DM performance improvement, thus bringing positive change to employees and organizations that need it most.

CHAPTER 4: RESULTS & DISCUSSION

This chapter presents the results of the research and provides a discussion of them in the context of the existing literature. The results are divided per research objective, with every section presenting the results related to a particular objective. The first section centers on the results of the AHP conducted to weigh the 12 DM indicators making up the CDM3. The second describes the results of applying the CDM3 to evaluate the maturity of ten construction companies in Manitoba whereas the third presents the results of using three safety metrics and five DM metrics to evaluate the safety and DM performance of eight and four of these companies respectively. The fourth section explores the relationships between companies' DM maturity, as measured using the CDM3 and their DM and safety performance, as measured using the metrics. The fifth and final section provides recommendations to improve the maturity of construction organizations' DM practices based on all research results.

4.1 Objective #1: Developing and Validating Disability Management Indicators for Construction Organizations

The AHP evaluation showed that the consistency ratios for all pairwise comparison matrices were within the acceptable range of 0.0325 to 0.077. The overall consistency ratio equalled 0.0534 which was below the acceptable maximum of 0.10, indicating that the judgements of the experts were consistent and thus reliable. Table 9 below presents the resulting weights of importance and rankings of the 12 indicators, whereas the following three subsections identified the highest ranked indicators, the lowest ranked indicators and the ranking of organizational and individual-level

indicators. The discussion of these rankings is conducted within the context of the broader literature, focusing in particular on the research completed by Winter et al. (2015) and aiming to evaluate disability management (DM) in the Manitoban construction industry.

Table 9: Ranking and Weights of Proposed DM Indicators

Rank	Indicator	Category	Final Weights of Importance
1	Return to Work and Accommodation Practices	Individual	0.157
2	Disability and Injury Prevention Practices	Organizational	0.138
3	Senior Management Support Practices	Organizational	0.136
4	Transitional Program Management Practices	Organizational	0.100
5	Regulatory and Compliance Policies	Organizational	0.098
6	Program Evaluation Practices	Organizational	0.084
7	Recruitment and Retention Policies	Organizational	0.058
8	Ergonomic Practices	Organizational	0.053
9	Communication Practices	Individual	0.052
10	Case Management Practices	Individual	0.045
11	Claims Management Practices	Individual	0.040
12	Physical Accessibility Management Practices	Organizational	0.038
		∑weight	1

4.1.1 Highest Ranked Indicators

Table 9 above shows that the highest ranked DM indicator in Manitoba: “Return to work and accommodation” practices was deemed 4.5 times more important than the lowest ranked indicator: “Physical accessibility management” practices. These results were in line with the research conducted by Winter et al. (2015) which found that the three most implemented practices by construction organizations in Manitoba involved: 1) providing disabled employees with modified or alternate work opportunities, 2) developing a RTW policy and 3) developing customized RTW plans for these employees. This was also in line with earlier work conducted by Lingard and Saunders, (2004) and Newton and Ormerod (2005) which had found RTW to be the dominant determinate of DM in construction workplaces. Krause et al. (1998) had also shown that modified work can cut in half the time needed for employees to RTW and double the likelihood of their

return following an injury.

"Disability and injury prevention" practices ranked as the second most important indicator. This ranking reflects the importance of health and safety management within the Manitoba construction industry and the consequent tightening of relevant regulations at the provincial level (WCB 2013). This was also mirrored in Winter et al. (2015) which showed that 67% of the organizations that had implemented an accredited OHS program (i.e. a Certificate of Recognition program) also implemented a DM program, further confirming the potential link between health and safety and DM. This ranking is also in cognizance with the literature which considers preventative practices to be successful pillars of DM programs and the most effective at reducing the risk of work injuries, related claims and leaves (Akabas et al. 1992, Angeloni 2013, Lingard and Saunder 2004). Despite the importance of these preventative practices, musculoskeletal (MSI) injuries were found to be the most common type of injury in Manitoba in Winter et al. (2015), calling into question the effectiveness of these practices for MSI injuries in particular.

Discussions with the experts during the AHP pointed to the critical role of "Senior management support" which explains its ranking as the third most important DM indicator. This is in line with earlier work by Habeck and Hunt (1999), Shrey and Olsheski (1992), Lingard and Saunder (2004) and Shrey (1995) who had agreed that management support of employees is a critical determinant of rehabilitation, RTW and overall DM program success. The ranking of this indicator was below that of "Disability and injury prevention" practices by only 0.02, reflecting the almost equal importance of these two indicators and the need for construction organizations to consider them concurrently to improve their DM programs.

"Transitional program management" practices came in next as the fourth most important indicator. These practices aim to provide generic DM practices for injured employees that will be customized to individual employees during case management. Its ranking is not surprising given that Winter et al. (2015) showed that 92% of surveyed organizations with a DM program in Manitoba provided modified or alternate work opportunities whereas only 62% customized their RTW plans to individual employees.

"Regulatory and compliance" policies were found to be the fifth most critical indicator of the 12 indicators considered. This indicator was 2.6 times more important than the least important indicator: "Physical accessibility management" practices, yet 1.6 times less important than the highest ranked indicator: "Return to work and accommodation" practices. This ranking could reflect a moderate level of awareness of DM legislation and its importance within the Manitoban construction industry. It could also reflect inadequate DM legislation and enforcement of that legislation in the Manitoban context. It is in line with the research conducted by Winter et al. (2015) where surveyed organizations were given four potential reasons for why they should have a DM program and asked to rank them in terms of their importance. Of the four reasons provided, these organizations ranked the need to comply with existing legislation as the third most important. It is also in line with results by Newton and Ormerod (2005) and Smallwood and Haupt (2008) which showed that construction organizations had little to no formal practices in place to support disability, with some finding compliance with existing regulations to be costly with little return.

"Program evaluation" practices were ranked as the sixth most important indicator of the 12

indicators investigated and were thus deemed as neither too important nor too insignificant by the AHP experts. These practices aim to assess and monitor the implementation of DM procedures, regulations and practices within the organization with the aim of improving them. Despite their relative significance in the literature (Robinson et al. 2014), Winter et al. (2015) also found that only 47% of surveyed organizations monitored the effectiveness of their RTW programs, validating thus the results of the AHP and reinforcing the need to pay more attention to this aspect of DM.

4.1.2 Lowest Ranked Indicators

"Recruitment and retention" policies ranked seventh and were thus deemed as reasonably non-critical by the expert group. This is not surprising given that construction companies' recruitment and retention practices usually cover issues that apply to any employee and do not thus focus specifically on disability (Newton and Ormerod 2005). It is why 47% of the surveyed construction companies in Winter et al. (2015) did not employ any employees disabled as a result of a workplace accident whereas 32% of them employed less than 1%. These companies also identified the lack of suitable modified or alternate work as the most important barrier to the return of disabled employees back to the workplace. This reinforces the need to place more emphasis on the provision of such work in order to improve retention practices and encourage the return of injured and disabled employees to the workplace.

Due to the laborious nature of the construction industry, its employees are more likely to suffer from pain in the neck, shoulders and low back and from muscular disorders (Johansson and Rubenowitz 1992, Johansson 1994). In fact, Winter et al. (2015) showed that disabilities due to

MSI were the most common disability accommodated by construction organizations in Manitoba. This reinforces the need for ergonomic workplace designs that manage and mitigate some of these issues. Unfortunately, "Ergonomic" practices, a relatively newer indicator in the DM literature ranked in eighth place only, reflecting its low importance to practitioners in the industry. This agrees with the results by Winter et al. (2015) which showed that only 25 to 33% of surveyed organizations in Manitoba provided accommodations such as accessible workstations, washrooms and transportation to their employees. Despite their cost, these accessible workspaces can help employees return to their original jobs faster, taking the pressure off having to provide them with modified or alternate jobs.

"Communication" practices came in ninth place despite studies such as Brooker et al. (2012) and Westmorland et al. (2005) stressing the importance of communicating with employees to make them feel more valued and want to RTW faster. "Case management" practices also ranked as the 10th most important indicator despite case management being one of the main pillars of DM in the broader literature (Angeloni 2013). This ranking is in line with their ranking of "transitional program management practices" in fourth place and is reflective of the tendency of the Manitoban construction industry to focus on generic DM programs that do not always cater to the individual needs of disabled employees. It is also similar to the results by Winter et al. (2015) which had showed that only 64% of organizations with a DM program customized their RTW plans to individual employees.

"Claims management" practices were also seen as unimportant as evidenced by their low ranking (i.e. 11th place). Nevertheless, this ranking was in line with the literature on DM in construction

(e.g. Newton and Ormerod 2005, Lingard and Saunders 2004) which rarely took claims management into account when investigating DM. This is despite this same literature identifying cost as a key barrier to implementing DM, and the broader DM literature (e.g. Irving 2010) making the connection between effective claim management practices and decreased long-term costs. In Winter et al. (2015), construction organizations in Manitoba ranked reducing costs related to claims, insurance premiums, hiring and training as the second most important reason for why construction organizations should develop a DM program. This infers that although construction organizations recognize the long-term cost effectiveness of DM in general and of some practices such as claims management practices, they may still be unwilling to invest upfront in them, thus their lower importance to them.

"Physical accessibility management" practices was ranked as the least important indicator to DM performance. Despite their importance to managing disability in general (Newton et al. 2007), this ranking agreed with the research by Winter et al. (2015). The research had shown that only 6 to 33% of surveyed organizations provided physical accommodations such as accessible workstations, technical aids and devices, accessible elevators, accessible workstations and accessible transportation, with larger organizations providing those more often than smaller ones. In contrast, 94% of these organizations provided modified or alternate work opportunities. This speaks of the need to focus on improving the physical accessibility of the industry given its dynamic nature and ongoing physical challenges.

4.1.3 Ranking of Organizational and Individual-Level Indicators

Organization-level indicators were in general found to be more important to DM performance than

individual-level ones. Five of the six highest ranked indicators were organizational in nature whereas three of the four lowest ranked indicators were individual. This focus on organizational versus individual practices was in line with the results by Winter et al. (2015) which had showed that only a small proportion of responding organizations in Manitoba provided more extensive accommodations for employees requiring individualized accommodations. The construction industry in Manitoba appears therefore more likely to implement practices that target the overall organization than those that are tailored to specific individuals. This could be due to the cost and human resources associated with implementing these individual practices in comparison with organizational ones and the industry's reluctance to allocate that much money and personnel to manage disability as shown in Winter et al. (2015). Future research should therefore focus on investigating the cost of implementing these two different types of practices further. The higher ranking of organizational indicators can also be traced to the social model of disability, which according to Clark et al. (2009) is the dominant model adopted when managing disability in construction. The social model explains disability in social terms focusing on the ways in which the physical, cultural and social organization exclude or disadvantage disabled people (Pfeiffer 2001). It tends therefore to focus more on organizational practices, that is, altering the organization to integrate disabled persons. Future research would need to test these hypotheses further.

4.1.4 Indicators Relevance and Applicability

The developed and validated indicators provide a solid reference point in the emerging area of DM for the construction industry. By relying on evidence from the literature and expert input, the research aimed to bridge the gap between research and practice regarding DM. Defining DM indicators can help ensure construction workplaces are mindful of the components and practices

involved in preventing, managing and evaluating DM. It also helps them determine relevant practices that should be implemented accordingly. This allows employees to be accurately diagnosed and have an appropriate RTW plan that allows access to evidence-based therapy, which is a key element to effective DM. Until now, construction workplaces had approached DM as part of health and safety management despite evidence from the literature showing that integrated DM goes beyond this. When implemented, these indicators would not only protect employees from work hazards but also promote improvements in safe behaviour: an aspect often overlooked in tertiary prevention, thus the importance of proactive primary and secondary prevention (Angeloni 2013). The impact of implementing these DM indicators will likely include improved employee health and safety and improved employee morale and satisfaction.

4.2 Objective #2: Developing and Implementing Construction Disability Management Maturity Model

This section presents the results of the analysis of the CDM3 assessment worksheet responses. The Cronbach's alpha (α) value for the assessment worksheet was 0.944, and was thus above the acceptable internal consistency and reliability threshold of 0.70. The analysis of the assessment responses focused on evaluating the DM maturity of the participating companies and of their individual indicators. It also involved investigating the maturity of the key practices making up each individual indicator. A sample case study analysis focusing on Company 1 in particular was also presented to demonstrate the CDM3's application to an individual company. These results were also discussed within the wider context of the literature.

4.2.1 Construction Companies' Maturity

The ten participating companies had an overall *average MS Company* of 4.06, with an *average PG Company %* of 18.68% (how much they would need and were thus deemed to be performing at the quantitatively managed maturity level (i.e. with *MS Company* greater than or equal to 4 and below 5). Six of the ten companies were operating at the quantitatively managed level as shown in Figure 6 and were thus efficient at implementing DM. Company 7 had the highest *MS Company* at 4.48 whereas Company 8 had the lowest *MS Company* at 3.52. Company 7 had the highest *MS Company unweighted* at 4.44 whereas Company 8 had the lowest *MS Company unweighted* at 3.40.

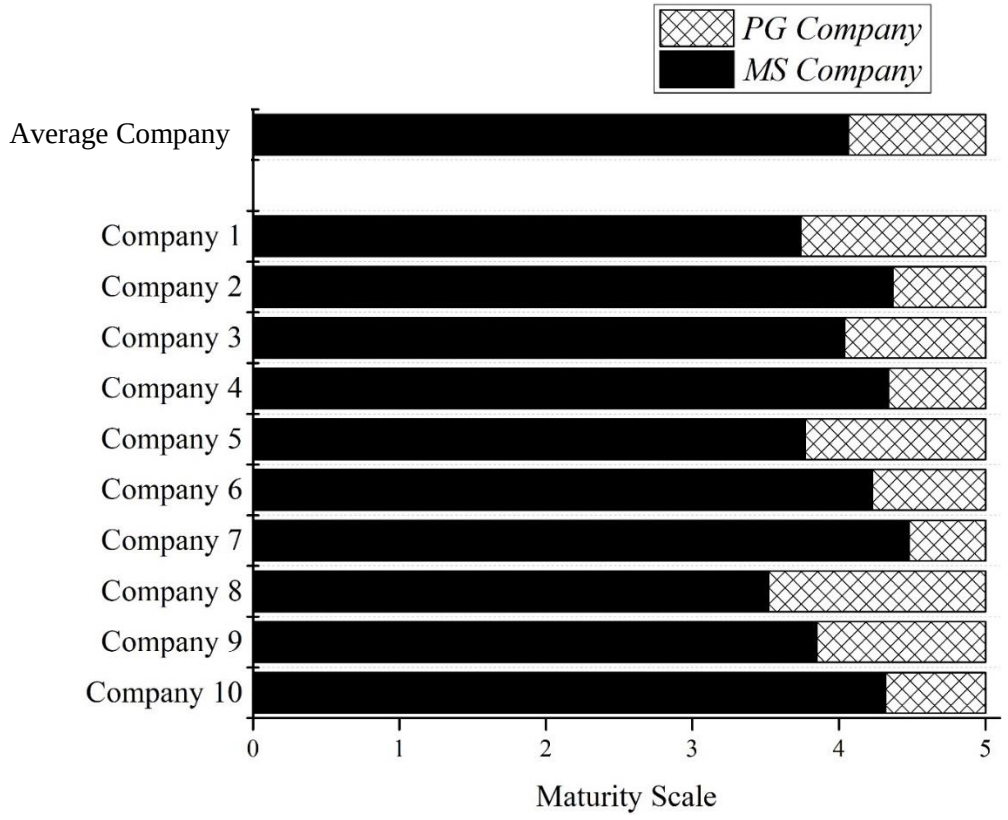


Figure 6: *MS Company* of Sampled Companies

The three most mature companies were Companies 7, 2 and 4 and had *MS Company* of 4.48, 4.37

and 4.34 respectively. These three companies had relatively lower *MS Indicator* (i.e. greater than or equal to 3 and below 4) in the indicators with lower *AHP weights* such as "Physical accessibility management" which had an *AHP weight* of 0.038. "Senior management support", "Disability and injury prevention" and "Ergonomic" practices were the three most mature indicators within these three companies and had average *MS Indicator* of 4.92, 4.59 and 4.37 respectively. These indicators also had high *AHP weights*, indicating a high level of agreement between these companies and industry experts on the most critical indicators that affect DM performance. In contrast, the three least mature companies: Companies 8, 1 and 5 had *MS Company* of 3.52, 3.74 and 3.77 respectively. These companies had lower *MS Indicator* (i.e. greater than or equal to 3 and below 4) in the indicators with higher *AHP weights* such as "Program evaluation" which had an *AHP weight* of 0.084. "Program evaluation" and "Ergonomic" practices were the least mature indicators within these three companies with *average MS Indicator* of 2.81 and 3.0 respectively even though they were highly ranked by the AHP experts (ranked 6^{th} and 8^{th} respectfully). Because of this disconnect between the *MS Indicator* and their *AHP weights*, they resulted in low *MS Company*, reflecting low overall DM performance in these companies. An observation made in regards to companies with *MS Company* values below 4 (i.e. the standardized level), is that their least mature practices were those that were ranked highest by the AHP experts. These findings reinforce the need for construction companies to focus on improving the indicators that were ranked highest by the AHP experts to improve their overall maturity as much as possible. This is not to imply that other indicators should be ignored since the most mature companies tended to have high maturity (i.e. *MS Indicator* greater than or equal to 4) across the 12 indicators, reflecting consistently high performance throughout.

Figure 7 shows that the overall *MS Company* of 8 of 10 companies increased after considering *AHP weights*, which reflected a focus by these companies on implementing the most important indicators and practices identified by the expert group. The figure also shows the company sizes, with small, medium and large represented by S, M and L. The largest change between *MS Company w/o AHP* and *MS Company* (i.e. before and after considering AHP weights respectively) was detected in Company 6, where these values changed from 4.07 to 4.23 respectively. This showed this company was the most effective at targeting and implementing the most important practices such as "Return to work and accommodation" practices. By contrast, these values decreased by 0.03 and 0.08 in Companies 3 and 9 once the *AHP weights* were applied. This is because these companies focused on implementing less important practices as assessed by the expert group such as "Claims management" which had an *AHP weight* of 0.040. These results reinforce the need to focus on determining the most important DM indicators and practices and improving them as opposed to the less important ones to generate the largest improvements in DM performance. While the level of importance of these indicators was determined in this research by the expert group; in practice, they can be determined internally by every company or set at the industry level as benchmarks to be adopted by the wider industry.

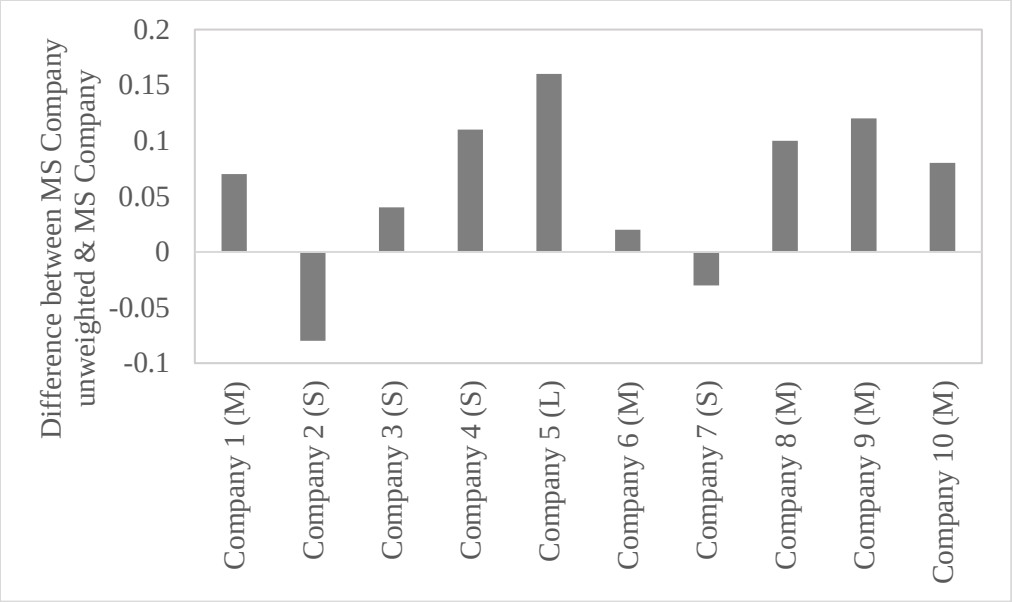


Figure 7: Difference between *MS Company unweighted* values and *MS Company*

An analysis of the *MS Company* of the 10 companies as a function of their size showed that small-sized companies (0-100 employees) tended to have higher *MS Company* (e.g. 4.48 and above) than medium to large ones (<100 and <500 employees), with the most mature company (i.e. Company 7) being a small sized one. Within the sample, there were 4 small-sized companies performing at the quantitatively managed level with an *average MS Company* of 4.30, and 6 medium to large-sized ones operating at the standardized level, with an average *MS Company* of 3.91. The three most mature companies: Companies 7, 2 and 4 were all small-sized companies, whereas the two least mature ones, 1 and 8 were medium to large ones. While these findings do not necessarily reflect the state of the Manitoban construction industry due to the size of the sample assessed, they contrast with the findings by Winter et al. (2015). According to them, smaller companies (0-100 employees) found it more difficult to provide DM accommodations than medium to larger ones. The latter group of companies also developed more customized RTW plans than the former. Therefore, the expectation was that larger companies would be more mature and thus better able

to accommodate injured and disabled employees than smaller ones (Kenny 1999, Lingard and Saunders 2004). The fact that the smaller companies assessed were more mature could be due to the tendency for these companies to be family businesses and thus more in tune with the needs of their employees, thereby providing them with more personalized care than larger ones. Informal discussions with these companies pointed to the flexibility of smaller companies with respect to the work opportunities provided to returning workers in particular. This result could also be due to sampling bias whereby the small companies assessed as part of this research were more mature on average than smaller companies within the industry at large and thus not representative of them. Therefore, their performance may have been uncharacteristically higher than that of small companies in general, which could also explain their willingness to participate in this research.

4.2.2 Maturity of Indicators

Table 10 below shows the *MS Indicator %* for every indicator in every company, as well as the *average MS Indicator* % and the *average MS Indicator* for every indicator across the ten companies. As shown, some companies' indicators achieved full maturity (i.e. *AS Indicator %* = 100). However, when averaged, none of the indicators did (i.e. *average MS Indicator %* = 100). The *average PG Indicator %* for these indicators ranged from 8% to 28.2%. "Senior management support" was found to be the most mature DM indicator on average across the 10 companies with an *average MS Indicator* of 4.60. This was followed by "Disability and injury prevention" practices, with an *average MS Indicator* of 4.44. Only 5 of the 12 indicators were operating at the quantitatively measured level (i.e. *average MS Indicator* greater than or equal to 4 and below 5), with the remaining operating at the standardized level (i.e. *average MS Indicator* greater than or equal to 3 and below 4). The fact that all indicators were performing at a level 3 or higher is a

positive indication of growth and shows that the companies assessed were aware of the practices that needed to be implemented and were taking proactive steps to implement them. While companies must continue paying attention to mature indicators with *MS Indicator* greater than or equal to 4, it is the less mature indicators with *MS Indicator* below 4 that will drive growth and need to be the focus of their attention. Those interviewed acknowledged that the model with its breakdown of DM practices helped them detect deficiencies within their DM programs and identify opportunities for improving them and by extension their DM performance. A few companies admitted that DM was a fairly new area for them despite acknowledging its importance.

There also seems to be some commonality between the average maturity of the 12 indicators evaluated as determined by their *average MS Indicator* and their level of importance as determined by their *AHP weights* in section 4.1. "Senior management support" was found to be the most mature indicator (i.e. *average MS Indicator* = 4.60) and the third most important indicator (i.e. *AHP weight* = 0.136). "Recruitment and retention" policies were found to be the least mature indicator (i.e. *average MS Indicator* = 3.59) and ranked seventh in terms of importance (i.e. *AHP weight* = 0.058). Nevertheless, although "Return to work and accommodation" was rated as the most important indicator (i.e. *AHP weight* = 0.058), it was one of the less mature indicators (i.e. *average MS Indicator* = 3.86), despite the literature defining RTW as the ultimate goal of DM (Shrey and Hursh 2001). Seven of the ten companies assessed identified the lack of DM training programs for supervisors and the lack of suitable job opportunities for disabled employees as key challenges to their RTW. This was also in line with the results of the research by Winter et al. (2015) which had identified the lack of suitable alternative work as the most important barrier to DM, reinforcing the need to improve these RTW practices.

Table 10: Maturity Scores for Indicators across Sampled Companies

MS Indicator %	CP	CMP	RAP	CLP	DIP	TPM	PAP	PEP	SMP	RCP	RRP	EP
Company 1	76	80	74	64	82	71	74	67	85	80	64	57
Company 2	85	91	86	84	90	91	92	91	100	80	64	78
Company 3	60	88	66	80	90	86	92	83	85	84	73	90
Company 4	58	92	76	92	96	79	100	91	100	92	76	86
Company 5	76	81	74	66	82	73	76	66	85	80	69	56
Company 6	75	78	80	64	97	73	84	86	100	96	76	68
Company 7	87	90	90	96	90	81	72	95	95	92	79	98
Company 8	64	60	66	44	87	47	92	35	100	76	73	72
Company 9	71	88	72	88	82	79	76	82	70	72	77	86
Company 10	89	84	88	84	91	80	72	86	100	84	69	84
Average MS Indicator %	74	83	77	76	89	76	83	78	92	84	72	78
Average MS Indicator	3.71	4.16	3.86	3.81	4.44	3.80	4.15	3.91	4.60	4.18	3.59	3.88

Communication practices (CP)	Physical accessibility management practices (PAP)
Case management practices (CMP)	Program evaluation practices (PEP)
Return to work and accommodation practices (RAP)	Senior management support practices (SMP)
Claims management practices(CLP)	Regulatory and compliance policies (RCP)
Disability and injury prevention practices(DIP)	Recruitment and retention policies (RRP)
Transitional program management practices (TPM)	Ergonomics practices (EP)

4.2.3 Maturity of Practices

This section presents the results of the maturity of the practices making up each of the 12 DM indicators of the CDM3 (i.e. *MS Practice*) across the ten evaluated companies. The maturity of these key practices are depicted graphically, with the practices themselves referred to based on the indicator they belong to (e.g. CP, CMP and RAP) and their sequence and number (e.g. 1, 2, and 3) in the model's assessment worksheet in Appendix D. Table 11 shows a summary of the most matured and least mature practices within every DM indicator.

4.2.3.1 Maturity of Communication Practices

Figure 8 depicts the average maturity of the 11 practices making up the indicator: "Communication practices". "Communication practices" seek in general to provide all employees with specific information about the company's DM strategy and accommodations provided to returning employees following an injury or disability. As shown in Figure 6, none of the key practices achieved full maturity across all companies. With the exception of two practices (i.e. CP9 and CP10), all other practices were operating at the standardized level or above (i.e. *MS Practice* greater than or equal to 3). All practices had an overall *MS Indicator* of 3.71. "Providing employees with regular health and safety training" (CP8) was deemed the most mature practice, with an average *MS Practice* of 4.7. This is not surprising given the importance of health and safety training in construction, the resources invested in such training and the legal implications of not providing it. "Providing injured and disabled employees with relevant information in a timely manner" (CP4), and "encouraging employees to freely express their injury claim concerns and to make suggestions for improvement" (CP5) were the next two most mature practices, with *MS Practice* scores of 4.3 and 4.2 respectively. On the other hand, "involving employees in the

development of DM policies and programs, specifically those that directly affect them" (CP9), and "regular assessment of employees' DM knowledge" (CP10) were found to be the least mature practices with *MS Practice* scores of 2.7 each. The low maturity of these practices show that while employees are kept aware of relevant DM information, they're not actively involved in the development of that information and their knowledge of it is not regularly evaluated. This highlights thus opportunities to improve on these least mature practices.

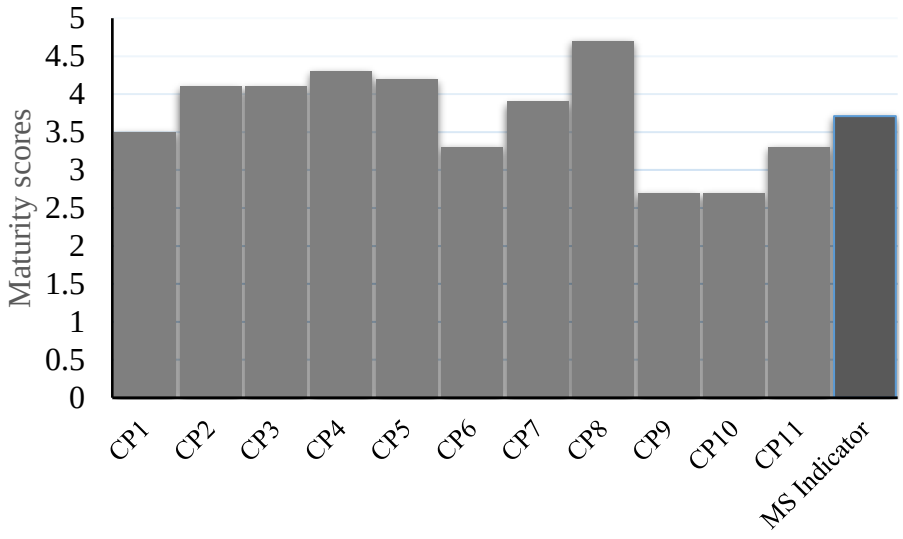


Figure 8: Maturity Scores for Communication Practices

4.2.3.2 Maturity of Case Management Practices

Figure 9 below illustrates the maturity of the 18 practices comprising "Case management practices". "Case management practices" aim in general to manage the injury and rehabilitate every injured worker individually by managing the health and social services provided to that worker. As shown in Figure 8, none of the practices achieved full maturity. On average, practices were operating at the quantitatively managed level (i.e. *MS Practice* greater than or equal to 4) with a few (i.e. CMP8, CMP9, CMP12, CMP13, CMP16 and CMP18) operating at the

standardized level (i.e. *MS Practice* greater than or equal to 3). The practices had an overall *MS indicator* of 4.16. “Ensuring treating physicians are able to identify the employee’s physical and mental capacities and related restrictions and specify a target RTW date” (CMP7) was deemed the most mature practice with an average *MS Practice* of 4.9. This is not surprising given that this practice is primarily dependent on the physician treating the injured worker rather than the company itself and refers to the basic duties of any physician. “Contacting employees shortly after an injury or illness to express concern and offer assistance (i.e. early intervention)” (CMP2), and “subsequent follow-up with the employee off work to assess his or her ability to return to work” (CMP6) were found to be the next two most mature practices, with *MS Practice* scores of 4.7 each. These practices are basic practices that aim to support injured employees and ensure their prompt return to work; their high level of maturity is therefore expected. “Ensuring a process is in place for finalizing rehabilitations decisions when there are disagreements about them” (CMP9) was found to be the least mature practice, with an *MS Practice* of 3.1. This may be due to the practice requiring a defined specific process in place. “Communicating proactively with physicians about suitable duties for injured employees” (CMP8) and “Ensuring the DM practitioner provides ill, injured or disabled employees with all case management services needed in a timely and coordinated manner” (CMP16) were the next least mature practices, with an *MS Practice* score of 3.6 each. These practices are more sophisticated DM practices that require the proactive involvement of companies and the provision of a wide range of DM services that many companies may not be providing. Their low level of maturity is therefore not unexpected and is completely in line with the results of the survey conducted by Winter et al. (2015). The survey results had shown that only 22% of responding construction companies in Manitoba had hired a DM practitioner or established a DM committee.

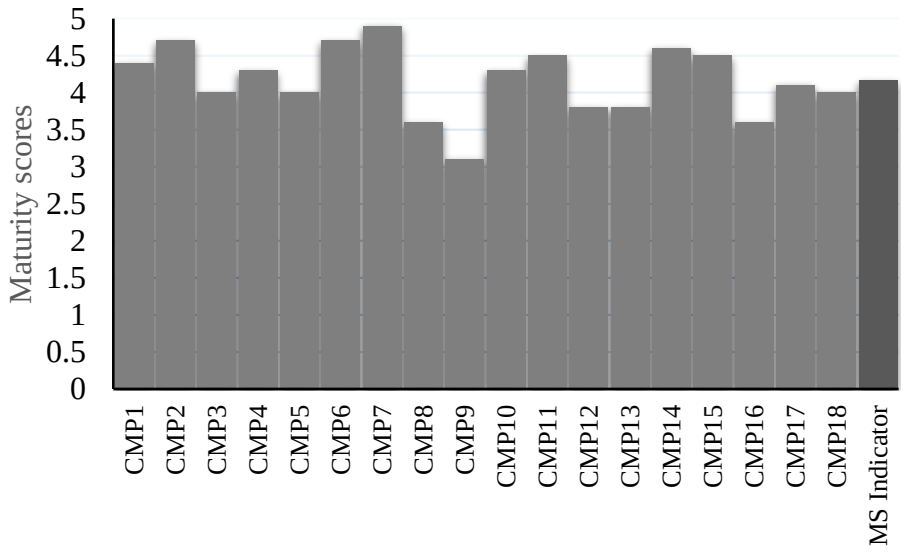


Figure 9: Maturity Scores for Case Management Practices

4.2.3.3 Maturity of Return to Work and Accommodation Practices

Figure 10 depicts the maturity of the ten practices within "Return to work and accommodation practices". "Return to work and accommodation practices" proactively focus on ensuring the safe and early return to work of injured employees and providing them with the accommodations needed to enable that return. As evident from Figure 9, none of the key practices achieved full maturity across all companies. Five of the 10 practices were operating at the quantitatively managed level (i.e. *MS Practice* greater than or equal to 4), with the remaining operating at the standardized level. These practices had an overall average *MS Indicator* of 3.86. "Ensuring the employee and management work together to develop a suitable RTW plan for the employee" (RAP3) and "updating the plan as rehabilitation progresses" (RAP10) were the most mature practices with average *MS Practice* scores of 4.4 and 4.3 respectively. Being that one of the main aims of DM is the early RTW of employees, the existence of established procedures to map out a

RTW plan is only natural and expected. Comparatively, “the completion of a formal functional assessment of the injured employee’s abilities and a formal job analysis for existing jobs” (RAP6) and “the comparison of employee’s abilities to job demands to determine suitable jobs for the employee” (RAP7) were two of the three least mature practices, with *MS Practice* scores of 3.2 and 3.6 respectfully. “Conducting employee capacity evaluations when there is conflicting or inadequate medical information” (RAP1) was the third least mature practice, with an *MS Practice* of 3.3. The low maturity of these practices may be due to the fact that they are more elaborate and specific and require companies to go beyond the standard practices they use when identifying suitable jobs for returning employees. Winter et al. (2015) had also shown that although 92% of responding organizations provided modified or alternate jobs to returning employees, 45% found identifying those jobs to be the most important barrier to the successful return of employees to the workplace. This may be due to the low maturity of these specific practices which implies a low level of implementation of them.

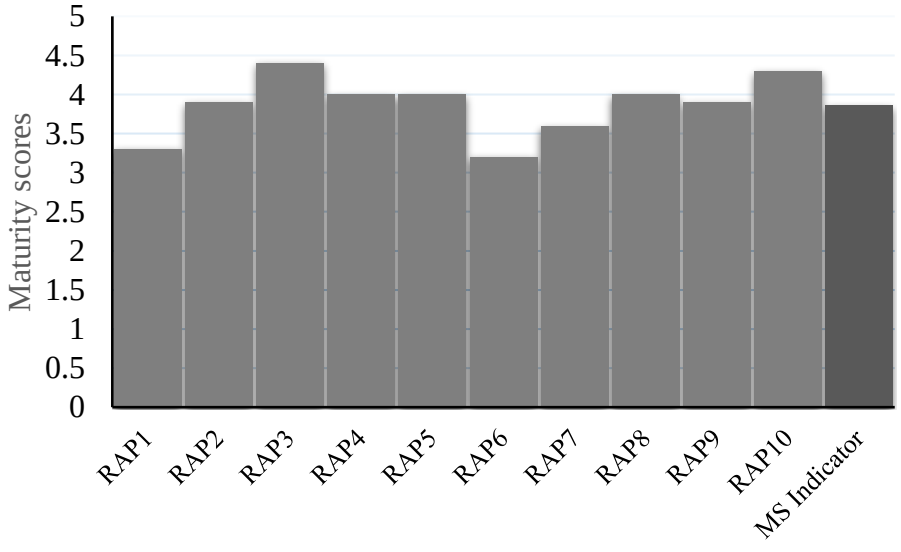


Figure 10: Maturity Scores for Return to Work and Accommodation Practices

4.2.3.4 Maturity of Claims Management Key Practices

Figure 11 illustrates the maturity of the five practices within "Claims management practices" across all companies. "Claims management practices" aim to manage claims related to occupational and non-occupational injuries or illnesses and that may entitle the individual worker to long-term disability benefits. As shown in Figure 10, none of the key practices achieved full maturity. With the exception of CLP5, all other practices were operating at the standardized level or above (i.e. *MS Practice* greater than or equal to 3), making this indicator the third least mature indicator of the 12. The practices had an overall *MS Indicator* of 3.81. A more detailed analysis showed that "ensuring the claims or benefits program is designed to support early intervention and RTW" (CLP5) was the most mature practice (i.e. *MS Practice* of 4.3). All other practices received *MS Practice* scores between 3.65 and 3.7 and were thus at a lower but very similar level of maturity. These practices include: "ensuring claims management practices are clearly defined as part of the DM program" (CLP1), "ensuring the claims management process is well coordinated from initial injury to claim resolution" (CLP2), "evaluating long-duration claims to determine whether more intensive services are required" (CLP3) and "providing ample information on medical certificates for sick leave, ill or injured employees' entitlements, and administrative requirements including those related to employees' compensation" (CLP4). These results highlight thus opportunities to improve the claims management process as it relates to DM specifically.

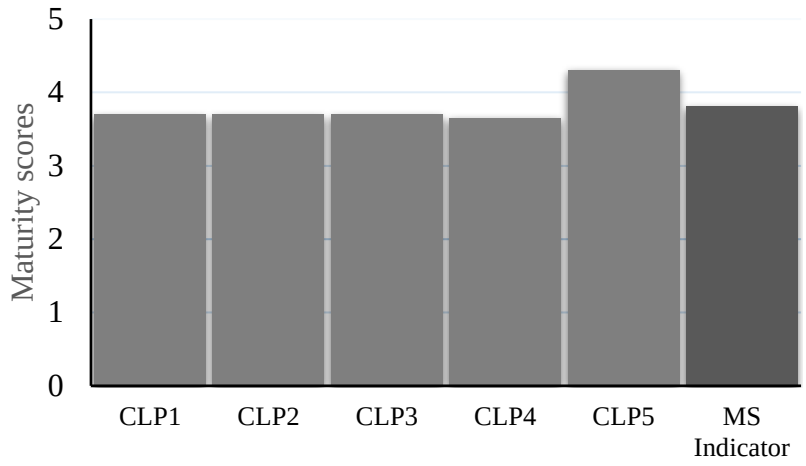


Figure 11: Maturity Scores for Claims Management Practices

4.2.3.5 Maturity of Disability and Injury Prevention Practices

"Disability and injury prevention practices" (DIP) included a total of 25 practices and was thus the indicator with the highest number of practices out of the twelve indicators defined as part of the CDM3. These practices cover preventative aspects of DM programs and aim thus to avoid the occurrence of accidents and injuries. As shown in Figure 12 below, 3 out of the 25 DIP practices achieved full maturity across all companies and received thus each an *MS Practice* score of 5. These practices included the "provision of first-aid services to injured employees as well as first-aid kits" (DIP5), "the provision of qualified first-aid attendants to employees during regular work hours" (DIP6) and "the development of hazard management assessment procedures and their update on a regular basis, especially after the occurrence of accidents" (DIP25). Practices within this indicator were operating on average at the quantitatively managed level or above (i.e. *MS Practice* greater than or equal to 4), with an overall *MS Indicator* of 4.4, making them the second most mature indicator behind SMP. This was not surprising given that these practices are preventative practices and are thus more related by nature to health and safety than DM. They are thus expected to be more mature than disability-focused practices given the relative maturity of

health and safety programs in comparison to DM programs in the construction industry. Only 2 out of the 25 practices operated at the planned and managed level (i.e. *MS Practice* greater than 2 but less than 3) and were thus the least mature. These included "the allocation of a budget for disability and injury prevention strategies" (DIP10) (*MS Practice* score of 2.6) and "the implementation of stress management and health and wellness programs" (DIP9) (*MS Practice* score of 2.9).

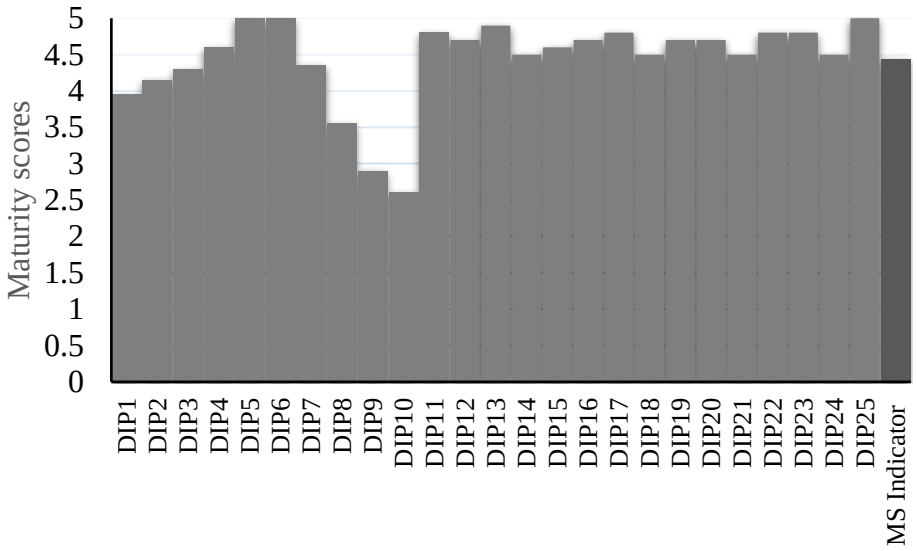


Figure 12: Maturity Scores for Disability and Injury Prevention Practices

4.2.3.6 Maturity of Transitional Program Management Practices

Figure 13 illustrates the maturity of the 14 practices within "Transitional program management practices". These practices cover the development of generic DM programs for injured employees, which can be later customized to the individual employee as part of CMP. As shown in Figure 11, none of the practices achieved full maturity, with practices operating on average at the standardized level (i.e. *MS Practice* greater than 3 but less than 4), with an overall *MS Indicator* of 3.80. The

"provision of productive and meaningful temporary transitional work" (TPM13) was found to be the most mature practice, with *an MS Practice* of 4.5. This is in line with the findings related to RAP which had shown that construction companies worked collaboratively with employees to develop a suitable RTW plan (RAP3) and update the plan as rehabilitation progresses (RAP10) and that these two practices were the most mature. The next two most mature TPM practices included "the assignment of a specific individual to lead the DM program" (TPM6) and the "analysis of the accommodation needs of injured employees who cannot return to their original jobs" (TPM9) which received each a *MS Practice* score of 4.2. While the assessment does not delve into the specific accommodations provided to these injured and disabled employees, Winter et al. (2015) had shown that 94% and 83% of responding companies provided specifically "modified/ alternate work" and "modified hours/ days". Only 33% and 31% of responding companies provided more expensive physical accommodations such as accessible workstations and accessible washrooms respectively. The two least mature practices included "the effective use of technological and organizational tools to reduce the length of disability leaves" (TPM2) and "the active monitoring of injured, ill or at-risk employees" (TPM3). Each received an *MS Practice* score of 3.1. The low maturity of these two practices may be due to them being elaborate practices that require a more active involvement of construction employers in DM and heavy investments in technology and personnel. In addition, the "availability of a DM practitioner and a committee consisting of both management and worker representatives" (TPM7) was the next third least mature practice with an *MS Practice* of 3.4. This is in line with Winter et al. (2015)'s survey results which had found that only 22% of responding construction companies hired a DM coordinator or established a DM committee.

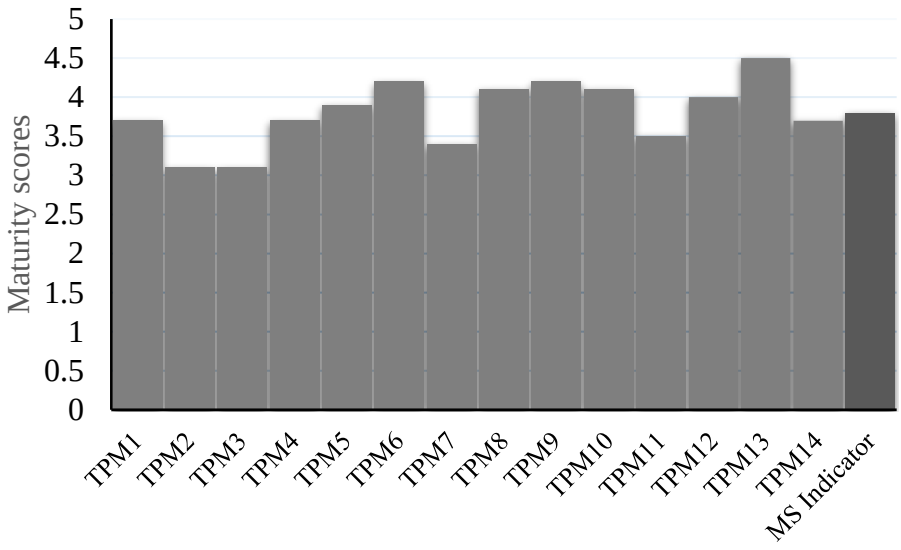


Figure 13: Maturity Scores for Transitional Program Management Practices

4.2.3.7 Maturity of Physical Accessibility Management Practices

Figure 14 depicts the maturity of the five practices making up "Physical accessibility management practices". These practices aim in general to improve the physical accessibility of construction workplaces to people with disabilities by providing them among other things with physical accommodations that would facilitate their RTW. These practices had on average an overall *MS Indicator* of 4.15 and were thus found on average to operate at the quantitatively managed level (i.e. *MS Practice* greater than or equal to 4). "Providing well trained and motivated staff that can safely evacuate the workplace in an emergency situation" (PAP1) was found to be the most mature practice, with an *MS Practice* of 4.8. "Investigating all possible physical accommodations for employees with physical disabilities" (PAP3) was the second most mature practice and had an *MS Practice* of 4.4 whereas "the actual provision of those measures to employees" (PAP4) had an *MS Practice* of 3.9 only. This shows that although a company may actively investigate physical accommodation measures for injured and disabled employees, they may not end up providing these

measures. Therefore, not surprisingly, “the general incorporation of physical accessibility features and accommodations such as lifts, ramps and rails in the workplace” was the least mature practice, with an *MS Practice* of 3.65. These results are in line with Winter et al. (2015). The study had shown that although 94% and 83% of responding organizations in Manitoba provided “modified/ alternate work” and “modified hours/ days” respectively, only 33% of them provided accessible workstations. Moreover, only 31% offered accessible washrooms, 11% provided handrails and ramps and a mere 6% offered accessible elevators. These results reinforce the need to provide these physical accommodations to enable the full return of disabled employees who would not be able to return otherwise.

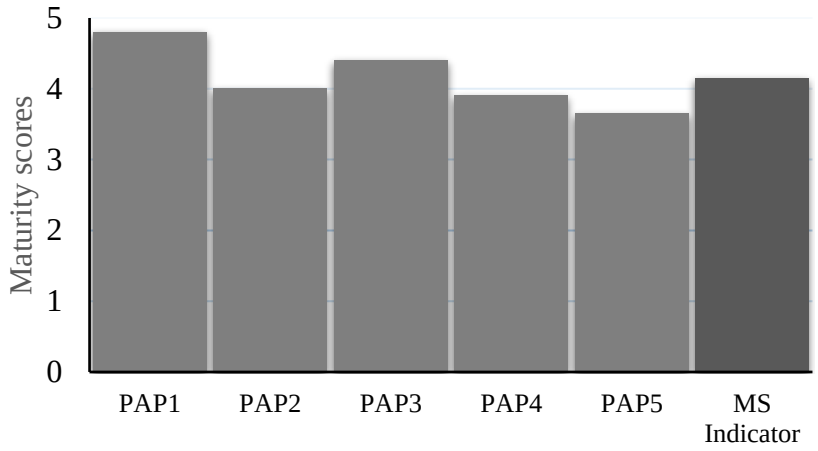


Figure 14: Maturity Scores for Physical Accessibility Management Practices

4.2.3.8 Maturity of Program Evaluation Practices

Figure 15 illustrates the maturity of the thirteen practices comprising “Program evaluation practices” (PEP). PEP aim to evaluate DM programs, customized individual RTW programs and injury and illness statistics to determine necessary program modifications and improvements. The analysis of the results showed that these practices operated on average at the standardized level

(i.e. *MS Practice* greater than or equal to 3) at an overall *MS Indicator* of 3.91. The indicator was ranked as the 6th most mature indicator only which is not surprising given that it deals with the evaluation and improvement of DM programs: an aspect that construction companies have not refined given that many remain without a DM program. None of the PEP practices achieved full maturity. “Maintaining a record of illnesses or injuries in the workplace” (PEP1), “ensuring the anonymity and confidentiality of DM data” (PEP11) and “building a database containing injury and illness data for individual employees” (PEP4) were found to be the most mature practices, with *MS Practice* scores of 4.8, 4.7 and 4.4 respectively. The high maturity of these practices is a sign these companies have optimized their DM injury record-keeping practices. “Using historical data to predict future DM program costs” (PEP7) and “tracking costs associated with the development and implementation of a DM program” (PEP6) were the two least mature practices at *MS Practice* scores of 2.8 and 3.4 respectively. Their low maturity shows that although construction companies may have optimized their injury record-keeping practices, they still need to improve their tracking of actual and future DM program costs. This may explain why many companies remain misinformed about these costs (Angeloni 2013).

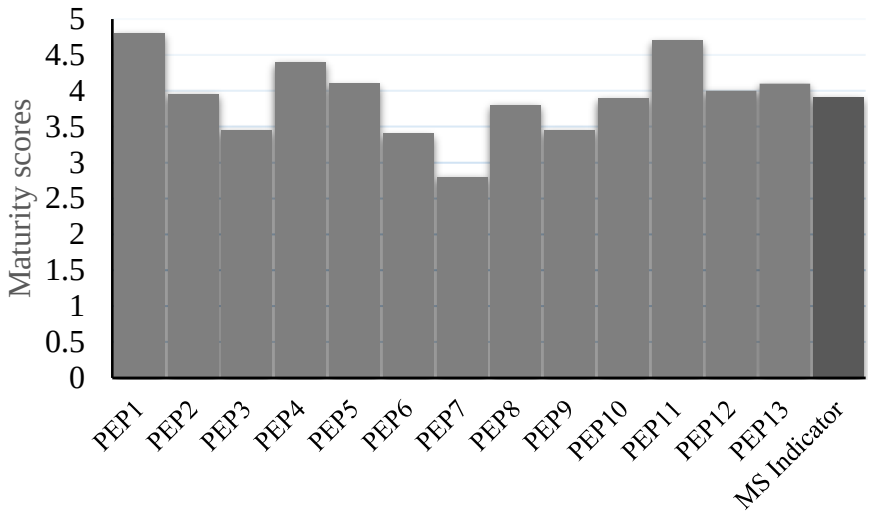


Figure 15: Maturity Scores for Program Evaluation Practices

4.2.3.9 Maturity of Senior Management Support Practices

"Senior management support practices" comprised only four practices and was thus the indicator with the lowest number of practices. These practices aimed to garner support at the senior management level to ensure the effective implementation of DM programs. Figure 16 illustrates the maturity of these four key practices. Overall, although none of the practices achieved full maturity, they were the most mature on average of all indicators and achieved therefore an *MS Indicator* of 4.6. "Ensuring the DM manager receives support from top management" (SMP2) was the most mature practice with an *MS Practice* of 4.7. "Spending time and money to improve the organization's DM performance" (SMP3), and "considering DM as important as other project management goals like quality and service" (SMP4) each scored *MS Practice* ratings of 4.6. The least mature although still highly rated practice: "involving senior management in the implementation of the DM program (SMP1) received an *MS Practice* of 4.5. The high maturity of the four indicators is not surprising given the need for senior management to drive and lead the development and implementation of a DM program for that program to be effective and garner

support at the lower levels. These practices are therefore expected to be some of the most mature DM practices ever.

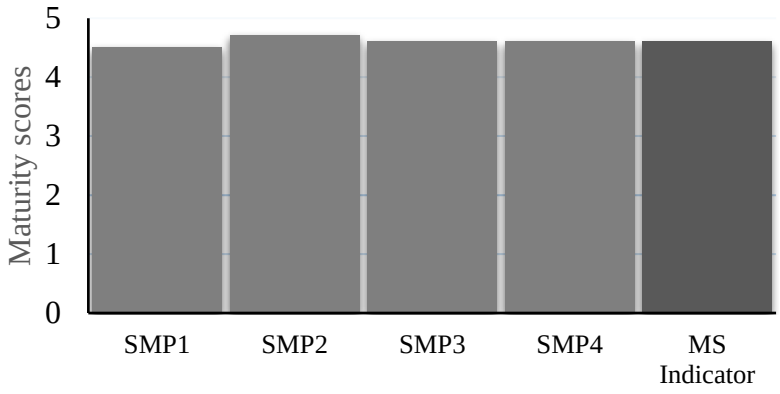


Figure 16: Maturity Scores for Senior Management Support Practices

4.2.3.10 Maturity of Regulatory and Compliance Practices

Similar to PAP, "Regulatory and compliance policies" encompassed only five practices. These practices aimed to ensure compliance with existing legislation with respect to issues such as salary replacement, job accommodation, transitional employment, budgetary responsibility and vocational training. As shown in Figure 17, none of the key practices achieved full maturity. These practices operated on average at the quantitatively managed level (i.e. *MS Practice* greater than or equal to 4) and received an average *MS Indicator* of 4.18. "Formulating a DM strategy in accordance with national legislation, policy and practice" (RCP2) was found to the most mature practice, with an *MS Practice* of 4.8. This is expected given that companies' first priority is to comply with the law and thus to ensure their DM strategy and program comply with existing DM legislation. "The consideration of DM as a priority that contributes to business success and an integral part of the workplace human resource development strategy" (RCP1) also ranked high, with an *MS Practice* of 4.4. The "DM strategies which ensure provision for employees who support

a disabled members" (RCP5) was found to be the least matured practice, and had an *MS Practice* of 3.5.

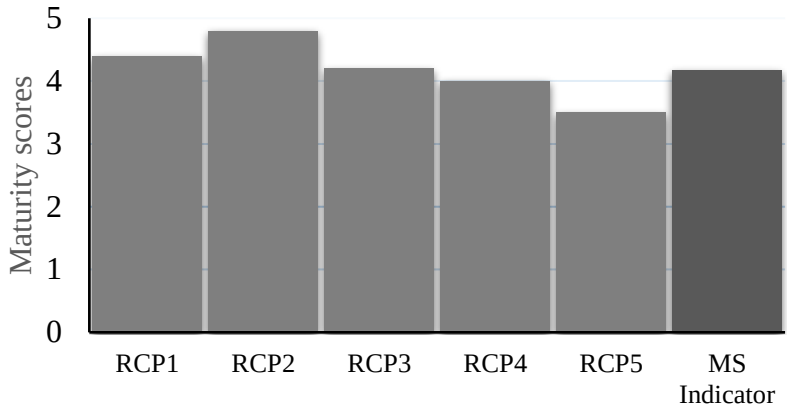


Figure 17: Maturity Scores for Regulatory and Compliance Practices

4.2.3.11 Maturity of Recruitment and Retention Practices

"Recruitment and retention policies" was the least mature indicator (i.e. *MS Indicator* of 3.59) of the 12 analyzed. This indicator included 14 practices that covered the recruitment of new employees and the retention of injured ones, emphasising throughout the principle of non-discrimination and equitable opportunities to all. Figure 18 below depicts the maturity of these practices. As shown, none of these practices achieved full maturity. "Ensuring information about an employee's disability is only passed on to the staff and managers that need it and only with the employee's consent" (RRP11) was the most mature practice (i.e. *MS Practice* of 4.5) and a sign of companies' strict adherence to the principles of confidentiality and privacy. "Investigating all possible accommodations to take advantage as much as possible of the skills of employees with disabilities" (RRP2), and "clearly defining job descriptions, explaining duties and incorporating them into the work orientation of new employees" (RRP13) were the next two most mature practices (i.e. *MS Practice* scores of 4.2 each). Their high maturity was in line with the high

maturity of the TPM practice of analyzing the accommodation needs of injured employees who cannot return to their original jobs (TPM9) and of the PAP practice of investigating all possible physical accommodations for employees with physical disabilities (PAP3). On the other hand, "the inclusion of disabled employees or disability experts as part of the recruitment staff" (RRP8) was found to be the least mature practice (i.e. *MS Practice* of 2.1). "Auditing the recruitment process to assess whether people with disabilities are overrepresented in rejection decisions for positions" (RRP14) was the second least mature practice (i.e. *MS Practice* of 2.7). The low maturity of these practices reinforce the need to improve the process used to recruit new employees to ensure its fairness to people with disabilities.

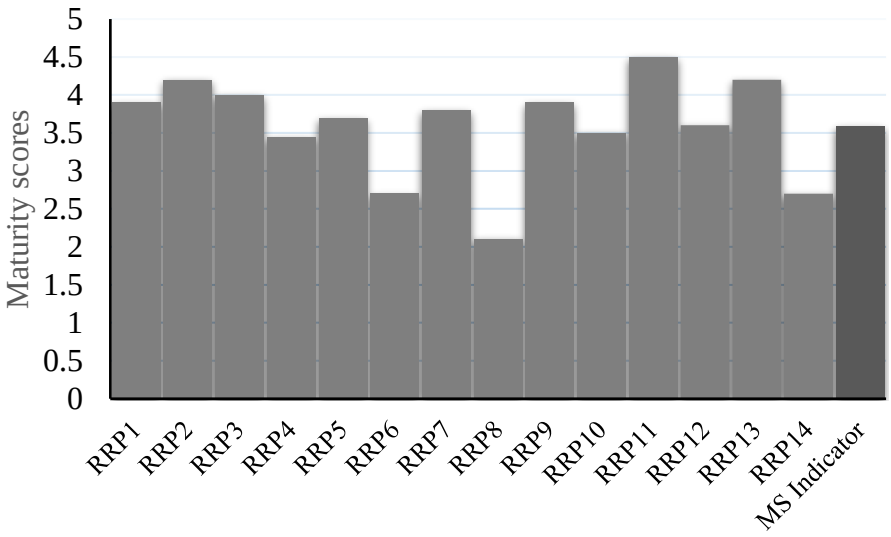


Figure 18: Maturity Scores for Recruitment and Retention Practices

4.2.3.12 Maturity of Ergonomics Key Practices

Figure 19 depicts the maturity of the ten practices within "Ergonomic practices". These practices aimed to ensure the design of work processes and spaces that minimize injuries, complaints, staff turnover and work absenteeism, meet employers' social and legal obligations and improve

employees' health and safety. These practices were operating on average at the standardized level or above (i.e. *MS Practice* greater than or equal to 3), with an overall *MS Indicator* of 3.88. "Undertaking ergonomic interventions as needed" (EP1) and "using ergonomic principles when purchasing new tools, equipment, or furniture" (EP7) were found to the most mature practices with *MS Practice* scores of 4.4 and 4.2 respectively. The high maturity of these practices may be due to them being more general practices that did not define specific actions. They may thus be easier to implement than other more specific practices. These more specific practices were more difficult to implement and thus the least mature of these ergonomic practices. They involved: "rotating or changing job responsibilities to minimize exposure to ergonomic risks" (EP6), "evaluating ergonomic interventions to determine if they were successful" (EP2) and "designing jobs to remove repetitive movements" (EP4). These three practices had *MS Practice* scores of 3.4, 3.5 and 3.6 respectively and required interventions such as the proactive redesign and redefinition of existing jobs and the monitoring and evaluation of these interventions.

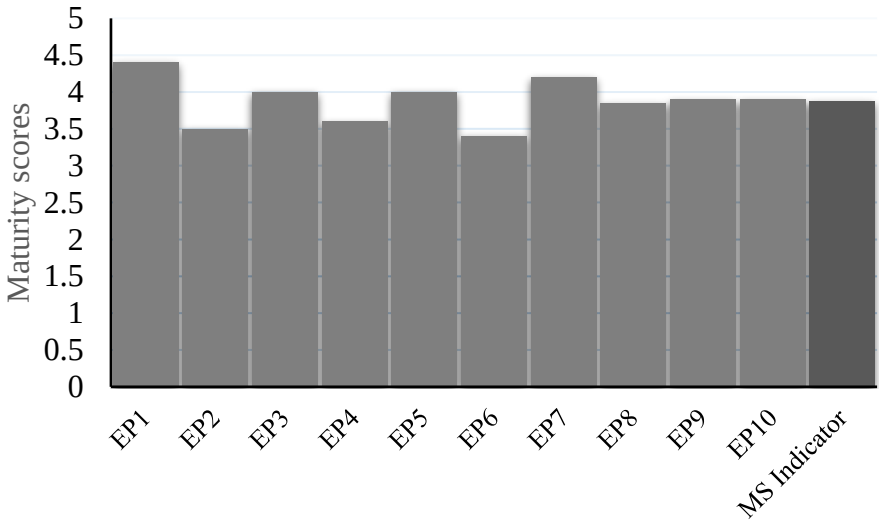


Figure 19: Maturity Scores for Ergonomics Practices

Table 11: Summary of most Mature and least Mature Practices

Indicators	Most mature Practices	Least Mature Practices
Communication practices (CP)	CP7 , CP8	CP9, CP10
Case management practices (CMP)	CMP6, CMP2, CMP6	CMP9, CMP8, CMP16
Return to work and accommodation practices (RAP)	RAP3, RAP10	RAP1, RAP2
Claims management practices (CLP)	CLP5	CLP4
Disability and injury prevention practices (DIP)	DIP4, DIP5, DIP25	DIP8, DIP9, DIP10
Transitional program management practices (TPM)	TPM6, TPM9, TPM13	TPM2, TPM3, TPM7
Physical accessibility management practices (PAP)	PAP1,PAP3	PAP4, PAP5
Program evaluation practices (PEP)	PEP1, PEP11	PEP6, PEP7
Senior management support practices (SMP)	SMP2	SMP1
Regulatory and compliance policies (RCP)	RCP1, RCP2	RCP4, RCP5
Recruitment and retention policies (RRP)	RRP2, RRP11,RRP13	RRP6, RRP8, RRP14
Ergonomics practices (CP)	EP1,EP7	EP2,EP4, EP6

4.2.4 Company 1 Case Study

Table 12 summarizes findings related to Company 1. The company received an overall *MS Company w/AHP* of 3.64 and an *MS Company* of 3.74, making its *PG Company* 25.2%. The increase in the *MS Company* in comparison to the *MS Company w/AHP* shows Company 1 placed emphasis on the indicators that were deemed more critical to overall DM, such as "Senior management support" which had an *AHP weight* of 0.136. Of significance is that "Return to work and accommodation" and "Disability and injury prevention" practices, which were assigned the highest AHP weights of 0.157 and 0.138 respectively had *MS Company* of 3.70 and 4.12 respectively. This is in line with both Lingard and Saunders (2004) and Newton and Ormerod (2005) who had found RTW to be a dominant determinate of DM in construction workplaces.

Nevertheless, these maturity scores also suggest room for improvement with respect to those two specific indicators. Although “Return to work and accommodation” was ranked as one of the most critical to overall DM performance, it was one of the least mature practices with a maturity score of 3.70. This is an indication that the company placed less emphasis on the timely return of injured employees back to work. Being that RTW is a dominated determinate of DM in the workplace, the company needs to reassess their RTW practices to ensure optimal performance.

The least mature indicators: “Recruitment and retention” policies and “Ergonomic” practices received *MS Company* of 3.18 and 2.85 respectively and ranked as the seventh and eighth most important indicators with *AHP weights* of 0.058 and 0.053 respectively. The maturity scores of these two indicators suggest that improving them will result in the greatest increase in the company’s overall maturity. An investigation of the practices that were rated the lowest within each of those two indicators can help the company determine how best to improve their maturity. For instance, in looking at practices within “Recruitment and retention” policies, Company 1 would be advised to better 1) train their staff on issues involving equal opportunity, diversity and disability, 2) adopt alternative ways of testing for job skill requirements instead of relying on traditional job qualifications, 3) consider all possible accommodations that would best take advantage of disabled employees’ skills and 4) provide occupational training opportunities for disabled employees unable to return to their original work. These recommendation when implemented should improve DM performance, however future research is need to follow up on the aftermath of the model application and how companies use these recommendations to improve DM performance. Based on the model assumptions, increases in DM scores denotes improvements in overall DM performance. When recommendations are strategically and diligently

implemented, assessed DM maturity should increase when the model is reapplied.

Table 13 details the potential opportunities and strategies identified for Company 1 based on its assessment of performance to enable continuous improvements in deficient areas. Appendix H shows the anonymized individual report that was provided to this company. Similar reports reporting on the results of the application of the CDM3 were provided to each of the other nine companies in the sample. The recommendations are base on practices which received a maturity score of 3 or below. These practices were deemed that least matured and required additional improvement.

Table 12: *MS Company* and *MS Indicator* scores breakdown for Company 1

	CP	CMP	RAP	CLP	DIP	TPM	PAP	PEP	SMP	RCP	RRP	EP
AS Indicator	42	72	37	16	103	50	18.5	43.5	17	20	44.5	28.5
OS Practice	55	90	50	25	125	70	25	65	20	25	70	50
MS Indicator %	76	80	74	64	82	71	74	67	85	80	64	57
MS Indicator	3.82	4.00	3.70	3.20	4.12	3.57	3.70	3.35	4.25	4.00	3.18	2.85
MS Company unweighted	3.64											
MS Company	3.74											

Communication practices (CP)	Physical accessibility management practices (PAP)
Case management practices (CMP)	Program evaluation practices (PEP)
Return to work and accommodation practices (RAP)	Senior management support practices (SMP)
Claims management practices(CLP)	Regulatory and compliance policies (RCP)
Disability and injury prevention practices(DIP)	Recruitment and retention policies (RRP)
Transitional program management practices (TPM)	Ergonomics practices (EP)

Table 13: Potential DM opportunities for Company 1 to Improve DM Performance

Practice Area	Potential Opportunity
Communication practices (CP)	• Bring DM in the workplace to the attention of all employees and in a language that can be easily understood • Ensure employees receive regular training concerning injury management and claims • Develop and monitor communication routes • Develop a method for communicating policy changes • Ensure open communication with employees • Implement early DM intervention strategies • Assess employee knowledge on DM interventions
Case management practices (CMP)	• Develop and implement a post-RTW monitoring and coordination plan for employees • Ensure effective initial assessment of physical and functional rehabilitation • Develop and implement occupational rehabilitation counselling and job skill retraining for employees
Return to work and accommodation practices (RAP)	• Conduct a job needs assessment and analysis • Conduct a functional assessment for injured employees to assess which jobs would be most suitable for them • Implement job and workstation modifications • Conduct a vocational assessment to ensure appropriate job placement for employees unable to return to their original positions • Conduct intermediate evaluation of employees returning on modified duties to assess if they are ready to progress to original work or require more suited modified work
Claims management practices (CLP)	• Monitor claims management from initial injury to claim resolution • Evaluate long-duration claims to assess progress in order to ensure quick resolution
Disability and injury prevention practices (DIP)	• Develop and implement mental health and stress management programs • Promote the proper use and handling of safety equipment, materials and resources in all situations and enforce it where required • Manage hazards prior to the start of projects by describing each hazard, its potential impact and suggested control mechanisms • Manage work-related tasks, as well as the promotion of safe practices when defining health and safety roles and responsibilities • Review employees' current knowledge of health and safety practices on a timely basis

	• Review employees' health and safety performance on a timely basis • Encourage employees to implement hazard management controls and recognize them for doing so
Transitional program management practices (TPM)	• Develop workplace job accommodation alternatives across the company • Develop a defined process to assess occupational training needs of injured employees and identify the skills they require to return back to work in some capacity
Program evaluation practices (PEP)	• Track and analyze workplace incident data to benchmark DM performance • Evaluate injuries which require case management to ensure due protocol was followed and determine what could be improved on subsequent cases • Develop a defined process to evaluate the cases of employees on leave due to injury to ensure their early RTW and the cases of employees on modified duty to determine the changes needed as part of their rehabilitation • Track and analyze injury and illness statistics to benchmark DM performance • Develop a defined process to implement recommended DM program modifications and improvements based on the data analysis
Recruitment and retention policies (RRP)	• Revise recruitment polices to ensure a fair assessment of all candidates irrespective of disability • Ensure pre-employment tests and selection criteria are fair to ensure equal employment opportunity • Develop a defined process to ensure the retention and the gradual RTW of injured employees
Ergonomic practices (EP)	• Develop a defined process to ensure jobs are designed to reduce heavy lifting • Use ergonomic principles when designing and setting up workstations and work areas • Use ergonomic principles when purchasing new tools, equipment, or furniture • Use ergonomic principles when assisting disabled employees

4.2.5 Model Relevance and Applicability

The sampled companies agreed that the CDM3 with its breakdown of DM practices helped them detect deficiencies within their DM programs and identify opportunities for improving them and by extension their DM performance. According to them, a key strength of the model is that it enabled them to quantify their DM performance through the calculation of DM maturity scores for every key indicator and for the company as a whole. The model also helped them realize that in order for their DM practices to fully mature, they needed to not only define and use DM practices (i.e. Maturity levels 1 and 2) but also to standardize these practices (i.e. Maturity level 3), implement them accurately and efficiently (i.e. Maturity level 4), and continuously improve them (i.e. Maturity level 5). The companies also agreed on the comprehensiveness of the model. Companies noted that the model captured practices they had not thought of and did not know were needed as part of their DM programs. This was useful in particular to the few companies that had just started implementing DM. Those interviewed also found the model to be practical, simple and easy to implement.

Feedback from the companies also showed that typically, very few of them had a separate policy on disability. The majority had it embedded within their health and safety programs. The problem as highlighted by the companies is that this creates a myopic and restrictive approach to DM. This is evidenced by companies restricting their DM primarily to preventative practices as is usually the case with health and safety despite DM extending beyond this as demonstrated in the literature.

A key issue encountered in the implementation of the model involved the time it took to conduct random verifications of some existing practices. These verifications usually entailed locating and

reviewing relevant documents within the company. Furthermore, while it was usually possible to verify the outcomes associated with most of the indicators, there were a few instances when this was not possible. As the indicators are continually refined over time, the verification of the outcomes and indicators will become easier and more stringent. This is key to ensuring responses correlate with actual practices in order to minimize all levels of subjectivity.

The actual long-term practicability and usefulness of the CDM3 were also not directly evaluated. Therefore, future research will need to evaluate how the model's maturity scores and the recommendations stemming from the application of the model are implemented by companies and their overall impact on DM performance. Because of the small number of companies evaluated, the research is considered exploratory in nature and as such, its results cannot be considered representative of all construction companies in Manitoba. Future research should focus on evaluating a larger number of companies to enable the generalization of the results and further validation of the model. Nevertheless, while the sample does not allow for this, it provides insights into how companies approach DM and where improvements are possible. More research is also needed to validate the effectiveness of the CDM3 in companies with different organizational cultures and business environments.

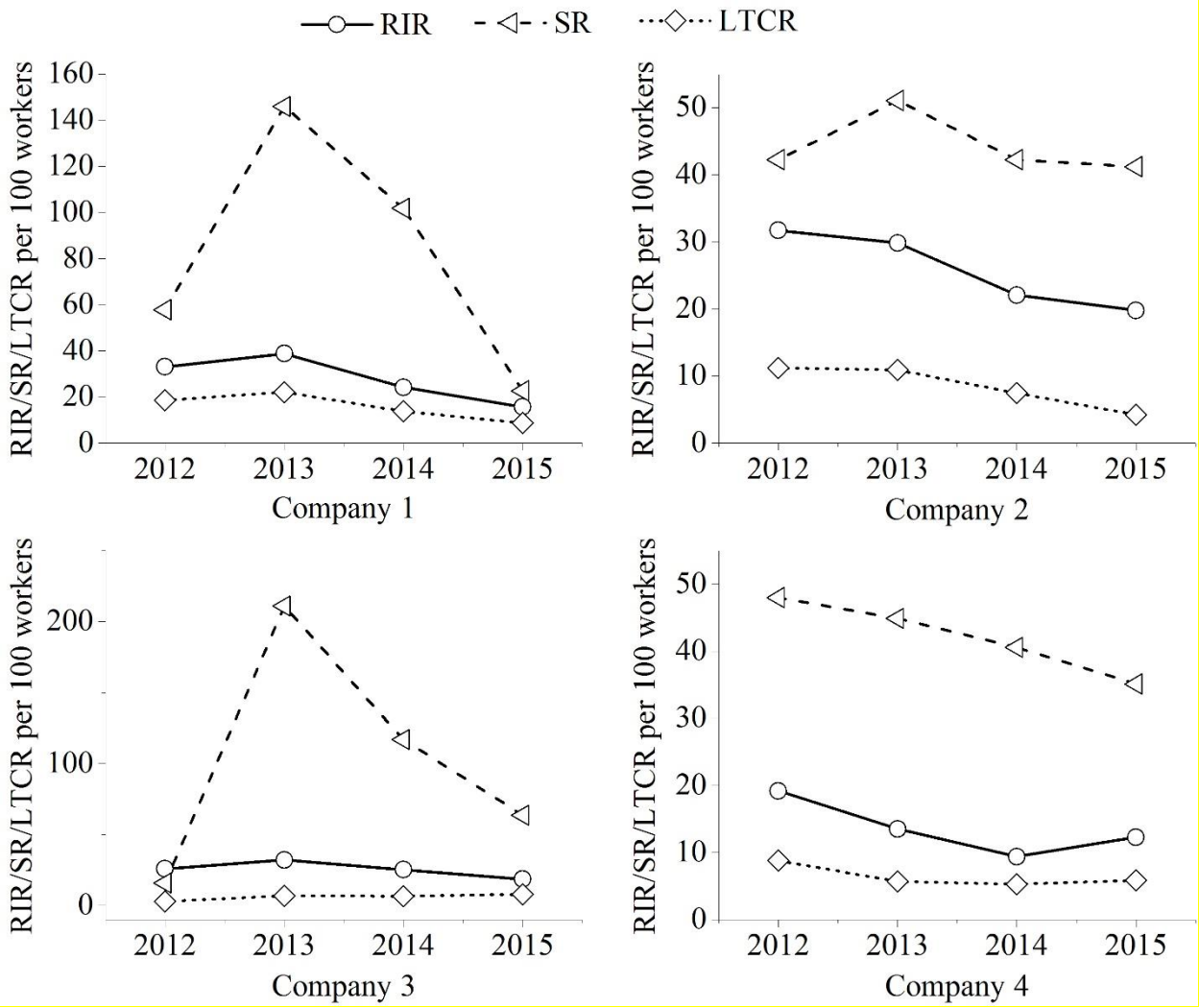
4.3 Objective #3: Developing and Implementing Disability Management and Safety Metrics for Construction Organizations

This section presents the results of measuring the safety and DM performance of the sampled

companies using the safety and DM metrics developed in this research. The safety performance results are presented first and followed by the DM performance results. The relationship between the safety and DM performance results is explored next before evaluating the safety and DM performance of Company 1 in particular. This is followed by a discussion of the relevance and applicability of the safety and DM metrics used as part of this research.

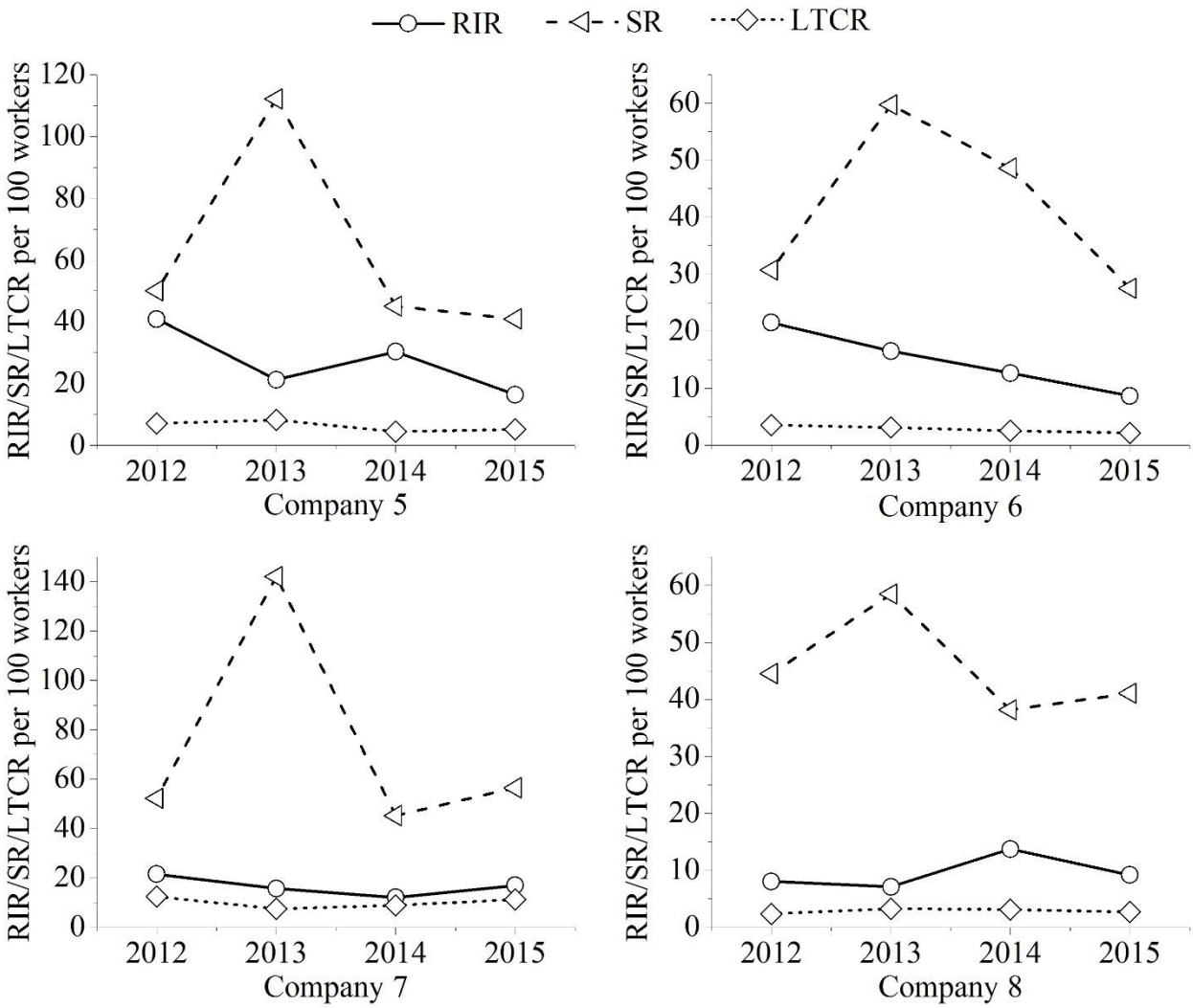
4.3.1 Safety Performance

Figures 20 and 21 present the recordable injury rate (RIR), severity rates (SR) and the lost time case rates (LTCR) for the eight evaluated companies per 100 employees over the four-year research period. The emerging trend is a gradual decline in RIR and LTCR over the four years whereas SR remained relatively high during the same period. Four of the eight companies were small-sized whereas the other four were medium and large-sized. The literature showed that smaller companies tended to have high incident rates, or incident rates that fluctuate significantly from year to year (OHSHA, 2010). This is because of the small number of employees and hence the lower number of labour hours worked in these companies. However, the data in this research does not support this assertion, given that the small-sized companies in this research had relatively lower incident rates than the medium and large-sized companies. Detailed results are provided below.



RIR- Recordable injury rate
SR- Severity rate
LTCR- Lost time case rate

Figure 20: Safety Performance Trends (Companies 1-4)



RIR- Recordable injury rate
SR- Severity rate
LTCR- Lost time case rate

Figure 21: Safety Performance Trends (Companies 5-8)

Figure 20 shows that Company 1's RIR decreased from 33.05 in 2012 to 15.66 incidents per 100 employees in 2015, with its SR increasing from 57.84 in 2012 to a high of 145.89 in 2013 and then decreasing to 22.66 in 2015. This medium-sized company had the highest number of incidents resulting in lost days, with a LTCR of 18.59 in 2012 and a high of 22.16 in 2013. According to data published by the Manitoba Workplace Injury and Illness Statistics (2007-2016), the average

LTCR for building construction was 6.4 in 2012, 5.6 in 2013, 5.4 in 2014, 5.0 in 2015 and 4.4 in 2016. Similarly, for heavy construction, the LTCR values were 4.5 in 2012, 4.5 in 2013, 4.5 in 2014, 4.7 in 2015 and 3.7 in 2016. Therefore, the company's performance during those same periods was significantly below the industry average, with the company experiencing almost three times as much LTCR in 2012 and 4 times as much in 2013. Likewise, Company 2 and Company 3, both small-sized experienced a decline in their RIR from 31.7 incidents per 100 employees in 2012 to 19.77 in 2015, and from 25.9 incidents per 100 employees in 2012 to 18.51 in 2015 respectively. While Company 2's SR remained relatively the same from 42.25 in 2012 to 41.21 in 2015, Company 3 experienced the most fluctuations in its SR, with a high of 211.03 in 2013 and a low of 63.5 in 2015. This shows the severity of these injuries was very high during this period even though Company 3's LTCR was only 2.88 in 2012, 6.88 in 2013, 6.64 in 2014 and 7.93 in 2015. This demonstrates the danger of relying on one metric alone to determine safety performance, since a single metric captures only one aspect of performance and is not representative of the entire picture. Company 4 overall had consistently low RIR, SR and LTCR figures from 2012 to 2015. Its RIR ranged from 19.2 in 2012 to 12.3 in 2015 with a low of 9.41 incidents per 100 employees in 2013. The amount of lost days to incidents (i.e. SR) also decreased from a high of 48 in 2012 to a low of 35.14 in 2015. Although it's LTCR of 8.8 in 2012 was above the Manitoba average, the rate improved significantly from 2013 to 2015, and went below 6 in 2015.

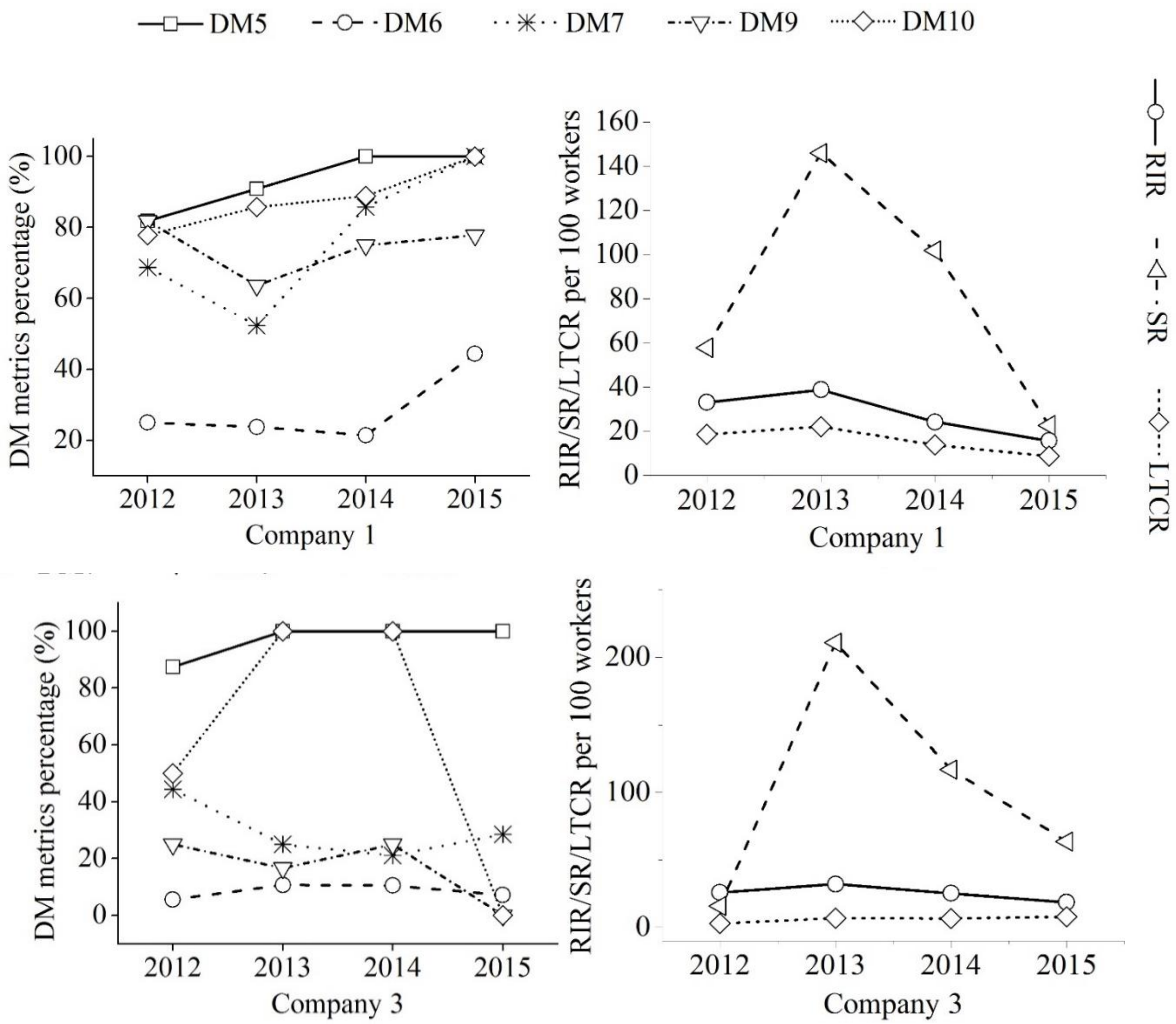
With respect to Companies 5 to 8 shown in Figure 21, Company 5 experienced an increase in safety performance as reflected by its RIR and LTCR over the four-year period. The number of incidents per 100 employees (i.e. RIR) decreased from 40.9 in 2012 to 16.42 in 2015, whereas its

LTCR increased from 50.1 in 2012 to a high of 112.13 in 2013 before experiencing a decline to 40.91 in 2015. There was a large discrepancy between the company's SR and LTCR. For example, in 2013, although only 21.22 incidents were recorded per 100 employees (i.e. SR), Company 5 lost 112.13 days per 100 employees (i.e. LTCR) during that same period. Company 6 and Company 7 had very similar low RIRs, ranging between 21.5 in 2012 and 8.65 in 2015 for Company 6 and between 21.54 in 2012 and 16.96 in 2015 for Company 7. Company 6 also had very low LTCR, declining from an average low of 3.54 in 2012 to 2.14 in 2015. However, just like for Company 5, its SR increased from 30.7 in 2013, to 59.7 in 2013 and 48.6 in 2014. Company 7 on the other hand experienced higher LTCR which went from 12.43 in 2012 to 11.3 in 2015. The severity of its incidents (i.e. SR) was also higher than Company 6's and increased from 52.19 in 2012 to 142.05 in 2013 before declining to 56.52 in 2015. Company 8 had the best overall safety performance. It not only had the lowest RIR of 8.05 in 2012 to 9.91 in 2015; its number of lost days to incidents (i.e. SR) also declined from 44.51 in 2012 to 41.08 in 2015. The number of incidents resulting in lost days (i.e. LTCR) was also very low and ranged from 2.37 in 2012 to 2.7 in 2015. This company's metrics demonstrated its high commitment to safety.

The analysis revealed a relationship between RIR and SR values. More specifically, Spearman's correlation test showed a positive statistically significant correlation between RIR and SR values with an R of 0.565 and a p-value of 0.023. This means that if the number of incidents per 100 employees increases, the number of days lost to incidents will also increase and vice-versa. No statistically significant relationships could be detected between RIR and LTCR values or between SR and LTCR values.

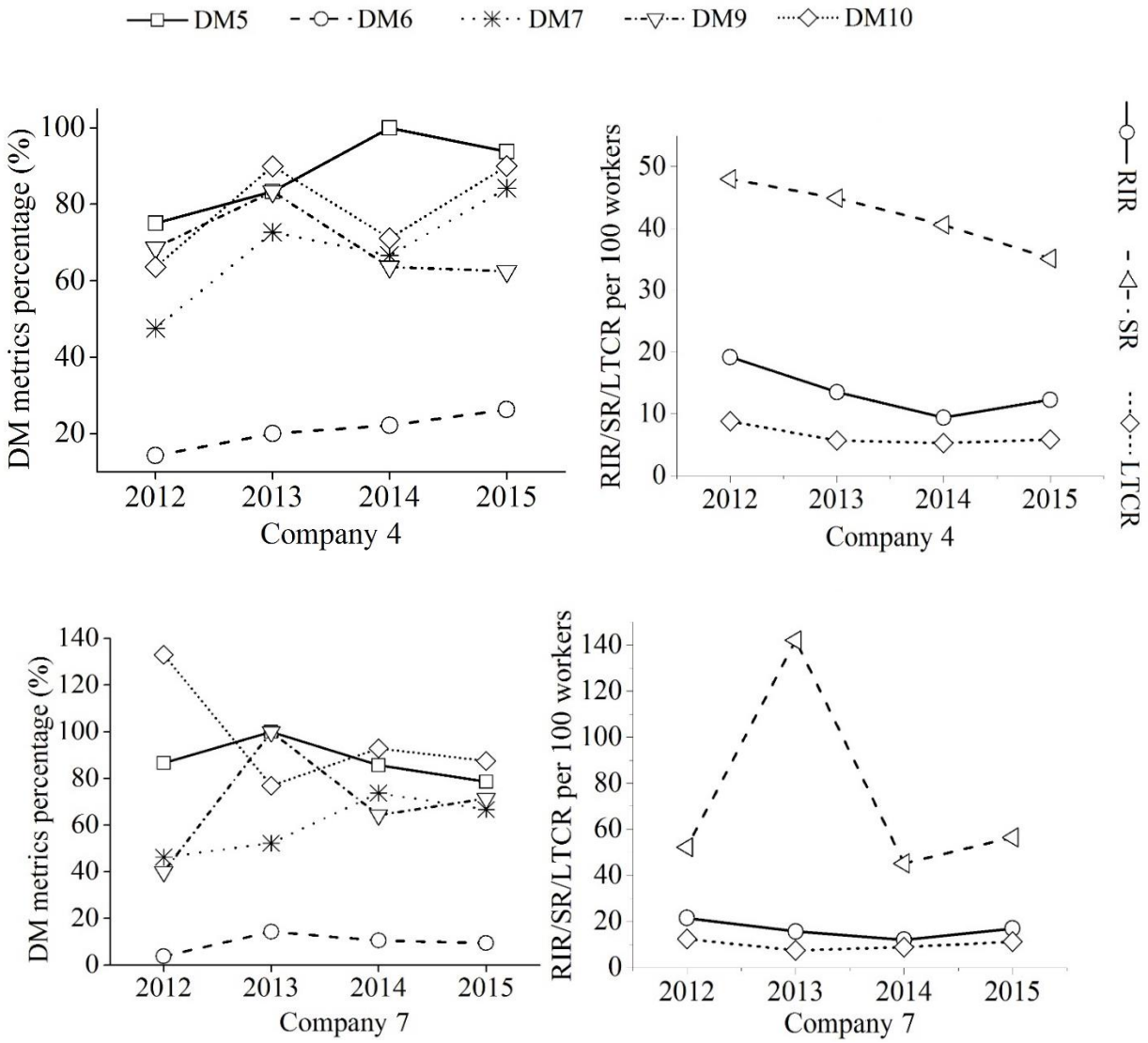
4.3.2 Disability Management Performance

Figure 22 and 23 shows the performance of Companies 1, 3, 4 and 7 with respect to the DM5, DM6, DM7, DM9 and DM10 metrics , with their corresponding safety performance metrics.



DM5-% of employees who returned back to work
DM6-% of injuries that required case management
DM7-% of employees off due to injury
DM9-% of employees placed on modified duties
DM10-% of employees transitioned from modified work to original

Figure 22: DM and Safety Performance Trends (Companies 1 and 3)



DM5-% of employees who returned back to work
DM6-% of injuries that required case management
DM7-% of employees off due to injury
DM9-% of employees placed on modified duties
DM10-% of employees transitioned from modified work to original

Figure 23: DM and Safety Performance Trends (Companies 4 and 7)

Figure 22 shows that Company 1 and Company 3 witnessed an increase in the percentage of employees returning back to work (i.e. DM5) between 2012 and 2013. That percentage increased from 81.81% to 90.9% for Company 1 and from 87.67% to 100% for Company 3 between 2012 and 2013 respectively. Both companies achieved a DM5 rate of 100% in 2014 and 2015, reflecting

a commitment by these companies to full accommodate and integrated injured employees returning to the workplace. Despite their lower safety performance as evidenced by their high RIR and SR for both companies in Figure 22, both companies appeared to have implemented proactive measures to ensure the return of employees following these injuries. Company 4 also saw a steady increase in that percentage (i.e. DM5) from 75% in 2012 to 100% in 2014, with that percentage dropping to 93.75% in 2015. Company 7 which had one of the lowest RIR and SR had a DM5 rate that ranged from 86.67% in 2012 to 78.57% in 2015, reflecting a lower commitment by them to the return of injured employees than Companies 3 and 4. These results show that high RIR and SR do not always translate to high DM5 values and vice-versa since a company with poorer safety performance may be able to integrate injured employees back to the workplace more effectively than a company with better safety performance. The results also highlight the importance of bringing back injured employees to the workplace as soon as they are able to do so. Studies (e.g. Westmorland and N. Buys 2004, Shrey 1995: 1996, Habeck et al. 1998, Loisel et al. 2002, Lingard and Saunders 2004) showed that employees who return to work early on modified duty are more likely to transition back to their original work and reintegrate faster. The longer the injured worker is away, the less likely they are to return back to work. Early referral to rehabilitation services is also strongly correlated with early RTW, both in terms of reducing the time taken to return and increasing the likelihood of that return (Westmorland and Buys 2004, Shrey 1995, Habeck et al. 1998, Krause et al. 2001).

DM6 measures the percentage of injured employees that required case management. Although this is not a direct measure of performance, it determines the number of injuries that require the assignment of a case manager and thus the use of case management practices. For Company 1,

DM6 increased from 25% in 2012 to 44% in 2015 even though the company experienced its lowest RIR and SR (i.e. 15.69 and 22.66 respectively) in 2015. Company 3 had the lowest percentage of injuries that required case management (i.e. DM6) of all companies with that percentage ranging from a low of 5.56% in 2012 to a high of 10.52% in 2014. During that same period, its SR went from a low of 15.83 in 2012 to a high of 116.93 in 2014. This reflects a potential relationship between the severity rate of incidents and the number of injuries that require case management. This is not surprising given that case management is usually assigned to severe injuries. Therefore, a higher SR should lead to a higher number of cases management injuries. That relationship was also detected in Company 7 where the company experienced its highest DM6 (i.e. 14.28%) and SR (i.e. 142.05) in 2013 and its lowest DM6 (i.e. 3.85%) and SR (52.19) in 2012. Company 4's DM6 increased gradually from 2012 to 2015, moving from 14.29% in 2012 to 26.3% in 2015. Nevertheless, Company 4's SR decreased during the same period from 48 in 2012 to 35.14 in 2015, calling into question the potential relationship found between SR and DM6 in Companies 3 and 7.

DM7 measures the percentage of injured employees who took time off work due to injury. Company 1 recorded the highest DM7 rates of all companies (i.e. 68.75% in 2012, 52.38% in 2013, 85.71% in 2014 and 100% in 2015) whereas Company 3 recorded the lowest (i.e. 44.44% in 2012, 25% in 2013, 21.05% in 2014 and 28.57% in 2015). Nevertheless, Company 3's SR was one of the highest (i.e. 211.03 in 2013 and 116.93 in 2014). This shows that, although a small number of injuries resulted in injury leave in this company, the number of days lost was significantly higher, meaning those injuries were very serious. Company 4's DM7 increased significantly from 47.6% in 2012 to 72.7% in 2013 whereas its RIR declined from 19.2 to 13.54

during that same period. This implies that although less employees were injured in this company over this time period, the percentage of employees who took injury leave rose sharply. Similarly, even though Company 7 had one of the lowest R1Rs for all years, 46.2% of its injured employees took time off work (i.e. DM7) in 2012.

DM9 and DM10 measure the percentage of injured employees placed on modified work and the percentage of injured employees who transitioned from modified work to their original work respectively. Company 1's DM9 ranged from a high of 81.81% in 2012 to a low of 63.63% in 2013 and reflect a commitment by the company to provide modified work to its injured employees. During the same period, the company's DM10 ranged from a low of 77.78% in 2012 to a high of 100% in 2015 whereas its DM5 varied between 81.81% in 2012 to 100% in 2015. These values reflect a potential relationship between the percentage of employees who returned to work (i.e. DM5), the percentage of employees who are placed on modified work (i.e. DM9) and the percentage of employees who returned to their original work (i.e. DM 10). This is not surprising given the interrelated nature of these three metrics. For Company 3, although the company's DM5 showed that 100% of injured employees returned back to work starting in 2013, its DM9 showed that only 16.67%, 25% and 25% were placed on modified duties in 2013, 2014 and 2015 respectively. This implies that most injured employees were able to return back to their original work. In 2012, 50% of employees placed on modified work in Company 3 transitioned to their original work (i.e. DM10), with that rate increasing to 100% in 2013 and 2014. Company 4 recorded relatively high rates of transition from modified work to original work (i.e. DM10) with that rate going from 63.63% in 2012 to 90% in 2013, 71.14% in 2014 and 90% in 2015. Interestingly, Company 7 experienced a DM10 of 133% in 2012. This implies that all employees

who were place on modified duty in 2012 in addition to employees who were placed on modified duty in previous years transitioned to their original work in 2012. This rate went down in subsequent years to record 76.92% in 2013, 92.85% in 2014 and 87.5% in 2015.

Overall, the results showed that the companies assessed achieved in general high RTW rates for injured employees, with few unaccounted absences of injured employees. The results also showed most companies had increasing number of workers being off work due to injury. The percentage of injured employees placed on modified work and the percentage of injured employees who transitioned from modified work to their original work fluctuated for most companies over the 4 years. The identification of these data trends in DM is crucial to ensuring RTW accountability and follow-up, as without such measures, companies cannot assess whether the efficiency of the implemented DM practices.

4.3.3 Relationship between Safety and Disability Management Performance

Spearman's non-parametric correlation test was used to assess the relationships between each of the three safety metrics (i.e. RIR, SR and LTCR) and each of the five DM metrics applied (DM5, DM6, DM7, DM9 and DM10). The analysis showed that none of these relationships was statistically significant. Because a correlation coefficient can only tell whether a DM metric and a safety metric have a non-linear relationship, the absence of this linear relationship does not negate the fact that there could be a non-linear relationship between these two variables. This non-linear relationship would not therefore be detectable using Spearman's non-parametric correlation test. This being an exploratory research, future research should investigate these relationships in a much

larger number of companies to ascertain whether or not a linear relationship exists.

4.3.4 Company 1 Case Study

Table 14 summarizes the safety and DM performance of Company 1 using relevant metrics and how this company's metrics compare to the average values for all companies over the four-year study period. This is to assess the company's relative safety and DM performance and identify potential opportunities for improvements. With respect to safety, the table shows that the company's RIR rose from 2012 (i.e. 33.05) to 2013 (i.e. 38.78) before declining considerably over the next two years and reaching a value of 15.69 in 2015. Nevertheless, the rate remained higher than the average RIR for all companies in each year. Similarly, the company's SR almost tripled between 2012 (i.e. 57.84) and 2013 (i.e. 145.89) before decreasing steadily over the next two years and reaching a level in 2015 (i.e. 22.66) that is far below that of 2012. The rate was higher though than the average rate for all companies for all years except in 2015. A similar trend was also observed with the company's LTCR. The company's LTCR increased from 2012 (i.e. 18.59) to 2013 (i.e. 22.16) before decreasing over the next two years and recording a value of 8.71 in 2015. The rate was also higher than the average sample rate over the four-year period. These trends show that the company's overall safety performance declined from 2012 to 2013 before improving considerably over the next two years and reaching a level in 2015 than is far higher than the one in 2012. Despite that increase in performance, the company's safety performance remained lower throughout the four-year study period than the average performance of all companies. The company's safety performance was also much worse than the Manitoba building industry's average which recorded a LTCR value of 6.4 in 2012 and 4.4 in 2016 (Manitoba Workplace Injury and Illness Statistics (2007-2016)), thus the company's need to continue mobilizing its resources

to further improve this performance. Company 1's values also allude to a potential relationship between the three metrics such that when one metric increases from one year to the other, the other two also increase and vice-versa.

With DM, the percentage of employees who returned back to work (i.e. DM5) in Company 1 increased steadily over the four-year study period, reaching 100% in 2015. This percentage exceeded the average of the sampled companies in the last two years only. With respect to the percentage of injuries requiring case management (i.e. DM6), this percentage decreased steadily from 2012 (25.00) to 2014 (21.42) but increased considerably in 2015 reaching an all-time high of 44.44. Unlike for DM5, this percentage was higher over the whole study period than the sampled companies' average. Similarly, despite an initial decrease in the percentage of employees off due to injury (i.e. DM7) from 2012 (i.e. 68.75) to 2013 (i.e. 52.38), this percentage increased considerably in 2014 (85.71) and in 2015 (100) and was also higher in each year than the average for all companies. The percentage of employees placed on modified duties (i.e. DM9) also decreased from 2012 (i.e. 81.81) to 2013 (i.e. 63.63) but increased marginally in 2014 (i.e. 75) and 2015 (i.e. 77.78). This metric's values for Company 1 also exceeded the average values of the sampled companies over the whole study period. The company also witnessed a steady increase in the percentage of employees who transitioned from modified work to original work (i.e. DM 10) over the four-year period, moving from 77.78% in 2012 to 100% in 2015. Unlike other metrics, it exceeded the average for all companies in 2014 and 2015 only. The values for all of these metrics reflect an increasing commitment over the years by the company to accommodate and integrate injured employees returning to the workplace following an injury. Although more employees returned to work over the years (i.e. DM5), more employees were also off due to injury (i.e. DM7)

which may explain the company's increased assignment of case managers to injured employees (i.e. DM6). It may also explain its increased placement of employees on modified work (i.e. DM9) and the increased return of employees from modified work to their original jobs (i.e. DM10). These values point in particular to a potential relationship between the percentage of employees who returned to work (i.e. DM5), the percentage of employees who were placed on modified work (i.e. DM9) and the percentage of employees who returned to their original work (i.e. DM 10). This is not surprising given the interrelated nature of these three metrics.

Table 14: Sample Safety and DM performance of Company 1

Metric	2012	2013	2014	2015
Safety Performance Metrics				
RIR (Company 1)	33.05	38.78	24.17	15.69
RIR (All Companies)	25.23	21.85	18.71	14.69
SR (Company 1)	57.84	145.89	101.84	22.66
SR (All Companies)	42.68	103.15	59.83	41.06
LTCR (Company 1)	18.59	22.16	13.81	8.71
LTCR (All Companies)	8.37	8.46	6.52	6.00
DM Performance Metrics				
DM5-% of employees who returned back to work (Company 1)	81.81	90.90	100	100
DM5 (All Companies)	*82.74*	*93.55*	*96.43*	*93.08*
DM6- % of injuries that required case management (Company 1)	25.00	23.80	21.42	44.44
DM6 (All Companies)	*12.18*	*17.19*	*16.16*	*21.85*
DM7-% of employees off due to injury (Company 1)	68.75	52.38	85.71	100
DM7 (All Companies)	*51.75*	*50.60*	*61.78*	*69.86*
DM9- % of employees placed on modified duties (Company 1)	81.81	63.63	75.00	77.78
DM9 (All Companies)	*53.88*	*65.91*	*59.98*	*52.92*
DM10- % of employees transitioned from modified work to original (Company 1)	77.78	85.71	88.89	100
DM10 (All Companies)	*81.10*	*88.16*	*88.22*	*69.38*

Although the company's safety performance metric values were below the average of the sampled companies in general, its DM performance metrics were above these companies' average. This does not necessarily imply that Company 1's DM performance was better on average than the other companies' DM performance. This is because the higher percentage of case management injuries (i.e. DM6) for example in Company 1 could be due to the seriousness of the injuries in that company rather than to the company's increased ability to develop a customized program for every injured worker individually. The higher percentage of employees off due to injury (i.e. DM7) could also simply be a sign of the seriousness of the injuries that require time off rather than the company's inability to accommodate employees in a way that would avoid time off. Similarly, the higher percentage of employees placed on modified duty (i.e. DM9) could simply be an indication that more employees are feeling better and ready to get back to work at this specific point in time. It does necessarily measure the company's ability to provide modified work to its returning employees. Therefore, these values need to be interpreted with care as they have the potential to be misinterpreted. There's a need to use more than one DM metric together and to collect additional information about DM performance beyond those metrics so that those metrics cannot be misinterpreted and so that companies can thoroughly assess their DM performance. There's also a need to provide companies with guidance on how to interpret those metrics in order to improve DM performance. Future research should therefore develop an interpretation map that links related metrics together in order to help companies interpret their results further.

4.3.5 Metrics Relevance and Applicability

The results indicated that although there was a positive correlation between RIR and SR in the sample of companies analyzed, this is not always the case in practice. The findings also reinforced

the importance of assessing different safety metrics to determine relative safety performance. Relying on one metric alone to do so was found to be a misrepresentation of that performance due to the skewedness of that metric. A key observation made was that the companies assessed typically measured safety performance using one or two safety metrics only. This implies that companies viewed safety performance from a narrow perspective, ignoring other key measurements that can enable a more comprehensive analysis of performance. Another limitation observed during the safety metrics data collection involved the manual storage of the safety data. Of the eight companies sampled, only three stored their safety data electronically. The manual storage of the data made retrieving it quite tedious and time-consuming, which made the identification and mitigation of the companies' safety-related issues also more difficult. A key limitation of the research is that, the DM metrics used in isolation may not necessarily point to a deficiency in the DM performance and thus may easily lend themselves to misinterpretation. The metrics are exploratory in nature and are therefore not exhaustive in themselves. Future research should focus on developing additional metrics as well as formally validating all of the 12 metrics proposed in the research.

With respect to DM, the results showed that the companies assessed achieved in general high RTW rates for injured employees, with few unaccounted absences of injured employees. The identification of such gaps is crucial to ensuring RTW accountability and follow-up, as without such measures, these gaps may not be detected and affected employees may not be properly accommodated. The measurement of the number of injuries that required case management could also help companies assess the quality of that case management and required modifications. Although some of the companies that recorded high incidents rates recorded high RTW rates, the

statistical analysis of the data did not point to any direct relationship between safety and DM performance data, potentially because of the small number of companies assessed. The findings also revealed that some companies were more successful than others in providing modified work to returning employees and in transitioning employees from modified work to their original jobs. This is a key determinant of effective DM and RTW programs as identified by Lingard and Saunders (2004) and reinforces the need for future research to investigate the physical and mental requirements of jobs within the industry. This is to ensure that returning employees are provided with work that takes full advantage of their physical and mental abilities.

The results also showed that even though existing safety metrics in the literature provide an adequate benchmark of companies' safety performance, they do not adequately benchmark their DM performance. Therefore, construction companies should start benchmarking their DM performance using the DM metrics developed throughout this research. This should involve them tracking, setting targets and reviewing these metrics on a regular basis with the aim of improving them. One key limitation of this research was that the companies assessed did not track all of the data required to calculate all of the safety and DM metrics defined in this research. The eight companies evaluated collected data for only 3 of the 15 safety metrics included in this research. Moreover, only four of these eight companies collected DM metric data. These four companies collected data for only five of the 12 DM metrics proposed in this research. This restricted the DM metrics that could be calculated and thus the evidence available about these companies' DM performance. Another key limitation related to the need for construction companies to use many of these metrics together to fully benchmark DM performance as a single metric alone could be interpreted in a number of ways and thus mislead its users. This being said, when used together,

the proposed metrics provide leading indicators of DM performance that the safety metrics do not provide. They also provide a form of accountability that ensures proactive support at the organizational level. Applying a supportive rather than a transactional approach to DM can maximize engagement opportunities and help organizations recognize early signs of ineffectiveness in the workplace.

4.4 Objective #4: Evaluating Construction Organizations' Disability Management and Safety Performance

The research involved investigating the relationship between the results stemming from applying the CDM3 to evaluate companies' DM maturity and the results stemming from applying the safety and DM metrics to evaluate companies' safety and DM performance respectively. More specifically, the first subsection focuses on analyzing the relationship between the CDM3's overall maturity scores and the DM metrics for the companies evaluated. The second focuses on analyzing the relationship between the CDM3's overall maturity scores and the safety performance metrics whereas the third explores the relationship between the maturity of DM indicators and the DM metrics. The third subsection delves into the relationship between the maturity of individual DM indicators and the safety metrics. The subsequent subsections describe the interrelationships between the maturities of the different DM indicators, the relationship between the leading and lagging indicators of performance in the case of Company 1 in particular and the implications of all the findings in this section.

4.4.1 Relationship between Overall Disability Management Maturity and Disability Management Performance

The research involved investigating the relationship between the companies' overall DM maturity scores (i.e. leading indicators of performance) and each of the five DM metrics applied to those companies (i.e. lagging indicators of performance). This is to explore the way in which a company's overall DM management maturity relates to its injured employees' rate of return (i.e. DM5), the percentage of employees that required case management (i.e. DM6), the percentage of employees off work due to injury (i.e. DM7), the percentage of employees on modified duty (i.e. DM9) and the number of employees transitioning from modified work to their original work (i.e. DM10). This relationship was assessed in the four companies to which the DM metrics were applied (i.e. Companies 1, 3, 4 and 7). This assessment was conducted with a key limitation in mind. The DM metrics were collected annually from 2012 to 2015, whereas the maturity assessment was conducted in 2016. For the relationship to be plausible, the maturity assessment would have needed to be conducted annually between 2012 and 2015 with the results for each year correlated to the DM metric results for that same year. Another option would have been to collect the DM metrics for 2016 and correlate them to the 2016 maturity assessment results. It can even be argued that since the maturity model is a predictive model (i.e. leading indicators), future research should correlate the maturity assessment results to the DM metrics (i.e. lagging indicators) of the year following the year on which the model was applied. This is to assess whether predictive performance correlates with actual performance.

Figure 24 illustrates the average DM metric scores for these four companies over the four-year research period from 2012 to 2015 against these companies' overall maturity (i.e. *MS Company*)

scores. In looking at the graph, no relationship appears to exist between companies' *MS Company* scores and the five DM metrics. For example, no relationship seems to exist between companies' *MS Company* for DM and their employees' rate of return (i.e. DM5). Company 7 had an overall maturity score (*MS Company*) of 4.48, but an average DM5 of 87.74% whereas Company 1 had an *MS Company* of 3.74 but a DM5 of 93.18%. This is not entirely surprising given that a company's overall DM maturity scores (i.e. *MS Company*) measures their overall maturity with respect to 12 different indicators whereas DM5 focuses specifically on employees' RTW. Therefore, it's possible that a company would achieve low maturity on a relevant indicator (i.e. *MS Indicator*) such as "Return to work and accommodation" yet still end up with a high average maturity score (i.e. *MS Company*) because of it achieving high maturity scores on other irrelevant indicators. Similarly, no relationship appears to exist between the average percentage of employees placed on modified duty (i.e. DM9) and companies' *MS Company* scores. For example, Company 1 had an *MS Company* score of 3.74 but an average DM9 of 74.5% whereas Company 3 had an *MS Company* score of 4.04 but a DM9 of only 16.6%. This does not necessarily imply that Company 3's ability to place injured employees on modified duty is low. It may simply mean that most injured employees in Company 3 were able to return back to their original duties. In looking at the average DM5 and DM9 values of Company 3, it can be concluded that of the 96.88% of injured employees who returned back to work (i.e. DM5), only 16.6% were placed on modified duty (i.e. DM9). The DM9 metric should not therefore be used in isolation when interpreting overall DM performance, as it can misrepresent DM overall performance. It should be used in conjunction with other metrics such as DM5 to get a better picture of performance. This is because DM5 measures the percentage of workers who returned to work, regardless of whether they returned to either their original jobs or to alternative or modified jobs whereas DM9 measures the

percentage of workers placed on modified duty. So essentially DM9 gives further context to DM5, as it states how many of those workers who actually returned were placed on modified duty, highlighting the value of using both metrics together.

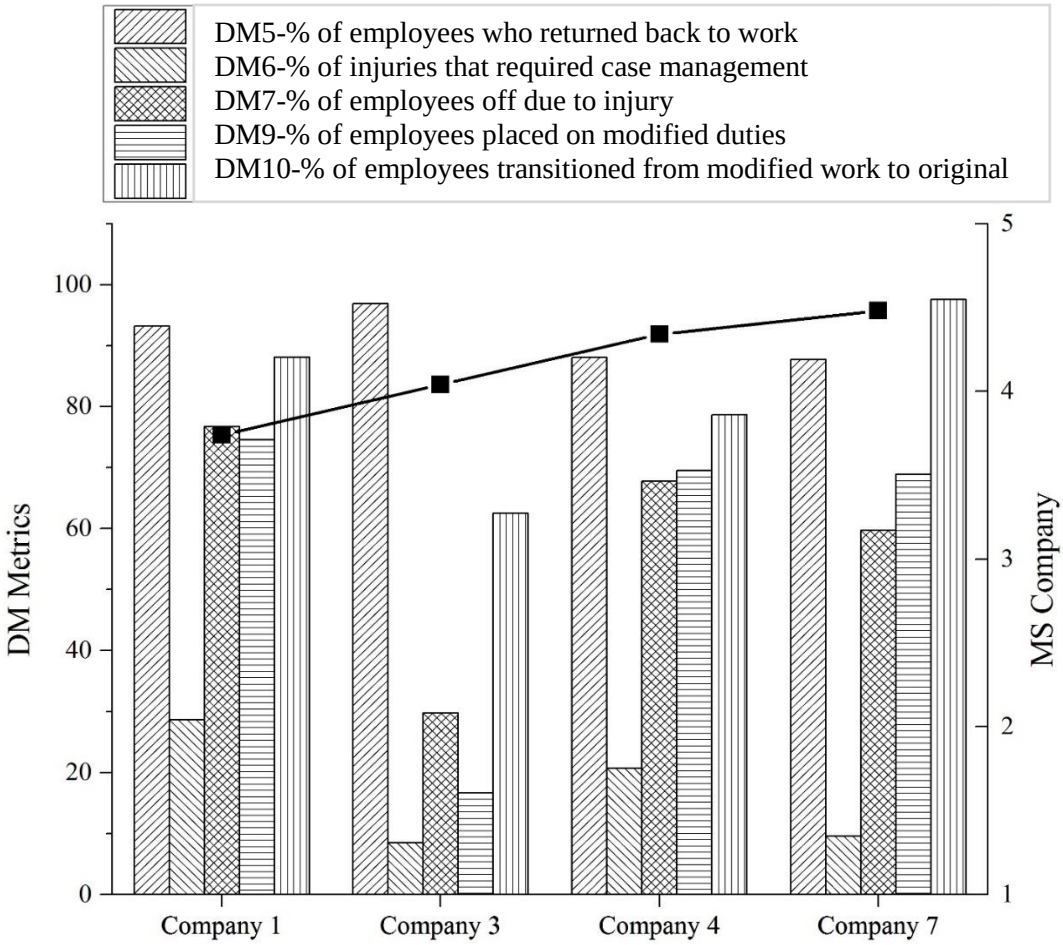


Figure 24: Comparison of DM Maturity and Metrics Data

The lack of a relationship between companies' overall DM maturity scores (i.e. *MS Company*) and their DM performance metrics could also be due to the level of subjectivity associated with evaluating a company's maturity using leading indicators of performance such as the CDM3. This evaluation of maturity relies on the subjective assessment of respondents. Respondents are required to assess the extent to which they think key practices are implemented. Therefore, they

may rate their practices as more mature than they really are. Respondents in one company may also rate their practices as more mature than respondents in another company even though the practices in both companies may be at the same level of maturity. Therefore, it would be ideal even though highly impractical if one person were to conduct the assessment of all companies. This also highlights the importance of measuring performance using lagging and leading indicators simultaneously. Leading indicators of performance can help companies determine factors affecting the risk of injury and accommodations available to injured employees. They can also make them more proactive by helping them identify opportunities for improvement before the fact, i.e. before the occurrence of an accident or injury. How well these efforts work in practice will need to be assessed using lagging indicators of performance. Evidence of decreasing rates of return can for instance be a sign that improvements are needed in the DM program. However, lagging indicators do not typically pinpoint where a DM program might need improvement, only how badly it needs it. Since lagging indicators do not explain the "why" behind the bottom line, companies may tend to respond with broad, general corrective actions. Nevertheless, lagging indicators can be useful when identifying trends in past performance. A potential weakness of them is that, unlike leading indicators, companies typically react to them after the fact, which may not be ideal when it comes to preventing work accidents and injuries and keeping employees healthy and safe.

This lack of a relationship between the CDM3 (i.e. leading indicator of performance) and the DM metrics (i.e. lagging indicator of performance) should be investigated in a larger research sample given that this research only evaluated this relationship in four companies. Future research should also focus on investigating companies that collect most if not all of the data related to the 12 DM metrics developed in this research. This may help establish relationships between the CDM3 and

the DM metrics that cannot be detected using only five metrics. Because this area of research is relatively new, there are no direct comparisons that can be made to other studies in the literature evaluating DM. However, a comparison to other studies evaluating other aspects of performance using leading and lagging indicators simultaneously (e.g. Willis and Rankin 2011, Goggin and Rankin 2010) showed similar results. Although Willis and Rankin (2011) had found a potential relationship between the overall maturity of the construction industry and it's lagging performance, this relationship could not be statistically proven despite the research's large sample size. This was also echoed by Goggin and Rankin (20010) who had found a relationship between a company's health and safety maturity score and their health and safety performance in some companies only. Additionally, McCabe et al. (2008) only established a relationship between some health and safety factors (i.e. the leading indicators) and the prevalence of accidents (i.e. the lagging indicators).

Running Spearman's correlation test between overall DM maturity of the 4 assessed companies and their measured DM performance using metrics, the results found significant very strong negative correlation between DM6, the percentage of workers requiring case management and overall DM maturity, with an R-value of -0.975 and a p-value of 0.025. By implication, the correlation implies the higher the overall DM maturity, the lower the percentage of worker that require case management, and vice versa. A negative correlation between the overall DM maturity and DM6 means that one variable increases whenever the other decreases. This relationship may or may not represent causation between the two variables, but it does describe an existing pattern. The existence of a relationship goes to validate to an extent the connection between DM maturity and the developed metrics. Performing a regression analysis to quantify the predictability of the negative relationship between the two variables would further explain the effects overall DM

maturity has on DM6 and thus the other DM metrics. This cannot be done due to the sample size. The existence of the relationship however pinpoints to not only the validity of the metrics in measuring DM performance, but also indicative of the positive effects improved DM has on the number of injuries requiring case management.

4.4.2 Relationship between Overall Disability Management Maturity and Safety Performance

The research involved investigating the relationship between companies' overall DM maturity scores derived from using the CDM3 (i.e. leading indicators of performance) and each of the three safety metrics of RIR, SR and LTCR (i.e. lagging indicators of performance). This is to investigate whether companies with more mature DM practices have higher safety performance than companies with less mature DM practices. While the three safety metrics evaluated in this research do not reflect every aspect of health and safety performance, these metrics have been validated and accepted industry wide and are thus generally used by construction companies to track their safety performance. The data is discussed with a key limitation in mind. The safety metrics were collected annually from 2012 to 2015 whereas the maturity assessment was conducted in 2016. For the relationship to be valid, the maturity assessment needed to be conducted annually between 2012 and 2015 with the results for each year correlated to the safety metric results for that same year. Another option would have been to collect the safety metrics for 2016 and correlate them to the 2016 maturity assessment results. It can even be argued that since the maturity model is a predictive model (i.e. leading indicators), future research should correlate the maturity assessment results to the safety metrics (i.e. lagging indicators) of the year following the year on which the model was applied. This is to assess whether predictive performance correlates with actual

performance.

Figures 25, 26 and 27 depict box plots for the safety metrics of RIR, SR and LTCR over the 4 observed years for each company against the companies' overall DM maturity (i.e. *MS Company*) scores for the eight companies, represented by the line graph. The box plot shows the maximum, minimum and median RIR, SR and LTCR for each company over the 4 observed years. In general, companies with higher overall DM maturity (i.e. *MS Company*) appeared to have lower safety metric values and thus higher safety performance than companies with lower DM maturity. The standard deviation for the RIR values for all companies is 9.04, as compared to overall mean of 20.11 and a median of 18.86. The standard deviation (SD) of 9.04 means that most companies have RIR of 9.04 more or less of the average 20.11. Similarly the standard deviation for the SR values for all companies is 41.90 with an overall mean of 61.68 and a median of 46.62. Comparatively to RIR, companies SR values were more polarized, as SR values greatly varied from year to year and from company to company. Based on the distributions, SR values spiked for most companies in 2013 and 2014, with injury severity lowering in 2015. The standard deviation for LTCR was significantly less distributed, with SD of 4.69, an overall mean of 7.34 and a median of 6.76. From the data, it could be seen that companies with higher overall DM *MS Company* scores appeared to have lower RIR as shown in Figure 25. For instance, Company 7 had an *MS Company* of 4.48 and an average RIR of 16.58 over the four-year study period, whereas Company 1 had an *MS Company* of 3.74 and an average RIR of 27.92. Similarly, Company 4 had an *MS Company* of 4.34 and an average RIR of 13.61 whereas Company 5 had an *MS Company* of 3.77 and an average RIR of 27.21 over the four-year study period. This points to a potential relationship between construction companies' overall DM maturity (i.e. *MS Company*) and their RIR whereby

an improvement in companies' DM practices could translate to lower injury rates across their projects. Similarly to RIR, potential relationships could also be detected from Figures 25 and 26 between companies' overall DM maturity (i.e. *MS Company*) and their SR on one hand, and between their overall DM maturity and LTCR on the other. For example, Companies 2, 4 and 6 with the highest maturity scores (i.e. 4.37, 4.34 and 4.23 respectively) recorded the lowest SR (i.e. four-year averages of 44.19, 42.15 and 61.63 respectively) and LTCR (i.e. four-year averages of 8.45, 6.41 and 2.82 respectively). In contrast, Companies 1, 5 and 8 with the lowest maturity scores (i.e. 3.74. 3.77 and 3.52 respectively) recorded high SR (four-year averages of 82.06, 62.05 and 45.55 respectively), and LCTR (four-year averages of 15.82, 6.24 and 2.87 respectively).

These observations are logical given the strong overlap between the concepts of safety management and DM. For the most part, DM tends to fall under safety management in the construction industry. This is because DM essentially encompasses all aspects of safety management in its primary preventive practices such as injury and hazard preventative practices. However, DM extends beyond preventative practices to actually providing accommodations and implementing strategies that integrate disabled and injured employees back to the workplace. Therefore, given this overlap, it would not be surprising to see companies which improve their DM practices experience an improvement in their safety performance. Future research would need to test this observation statistically over a larger research sample. If this observation can be generalized to a larger population, it would provide a strong argument in favour of construction companies prioritizing DM due to its significant safety implications.

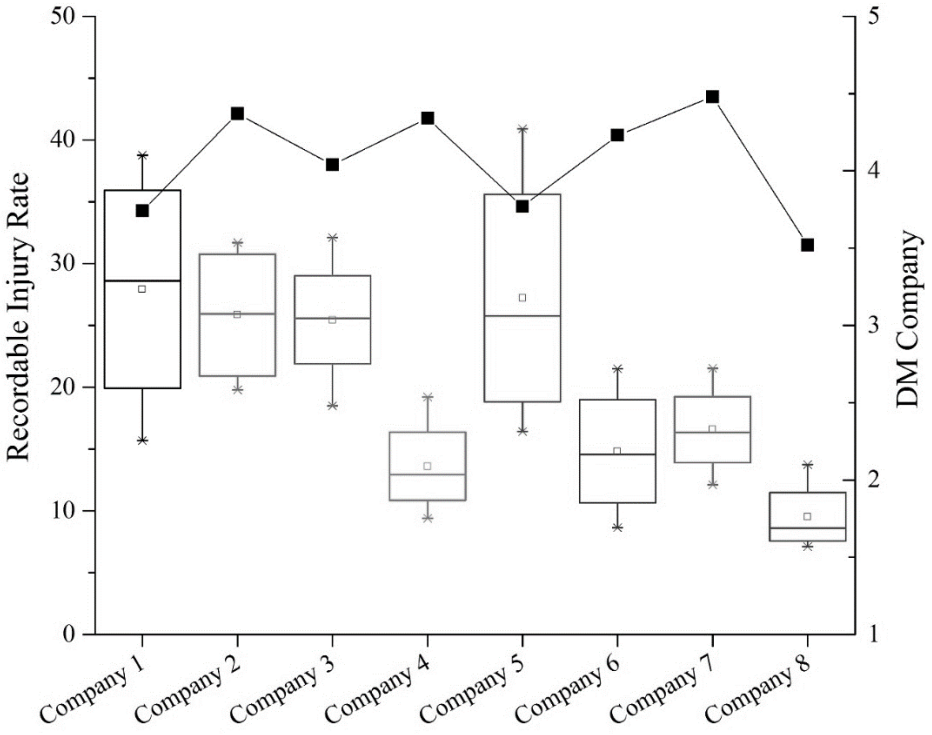


Figure 25: Comparison of DM Maturity and RIR

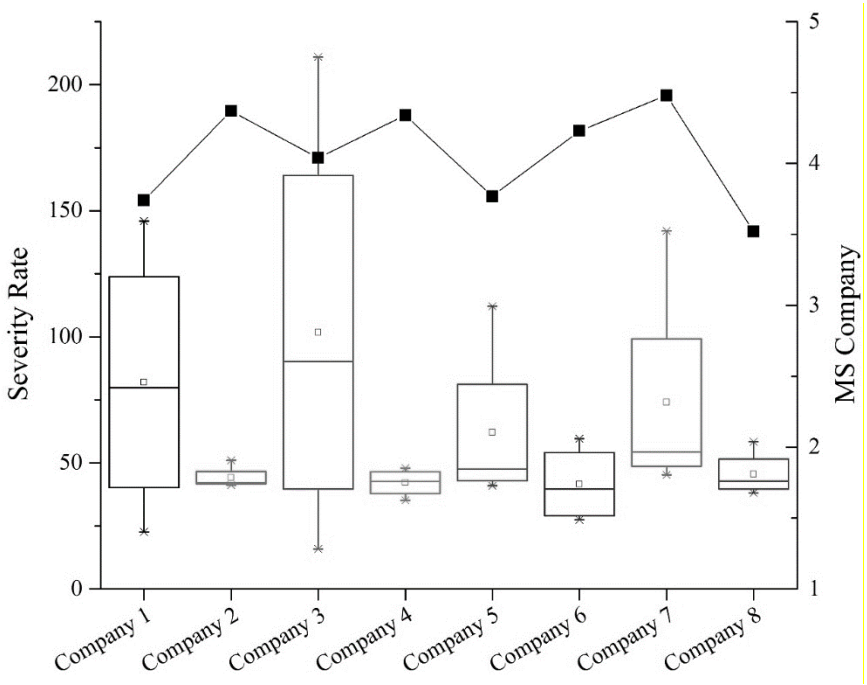


Figure 26: Comparison of DM Maturity and SR

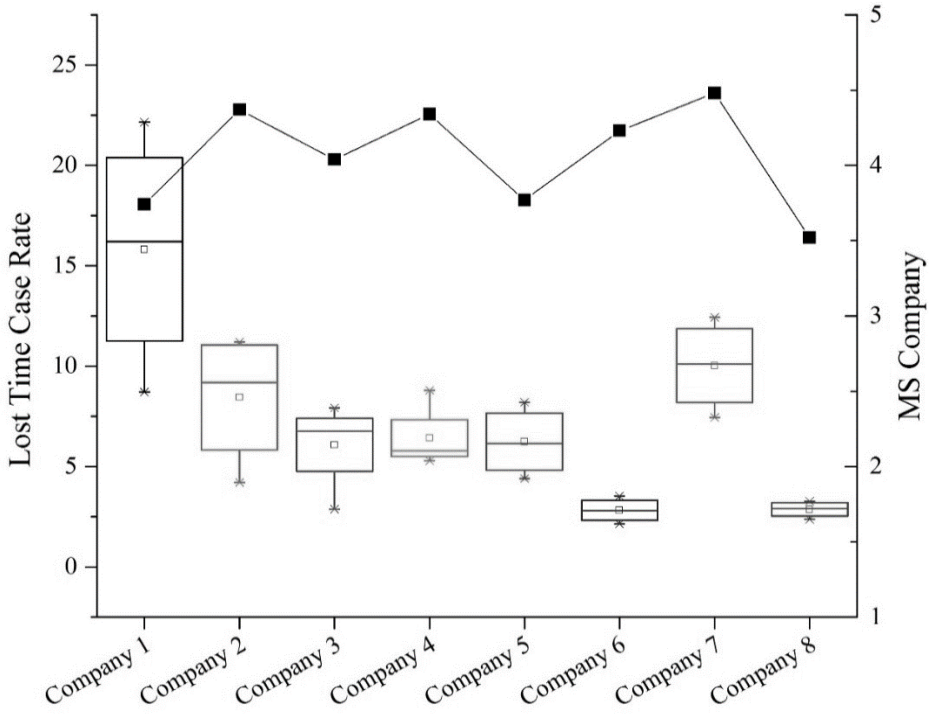


Figure 27: Comparison of DM Maturity and LTCR

There are a few exceptions to this general trend in the findings. Figures 26 and 27 show that although Company 7 had the highest *MS Company* (i.e. 4.48), it recorded high SR (i.e. 74) and LTCR (10.03) despite its low RIR (i.e. 16.58) as shown previously. This effectively means that the company recorded fewer injuries over the course of the four years but their severity and the amount of time lost to them were significantly higher. This highlights the importance of using more than one safety metric to measure safety performance instead of relying on a single one. Moreover, Company 8 had the lowest *MS Company* (i.e. 3.52) and recorded low RIR (i.e. 9.53), SR (i.e. 45.55) and LTCR (i.e. 2.87). Similarly, although Company 2 recorded a high *MS Company* of 4.37, it also recorded a high RIR of 25.84. This could be due to the fact that the RIR of Company 2 is being compared to its overall maturity score, rather than to the maturity of its "Disability and injury prevention" indicator which would be the most relevant indicator to compare its RIR to.

The company may have achieved low maturity on this particular indicator which would explain its high RIR but high maturity on most other indicators and thus high overall maturity. This reinforces the need to compare companies' safety metrics to the maturity of specific DM indicators (i.e. *MS indicator*) rather than overall DM maturity (i.e. *MS Company*). The low overall DM maturity of Company 8 may be due to the ad-hoc and random nature of its DM practices. Because of its low RIR, Company 8 may have not felt the need to standardize or prioritize its DM practices, thus its low overall DM maturity. This is risky as the lower maturity of the company's DM practices could in turn make it unable to deal with a rise in its RIR.

Further research should assess these potential relationships statistically on a larger sample of companies, as all this research can allude to is the possible existence of potential relationships between these various variables in the eight companies evaluated. This should help identify specific opportunities for optimizing performance and also identify shared trends between the leading and lagging indicators of performance.

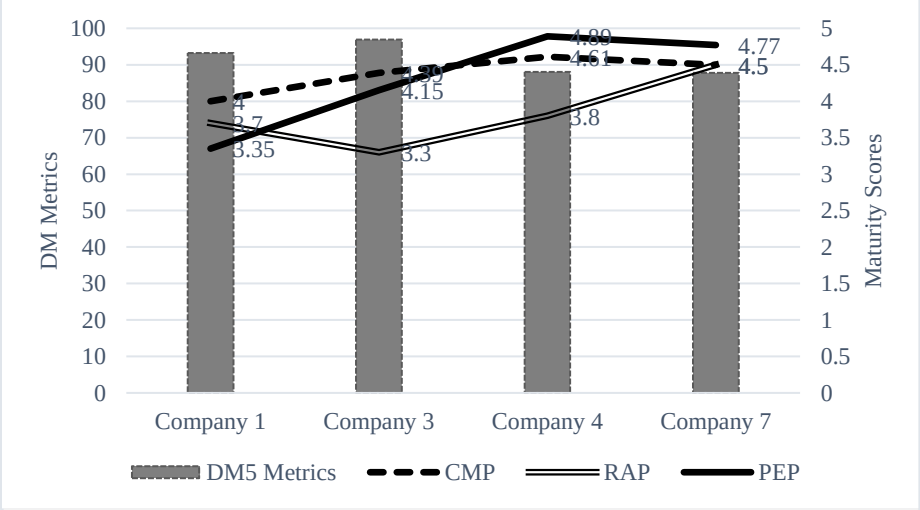
4.4.3 Relationship between Maturity of Disability Management Indicators and Disability Management Performance

As specified in the methods section, the relationship between the five DM metrics and the maturity of their corresponding indicators as detailed in Table 7 could only be assessed graphically because of the research's small sample size. Only four out of 10 companies provided data for the DM metrics, restricting thus the analysis to those four companies. As stated previously, another important limitation of the analysis was that the DM metrics were collected annually from the 2012 to 2015, whereas the maturity assessment of the different indicators was conducted in 2016.

Moreover, due to the small number of sampled companies, more rigorous statistical analysis such as regression analysis using the leading (MS scores) and lagging indicators (metrics) of performance could not be conducted. The research therefore analyzed trends in the relationship between maturity of DM indicators and DM performance using graphs. The research also analyzed the linear relationship between the metrics and the DM indicators using Spearman's correlation.

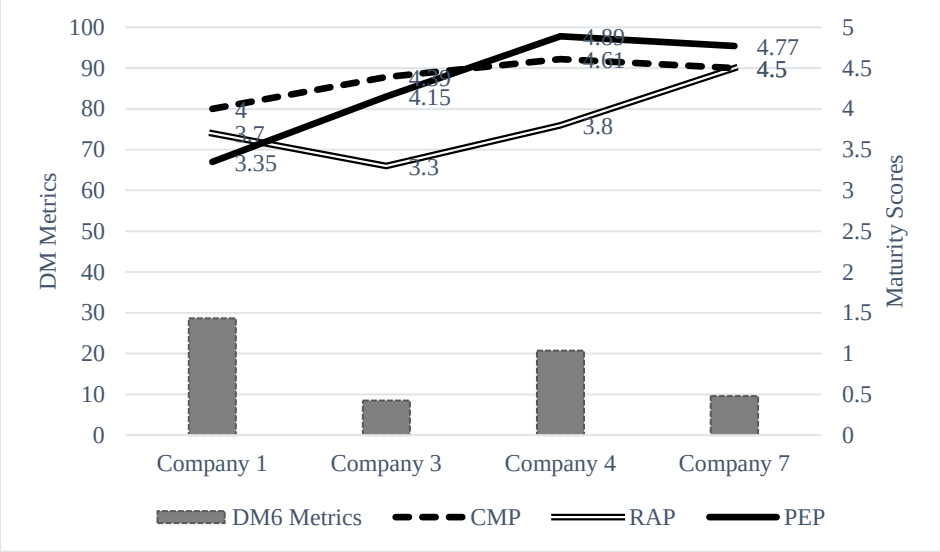
4.4.3.1 Trends between Maturity of Disability Management Indicators and Disability Management Performance

Figures 28, 29, 30, 31 and 32 depict the average of each DM metric over the four-year study period for each company versus the average maturity of each relevant indicator (i.e. *MS Indicator*) for each company.



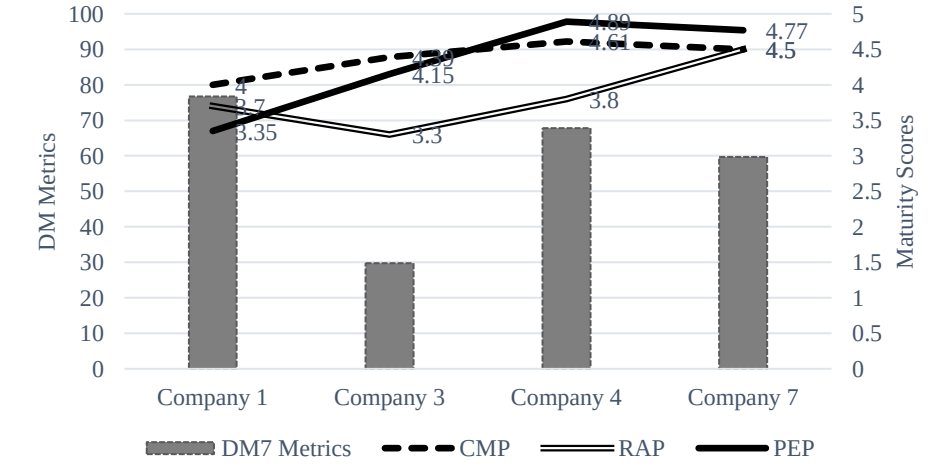
DM5-% of employees who returned back to work
Case management practices (CMP)
Return to work and accommodation practices (RAP)
Program evaluation practices (PEP)

Figure 28: Comparison between DM Indicators and DM5



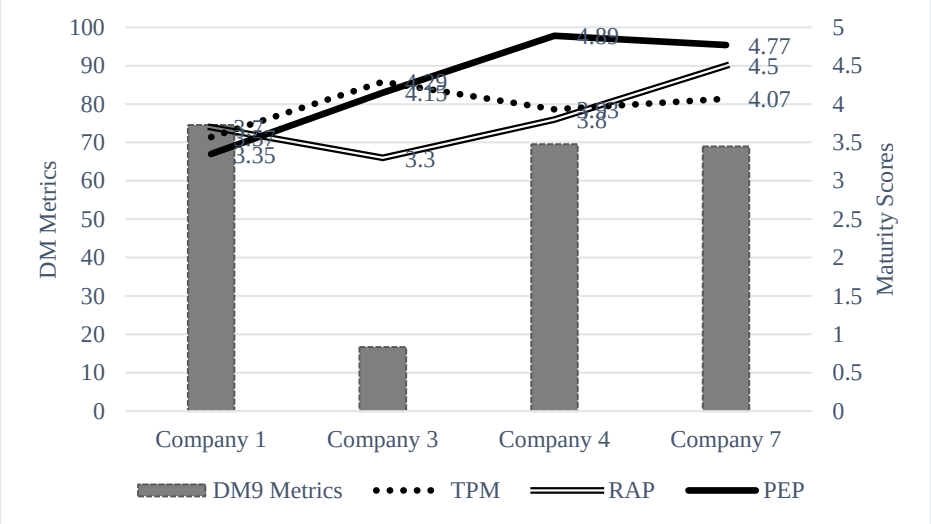
DM6-% of injuries that required case management
Case management practices (CMP)
Return to work and accommodation practices (RAP)
Program evaluation practices (PEP)

Figure 29: Comparison between DM Indicators and DM6



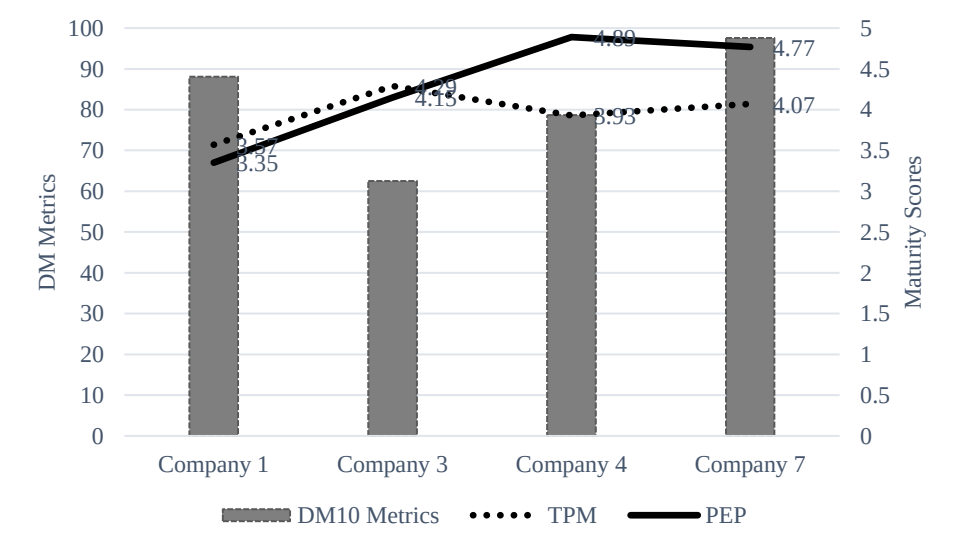
DM7-% of employees off due to injury
Case management practices (CMP)
Return to work and accommodation practices (RAP)
Program evaluation practices (PEP)

Figure 30: Comparison between DM Indicators and DM7



DM9-% of employees placed on modified duties
Return to work and accommodation practices (RAP)
Program evaluation practices (PEP)
Transitional program management practices (TPM)

Figure 31: Comparison between DM indicators and DM9



DM10-% of employees transitioned from modified work to original
Program evaluation practices (PEP)
Transitional program management practices (TPM)

Figure 32: Comparison between DM indicators and DM10

Surprisingly, these graphs did not highlight many relationships between these DM metrics and the maturity of related indicators. For instance, Figure 28 showed little relationship between the percentage of employees who returned back to work (i.e. DM5) and the maturity of its corresponding indicators: “Return to work and accommodation” (RAP), “Case management” (CMP) and “Program evaluation” practices (PEP). This is the case even though the expectation was that the higher the maturity of these indicators and of RAP in particular, the higher the percentage of employees who successfully returned to work. For example, Company 4 had the highest DM5 at 96.88% even though its indicators were the least mature comparatively, with RAP, CMP and PEP having *MS Indicator* scores of 3.7, 4.0, and 3.35 respectively. Similarly, Company 7 had a lower DM5 at 87.74% even though its RAP, CMP and PEP were more mature, with *MS Indicator* scores of 4.5, 4.5 and 4.77 respectively. Furthermore, Figure 29 did not pinpoint to any relationship between the percentage of injuries that required case management (i.e. DM6) and its corresponding indicators: “Return to work and accommodation” (RAP), “Case management” (CMP) and “Program evaluation” practices (PEP). This was surprising given that that more mature RAP, CMP and PEP were expected to decrease the severity of on-site accidents which would have in turn decreased the percentage of injuries requiring case management (i.e. DM6). Similarly, Figure 32 showed no clear relationship between the percentage of employees who transitioned from modified work to original work (i.e. DM10) and the maturity of its related indicators: “Transitional program management” (TPM) and “Program evaluation” practices (PEP). This was also surprising as the expectation was that the higher the maturity of these indicators, the higher the DM10 metric.

The only two figures to have shown a potential relationship between its leading and lagging indicators were Figures 30 and 31. Figure 30 depicted the relationship between the percentage of employees due off work due to injury (i.e. DM7) and the maturity of its corresponding indicators: "Return to work and accommodation" (RAP), "Case management" (CMP) and "Program evaluation" practices (PEP). The relationship was such that companies with lower maturity had higher DM7 whereas companies with higher maturity had relatively lower DM7. For example, Company 1 had *MS Indicator* scores of 3.7, 4.0 and 3.35 for RAP, CMP and PEP respectively but an average DM7 of 76.71%. This is in contrast with Company 7 which had *MS Indicator* scores of 4.5, 4.5 and 4.77 for RAP, CMP and PEP respectively and an average DM7 of 59.71 only. Similarly, Figure 31 alluded to a potential relationship but only between the percentage of employees who were placed on modified duty (i.e. DM9) and the maturity of the indicator: "Transitional program management" (TPM). No similar relationship could be observed between DM9 and the maturity of the other relevant indicators: "Program evaluation" practices (PEP) and "Return to work and accommodation" practices (RAP). The observed relationship was such that the higher the maturity of TPM, the lower the DM9 metric. For example, Company 3 had an *MS Indicator* value of 4.29 for TPM and a DM9 of 16.67% whereas Companies 1 and 4 had *MS Indicator* values of 3.57 and 3.93 for TPM respectively and a DM10 of 88.10% and 78.69% respectively. This relationship could be due to the assumption that more mature TPM would ensure the provision of adequate support (i.e. accommodations) that could help employees return to their original jobs directly rather than to modified jobs because of the lack of such support. For those who would still need to be placed on modified duty, more mature TPM could help them return to their original duties faster. This being said, the progression from modified duty to original duty could also depend on the nature of employees' original jobs, the nature and severity of their

injuries, their physical and mental capabilities and their rehabilitation progress. These are factors that are somewhat independent of the TPM practices used within a company. Future research should therefore investigate how these factors, together with these TPM practices can affect the percentage of workers placed on modified duty.

Because of the very small sample of companies evaluated, it was impossible to assert with any degree of certainty whether any of these relationships would exist in a larger sample of companies. Therefore, future research would need to substantiate them in a much larger sample of companies. Should these relationships exist, the disparity in performance between the leading indicators of the performance (i.e. the maturity of the relevant indicators) and the lagging indicators of performance (i.e. the DM metrics) could serve as an internal performance check for companies. It could allow companies to reassess their existing DM practices to ensure they are well implemented and lead to higher actual DM performance. These results also highlight the importance of assessing performance using both leading and lagging indicators of performance as one type of indicators alone may misrepresent DM performance.

The disconnect between companies' average DM metrics scores and their DM indicators' maturity could also be due to the level of subjectivity associated with evaluating a company's maturity using leading indicators of performance such as the CDM3. This is because the evaluation of maturity relies on the subjective assessment of respondents. The lack of a direct relationship could also be due to the nature of these metrics and how they are interpreted rather than the absence of an actual relationship between them. The higher percentage of case management injuries (i.e. DM6) for example could be due to the seriousness of the injuries rather than to the company's

increased ability to develop a customized program for every injured worker individually. The higher percentage of employees off due to injury (i.e. DM7) could also simply be a sign of the seriousness of the injuries that require time off rather than a company's inability to accommodate employees in a way that would avoid time off.

4.4.3.2 Correlations between Maturity of Disability Management Indicators and Disability Management Performance

The research also analyzed the linear relationships between the DM metrics, DM5, DM6, DM7, DM9 and DM10 and the all the DM indicators using Spearman's correlation, even those not directly measured by the metrics. Table 15 shows the statistically significant correlations found.

Table 15: Correlation between the DM metrics and DM Indicators

Correlations	**R-value**	**P-value**
Communication practices to DM10-% of workers who transitioned from modified work to original work	-0.920	0.080
Case Management practices to DM6-% of workers that required case management	-0.946	0.054
Claims management practices to DM6-% of workers that required case management	-0.979	0.021
Disability and injury prevention practices to DM7-% of workers due off work to injury	-0.922	0.078
Program evaluation practices to DM6-% of workers that required case management	-0.958	0.042
Senior management support practices to DM6-% of workers that required case management	-0.917	0.083
Senior management support practices to DM7-% of workers due off work	-0.908	0.092
Regulatory and compliance policies to DM6-% of workers that required case management	-0.997	0.003
Recruitment and retention practices to DM6-% of workers that required case management	-0.937	0.06
DM7-% of workers due off work to DM 9-% of workers placed on modified duties	0.971	0.029

Correlation is significant at the 0.1 level (2-tailed).

Using triangulation to facilitate validation of the metrics and the maturity model, the relationships between data collected through the metrics and DM indicators were analysed and cross verified. In regards to the indicators measured by the metrics, the results show a very strong negative linear relationship between Case management practices and DM6, the percentage of worker that required case management. The strong correlation goes to validate the DM metrics, specifically the DM6, as it does relate to an aspect of DM. From the findings, it can be stipulated that, as Case management practices mature, the percentage of workers requiring case management lowers and vice versa. This is significant especially in making arguments for improving Case management practices. The metric therefore can be said to demonstrate the efficiency of Case management practices, as it can lower the percentage of workers who require case management. Based on this finding, it can be implied that, companies who optimize their Case management practices should see a decrease in the percentage of workers requiring case management and vice versa. Similarly, very strong negative correlations were found between Disability and injury prevention practices and DM7, the percentage of workers due off work to injury, with an R-value of -0.922. The existence of a linear relationship is supported by literature, as the more efficient a company's safety management and prevention program is, the lower the number of injuries and thus, the number of workers who require leave due to injury. The very strong correlation between the metrics data (past data) and the maturity of DM indicators provides further validation for the develop metrics specifically as lagging indicators of DM performance. More data is required to analyze the effects and the relative strength of the relationship between the maturity of DM indicators and the DM metrics using regression analysis. Conducting regression in future research can also help predict DM performance, either lagging or leading DM performance.

Interestingly, very strong correlations were also detected between the DM metrics and DM indicators not directly measured by these metrics. The analysis found a very strong negative correlation between Communication practices and DM10, the percentage of workers who transitioned from modified work to original work, with an R-value of -0.920. The negative linear relationship between Communication practices and the percentage of workers who transitioned from original work is significant especially in understanding the effects of the DM indicators maturity on the DM metrics. By proxy, it can be implied that the maturity of Communication practices directly or indirectly effects the percentage of workers who transition from modified work to original work. The development of the measure DM10 was not determined to be directly related to Communication practices as specified in Table 8, but this was based on the experience of the researchers in analyzing each indicator and the developed metrics. The existence of a relationship shows firstly, the interconnectivity of the DM indicators and possible overlap in the indicators assessed by the DM metrics. Secondly, it proves to an extent the validity of the metrics, as the metrics rightly relates with the indicators of DM performance. The negative relationship is significant and supports the maturity model which uses leading indicators of DM and the metrics which uses lagging indicators of DM performance. Communication practices is a bedrock in the DM program and can be said to be pivotal in all the other DM indicators. Similarly, the analysis detected very strong negative correlations between Program evaluation practices, Senior management support practices, Regulatory and compliance policies and Recruitment and retention practices to DM6, the percentage of workers that required case management, with R-values of -0.958, -0.917, -0.997 and -0.937 respectfully. The very strong negative linear relationship of these four DM indicators to the percentage of workers who require case management is further evidence of the relationship between the developed metrics and the DM indicators as lagging and leading

indicators of DM performance. The existence of the relationship goes to again validate the DM metrics as lagging indicators of DM performance as they relate to key DM indicators. By implication, the strong linear relationship proves that, the more mature DM practices have effects on overall DM performance as evidenced by lower percentage of workers that require case management. In the same vain, very strong negative correlation was found between Senior management support practices and DM7, the percentage of workers due off work to injury, with an R-value of -0.908. This means the more mature Senior management support practices are, the lower injury rate, thus the percentage workers that need to be off work. This is significant especially when understanding the impact of a company's senior management support and its impact on the implementation of DM and safety practices. The findings goes to buttress the importance of senior management support especially on DM performance, and as seen in this research, on the percentage of workers due off work to injury. With the existence of a very strong relationship, it can be argued that companies need to rethink their approach to DM as it could possibly result in decreasing the percentage of workers who need to be off work to injury.

These strong negative correlations between the maturity of DM indicators and the DM metrics provides ample evidence as a means to promote DM in construction workplace and encourage the active adoptions of these practices. With the possibility of lowering injured workers and reducing the injuries that require case management, construction companies will see the importance and value in continually improving their DM practices. Consequently it also proves the developed metrics do relate to DM maturity and their respective performance are connected and have an effect on one another. Future research is needed to investigate these linear relationships using regression analysis to determine the actual effects of improved DM practices on DM performance

measured by the metrics.

In regards to the relationship between the metrics themselves, very strong positive correlation was found between DM7, the percentage of workers due off work to injury and DM, the percentage of workers placed on modified duties, with an R-value of 0.971. By implication, as the percentage of workers due off work increases, the percentage of workers requiring modified work also increases. This relationship is supported by DM and safety management literature. Naturally, workers who get injured and require time off work, have more severe injuries and therefore require time off work. Part of these workers, based on their level of injury and job requirements may not be able to return to their original jobs right away, thereby requiring modified work. The findings therefore support that, higher percentages of workers due off work to injury varies positively with the percentage of workers who would need modified work. This is significant to companies especially in forecasting RTW needs based on injury levels and the number of workers who take time off work due to injury.

4.4.4 Relationship between Maturity of Disability Management Indicators and Safety Performance

The relationships between the three safety metrics of RIR, SR and LTCR and the maturity of specific DM indicators were also assessed using Spearman's correlation test. Significant correlations are presented in Table 16 below.

Table 16: Correlation between the DM Indicators and Safety Metrics

Correlations	R-value	P-value
Senior management support practices to Recordable injury rate	-0.730	0.040
Senior management support practices to Severity rate	-0.861	0.006
Retention and recruitment policies to Recordable injury rate	-0.711	0.048

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

Of the 12 DM indicators investigated, only "Senior management support" practices and "Retention and recruitment" policies showed statistically significant correlations to the metrics. More specifically, the results revealed a statistically significant negative correlation between the maturity of "Senior management support" practices and RIR, with an R-value of -0.730 and a p-value of 0.040. There was also a statistically significant negative correlation between the maturity of "Senior management support" practices and SR, with an R-value of -0.861 and a p-value of 0.006. Additionally, the results showed a negative correlation between the maturity of "Retention and recruitment" policies and RIR with an R-value of -0.711 and a p-value of 0.048. Interestingly, no relationship was found between the maturity of companies' "Disability and injury prevention" practices and these safety metrics despite speculating that this relationship may exist in subsection 4.4.2. Future research should explore these relationships in a much larger sample of companies.

4.4.5 Interrelationships between Maturities of Disability Management Indicators

The research also involved investigating the relationships between the maturities of the various DM indicators using Spearman's correlation test. Significant correlations are shown in Table 17 below.

Table 17: Correlation between the DM Indicators

Correlations	**R-value**	**P-value**
Case management practices to Claims management practices	0.922	0.001
Case management practices to Transitional program management practices	0.790	0.020
Case management practices to Program evaluation practices	0.755	0.031
Return to work and accommodation practices to Program evaluation practices	0.849	0.008
Claims management practices to Program evaluation practices	0.855	0.007
Claims management practices to Transitional program management	0.789	0.020
Program evaluation" practices to Transitional program management practices	0.723	0.049
Regulatory and compliance polices to Disability and injury prevention practices	0.810	0.015
Regulatory and compliance polices to Recruitment and retention polices	0.727	0.041

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

The results revealed a strong statistically significant positive correlation between the maturity of "Case management" practices and the maturity of "Claims management" practices, with an R-value of 0.922 and a p-value of 0.001. This is not surprising given that the way a company manages the services provided to an injured worker following his or her injury (i.e. "Case management" practices) should include as part of it the management of that worker's injury claims (i.e. "Claims management" practices). This being the case, both types of practices are still very different. This is because "Claims management" practices entail managing claims related to occupational and non-occupational injuries or illnesses whereas "Case management" practices deal with the individual employee following an injury with the aim of managing the injury and rehabilitating him or her. Similarly, "Case management" practices correlated positively with "Transitional program management" practices with an R-value of 0.790 and a p-value of 0.020, and with

"Program evaluation" practices with an R-value of 0.755 and a p-value 0.031. This is also logical given that the development of strong customized individual DM programs for severely injured employees (i.e. "Case management" practices) requires first the development of a strong generic DM program for all injured employees (i.e. "Transitional program management" practices). Furthermore, an improvement in the way a company evaluates the effectiveness of its DM program (i.e. "Program evaluation" practices) should naturally lead to an improvement in the effectiveness of that program including its "Case management" practices.

The findings also indicated a strong positive correlation between the maturity of "Return to work and accommodation" practices and "Program evaluation" practices with an R-value of 0.849 and a p-value of 0.008. This is also expected given that an improvement in the way the company evaluates the effectiveness of its DM program (i.e. "Program evaluation" practices) should lead to improved "Return to work" practices. Likewise, "Claims management" practices correlated positively with "Program evaluation" practices with an R-value of 0.855 and a p-value of 0.007, and with "Transitional program management" with an R-value of 0.789 and a p-value of 0.020. This is because an improvement in the evaluation of an existing DM program (i.e. "Program evaluation" practices) should naturally lead to more effective "Claims management" practices as those practices are part of that overall program. Moreover, only a strong DM program (i.e. "Transitional program management" could lead to the development of strong "Claims management" practices. "Program evaluation" practices and "Transitional program management" were also found to positively correlate with an R-value of 0.723 and a p-value of 0.049. This relationship is also expected since an improvement in the way a company evaluates its DM program (i.e. "Program evaluation" practices) should naturally result in an improved DM program

overall (i.e. “Transitional program management” practices). “Regulatory and compliance” polices was also found to positively correlate with “Disability and injury prevention” practices with an R-value of 0.810 and a p-value of 0.015, and with “Recruitment and retention” polices with an R-value of 0.727 and a p-value of 0.041. These relationships are logical given that an improvement in a company’s compliance with existing DM guidance (i.e. “Regulatory and compliance” policies) should improve the ways in which it prevents workplace injuries and accidents (i.e. Disability and injury prevention” practices) and recruits and retains employees (“Retention and recruitment” policies). These positive correlations are not unexpected given the interrelatedness of the different indicators making up the CDM3 and given that they all contribute to a company’s overall DM maturity. An improvement in one indicator should therefore lead to improvements in other indicators. Therefore, understanding these relationships provides insight into their interdependencies.

4.4.6 Company 1 Case Study

Subsection 4.2.3 presented the results related to the maturity of the DM indicators of Company 1 whereas Subsection 4.3.4 presented the results related to its DM and safety metrics. This subsection seeks to merge the findings of the two subsections to investigate the potential relationships between the maturity of the company’s DM practices (i.e. its leading indicators of performance) and its actual DM and safety performance (i.e. its lagging indicators of performance). Table 14 shows the overall maturity of Company 1 (i.e. *MS Company*) as well as the maturity of its different indicators (i.e. *MS Indicator*) versus the average corresponding maturity values of all analyzed companies. The table also shows the average safety and DM performance metrics for Company 1 over the four-year study period in comparison to the average

corresponding values of all evaluated companies.

As per Table 18, the analysis of the company's safety performance metrics showed that the company's safety metrics (i.e. RIR, SR and LTCR) had values (i.e. 27.22, 82.06, and 15.82 respectively) that were well above the average values of the eight companies evaluated (i.e. 20.12, 61.68, and 7.34) over the four-year study period. This indicates that the company's safety performance was considerably below the average safety performance of the eight companies evaluated. This was also in line with the company's overall maturity (i.e. *MS Company* of 3.74) which was well below the average *MS Company* of 4.06 of the eight companies evaluated. These observations point thus to a potential relationship between the company's DM maturity and its safety performance.

The company's DM performance metrics showed mixed results. As per Table 14, the average values of the five DM metrics for the four-year study period for Company 1 (i.e. DM5 = 93.18%, DM6 = 28.67%, DM7 =76.71%, DM9 = 74.56% and DM 10 = 88.10%) were all above the average values of the four companies analyzed (i.e. DM5 = 91.45%, DM6 = 16.85% , DM7 = 58.50%, DM9 = 58.17% and DM 10 = 81.72%) . This suggests mixed results. For example, the higher percentage of employees who returned back to work (i.e. DM5) and of employees who transitioned from modified work to original work (i.e. DM10) in Company 1 implied better DM performance than the average. Nevertheless, the higher percentage of employees requiring case management (i.e. DM6) and of employees off due to injury (i.e. DM7) in Company 1 suggested worse DM performance than the average. Because the company had an overall *MS Company* (i.e. 3.74) that was below the average *MS Company* of the four companies analyzed (i.e. 4.15), there appeared to

be a disconnect between the overall maturity of Company 1 and its DM performance metrics. This disconnect may be due to the way Company 1's DM performance is analyzed which could be caused by the way its DM metrics are interpreted. For instance, the higher percentage of case management injuries (i.e. DM6) in Company 1 could be due to the seriousness of the injuries rather than to the company's increased ability to develop a customized program for every injured worker individually. Similarly, the higher percentage of employees placed on modified duty (i.e. DM9) could simply be an indication that more employees are feeling better and ready to get back to work at this specific point in time. It does not necessarily measure the company's ability to provide modified work to its returning employees. The disconnect between DM maturity and DM performance in Company 1 does not therefore necessarily suggest the absence of a relationship between those two aspects. It just reinforces the need to investigate other factors that would help interpret the values of the DM metrics more accurately.

The lack of a direct relationship between the company's overall maturity and its DM performance metrics could also be due to the metrics not covering each of the 12 indicators. It would therefore make more sense to compare the company's DM performance metrics to the maturity of the specific indicators each metric is related to. Table 7 shows these metrics and their corresponding indicators. An analysis of the relationship between the number of employees who returned back to work (i.e. DM5) and the maturity of "Return to work and accommodation" (RAP) practices showed that the average DM5 for Company 1 (i.e. 93.18%) was slightly above the average DM5 of all companies (i.e. 91.45%), implying thus average performance. The *MS Indicator* of its RAP (i.e. 3.70) was also very slightly below the average of all companies (i.e. 3.83), suggesting average performance too and thus pointing to a potential relationship between the two aspects. Similarly,

there may be a potential relationship between the number of injuries that required case management (i.e. DM6) and the maturity of the company's CMP and PEP but not of its RAP. This is because the analysis showed that the company's average DM6 (i.e. 28.67%) was well above the average of all companies (i.e. 16.85%) over the four-year study period, implying thus worse performance. The maturity of the company's CMP and PEP (i.e. 4.00 and 3.35 respectively) were also well below the average of the four companies evaluated (i.e. 4.38 and 4.20 respectively), suggesting also worse performance than the average and thus a potential relationship there too. Another relationship appeared to exist between the average percentage of employees that were off due to injury (i.e. DM7) in Company 1 and the maturity of its CMP and PEP but not of its RAP. The analysis showed that Company 1's DM7 (i.e. 76.71%) was above the average DM7 of all companies (i.e. 58.50%), implying thus worse DM performance. Because the maturity of the company's CMP and PEP were also well below the companies' average as shown earlier, a potential relationship may therefore exist between the company's DM7 and the maturity of these indicators. There was also a relationship between the percentage of employees placed on modified duties (i.e. DM9) in the company and the maturity of its TPM and PEP but not of its RAP. The analysis showed that the company's DM9 (i.e. 74.56%) was higher than the average (i.e. 58.17%), implying worse DM performance. The maturity of the TPM and PEP of the company (i.e. 3.57 and 3.35 respectively) were also lower than the average (i.e. 3.96 and 4.20 respectively), suggesting also worse DM performance and thus a potential relationship between DM9 and the maturity of those indicators. Finally, no relationship appeared to exist between Company 1's DM10 and the maturity of its TPM and PEP.

Table 18: Summary of Company 1's Indicators Average Maturity, Safety and DM Performance Metrics

DM Maturity												
Indicators	**CP**	**CMP**	**RAP**	**CLP**	**DIP**	**TPM**	**PAP**	**PEP**	**SMP**	**RCP**	**RRP**	**EP**
MS Indicator (Company 1)	3.82	4.00	3.70	3.20	4.12	3.57	3.70	3.35	4.25	4.00	3.18	2.85
MS Indicator (All Companies)	*3.52*	*4.38*	*3.83*	*4.15*	*4.47*	*3.96*	*4.23*	*4.20*	*4.56*	*4.35*	*3.63*	*4.14*
MS Company			Company 1						*All Companies*			
			3.74						*4.15*			

Safety Performance Metrics		
	Company 1	*All Companies*
Average RIR	27.22	*20.12*
Average SR	82.06	*61.68*
Average LTCR	15.82	*7.34*

DM Performance Metrics		
	Company 1	*All Companies*
Average DM5	93.18%	*91.45%*
Average DM6	28.67%	*16.85%*
Average DM7	76.71%	*58.50%*
Average DM9	74.56%	*58.17%*
Average DM10	88.10%	*81.72%*

Communication practices (CP)	Physical accessibility management practices (PAP)
Case management practices (CMP)	Program evaluation practices (PEP)
Return to work and accommodation practices (RAP)	Senior management support practices (SMP)
Claims management practices(CLP)	Regulatory and compliance policies (RCP)
Disability and injury prevention practices(DIP)	Recruitment and retention policies (RRP)
Transitional program management practices (TPM)	Ergonomics practices (EP)

4.4.7 Discussion and Implications of Findings

The research entailed exploring the relationship between the developed CDM3 on one hand and the DM and safety metrics used in four and eight companies in Manitoba respectively on the other. While the research could not validate the existence of these relationships because of its small sample size, it led to interesting findings that make these relationships plausible in a larger sample of companies. At their most basic levels, these relationships would aim to continuously improve DM practices in order to lower injury rates. Future research should therefore investigate these relationships in a much larger sample of companies. It should also reduce the level of subjectivity associated with evaluating a company's maturity by improving for instance the rigour of the verifications done and which involves checking the company's responses against its own project and organizational documents. The DM indicators as well as the DM metrics also need to be formally validated. More information about a company's DM performance also needs to be collected so that assessors can interpret the company's DM metrics more accurately and decide on whether the resulting values suggest good or bad DM performance. Finally, the maturity assessment needs to be conducted on or before the time period for which the DM metrics data is being collected.

The findings highlighted the importance of fostering a safer workplace with a culture of continuous improvement and reinforced the need for effective benchmarks that would have a positive impact on the workplace. The best practices developed as part of the CDM3 represent leadings indicators of performance that provide employees and managers with immediate feedback on actions that can improve the way in which injury and disability are managed in the workplace. They also offer an important check on the integrity of systems and processes designed to foster safe work conditions.

Despite the benefits of leading indicators of performance, the discrepancies in DM performance found using leading and lagging indicators underline the limitations of relying on leading indicators alone. This is because leading indicators can be based on a subjective assessment that may underestimate or overestimate the level at which specific DM practices are implemented. In other cases, an organization can misidentify DM behaviours and activities that lead to positive performance, thus the need for a thorough audit of how practices are implemented by a neutral third party. This should be followed by the implementation of corrective actions that address underlying DM deficiencies. For these reasons, a comprehensive workplace DM program should employ both leading and lagging indicators as outlined in this research. Leading indicators are proactive by nature and provide a framework for benchmarking behaviours and activities prescribed in DM programs. Lagging indicators measure the ability of those behaviours and activities to drive specific outcomes. In other words, leading indicators dictate the action plan while lagging indicators measure the effectiveness of that plan in achieving the desired outcomes.

Construction companies should therefore consider implementing the practices inherent in the 12 DM indicators of the CDM3 and continuously improve that implementation to achieve higher levels of performance. Future research should consider applying and validating the 7 other metrics not used as part of the research. They should also consider using all of the 12 DM metrics defined as part of this research to benchmark and improve actual performance. They should refrain from relying on only one or a few of those metrics to quantify performance as doing so may not give them an accurate evaluation of actual performance. More work should thus go into collecting the relevant data that will enable the calculation of all of those metrics and into the electronic storage

and documentation of that data to enable its easy retrieval when needed. Future studies should also collect more data to enable further interpretation of DM performance using metrics and maturity model.

4.5 Objective #5: Making Recommendations to Improve Construction Organizations' Disability Management Performance

The research involved developing recommendations to improve construction organizations' DM performance based on the findings of the research as a whole. These recommendations provide guidance to construction organizations looking to implement DM and are based in particular on the best practices defined as part of the DM indicators making up the CDM3 and included in the assessment worksheet shown in Appendix G. These recommendations are presented in bullet-point format and categorized per DM indicator as follows:

Communication Practices

- Design a DM program that maximizes internal and external program support.
- Bring DM to the attention of all employees in a language that can be easily understood.
- Open communication lines and encourage employees to voice their concerns and make suggestions about DM.
- Provide employees affected by the DM program with relevant information in a timely manner.
- Encourage employees to freely express their injury claim concerns and to make suggestions

for improvement.

- Provide employees with regular training about injury management and claims.
- Inform employees of policy changes made concerning injury management and claims.
- Provide employees with regular health and safety training.
- Involve employees in the development of policies and programs related to DM, specifically those that directly affect them.
- Assess employees' knowledge of DM on a regular basis.
- Develop a strategic plan that supports a collaborative DM program.

Case Management Practices

- Contact the employee who becomes injured or ill to explain DM services offered and to provide support.
- Contact the employee shortly after an injury or illness to express concern and offer assistance.
- Maintain regular communication with the injured employee's physician to facilitate RTW.
- Conduct an initial assessment of the physical and functional capabilities of the injured employee.
- Conduct a job assessment upon learning about the level of injuries of the employee to determine task restrictions.
- Follow-up with the employee off work to assess his or her ability to RTW.
- Ensure treating physicians are able to identify the employee's physical and mental capacities and related restrictions and specify a target RTW date.
- Communicate proactively with physicians about suitable duties, the physical demands of

jobs and the provision of transitional work.

- Ensure a process is in place for finalizing rehabilitations decisions when there are disagreements about them.
- Follow-up with the employee after his or her leave of absence has ended to facilitate his or her RTW.
- Appoint a case manager for every individual injury case or at least for every severe injury case.
- Provide the DM practitioner with a formal DM training program.
- Examine people applying for a DM practitioner position thoroughly to ensure they have the required skills, knowledge and training.
- Ensure the DM practitioner provides ill, injured or disabled employees with all case management services needed in a timely and coordinated manner.
- Ensure the DM practitioner is in regular contact with all relevant stakeholders for active cases.
- Document case activities in compliance with standard practice and regulations.

Return to Work and Accommodation Practices

- Conduct physical and mental capacity evaluations when there is conflicting or inadequate medical information.
- Ensure the evaluations provide the information needed to develop a rehabilitation plan and to identify the employee's functional abilities.
- Ensure the employee and management work together to develop a suitable RTW plan for the employee and update it as rehabilitation progresses.

- Conduct a job analysis that identifies the physical and mental requirements of jobs.
- Conduct a functional assessment of the employee's capacities and job limitations.
- Complete a formal job analysis or functional job description for every job so that the employee's abilities can be compared to job demands.
- Modify job tasks and responsibilities so that they are consistent with the employee's health status and his or her current capabilities.
- Conduct vocational assessments and investigate alternative job placements for employees unable to return to their original positions.

Claims Management Practices

- Ensure the claims management process is well coordinated from initial injury to claim resolution.
- Evaluate long-duration claims to determine whether more intensive services are required.
- Provide ample information on medical certificates for employee's sick leave, injured employees' entitlements, and other related information for employees' compensation claims.
- Ensure the claims or benefit program is designed to support early intervention and RTW.

Disability and Injury Prevention Practices

- Define DM roles and responsibilities as well as disability and injury prevention goals and objectives.
- Include intervention activities aimed at reducing workplace injuries and accidents in the DM process.

- Implement and monitor a hazard prevention program.
- Provide first-aid services to injured employees and ensure the availability of first-aid kits.
- Provide qualified first-aid attendants to employees during regular work hours.
- Develop strategies that promote employee health and wellness.
- Provide incentives as part of an employee health and wellness program to encourage employee participation in that program.
- Allocate a budget for disability and injury prevention strategies.
- Develop an accident prevention and safety program administered by a joint worker-management committee.
- Involve employees in safety training programs and safety committees designed to enhance workplace safety.

Transitional Program Management Practices

- Set transitional work program management goals and objectives.
- Actively monitor injured, ill or at risk employees.
- Involve employees and management in the development and management of transitional work programs.
- Provide training to the DM practitioner responsible for return to work (RTW) coordination.
- Implement a written program for individual RTW plans.
- Evaluate the accommodation needs of injured employees who cannot return to their original positions.
- Ensure consistent management of occupational and non-occupational injuries and illnesses.
- Establish a comprehensive RTW program collaboratively with trade unions.

- Provide productive and meaningful temporary transitional work.
- Review disability case management intervention protocols to promote quality care, recovery and cost effectiveness.

Physical Accessibility Management Practices

- Provide well trained and motivated staff that can safely evacuate the workplace in an emergency situation.
- Provide training on evacuation techniques and assistance for disabled and elderly employees in an emergency situation.
- Investigate all possible physical accommodations for employees with physical disabilities.
- Incorporate physical accessibility accommodations such as lifts, ramps, rails in the workplace.

Program Evaluation Practices

- Maintain a record of illnesses or injuries in the workplace.
- Evaluate the outcomes of the employee health and wellness program.
- Build a database containing injury and illness data for individual employees.
- Hold periodic meetings for managers or departmental representatives whereby injury, illness and disability patterns are reviewed and analyzed.
- Track costs associated with the development and implementation of a DM program.
- Use historical data to predict future DM program costs.
- Develop an ongoing monitoring and evaluation process for accommodated employees.
- Evaluate the effectiveness of the organizational workplace strategy at regular intervals and

make improvements where required.

- Involve employee representatives in the evaluation of DM programs.
- Ensure the anonymity and confidentiality of DM data.
- Use injury and illness data to identify problem areas in the DM program.
- Analyze injury and illness data to determine their causes and identify solutions.

Senior Management Support Practices

- Involve senior management in the implementation of the DM program.
- Ensure the DM manager receives support from top management.
- Spend time and money to improve the organization's DM performance.
- Consider DM as important as other project management goals in the execution of projects.

Regulatory and Compliance Policies

- Consider DM a priority that contributes to business success and regard it as an integral part of the workplace human resource development strategy.
- Formulate a DM strategy in accordance with national legislation, policy and practice.
- Collaborate with employee representatives to formulate a strategy for DM in the workplace.
- Maximize the contributions and abilities of all staff, including those with disabilities and support adherence to occupational safety standards.

Recruitment and Retention Policies

- Take into account the occupational preferences of employees with disabilities.

- Investigate all possible accommodations to take advantage as much as possible of the skills of employees with disabilities.
- Implement alternative recruitment qualifying tests to create a fair opportunity for disabled job applicants.
- Provide training for recruitment staff to enable them to handle issues involving equal opportunity, diversity and disability.
- Include a disabled employee or disability expert as part of the recruitment staff.
- Encourage job applicants to identify arrangements or accommodations they may require in the workplace.
- Use the same scoring or assessment system for disabled and non-disabled job applicants.
- Ensure that information about an employee's disability is only passed on to the staff and managers that need it and only with the employee's consent.
- Audit the recruitment process to assess whether people with disabilities are overrepresented in rejection decisions for positions.

Ergonomics Practices

- Undertake ergonomic interventions as needed.
- Evaluate ergonomic interventions to determine if they were successful.
- Design jobs to reduce heavy lifting.
- Design jobs to remove repetitive movement.
- Use ergonomic principles when designing and setting up workstations and work areas
- Rotate or change job responsibilities to minimize exposure to ergonomic risks.
- Use ergonomic principles when purchasing new tools, equipment, or furniture.

- Modify work areas and work stations to minimize ergonomic risks before injuries occur.
- Use ergonomic principles when assisting disabled employees returning to work.
- Provide ergonomics training to minimize the risk of injury.

CHAPTER 5: CONCLUSION

This chapter summarizes the methods and results associated with achieving each research objective. This is followed by a discussion of the study's limitations and recommendations for future research. The chapter ends with a presentation of the overall implications of the study and a summary of future research to be conducted by the Construction Engineering and Management Group at the University of Manitoba and that builds on this one.

5.1 Summary of Findings

The research investigated the DM performance of the Manitoban construction industry and its relation to safety performance. Table 19 shows a summary of its overall findings.

Table 19: Summary of Overall Research Results

Objective Research methods	Summary of results
Objective 1: Develop and validate DM indicators that can be used to evaluate construction organizations' DM performance Methods: • A comprehensive literature review was undertaken to develop these indicators. • An AHP was used to conduct pairwise comparisons of these indicators to rank them, with eight construction management experts selected using chain referral sampling. • Each expert conducted the pairwise comparison of the 12 indicators individually. • All resulting data was analyzed.	• Twelve DM indicators were developed and categorized into individual-level and organizational-level indicators. • Consistency ratios of all the experts ranged from 0.0325 to 0.077, with an overall average of 0.0534. • "Return to work" and "Disability and injury management" practices were found to be the most critical indicators. • In contrast, "Physical accessibility management" and "Claims management" practices were the least important. • "Senior management support" practices was ranked the 3rd most important DM indicator. • "Return to work and accommodation" practices was deemed 4.5 times more critical than the lowest ranked indicator: "Physical accessibility management". • "Case management" practices was ranked as the 10th most important DM indicator. • Organization-level indicators were in general deemed to be more important to DM performance than individual-level ones. • The 12 indicators were in general deemed to be encompass the best practices that construction firms should implement as part of a comprehensive DM program.
Objective 2: Develop and implement a model to evaluate the maturity of construction organizations' DM practices Methods: • A maturity model: the Construction Disability Management Maturity Model (CDM3) was developed based on the 12 DM indicators defined as part of the first objective to benchmark construction organizations' DM performance. • The model used an assessment worksheet, containing 134 close-ended, Likert scale questions for its implementation.	• The Cronbach's alpha (α) value for the assessment worksheet was 0.944 and was thus above the acceptable threshold. • The ten companies in Manitoba operated at the quantitatively managed maturity level, with an overall average of 4.06 out of 5. o Therefore companies had an overall potential growth rate of 18.68%. • The top three most mature companies, Companies 7, 2 and 4, had relatively lower *MS Indicator* scores (i.e. greater than or equal to 3 and below 4) in the indicators with lower AHP weights and higher *MS Indicator* scores in the indicators with higher AHP weights. • In contrast, the three least mature companies, Companies 8, 1 and 5 had lower *MS Indicator* scores (i.e. greater than or equal to 3 and below 4) in the indicators with higher AHP weights. • The maturity scores of 8 of 10 companies increased after considering the AHP weights

• Each question represented a DM best practice that responding organizations compared their existing practice against. • The model defined five different maturity levels for each practice. • It was administered through an assessment worksheet to ten construction companies in Manitoba. • All resulting data was analyzed.	of the DM indicators. • Smaller-sized companies were found to be more mature than large-sized companies. • "Senior management support" and "Disability and injury prevention" were found to be the most mature DM indicators. • In contrast, "Retention and recruitment" practices and "Communication" practices were the least mature. • The average potential growth for the indicators ranged from 8% to 28.2%. • "Senior management support" practices were the most mature practices, with a minimum *MS Practice* of 4.5 and an overall average *MS Indicator* of 4.6. • "Recruitment and retention" polices were the least mature, with a minimum *MS Practice* of 2.1 and an overall average *MS Indicator* of 3.59. • Company 1's results showed that, the company was operating at the standardized level with an *MS Company* score of 3.74. o "Senior management support" and "Return to work and accommodation" practices were its most mature indicators. o "Recruitment and retention" policies and "Ergonomic" practices were its least mature indicators.
Objective 3: Develop and implement metrics to evaluate construction organizations' DM and safety performance Methods: • A comprehensive literature review was conducted to identify the metrics used to evaluate contractors' safety and DM performance. • A total of 15 existing safety metrics were selected from the literature. • The literature review could not identify any explicit DM metrics. • A total of 12 new DM metrics were proposed based on quantifying the 12 DM indicators and inherent practices defined previously. • Only 8 of the 10 participating companies provided the relevant data for 3 safety metrics.	• Twelve DM metrics were developed to enable DM performance benchmarking using lagging indicators. • There was a gradual decline in companies' RIR and LTCR over the four years whereas their SR remained relatively high during the same period. • The companies' LTCR performance during 2012 and 2013 fell below the industry average of 6.4 in 2012 and 5.5 in 2013. • A positive statistically significant correlation was found between companies' RIR and their SR (r=0.565 with a p-value of 0.023). • The results showed that 3 out of the 4 evaluated companies witnessed an increase in the percentage of employees returning back to work (i.e. DM5) between 2012 and 2013. • There was a potential relationship between the percentage of employees who returned to work (i.e. DM5), the percentage of employees who are placed on modified work (i.e. DM9) and the percentage of employees who returned to their original work (i.e. DM10). • There were statistically insignificant correlations between every safety metric and every DM performance metric.

• Only 4 of the 10 companies provided the relevant data for 5 DM metrics. • This data was collected from 2012-2015. • All resulting data was analyzed.	• Company 1's results indicated that the company's safety performance metric values were below the average of the eight sampled companies. ○ Its DM performance metrics were above the average of the four sampled companies.
Objective 4: Evaluate the relationship between the maturity of construction organizations' DM practices, their DM performance and their safety performance Methods: • Data collected as part of the first three objectives of the research was used to achieve this objective. • The relationship between companies' overall DM maturity evaluated using the CDM3 and their DM performance evaluated using relevant metrics was investigated. • The relationship between companies' overall DM maturity and their safety performance evaluated using metrics was investigated. • The relationship between the maturity of companies' specific DM indicators evaluated using the CDM3 and their DM performance was investigated. • The relationship between the maturity of companies' specific DM indicators and their safety performance was investigated. • The interrelationships between the maturity of companies' DM indicators were investigated. • A combination of bar charts, lines and box plots were used to graphically depict some of these potential relationships. • Spearman's non-parametric correlation was also used to investigate some of these relationships.	• The relationships between companies' overall maturity using the CDM3 and their DM performance metrics were found to be statistically insignificant • However, analysis of relevant graphs showed that companies with higher maturity scores had relatively lower rates of return (DM5), and companies with lower maturity scores had higher rates of return. • There were strong statistically significant negative correlation between overall DM maturity and DM6-% of workers that required case management. • Companies with high overall company maturity scores had relatively lower safety metric scores, thus higher safety performance than companies with lower DM maturity. • Companies with lower "Return to work and accommodation", "Case management" and "Program evaluation" practices maturity had a higher percentage of employees off due to injury (DM7) than companies with higher maturity. • Companies with higher "Transitional program management" practices maturity also had a lower percentage of employees placed on modified duty (DM9) than companies with lower maturity. • There were strong statistically significant negative correlations between the maturity of 1) Communication practices and DM10-% of workers who transitioned from modified work to original work, 2) Case Management practices and DM6-% of workers that required case management, 3) Claims management practices and DM6-% of workers that required case management, 4) Disability and injury prevention practices and DM7-% of workers due off work, 5) Program evaluation practices and DM6-% of workers that required case management, 6) Senior management support practices and DM6-% of workers that required case management, 7) Senior management support practices and DM7-% of workers due off work, 8) Regulatory and compliance policies and DM6-% of workers that required case management, 9) Recruitment and retention practices and DM6-% of workers that required case management and 10) DM7-% of workers due off work and DM 9-% of workers placed on modified duties. • There were strong statistically significant negative correlations between the maturity of 1) "Senior management support" practices and RIR, 2) "Senior management support"

	practices and SR and 3) "Retention and recruitment" practices and RIR.
	• There were also strong statistically significant positive correlations between the maturity of: 1) "Case management" and "Claims management" practices, 2) "Case management" and "Transitional program management" practices, 3) "Return to work and accommodation" and "Program evaluation" practices, 4) Claims management" and "Program evaluation" practices, 5) "Program evaluation" and "Transitional program management" practices and 6) "Regulatory and compliance" policies and "Disability and injury prevention" practices.
	• Company 1's safety performance was well below average over the four-year study period in comparison to the eight sampled companies.
	  o The company's overall DM maturity (i.e. *MS Company*) was also considerably below the average of the eight sampled companies.
	  o Company's DM performance using metrics indicated mixed results.
	  o The results also suggested a lack of a direct relationship between the company's overall maturity and its DM performance metrics.

Objective 5: Make recommendations to improve the maturity of construction organizations' DM practices Methods: • The recommendations are based on findings on the overall research, in particular the indicators and best practices defined as part of the CDM3	• Recommendations aiming to improve the maturity of construction organizations' DM practices were categorized per DM indicator defined as part of Objective 2. • A full list of those recommendations can be found in section 4.5.

5.2 Limitations and Recommendations

One key limitation of the research includes its small sample size. Although companies were recruited in a number of ways, many companies declined despite emphasizing the benefits to them of participating in this research. This is mainly because a number of them were not comfortable enough with the research topic due to its sensitivity. These companies were also not comfortable with their DM and safety performance being assessed by the research team and with releasing the required data to them. The work's research ethics certificate confirming review and approval of the research by the University of Manitoba Research Ethics Board did not help alleviate this discomfort. Similarly, pledges of confidentiality and anonymity stipulating that the team would not share the data with any other party and that the companies participating in the research would remain anonymous did not help change their minds. Moreover, although a number of companies expressed interest in the research, the workloads of key individuals within them with expertise on the topic and who would need to complete the CDM3 assessment worksheet led to scheduling conflicts that prevented them from participating in it.

These issues meant it took a great deal of time (i.e. approximately 8 months) to recruit companies and more so (i.e. approximately 16 months) to gather the required data. The small sample size of ten construction companies in Manitoba made the research exploratory in nature and as such, the results derived from applying it to these companies cannot be considered representative of all construction companies in Manitoba. The small sample size did not help uncover statistically significant relationships between companies' DM maturity, and their DM and safety performance. Therefore, future research should investigate these relationships in a larger number of companies. Future research should also analyze these relationships statistically. Regression Analysis, Analysis

of Covariance and Canonical Correlation Analysis could be used on a larger sample to evaluate the relationships between the individual DM indicators and their effects on overall DM performance. These same tests could be used on a larger sample to analyze the relationships between the DM metrics and safety metrics, DM maturity and DM performance and between DM maturity and safety performance. A larger sample may also help identify the most effective DM practices implemented by companies of different sizes.

Despite the strengths of the AHP used to determine the relative weights of importance of the DM indicators making up the CDM3, the process took a lot of time and effort to complete it. Experts carrying out the AHP became noticeably tired as time went on. Hence, more research is needed to simplify and facilitate the pairwise comparison portion of the AHP, especially for large and complex applications that encompass more indicators. Future research should also focus on involving more experts in the process and on recruiting them from across Canada if the intent is to apply the CDM3 to construction companies across the country. There may also be a need to use the Delphi process in conjunction with the AHP. The Delphi technique helps build consensus by using multiple rounds to collect data from a group of experts. The anonymous responses are then aggregated and shared with the group after each round in order for them to decide whether they would like to change their responses or keep them as is.

Despite its strengths, there were some issues associated with the implementation of the CDM3. One issue involved the time it took to conduct random verifications of some existing practices. Due to limited finances and a strict schedule, only two researchers were available at any point in time to conduct them. This limited the extent of the verifications conducted. Furthermore, the DM

indicators making up the CDM3 and the actual long-term practicability and usefulness of the CDM3 were not directly evaluated. The small number of companies evaluated did not allow for the generalization of the results and for further validation of the model. Therefore, more research is needed to validate these indicators and to validate the effectiveness of the CDM3 in construction organizations with different cultures and business environments. Further refinement of the model is also needed to ensure it continues to reflect current practice and to ensure its continued usefulness to members of academia and the industry. There is also a need to make it more difficult for respondents to determine the most desirable response when completing the assessment worksheet, which may require a redesign of the questions and practices making up each DM indicator. This is to reduce as much as possible the tendency for respondents to select socially-acceptable responses rather than the ones that best reflect their actual practices, and thus to reduce the subjective bias respondents may have when using the model. There is also a need to change the current asymmetrical Likert scale used in the responses and that ranges from “Disagree” to “Strongly Agree” to a more symmetrical one ranging from “Strongly Disagree” to “Strongly Agree”. This is to ensure that the scale used is neutral and does not introduce any bias by unintentionally favouring one set of responses more than others.

Another key limitation was the fact that participating companies did not collect most of the data needed to calculate the safety and DM metrics used in this research. Because of this, only three of 15 safety metrics and five of 12 DM metrics could be calculated and analyzed as part of the research. For the safety data, most companies relied on only one or two safety metrics to benchmark their safety performance. For the DM data, because DM is a newer concept in construction and all DM metrics used in this research were new metrics that did not exist in the

industry or literature, most companies did not track the data required to measure them. This limited the number of companies that could participate in the collection and analysis of the DM metrics to only four companies. It also limited the statistical analysis that could be conducted on them and the relationships that could be uncovered based on that analysis. Due to small number of companies evaluated, more rigorous statistical analysis such as regression analysis using the leading (i.e., MS scores of the CDM3) and lagging indicators (i.e., metrics) of performance could not be conducted. Future research should focus on evaluating more companies that collect most if not all of the data related to the 15 safety metrics and 12 DM metrics considered in this research. This may help establish new relationships between the CDM3 and the DM metrics and between the safety and DM metrics that could not be detected using only three safety metrics and five DM metrics.

Another limitation of the research is that the DM metrics used in isolation may not necessarily point to a deficiency in the DM performance and easily lend themselves to misinterpretation. For example, the percentage of injuries that required case management (DM6) can be subject to misinterpretation. A company with lower rates does not necessary imply an inability to develop a customized program for every injured worker individually, but the rates should be analyzed in respect to the severity of injuries. Similarly, the higher percentage of employees placed on modified duty (i.e. DM9) could simply be an indication that more employees are feeling better and ready to get back to work at this specific point in time. It does necessarily measure the company's ability to provide modified work to its returning employees. Future research should therefore focus on collecting data for the 12 metrics and analyzing them collectively, as data for only one or two metrics would not characterize overall DM performance. Future research should also develop an interpretation map that links related metrics together in order to help companies interpret their

results further. Although the developed DM metrics were informally validated by participating companies, future research should also focus on formally validating them. There is also a need to develop and validate new DM metrics as those 12 do not necessarily capture every facet of DM performance.

Another limitation involved the discrepancy in the timing of the DM maturity assessment versus that of the DM and safety metrics collection. For the relationship between DM maturity on one side and DM or safety metrics on the other side to plausible, the maturity assessment would have needed to be conducted annually between 2012 and 2015. This would have allowed the results for each year to be correlated to the DM or safety metric results for that same year. Another option would have been to collect the DM or safety metrics for 2016 and correlate them to the 2016 maturity assessment results. It can even be argued that since the maturity model is a predictive model (i.e. leading indicators), future research should correlate the maturity assessment results to the DM or safety metrics (i.e. lagging indicators) of the year following the year on which the model was applied. This is to assess whether predictive performance correlates with actual performance. This should also allow for modelling the relationship between leading and lagging performance which would enable the prediction of future performance.

Another key limitation of the research was the manual and paper-based administration of the CDM3 and metrics developed. The research involved meeting in person with every construction company's team to administer paper versions of the worksheet for the CDM3 and of the data collection form for the metrics. This made for a tedious and time-consuming process that was contingent on the mutual availability of the research and company teams. The collected data could

not also be analyzed immediately. This prevented companies from receiving immediate feedback on their performance and discouraged them from using the tools on a regular basis to benchmark performance, which hampered the adoption of the tools on a larger scale. Future researchers should therefore develop easily accessible web-based versions of the tools that would enable the electronic collection and analysis of the data, and thus facilitate construction companies' long-term adoption of them. Future research should also investigate the financial costs and benefits associated with implementing a comprehensive DM program.

5.3 Contributions and Overall Implications of the Research

This research is the very first study to evaluate DM in the construction industry using leading and lagging indicators of performance in Canada and internationally. This research is the first to develop benchmarking tools (i.e. the CDM3 and DM metrics) to assess DM performance and validate DM indicators for the construction industry, and the first to focus on applying those indicators to the Canadian construction industry in particular. Given the poor safety record of the industry and the challenges associated with employing injured and disabled employees, the development of DM indicators should enable construction organizations to develop DM programs that better meet the needs of disabled employees, and ensure their return to the workplace. It should also enable them to evaluate, benchmark and improve these programs and thus their DM performance. Despite progress in the field, there's still reluctance by some organizations to overly invest in DM programs, and develop customized RTW programs that require significant financial and human resources.

The research enabled the benchmarking of DM performance with the development and

implementation of the CDM3. The model identified and evaluated key practices of DM, relying on proactive rather than reactive measures. The consolidation of factors from past studies, the priority analysis of those factors through AHP, and their implementation via field application present academics with an opportunity to better understand construction DM. It also helps explain a company's approach to DM and how practitioners can implement DM successfully by allowing them to proactively assess a company's existing practices instead of relying on post-accident investigations. As part of the model, the research also outlined and defined DM best practices. These best practices provide the benchmarks that construction organizations should aim for as part of their DM programs. As leading indicators, they provide employees and managers with immediate feedback on actions that can lead to incidents or injuries. They also offer an important check on the integrity of systems and processes designed to foster safe work conditions. The CDM3 and its best practices should therefore enable companies to develop, evaluate, benchmark and ultimately improve their own DM programs. They should also justify the need for further investments in existing DM programs to ensure earlier return to work and better accommodation of injured employees. These changes if made throughout many construction companies in collaboration with industry associations can make the adoption of DM programs more mainstream at the industry level and challenge the traditional perception that disabled people have no place in the industry. It can also lead to these programs becoming a legal requirement in the same way health and safety programs are. In this case, companies that are serious about health and safety would need to show that DM is a priority, that due diligence is exercised and that policies and practices in place meet or exceed existing standards. Additionally, the developed model can be adapted and implemented across other industries such as the manufacturing, mining and transportation industries.

The research also addressed the lack of specific DM metrics in the literature by proposing 12 new DM metrics and using five of them to evaluate construction companies' actual DM performance. While leading indicators of performance such as the CDM3 can help identify opportunities for improvement before the fact, i.e. before the occurrence of an accident or injury, they cannot determine how these opportunities will work in practice. This will need to be assessed using lagging indicators of performance such as metrics. These metrics help assess and quantify related performance after the fact, i.e. after the occurrence of an accident or injury. They provide objective benchmarks that researchers and practitioners can use to evaluate actual rather than expected performance. They help track and analyze safety and DM performance data, and enable construction companies to determine the impact of more mature practices on actual DM performance. The DM metrics in particular should enable benchmarking of DM performance at the company and industry levels and over time. The correlation of DM lagging and leading indicators of performance should also help companies compare expected performance to actual performance and formulate strategies to address gaps in their DM performance and predict and protect against potential accidents and injuries before their occurrence.

5.4 Future Work

A new research proposal has been submitted and awarded funding by the Research Workplace and Innovation Program of the Employees Compensation Board of Manitoba to build on the work conducted as part of this PhD research. This new research project aims to address some of the limitations of this research, in particular its small sample size, the limited data analysis conducted as part of it and the manual and paper-based administration of the tools. It will involve providing

the construction industry with free, accessible web-based tools that enable construction workplaces to benchmark their DM. It will also involve deploying and promoting the adoption of these tools by construction workplaces in MB and using them to evaluate the actual DM performance of the construction industry in Manitoba. The project will be conducted in partnership with the Construction Safety Association of Manitoba (CSAM) and the Manitoba Heavy Construction Association (MHCA). The tools will thus be deployed and promoted within the building and heavy construction sectors and adopted by local building and heavy contractors. The project will establish a Project Advisory Committee (PAC) of four to six members made mainly of representatives from the University of Manitoba, CSAM and the MHCA to advise on key project activities.

The web-based versions of the tools will be hosted online separately by both the CSAM and the MHCA. In the CSAM, the tools will be integrated to a new dashboard that is currently being developed to host another safety benchmarking project and that will be accessible through the association's website. In the MHCA, the tools will be made available through a simpler interface on its website. The UM team will agree with the PAC on the specific features, requirements, layout and functionality of the web-based tools. An interactive local digital media company: Bit Space Development will be hired to act as the technology coordinator for the project and to design and develop those tools online based on those requirements. Upon logging onto the web-based dashboard, the questionnaire making up the CDM3 will be made available to companies, together with the data required to calculate the metrics. Once developed, the tools will be piloted prior to their deployment. Feedback from the pilot study will be used to further refine the web-based versions of the tools prior to their eventual deployment. Upon their online deployment, all member companies of the CSAM and the MHCA will be invited to test their sector's version of the tools.

A marketing campaign will be launched with strong support from the CSAM and the MHCA to inform members of both associations about the study by email, on their websites and in their newsletters and newspaper inserts.

The web-based tools will be designed to archive every company's responses and to provide each with an immediate online assessment of these responses every time they use them. The assessment will benchmark their actual performance against past performance and against average industry performance. It will also identify specific actions they can take to ensure continuous improvement of their DM and RTW performance. The web-based tools will enable construction workplaces to depict assessment results in a tabular or chart format and to customize them based on a number of different criteria such as year, industry sector, company size, and practice area. The web-based online accessibility of the tools will encourage construction workplaces to use them regularly, promoting thus their adoption across all of Manitoba. The tools are expected to permanently remain on the CSAM and MHCA's websites so that member companies can continue to use them after the project has ended. This should lead to the building of an industry-wide web-based DM and RTW database that will aggregate all assessment results and provide real-time industry averages that construction companies can compare themselves against for benchmarking purposes.

The project will enable the practical application of existing knowledge in new ways that foster the rehabilitation and RTW of injured construction employees. It will build on the tools developed in this research project to provide creative technological solutions that improve OHS practices and behaviour and foster the rehabilitation and RTW of injured employees. The web-based tools will enable construction workplaces to receive assessment results immediately, providing each with

empirical evidence about their actual performance in comparison to past performance and to average industry performance. This immediate feedback should allow companies to identify their most effective DM and RTW practices and ones in need of improvement. This should help them focus resources on improvements with the greatest potential for bottom-line impact.

5.5 Concluding Remarks

The role of the construction workplace in reducing injuries and improving DM evokes widespread responsibility because all practitioners (e.g. senior managers, first-line supervisors, employees) can benefit from ensuring the highest possible level of employee well-being, health and safety. The construction industry is witnessing a gradual paradigm shift towards a more inclusive and integrated workplace, where construction employers have to rethink the inclusiveness and accessibility of their workplaces. These employers have to rethink in particular their approach to integrating injured and disabled employees back to these workplaces and the consequences of not prioritizing their well-being. This research spearheads this gradual shift and makes solid arguments in favour of it. This research not only makes the case for more inclusive construction practices, but also provides the tools and strategies for the successful implementation of inclusive DM programs. Inclusive DM programs go beyond what is traditionally implemented as part of a health and safety program to ensuring the employment and accommodation of returning disabled and injured employees post-injury.

This research is the first on the topic and serves thus as a foundation for future research in the field. This future research could, through the active involvement of a wide range of stakeholders comprising researchers, practitioners, policy-makers and the public increase capacity for this type

of research in Canada. It could also develop a body of knowledge that can be translated to evidence-based guidance on DM in construction at all levels (i.e. municipal, provincial and federal). These efforts could also help increase funding allocated to relevant research and to intervention strategies that would institutionalize DM programs in the construction industry. These intervention strategies would raise awareness on the importance of these programs among all stakeholders. This is important because it's only through the collective engagement of these stakeholders that the construction industry as a whole can reap the benefits of these large-scale industry-wide initiatives and see a significant change in the way it manages safety and disability.

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Appendix A

AHP INSTRUCTIONAL SHEET

Background

AHP is an analytic decision making method used to select the best alternative from a number of alternatives using several criteria, which is the twelve indicators identified from extensive literature review. The specific criteria for comparison will be the relative importance of an indicator to another in relation to Disability Management overall performance in construction. The indicators will be prioritized by determining the relative weights of the twelve primary indicators using pairwise comparison. The results will be multiplied and correlated with the second and third stage data. This research ethics application is for the first stage only; a separate application will be submitted for the second and third stage after completion of the first stage.

The research will include a maximum of disability management, construction and health and safety experts who will be engaged in an AHP session to determine the parameter weights for the twelve indicators. The AHP process will be based on the expert knowledge and experience of participants in the construction field. Participants of the sessions will seek to make pairwise comparisons of twelve indicators using a nine-point fundamental scale. To ensure consistency of the pairwise comparison, each participant will ask himself or herself which indicator is more important to the overall performance of DM. The relative level of importance will be rated on a nine point scale from “Strongly Disagree” (1) to “Strongly Agree” (9). The subjective ratings will be quantified using the AHP analysis process to determine the weights of each indicator (i.e the eigenvectors or Eigen functions represents the relative importance of the various indicators).

The AHP methodology compares criteria, or alternatives with respect to a criterion, in a natural, pairwise mode. To do so, the AHP uses a fundamental scale of absolute numbers that has been proven in practice and validated by physical and decision problem experiments. The fundamental scale has been shown to be a scale that captures individual preferences with respect to quantitative and qualitative attributes just as well or better than other scales (Saaty 1980, 1994). It converts individual preferences into ratio scale weights that can be combined into a linear additive weight w(a) for each alternative a. The resultant w(a) can be used to compare and rank the alternatives and, hence, assist the decision maker in making a choice. Given that the three basic steps are reasonable descriptors of how an individual comes naturally to resolving a multicriteria decision problem, then the AHP can be considered to be both a descriptive and prescriptive model of decision making. The AHP is perhaps, the most widely used decision making approach in the world today. Its validity is based on the many hundreds (now thousands) of actual applications in which the AHP results were accepted and used by the cognizant decision makers (DMs), Saaty (1994b).

There are three basic principles of AHP: decomposition, comparative judgments, and hierarchic

composition or synthesis of priorities [Saaty 1994b]. The decomposition principle is applied to structure a complex problem into a hierarchy of clusters, subclusters, sub-sub clusters and so on. The principle of comparative judgments is applied to construct pairwise comparisons of all combinations of elements in a cluster with respect to the parent of the cluster. These pairwise comparisons are used to derive 'local' priorities of the elements in a cluster with respect to their parent. The principle of hierarchic composition or synthesis is applied to multiply the local priorities of the elements in a cluster by the 'global' priority of the parent element, producing global priorities throughout the hierarchy and then adding the global priorities for the lowest level elements (usually the alternatives).

Determination of Parameter Weights

The performance parameters will be prioritised by determining parameter weights the twelve primary indicators (defined below) using pairwise comparison (Saaty, 1987). The five Construction experts will be engaged in determining the parameter weights for the different units DM. Table 1 shows an example of a completed pairwise comparison matrix. The comparisons will be performed using the fundamental scale for pairwise comparison (see Table 2) developed by Saaty (1987). Table 3 shows that the comparisons will be performed for half of the table; the blank boxes will be the opposite reciprocal of the filled boxes. In its use of AHP, the Construction Disability Management Disability Maturity Model (CDM3) considers the indicators as being the decision alternatives that are being compared and the criteria against which they are being compared is simply “which indicator is more critical/important to the performance of DM?”

Questioning Format (Comparison criteria)

For example: when comparing indicators A & B (on line 1), the decision criteria would assign figures as follows:

- 1 means A and B are equally important
- 3 means A is moderately more important than B, 1/3 or .033 means B is moderately more important than A.
- 5 means A strongly more important than B, and 1/5 or 0.2 means the opposite
- 7 means A has been demonstrated to have very strong importance than B and 1/7 or 0.14 means the opposite.
- 9 means A is extremely more important than B, 1/9 means the opposite
- The following values 2, 4, 6, and 8 can also be used if one is it certain how important one is more than the other or when compromise is needed

NB: Blank boxes or spaces will be the reciprocal of their diagonal value as shown for B, (AHP, is directional and only applies one way either up or down)

Table 1: Determination of indicator weights using pairwise comparison

	A	B	C	D	E	F	Parameter Weight (w)
A	1	c_1	c_2	c_3	c_4	c_5	w_1
B		1	c_6	c_7	c_8	c_9	w_2
C			1	c_{10}	c_{11}	c_{12}	w_3
D				1	c_{13}	c_{14}	w_4
E					1	c_{15}	w_5
F						1	w_6
Sum (Σ)	Σ_1	Σ_2	Σ_3	Σ_4	Σ_5	Σ_6	

c_1 to c_{15} are the number of pairwise comparisons that will be performed for primary parameters by each of the unit participants.

Table 2: Fundamental scale for pairwise comparison (Saaty, 1987)

Intensity of Importance	Definition	Explanation
1	Equal importance	Two indicators contribute equally to the objective/goal
3	Moderate importance	Experience and judgment slightly favor one indicator over another
5	Essential or strong importance	Experience and judgment strongly favor one indicator over another
7	Very strong importance	An indicator strongly favored over another and its dominance demonstrated in practice
9	Extreme importance	The evidence favoring one indicator over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values between adjacent judgments	When compromise is needed
Reciprocal	If activity i has one of the above numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i	

Completing the table

A drop box link will be sent with the instructional sheet which has your unique excel sheet (like the one shown on table 3) which you will fill out with your decision criteria numbers. The excel sheet has been programed such that you only need to fill out the top section of the table like that demonstrated in table 1. Once you complete it, you just need to save it and I will automatically get your completed table. You are free to make changes to your decision criteria even after you have saved it and I will only receive the latest version.

Disability Management Practice Areas (Indicators)

- *Communication practices*: Related practices cover information provided to all employees about the organization's strategy with respect to DM and accommodations provided at all levels in support of those with disabilities.

- *Case management practices*: These practices deal with individual employees once an injury occurs with the aim of managing their injury and rehabilitating them. Case management is a term used to describe a variety of strategies aiming to manage the health and social services provided to injured employees and their families (Brooker et al. 2012).

- *Return to work and accommodation practices*: These practices involve the completion of a job needs assessment to determine how the DM program can best meet the needs of employees with disabilities and bring them back to work. A comprehensive analysis of employees' skills is conducted to modify their original jobs or identify alternate jobs for which they would be more suited.

- *Claims management practices*: Related practices deal with managing claims related to occupational and non-occupational injuries or illnesses that may entitle individual employees to long-term disability benefits.

- *Disability and Injury prevention practices*: These practices cover the preventative aspects of DM programs. These have matured considerably in recent years and are critical to the overall performance of these programs and to controlling related costs. DM programs should educate employees on these aspects before the occurrence of disabling injuries.

- *Transitional program management practices*: These practices cover the development of a generic DM program for injured employees, which can be customized to individual employees during individualized case management.

- *Physical accessibility management practices*: These practices aim to improve the physical accessibility of construction workplaces to people with disabilities and as such cover physical workplace accessibility requirements.

- *Senior Management support practices*: These practices involve getting continuous and consistent support from senior management to ensure the effective implementation of DM programs.

- *Program evaluation practices*: These practices encompass the continuous evaluation of DM programs, customized individual RTW programs and injury and illness statistics to identify necessary program modifications and improvements and justify these programs' costs and benefits as well.

- *Regulatory and compliance policies*: These practices cover existing polices both at the federal and provincial levels. Additionally, it delves into specific policies developed by the organization in relation to accommodating injured and disabled employees. Policies can cover issues such as salary replacement, job accommodation, transitional employment, budgetary responsibility and vocational training when necessary.

- *Recruitment and retention policies*: Practices cover the recruitment process of employees in the construction workplace as well as procedures undertaken to ensure the retention of injured employees. The principle of non-discrimination should be respected throughout the process, to ensure maximal benefit to the employer and equitable opportunities to candidates with and without disabilities.

- *Ergonomic practices*: Related practices should ensure the design of work processes and spaces that minimize injuries, complaints, staff turnover and work absenteeism; meet employers' social and legal obligations and improve employees' health and safety.

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Appendix B

AHP INFORMED CONSENT FORM

UNIVERSITY

Faculty of Engineering

Department of Civil Engineering

Room E1-368A

Engineering

15 Gillson Street

Winnipeg, Manitoba

Canada R3T 5V6

Research Project Title: Evaluating the Accessibility of the Manitoban construction Industry to Disabled Construction Employees and its Relation to Safety Performance

Principal Investigator and contact information: Rhoda Ansah Quaigrain, PhD candidate, Room E1-368A Engineering, 15 Gillson St, University of Manitoba, Winnipeg, MB R3T 5V6 Canada, email: quaigrra@myumanitoba.ca

Advisor and contact information: Dr. Mohamed Issa, Assistant Professor, Construction Engineering and Management, Department of Civil Engineering, University of Manitoba, E3-589, EITC, 15 Gillson Street, Winnipeg, MB, R3T 2N2, email: Mohamed.Issa@umanitoba.ca

Sponsor (if applicable): Natural Sciences and Engineering Research Council of Canada and Employees Compensation Board of Manitoba

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Why have you been invited to participate?

You are being invited to participate in the first stage of a three stage research aiming to investigate disability management (DM) in the Manitoban construction industry and its relation to safety performance. Please read this consent form carefully before deciding on whether or not to participate in this research. Your participation in this project is voluntary and you may withdraw

from the project at any time prior to the completion of this interview. Your decision to participate or not will be kept in confidence by the researchers (see project team below) and will not be shared with anyone or any institution.

Project team

The project team includes Rhoda Ansah Quaigrain and Dr. Mohamed Issa. Miss Rhoda Quaigrain is a PhD candidate at the University of Manitoba and is supervised by Dr. Mohamed Issa. This AHP is part of Miss Quaigrain's research.

Why is the research being done?

The inadequacy of support and practices at the organizational and managerial levels affects the degree to which construction workplaces can accommodate disabled employees. It is therefore imperative to investigate the level of supports available as well as the mechanisms structured to enable full integration. The outcome of this research will provide a tool that construction organizations can use to evaluate the maturity level of their existing disability management (DM) practices. This research is the first stage of a three stage research. The essence of this stage is to conduct the in analytical hierarchy process (AHP) which is an analytic decision making method used to select the best alternative from a number of alternatives using several criteria.

What are you asked to do?

You are asked to participate voluntarily in the AHP to determine per your experience of working in the field the relative importance and weightings of the twelve identified practice areas of DM as it pertains specifically to construction workplaces. Your responses should draw from your experiences working in the field, project sites, human relations and knowledge gathered and obtained over the years. The session should take a maximum of 20 minutes of your time. You will be asked to complete a short demographics survey prior to the actual AHP. The demographic information seeks to help answer the research questions and (b) to help describe the sample characteristics.

Potential harm/ benefits

There is no known harm or direct benefits to participating in the research. However, your participation will help us better understand teachers' well-being in the context of school environments specifically.

Privacy and confidentiality

The AHP session will not be recorded with an audio electronic recording device. You are asked not to mention your name or refer to other colleagues by name or using any other identifiable information throughout the AHP session. Please use generic words to refer to them. Only the principal investigator and the advisor (i.e. supervisor) will have access to all the information that will be collected for the research. You will work independently and separately. All information gathered from you will be strictly confidential. The information will be completely anonymized and coded to ensure that your responses do not reveal your identity. Recorded weightings,

demographic data and identification codes will be kept in a locked cabinet accessible only by the principal investigator. Direct responses from this interview will not be included in any reports or research publications. Your employer will not have access to any of the data collected for this research. In addition, your employer will not be given any report with respect to the outcome of this stage of the research. At the end of April, 2016, the recorded raw weightings will be permanently deleted. Data sheets will be shredded and the soft copies will be permanently deleted, verified by the Advisor. This data will not be stored in any format by the researchers.

Dissemination

Your direct responses to the AHP will not be included in any report or scientific publication. Your responses will be analyzed for the purpose of developing and validating the maturity model. A copy of the raw weightings will be forwarded to you for verification and your records. You can request a copy of the results that will be generated at the end of this stage of the research; see details below.

Risk and Benefits

You are not required to answer any question in the AHP session you may find distressing. You do not have to answer every question to be able to participate in this research.

You have the right to change your mind

By signing this Informed Consent, you agree to the information contained in inhere and to participating in the research. In no way does this waive your legal rights nor release the researchers, or your employer from their legal and professional liabilities. You are free to withdraw from the research at any time, and to refrain from answering any questions without prejudice or consequence. You will not be required to provide an explanation for doing so. To withdraw from this research, please contact the principal investigator at quaigrra@myumanitoba.ca . In addition, you can also withdraw from this research by informing the principal investigator in person before, during or after the AHP session. Upon withdrawing from this research, your information will be permanently destroyed. If you decide to withdraw your information after you have provided it, you can do so by informing the principal investigator Rhoda Quaigrain at quaigrra@myumanitoba.ca. The principal investigator will permanently destroy your information. Alternatively, your information will be returned to you if requested in your email to the principal investigator; your information will not be duplicated for used in this research.

Can you request a summary of the research results?

You can request a summary of the research results either in electronic or printed version. This summary will be the eigenvectors of the twelve DM practice indicators that should be available by the end of December 2015. To request a summary of the research results, or to ask questions about this research , please contact the principal investigator Rhoda Quaigrain at quaigrra@myumanitoba.ca and provide your preferred contact details. Should you have any questions or concerns regarding this research project, you are welcome to contact the Chair of the University of Manitoba's Department of Civil Engineering as follows:

Dr. Ahmed Shalaby, Ph.D., P.Eng.
Professor and Head
Department of Civil Engineering
University of Manitoba
15 Gillson Street, EITC E1-368
Winnipeg, MB R3T 5V6
p: (204) 474-6818
e: Ahmed.Shalaby@umanitoba.ca

Ethics review

This research has been approved by the University of Manitoba Education/Nursing Research Ethics Board. If you have any concerns or complaints about this research you may contact any of the above-named persons or the Human Ethics Coordinator (HEC) at 474-7122 or email Margaret.Bowman@umanitoba.ca. A copy of this consent form has been given to you to keep for your records and reference.

How to participate

If you agree to participate in this survey and agree to the information contained herein, please inscribe your signature on the dotted line below.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the research at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

The University of Manitoba may look at the research records to see that the research is being done in a safe and proper way.

Participant's Signature …….. Date…….

Researcher's Signature …… Date……..

Appendix C

AHP ETHIC APPROVAL CERTIFICATE

UNIVERSITY OF MANITOBA | Research Ethics and Compliance
Office of the Vice-President (Research and International)

Human Ethics
208-194 Dafoe Road
Winnipeg, MB
Canada R3T 2N2
Phone +204-474-7122
Fax +204-269-7173

APPROVAL CERTIFICATE

August 25, 2015

NSERC and WCB

TO: **Rhoda Ansah Quaigrain** [redacted] (Advisor M. Issa)
Principal Investigator

FROM: **Thomas Falkenberg, Chair**
Education/Nursing Research Ethics Board (ENREB)

Re: **Protocol #E2015:069**
"Evaluating the Accessibility of the Manitoba Construction Industry to Disabled Workers and its relation to Safety Performance"

Please be advised that your above-referenced protocol has received human ethics approval by the **Education/Nursing Research Ethics Board**, which is organized and operates according to the Tri-Council Policy Statement (2). **This approval is valid for one year only**.

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

Please note:

- **If you have funds pending human ethics approval, please mail/e-mail/fax (261-0325) a copy of this Approval (identifying the related UM Project Number) to the Research Grants Officer in ORS in order to initiate fund setup. (How to find your UM Project Number: http://umanitoba.ca/research/ors/mrt-faq.html#pr0)**

- **if you have received multi-year funding for this research, responsibility lies with you to apply for and obtain Renewal Approval at the expiry of the initial one-year approval; otherwise the account will be locked.**

The Research Quality Management Office may request to review research documentation from this project to demonstrate compliance with this approved protocol and the University of Manitoba *Ethics of Research Involving Humans*.

The Research Ethics Board requests a final report for your study (available at: http://umanitoba.ca/research/orec/ethics/human_ethics_REB_forms_guidelines.html) **in order to be in compliance with Tri-Council Guidelines.**

umanitoba.ca/research

Appendix D

MATURITY MODEL ASSESSMENT WORKSHEET

The survey is divided into two parts, Individual level indicators and Organizational level indicators, which categories the 12 indictors based in applicability and level of implementation. Respondents are to choose how applicable each assessment question is to their overall organization and the extent to which each it is implemented within their organization.

PART ONE

Individual Level Intervention Indicators

Communication Practices (CP)

The practice entails information provided to all employees on disability in the workplace, along with specific information about the organizational strategy, and about any adaptations which may be needed in a working environment, workstation and work schedules to enable employees with disabilities to optimize their effectiveness.

Assessment Questions (Practices)

1. The current disability management program communication system is designed so as to maximize internal and external program support

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e) Strongly Agree

2. Disability management in the workplace is brought to the attention of all employees and in language that can be easily understood.

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e) Strongly Agree

3. Communication is open and employees feel free to voice concerns and make suggestions

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

4. Individuals affected by the disability management program are provided with appropriate information in a timely manner

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

5. Employees are freely able to express their injury claims concerns and make suggestions for improvement

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

6. Employees receive regular training concerning injury management and claims

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

7. Employees are informed of policy changes made concerning injury management and claims

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

8. Employees receive regular training/education in health and safety procedures on site and within work spaces (e.g causes of workplace injury, effective use of materials and equipment etc.)
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
9. Employees are involved in the development of policies and programs related to DM, specifically those that directly affect them
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
10. Employee's knowledge about disability management practices are assessed on a regular basis
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
11. There is a strategic plan that supports a collaborative disability management program
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

Case Management Practices (CMP)

The practice encompasses dealing with individual cases after the occurrence of injury with the aim to rehabilitating the individual. Case management is a term used to describe a variety of strategies for managing the health and social services for injured employees and their families and typically requires an understanding of multiple factors related to medical care, the work environment, and disability claim processes.

Assessment Questions (Practices)

1. A designated person is assigned to make contact with any employee who becomes injured or ill within a timely manner to explain the disability management program and to offer support.
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
2. Someone from your workplace contacts the employee shortly after an injury or illness to express concern and offer assistance (Renee et al, 2005).
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
3. Someone from your workplace maintains regular communication with the injured employee's physician to facilitate return to work.
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
4. Initial assessment of the physical and functional capability of the worker related to accommodations in the equipment and work environment are conducted in a timely manner
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
5. Job assessment is conducted upon the receiving the level of injuries as assessed by a physician to determine task restrictions
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
6. Someone from your workplace makes a follow-up contact with employees off work due to injury or illness and assesses their progress toward return to work.
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
7. Treating physicians are asked to identify employee restrictions and capacities and to specify a target return to work date.

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

8. Proactive and timely communication is made with physicians, sharing information with them about suitable duties, the physical demands of jobs, and the provision of transitional work

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

9. There is a process in place for finalizing policies regarding rehabilitations decisions when there are disagreements about disability management issues

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

10. A follow up of the employee is done after the leave of absence has ended to facilitate his or her adjustment to work post-disability

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

11. A Case manager is appointed for every individual case or at least case severe injury

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

12. A disability management practitioner (or designated individual) in the organization completed a formal training program in disability management

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

13. Candidates for hire as disability management practitioners are examined to ensure they have specific and relevant skills, knowledge and training.

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

14. Duties of the disability management practitioner (or designated individual) are designed in order to optimize return to work coordination and case management

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

15. The disability management practitioner is responsible for ensuring that ill, injured or disabled employees receive all case management services and assistance in a timely and coordinated manner.

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

16. For active cases, the disability management practitioner (or designated individual) is in regular contact with all relevant stakeholders (e.g. disability management committee, supervisors) involved in disability management.

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

17. Progress is monitored for achievement of targeted milestones through ongoing comparison with established best-practice guidelines in order to make recommendations, optimize functional recovery, and provide needed follow-up

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

18. Case notes and reports are prepared using applicable forms and systems in order to document case activities in compliance with standard practices and regulations

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

Return to Work and Accommodation Practices (RAP)

The practice includes the completion of a job needs assessment to determine how the DM program

can best meet the needs of employees with disabilities with the aim of incorporating the employee (individual) back into work. In this situation, a comprehensive analysis of employees' skills is done to modify their original jobs or identify alternate jobs within the organization for which the employee would be more suited.

Assessment Questions (Practices)

1. Capacity evaluations are conducted in situations where there is conflicting or inadequate medical information.

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

2. Evaluations provide detailed information necessary for the development of a rehabilitation plan, clarify prognosis for return to work, and help identify the individual's functional abilities for his or her own occupation or others.

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

3. A Collaborative approach is espoused in each case where the employee and management work together on to develop a return to work strategy for the individual

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

4. Job analysis is conducted by which the specific physical and mental demands of a job are identified

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

5. Functional assessment is conducted, in which the disabled employee's capacities and limitations relevant to particular job demands are thoroughly assessed

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

6. Formal job analyses or functional job descriptions are completed for each job in the workplace so that the worker's abilities can be compared to job demands

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

7. The organization performs worksite/job analyses using observation, interview, and records review in order to determine the requirements of the jobs in the workplace (follow up to question 6)

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

8. Job modification is conducted by which tasks and responsibilities are modified to be consistent with the employee's state of health and current capacities

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

9. Vocational assessment and alternative job placements are implemented for employees unable to return to their regular position following the onset of a disability/injury

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

10. The organization works with the employee to develop a return-to-work plan and, if necessary, update the plan as rehabilitation progresses

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

Claims Management Practices (CLP)

The practice encompasses instances where an employee has a non-occupational injury or illness, whereby the disability employee (individual) may be entitled to long-term disability (LTD) benefits. Similarly, where an employee suffers an occupational injury or illness he or she may be entitled to employees' compensation benefits.

Assessment Questions (Practices)

1. Claims Management practices are clearly defined in the workplace DM policies, goal setting and planning process

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

2. Claims management is well coordinated from initial injury to claim resolution.

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

3. Long duration claims are evaluated to determine whether more intensive services are required

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

4. Guidance and information is provided on medical certificates for sick leave, ill or injured employees' entitlements, and administrative requirements, including those related to employees' compensation

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

5. The current claims/benefit program is designed to support early intervention and return to work.

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

PART 2

Organizational Level Intervention Indicators

Disability and Injury Prevention Practices (DIP)

These practices cover the preventative aspects of DM programs, which have matured considerably in recent years and are critical to the overall performance of these programs and to controlling related costs. DM programs should educate employees on these aspects before the occurrence of disabling injuries

Assessment Questions (Practices)

1. Disability management policy and program roles and responsibilities have been clearly defined in the workplace's goal setting and planning process

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

2. Regular planning process is in place to set disability/injury management prevention goals and objectives

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

3. The disability management process includes intervention activities aimed at reducing workplace injuries and accidents

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

4. The organization implements and monitors a hazard prevention program

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

5. The organization provides first-aid services to employees and ensures the availability of first-aid kits

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

6. The organization makes qualified first-aid attendants available to employees during regular working hours

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

7. The organization has a program promoting employee health and wellness

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

8. Employee health and wellness programs provide incentives to encourage employee participation

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly agree

9. The organization implements stress management and health and wellness programs which have been demonstrated to reduce the number of disability claims (Lewis, 1993)

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

10. The organization allocates a budget for disability and injury prevention strategies

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

10b. If such a budget exist provide the range as to how much is allocated:

11. The organization has an accident prevention and safety program administered by a joint worker-management committee

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

12. Employees participate in both safety training programs and safety committees designed to enhance workplace safety.

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

Transitional Program Management Practices (TPM)

These practices cover the development of a generic DM program for injured employees that can be customized to the individual employee during the individualized case management.

Assessment Questions (Practices)

1. There is a regular planning process in place to set transitional work program management goals and objectives

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

2. The organization utilizes technological/organizational tools such as computerized clinical protocol (called “Work-Ability” programs) to reduce the length of disability leaves

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

3. The organization actively monitors injured, ill or at risk employees to determine if they should be referred to a disability management program

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

4. A collaborative approach involving employees and management is espoused in the development and management of disability management workplace programs specifically transitional work.

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

5. The organization provides formalized education for individuals responsible for RTW coordination and acting in the DM role

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

6. The designated individual leads the DM program

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

7. The organization has a disability management practitioner and/or a disability management committee consisting of both management and worker representatives

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

8. The organization implements a written program including policies, procedures and a process for individualized formal RTW plans

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

8b. What is the level of detail of the written program? (Follow up to previous question 8)

9. The organization initiates an analysis of the accommodation needs of injured employees who cannot return to their original job

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

10. The organization ensures consistent management of occupational and non-occupational injuries/illnesses

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

11. The organization ensures there is a documented comprehensive RTW program established collaboratively with unions

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

12. The organization provides productive and meaningful transitional work that is time limited

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

13. Transitional work that is provided progresses the employee with an injury or illness towards returning to a regular position at the organization

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

14. Reviews of disability case management intervention protocol are conducted using standards of care in order to promote quality care, recovery, and cost effectiveness

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

Physical Accessibility Management Practices (PAP)

These practices aim to improve the physical accessibility of construction workplaces to people with disabilities and as such cover physical workplace accessibility requirements.

Assessment Questions (Practices)

1. The organization has well trained and motivated staff so that premises can be safely evacuated in an emergency situation in less time than is suggested

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

2. Staff training programmes include evacuation techniques and assistance for disabled and elderly occupants

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

3. Managers and colleagues seek knowledge of any additional support and guidance that will help accommodate a new recruit (Workstation, toilets, canteens, rest rooms, emergency and evacuation procedures, etc.)

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

4. Requirements are met in advance of the candidate's starting date (follow up to previous question)

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

5. The organization's office premises incorporate physical accessibility features such as lifts, ramps, rails etc.

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

Program Evaluation Practices (PEP)

This is where the workplace program is evaluated regularly. This allows the employer to identify necessary program modifications and improvements and analyze injury and illness statistics (OHSAH, 2010). It also helps justify program costs and assess its benefits. The evaluation ensures that the program meets not only its overall objectives, but employees' needs as well. The RTW plan for each employee should also be evaluated accordingly.

Assessment Questions (Practices)

1. The organization maintains records of illness or injury in the workplace

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

2. Various data gathering techniques and statistical analyses are used to evaluate the impact of the interventions on program goals

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

3. The organization evaluates the outcomes of their employee health and wellness programs

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

4. There exists a database containing injury and/or illness data for individual employees and identifies information about trends (e.g., most common injury type)

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

5. Periodic meetings are held for managers or departmental representatives whereby injury, illness

and disability patterns are reviewed
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
6. The organization tracks costs associated with the disability management program
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
7. Trend data on direct and indirect costs is used to predict both the direct and indirect costs of disability management in the future
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
8. The organization has ongoing monitoring and evaluation process for individuals who are accommodated
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
9. The organization evaluates the effectiveness of their workplace strategy on the management of disability at regular intervals and make improvements where required
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
10. Worker representatives at the workplace have access to the evaluation and participate in it
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
11. Information regarding the disability management programme is made anonymous and confidentiality protected, before being distributed
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
12. The organization uses injury and illness data to identify problem areas and achieve accountability in the disability management program
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
13. The organization analyzes injury and illness data to target causes and identify solutions
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

Senior Management Support Practices (SMP)

These practices involve getting continuous and consistent support at the senior management level to ensure the effective implementation of DM programs.

Assessment Questions (Practices)

1. Top management is actively involved in the disability and safety program.
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
2. The safety manager receives support from top management.
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
3. The organization spends time and money on improving safety performance
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
4. The organization considers safety equally with service and quality in the way work is done
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

Regulatory and Compliance Policies (RCP)

These practices cover existing polices both at the federal and provincial levels. Additionally it delves into specific policies developed by the organization in relation to accommodating injured and disabled employees. Policies can cover issues such as salary replacement, job accommodation, transitional employment, budgetary responsibility and vocational training when necessary

Assessment Questions (RCP)

1. The organization considers the management of disability issues in the workplace a priority task that contributes to business success, and regards it as an integral part of the workplace human resource development strategy.

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

2. The disability management strategy is formulated in accordance with national legislation, policy and practice, taking into account national institutions and organizations in the field

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

3. In formulating a strategy for managing disability issues in the workplace, the organization collaborates with employee representatives and consults with disabled employees or their representatives.

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

4. The organization complements the human resource development strategy in its aim to maximize the contributions and abilities of all staff, including those with disabilities and support adherence to occupational safety and health standards and related early intervention and referral procedures

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

5. The disability management strategy considers provision for employees who support a disabled member

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

Recruitment and Retention Policies (RRP)

Practices cover the recruitment process of employees in the construction workplace as well the procedures undertaken to ensure the retention of injured employees. The principle of non-discrimination should be respected throughout the process, to ensure maximal benefit to the employer and equitable opportunities to candidates with and without disabilities.

Assessment Questions (Practices)

1. In developing measures for the redeployment of employees with disabilities, the organization takes into account the occupational preferences of those employees and consults with worker representatives, if necessary.

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

2. The organization ensures that all possible accommodation are considered in order to utilize the residual potential and skills of that worker, before other steps are taken

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

3. Competent authorities provides guidance, services and incentives to employers, in order to maximize opportunities for people with disabilities to retain their employment

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

4. Alternative recruitment qualifying tests and shift mechanisms are implemented to create a fair opportunity for disabled candidates

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

5. Alternative ways of testing skills are available for some jobs rather than relying on standard paper qualifications that some disabled people may have been denied the opportunity to obtain

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

6. Health requirements are justifiable for workplaces

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

7. Recruitment staff and selection panel members are trained to handle issues involving equal opportunity, diversity and disability

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

8. A disabled employee or disability expert is part of the recruitment panel

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

9. During an interview applicants with disabilities are invited to identify any particular arrangements they might require on a jobsite

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

10. The same scoring/assessment system is used for disabled and non-disabled candidate

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

11. The organization ensures that information about an individual's disability is only passed on to the staff and managers necessary and only with the person's consent

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

12. Managers, colleagues, trade union officials, and first aid staff are aware of the practical consequences of an individual's disability

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

13. Clearly defined job descriptions and explanations of duties are available at the earliest opportunity and forms part of the introduction process

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

14. Monitoring checks are implemented to see whether people with disabilities are overrepresented in rejection decisions for positions. If any patterns emerge, the whole recruitment process is checked

a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

Ergonomic Practices (EP)

Related practices should ensure the design of work processes and spaces that minimize injuries, complaints, staff turnover and work absenteeism; meet employers' social and legal obligations and

improve employees' health and safety.

Assessment Questions (Practices)

1. Ergonomic interventions are undertaken as needed.
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
2. Ergonomic interventions are evaluated to determine if they were successful
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
3. Jobs are designed to reduce heavy lifting.
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
4. Jobs are designed to remove repetitive movement.
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
5. Ergonomic strategies are used to improve workstations/ work areas.
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
6. Work rotations or changes in job responsibilities are used to minimize exposure to ergonomic risks.
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
7. Ergonomic factors are considered where purchasing new tools, equipment, or furniture.
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
8. Work areas/work stations are modified to minimize ergonomic risks before injuries occur.
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
9. Ergonomic approaches are used to assist disabled employees in returning to work.
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree
10. The organization provides education sessions on ergonomics to minimize the risk of injury
a) Disagree b) Somewhat Disagree c) Neutral d) Agree e)Strongly Agree

Appendix E

ASSESSMENT WORKSHEET ETHICS APPROVAL CERTIFICATE

UNIVERSITY OF MANITOBA | Research Ethics and Compliance
Office of the Vice-President (Research and International)

Human Ethics
208-194 Dafoe Road
Winnipeg, MB
Canada R3T 2N2
Phone +204-474-7122
Fax +204-269-7173

APPROVAL CERTIFICATE

October 20, 2015

NSERC/WCB

TO: **Rhoda Ansah Quaigrain** (Advisor M. Issa)
Principal Investigator

FROM: **Zana Lutfiyya, Acting Chair** [redacted]
Education/Nursing Research Ethics Board (ENREB)

Re: **Protocol #E2015:084**
"Evaluating the Accessibility of the Manitoba Construction Industry to Disabled Workers and its relation to Safety Performance – Phase 2"

Please be advised that your above-referenced protocol has received human ethics approval by the **Education/Nursing Research Ethics Board**, which is organized and operates according to the Tri-Council Policy Statement (2). **This approval is valid for one year only**.

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

Please note:

- **If you have funds pending human ethics approval, please mail/e-mail/fax (261-0325) a copy of this Approval (identifying the related UM Project Number) to the Research Grants Officer in ORS in order to initiate fund setup. (How to find your UM Project Number: http://umanitoba.ca/research/ors/mrt-faq.html#pr0)**

- **if you have received multi-year funding for this research, responsibility lies with you to apply for and obtain Renewal Approval at the expiry of the initial one-year approval; otherwise the account will be locked.**

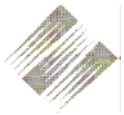
The Research Quality Management Office may request to review research documentation from this project to demonstrate compliance with this approved protocol and the University of Manitoba *Ethics of Research Involving Humans*.

The Research Ethics Board requests a final report for your study (available at: http://umanitoba.ca/research/orec/ethics/human_ethics_REB_forms_guidelines.html) **in order to be in compliance with Tri-Council Guidelines.**

umanitoba.ca/research

Appendix F

ASSESSMENT WORKSHEET INFORMED CONSENT FORM



Room E1-368A

Engineering

15 Gillson Street

Winnipeg, Manitoba

Canada R3T 5V6

Faculty of Engineering

Department of Civil Engineering

Research Project Title: Evaluating the Accessibility of the Manitoban construction Industry to Disabled Construction Employees and its Relation to Safety Performance

Principal Investigator and contact information: Rhoda Ansah Quaigrain, PhD candidate, Room E1-368A Engineering, 15 Gillson St, University of Manitoba, Winnipeg, MB R3T 5V6 Canada, email: quaigrra@myumanitoba.ca

Advisor and contact information: Dr. Mohamed Issa, Assistant Professor, Construction Engineering and Management, Department of Civil Engineering, University of Manitoba, E3-589, EITC, 15 Gillson Street, Winnipeg, MB, R3T 2N2, email: Mohamed.Issa@umanitoba.ca

Sponsor (if applicable): Natural Sciences and Engineering Research Council of Canada and Employees Compensation Board of Manitoba

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Why have you been invited to participate?

You are being invited to participate in the first stage of a three stage research aiming to investigate disability management (DM) in the Manitoban construction industry and its relation to safety

performance. Please read this consent form carefully before deciding on whether or not to participate in this research. Your participation in this project is voluntary and you may withdraw from the project at any time prior to the completion of this survey. Your decision to participate or not will be kept in confidence by the researchers (see project team below) and will not be shared with anyone or any institution.

Project team
The project team includes Rhoda Ansah Quaigrain and Dr. Mohamed Issa. Miss Rhoda Quaigrain is a PhD candidate at the University of Manitoba and is supervised by Dr. Mohamed Issa. This survey is part of Miss Quaigrain's PhD research.

Why is the research being done?
The inadequacy of support and practices at the organizational and managerial levels affects the degree to which construction workplaces can accommodate disabled employees. It is therefore imperative to investigate the level of supports available as well as the mechanisms structured to enable full integration. The outcome of this research will provide a tool that construction organizations can use to evaluate the maturity level of their existing disability management (DM) practices. This research is the second stage of a three stage research. The essence of this stage is to assess the implementation of DM in construction in relation to predefined practices areas of DM.

What are you asked to do?
You are asked to participate voluntarily in this survey to determine per your experience of working in the field the implementation levels of the twelve identified practice areas of DM as it pertains specifically to construction workplaces. Your responses should draw from your experiences working in the field, project sites, human relations and knowledge gathered and obtained over the years. The session should take a maximum of 45 minutes of your time.

Potential harm/ benefits
There is no known harm or direct benefits to participating in the research. However, your participation will help us better understand DM implementation in the construction industry.

Privacy and confidentiality
The survey session will not be recorded with an audio electronic recording device. You are asked not to mention your name or refer to other colleagues by name or using any other identifiable information throughout the focus group Please use generic words to refer to them. Only the principal investigator and the advisor (i.e. supervisor) will have access to all the information that will be collected for the research. All information gathered from you will be strictly confidential. The information will be completely anonymized and coded to ensure that your responses do not reveal your identity. Recorded weightings, demographic data and identification codes will be kept in a locked cabinet accessible only by the principal investigator. Direct responses from this interview will not be included in any reports or research publications. Your employer will not have access to any of the data collected for this research. In addition, your employer will not be given any report with respect to the outcome of this stage of the research. At the end of June, 2016, the recorded survey will be permanently deleted. Data sheets will be shredded and the soft copies will be permanently deleted, verified by the Advisor. This data will not be stored in any format by the

researchers.

Dissemination
Your direct responses to the survey will not be included in any report or scientific publication. Your responses will be analyzed for the purpose of developing and validating the maturity model. A copy of the raw weightings will be forwarded to you for verification and your records. You can request a copy of the results that will be generated at the end of this stage of the research; see details below.

Risk and Benefits
You are not required to answer any question in the survey you may find distressing. You do not have to answer every question to be able to participate in this research.

You have the right to change your mind
By signing this Informed Consent, you agree to the information contained in inhere and to participating in the research. In no way does this waive your legal rights nor release the researchers, or your employer from their legal and professional liabilities. You are free to withdraw from the research at any time, and to refrain from answering any questions without prejudice or consequence. You will not be required to provide an explanation for doing so. To withdraw from this research, please contact the principal investigator at quaigrra@myumanitoba.ca. In addition, you can also withdraw from this research by informing the principal investigator in person before, during or after the survey sessions. Upon withdrawing from this research, your information will be permanently destroyed. If you decide to withdraw your information after you have provided it, you can do so by informing the principal investigator Rhoda Quaigrain at quaigrra@myumanitoba.ca. The principal investigator will permanently destroy your information. Alternatively, your information will be returned to you if requested in your email to the principal investigator; your information will not be duplicated for used in this research.

Can you request a summary of the research results?
You can request a summary of the research results either in electronic or printed version. This summary will be the maturity scores that should be available by the end of March 2016. To request a summary of the research results, or to ask questions about this research , please contact the principal investigator Rhoda Quaigrain at quaigrra@myumanitoba.ca and provide your preferred contact details. Should you have any questions or concerns regarding this research project, you are welcome to contact the Chair of the University of Manitoba's Department of Civil Engineering as follows:

Dr. Ahmed Shalaby, Ph.D., P.Eng.
Professor and Head
Department of Civil Engineering
University of Manitoba

15 Gillson Street, EITC E1-368
Winnipeg, MB R3T 5V6
p: (204) 474-6818
e: Ahmed.Shalaby@umanitoba.ca

Ethics review

This research has been approved by the University of Manitoba Education/Nursing Research Ethics Board. If you have any concerns or complaints about this research you may contact any of the above-named persons or the Human Ethics Coordinator (HEC) at 474-7122 or email Margaret.Bowman@umanitoba.ca. A copy of this consent form has been given to you to keep for your records and reference.

How to participate

If you agree to participate in this survey and agree to the information contained herein, please inscribe your signature on the dotted line below.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the research at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

The University of Manitoba may look at the research records to see that the research is being done in a safe and proper way.

Participant's Signature …….. Date…….

Researcher's Signature …… Date……..

Appendix G

METRICS DATA SHEET

Instructions

Please fill out the data sheet with corresponding figures for the last **five (5) years**, ideally 2011-2015; a different work sheet for each year must be filled out.

Privacy and confidentiality

The data will not be recorded with an audio electronic recording device. You are asked not to mention your name or refer your company by name or using any other identifiable information throughout. Only the principal investigator will have access to all the information that will be collected for the research. All information gathered from you will be strictly confidential. The information will be completely anonymized and coded to ensure that your responses do not reveal your identity. Recorded weightings, demographic data and identification codes will be kept in a locked cabinet accessible only by the principal investigator. Direct responses from this data will not be included in any reports or research publications. Your employer will not have access to any of the data collected for this research. In addition, your employer will not be given any report with respect to the outcome of this stage of the research. At the end of June, 2016, the recorded data will be permanently deleted. Data sheets will be shredded and the soft copies will be permanently deleted, verified by the Advisor (university representative). This data will not be stored in any format by the researchers.

Performance	**Year:**												
Data	**Jan.**	**Feb.**	**March**	**April**	**May**	**June**	**July**	**August**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Total for year**
Number of injuries/illnesses													
Number of incidents/injuries that resulted in days away from work, restricted activity and/or job transfer													
Number of employees on modified or transitional work/duties													
Number of Accidents requiring immediate first aid													
Number of Employees													
Amount of time lost to incidents (hours)													
Number of work hours													
Number of employees off due to injury (short term less than 1 week)													
Number of employees off due to injury (long term more than 1 week)													

Number of employees off due to injury (long term to permanent leave or early retirement)													
Number of employees who returned back from injury leave (period less than three months)													
Number of employees who returned back from injury leave (period more than three months)													
Number of injuries that required case management													
Number of employees who transitioned from temporary work to their original work													
Cost of Claims													
Number of claims													
Cost of premiums													

Injury Breakdown

Injury type	**Year:**												
	Jan.	**Feb.**	**March**	**April**	**May**	**June**	**July**	**August**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Total for year**
Number fall injuries													
Number of equipment related injuries													

Number of injuries due to Repetitive motion													
Number of injuries due to falling objects or struck by objects													
Number of injuries due to Electric shock and arc flash													
Number of muscular injuries													

Appendix H

SAMPLE INDIVIDUAL COMPANY REPORT

Evaluating Disability Management in the Manitoban Construction Industry

Company 1 Report

Acknowledgement

This research was supported by a grant from the Research and Workplace Innovation Program of the Employees Compensation Board of Manitoba.

Project Overview

The Manitoba construction industry has a poor safety record. Approximately, 2,063 time loss injuries and 4,269 total injuries were reported by the industry to the Worker's Compensation Board of Manitoba (WCB) in 2012, representing approximately 14% of all reported injuries on that year (WCB 2013). This is despite construction employees representing only 6.7% of the total workforce in Manitoba in 2012. Despite a decrease in heavy and building construction's time loss injury rates from 11% and 7.5% in 2000 to 6.7% and 5.1% in 2011 respectively, these rates were still a lot higher than the 3.3% average time loss rate for all industries in 2012. Building and heavy construction's all injury rates at 14.5% and 10.3% respectively in 2012 were also a lot higher than the provincial average rate of 5.2%. These statistics reinforce the need for effective programs that ensure the timely and safe return of employees with a disability to the workplace and protect them from discrimination. Inadequate support and practices at the organizational and managerial levels affect the degree to which construction workplaces can accommodate disabled employees returning to the workplace. Despite the potential benefits of DM programs in reducing costs and improving workplace morale, many organizations in the construction industry appear unable to develop and implement them. This is met in the literature by limited research attention with no concrete frameworks for the implementation, monitoring and evaluation of construction-specific DM practices, and little empirical evidence about the maturity of DM practices in construction. Moreover, there's little empirical evidence about the maturity of these practices and the status of disability management (DM) in construction in general. Therefore, this research aimed to investigate DM in the Manitoban construction industry and its relation to safety performance. Specific objectives include developing and validating a model to evaluate the maturity of construction organizations' DM practices, and a set of metrics to evaluate their DM and safety performance. The research also evaluated the relationship between the maturity of construction organizations' DM practices, their DM performance and their safety performance. The research made use of maturity modelling to develop the required model. The model developed, called the Construction Disability Management Maturity Model, benchmarks performance in construction companies using 12 disability management indicators which were validated by 8 construction experts using analytical hierarchy process and administered to a sample of 10 general contractors in Manitoba through assessment worksheets. The research provides a tool that construction organizations can use to evaluate the maturity level of their existing disability management (DM) practices. The developed tool evaluates construction organizations' existing policies and practices against the best practices which an organization should aim for to improve their DM performance.

Research Overview

The Construction Disability Management Maturity Model (CDM3) adopts the concept of process improvement epitomised in the process maturity framework. The model aims to define key DM best practices in the literature, and evaluate the maturity of construction organizations' DM practices against these best practices, providing guidance for improving these organizations' overall DM. The CDM3 incorporates the twelve indicators, which are divided into two different categories based on their level of implementation and applicability: organizational level indicators and individual level indicators. These indicators represent clusters of related activities, which when adhered to enable the achievement of performance goals. The CMD3, has five possible levels of maturity associated with each indicator and the determination of each level of maturity is based on the presence of specific practices. The first level, 'Ad-hoc and chaotic' is assigned a maturity score

of either 0 or 1/5, the second level, 'Planned and managed' is assigned a maturity score of 2/5, the third level 'Standardized' is assigned a maturity score of 3/5, the forth level "Quantitatively measured' is assigned a maturity score of 4/5 and the fifth level 'Continuously refining' is assigned a maturity score of 5/5.

The research also measured safety performance using 3 safety metrics, which were Recordable injury rate (RIR), Severity rate (SR) and Lost time case rate (LTCR). Given the scarce DM metrics in the literature, the research developed DM metrics based on the 12 DM indicators identified as part of the second objective of this research. The research developed 12 DM metrics to assess DM performance using lagging indicators. The research however only measured 5 out of the 12 DM metrics because companies

Results

The model was implement on 10 general contractor organizations in Manitoba. Figure 1 depicts the aggregated maturity scores for level of implementation on a scale of 1 to 5 (Ad-hoc to continuously refining) indicating the average maturity score (MS) across all organizations, as well as your company's average values denoted by MS Company 1. Figure 2 provides a further breakdown based on the individual maturity of your indicators against the average maturity across the companies.

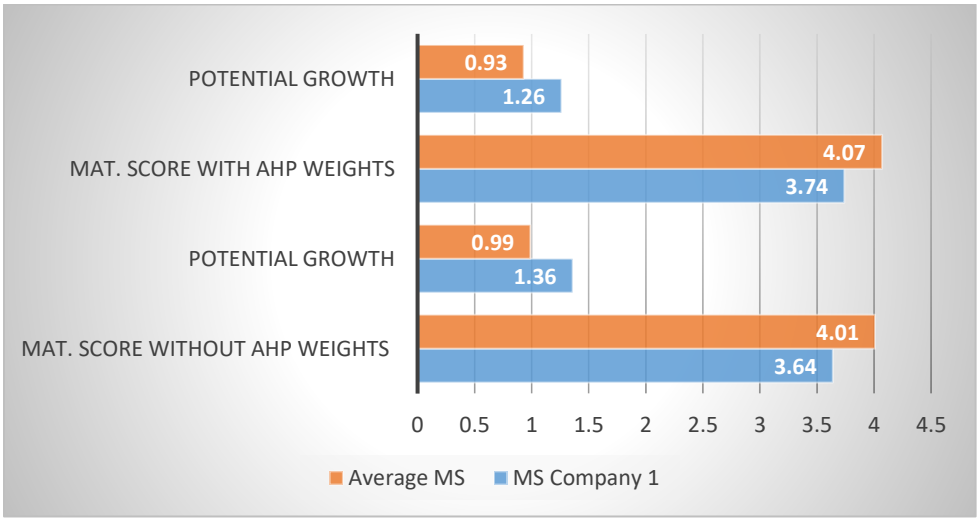


Figure 1: Company 1's Maturity Score and Potential Growth in comparison with average Maturity Score for all the companies

In general, companies had an overall average MS Company of 4.06, with an average PG Company of 18.68% and were thus deemed to be performing at the quantitatively managed maturity level. As expected, Senior Management Support was found to be the most mature DM indicator on average across the 10 companies with an average MS of 4.60. This was followed by Disability and Injury Prevention Disability with an average MS of 4.44. Only 5 out of the 12 indicators were operating at the quantitatively measured level (i.e. average MS greater than or equal to 4 and below 5), with the remaining operating at the standardised level (i.e. average MS greater than or equal to 3 and below 4). The fact that all indicators were performing at a level 3 or higher is a positive

indication of growth and shows that the companies assessed were aware of the practices that needed to be implemented and were taking proactive steps to implement them. The least matured indicators were Recruitment and Retention Polices and Communication practices.

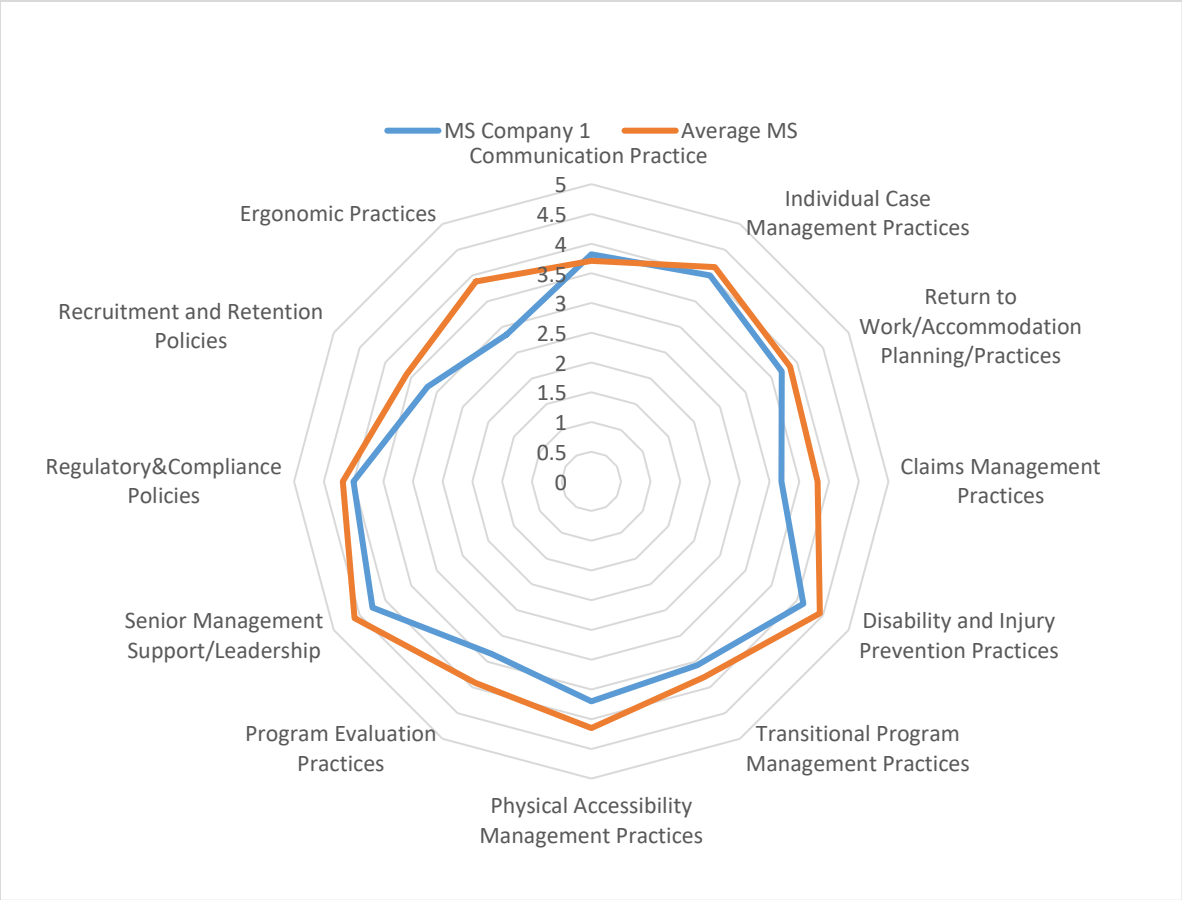


Figure 2: Company 1's Indicator Maturity Score in comparison with average Maturity Score for the indicators

Figure 2, provides comparison of your company with other companies on the implementation of the indicators. The orange line is the average of all companies and the blue line is your company's maturity score for each indicator. The radar chart explains that your company performed better than average of other companies in management practices where the solid blue line is above the orange line. Similarly, your company is behind other companies in implementing practices where the blue line is below the orange line. These are the practice areas which needs improvement at your company level.

Table 1 summarizes the performance of your company in regards to the Safety metrics and DM metrics, benchmarked against the sampled companies' averages. The table demonstrates how your company would potentially benchmark their DM performance in order to assess the state of their safety and DM programs and identify areas for improvements.

Table 1: Sample Safety and DM performance

Metric	2012	2013	2014	2015
RIR	33.05	38.78	24.17	15.69
Average across companies	25.23	21.85	18.71	14.69
SR	57.84	145.89	101.84	22.66
Average across companies	42.68	103.15	59.83	41.06
LTCR	18.59	22.16	13.81	8.71
Average across companies	8.37	8.46	6.52	6.00
DM5-% of employees who returned back to work	81.81	90.9	100	100
Average across companies	*82.74*	*93.55*	*96.43*	*93.08*
DM6- % of injuries that required case management	25	23.8	21.42	44.44
Average across companies	*12.18*	*17.19*	*16.16*	*21.85*
DM7-% of employees off due to injury	68.75	52.38	85.71	100
Average across companies	*51.75*	*50.60*	*61.78*	*69.86*
DM9- % of employees placed on modified duties	81.81	63.63	75	77.78
Average across companies	*53.88*	*65.91*	*59.98*	*52.92*
DM10- % of employees transitioned from modified work to original	77.78	85.71	88.89	100
Average across companies	*81.10*	*88.16*	*88.22*	*69.38*

From the table, your company's RIR declined steadily over the four observed years, with their injury rates exceeding the averages of the sampled companies. On the other hand, the SR of your company fluctuated over the four observed years. The company recorded a SR of 57.84 in 2012, 145.89 in 2013, 101.84 in 2014 and 22.66 in 2015. Compared to the averages of the sampled companies, your company recorded higher SR in the years observed expect for 2015, where the company performed significantly better with the lowest SR recorded across all companies. A similar trend was also observed in regards to your company's LTCR. Your company's LTCR fluctuated over the four years, with the highest 22.16 recorded in 2013 and the lowest 8.71 recorded in 2015. In all your company's LTCR fell above the sampled companies averages. Overall, in assessing your company's safety performance based on the metrics, your company needs to pay more attention in tightening its safety practices so as to lower the number of injuries on site and

the time lost due to injuries.

Similarly, in regards to your company's DM performance using the developed metrics, your performance steadily improved over the four observed years. For instance, the percentage of employees who returned back to steadily increased from 81.81% in 2012 to 100% in 2015, with your company's performance exceeding the averages of the sampled companies. Looking at the percentage of injuries that required case management, your company observed a higher proportion of injuries requiring case management compared to the averages of the sampled companies. For example in 2012 your company recorded 25% of all their injuries requiring case management compared to 12.18% averaged for the sampled companies. In regards to the percentage of employees off due to injury, your company similarly recorded higher percentages of employees going off work compared to the averages of the sampled companies. For example, your company recorded 68.75% in 2013 with the average being 51.75 and 100% in 2015 with the average being 69.86 across all sampled companies. In regards to the percentage of employees placed on modified duties, your company's performance exceeded the sampled companies' averages, with 81.81% being placed in 2013, 63.63% in 2013, 75% in 2014 and 77.78% in 2015. Comparatively the averages for the sampled companies were 53.88% in 2012, 65.91% in 2013, 59.98 in 2014 and 52.62% in 2015. In the percentage of employees who transitioned from modified work to original work, your company saw a steady increase over the four observed years, moving from 77.78% in 2012 to 100% in 2015. However, as compared to the averages of the sampled companies, which saw a decline in performance over the four years, your company saw an increase in performance.

Analyzing your company's performance data in figure 1 and table 1, shows that the company's a safety performance in respect to its RIR, SR and LTCR improved gradually over the observed years, with RIR moving from 33.05 in 2011 to 15.69 in 2015. With an overall *MS Company* of 3.74, your company was on the bottom tier comparatively to other companies in regards to DM performance. It is clear that, although your company has place emphasize on improving your safety practices over the years, evident by decreasing RIR, SR and LTCR, your company has yet to see the value in doing same for its DM practices. However, comparing your company's safety performance to that of is DM performance using the 5 DM metrics tells a different story. The company progressively over the 4 observed years performed significantly above average in regards to the percentage of employees who returned back to work (DM5), the percentage of injuries requiring case management (DM6), the percentage of employees off due to injury (DM7), the percentage of employees placed on modified duties (DM9), and the percentage of employees who transitioned from modified work to original work (DM10). This implies that, although the maturity of your company's overall DM program was below average comparatively, when analyzing its actual return to work and DM performance using the 5 DM metrics, your company performed significantly better. This is an indication of a possible disconnect between your company's leading and lagging indicators of DM performance, meaning that, although your practices are not as matured as other companies, you are still experiencing better output from the practices your company is implementing. Possible explanations of this disconnect could be explained by analyzing the maturity of your company's DM indicators to DM performance using the metrics.

Since the metrics analyzed do not cover every indicator but rather a few, it is prudent to analyze the maturity of your company's indicators to the DM metrics which measures them specifically. The analysis of your company's safety performance metrics showed that your company's safety metrics (i.e. RIR, SR and LTCR) had values (i.e. 27.22, 82.06, and 15.82 respectively), were well

above the average values of the eight companies evaluated (i.e. 20.12, 61.68, and 7.34) over the four-year study period. This indicates that your company's safety performance was considerably below the average safety performance of the eight companies evaluated. This was also in line with your company's overall maturity (i.e. MS Company of 3.74) which was also well below the average MS Company of 4.06 of the eight companies evaluated.

The company's DM performance metrics showed mixed results. As per Table 1, the average values of the five DM metrics for the four-year study period for Company 1 (i.e. DM5 = 93.18%, DM6 = 28.67%, DM7 =76.71%, DM9 = 74.56% and DM 10 = 88.10%) were all above the average values of the four companies analyzed (i.e. DM5 = 91.45%, DM6 = 16.85% , DM7 = 58.50%, DM9 = 58.17% and DM 10 = 81.72%) . This suggests mixed results. For example, the higher percentage of employees who returned back to work (i.e. DM5) and of employees who transitioned from modified work to original work (i.e. DM10) the Company implied better DM performance than the average. Nevertheless, the higher percentage of employees requiring case management (i.e. DM6) and of employees off due to injury (i.e. DM7) the Company implied worse DM performance than the average. Because the company had an overall MS Company (i.e. 3.74) that was below the average MS Company of the four companies analyzed (i.e. 4.15), there appeared to be a disconnect between the overall maturity of the Company and its DM performance metrics. This disconnect may be due to the way Company's DM performance is analyzed which could be caused by the way its DM metrics are interpreted. For instance, the higher percentage of case management injuries (i.e. DM6) the Company could be due to the seriousness of the injuries rather than to the company's increased ability to develop a customized program for every injured worker individually. Similarly, the higher percentage of employees placed on modified duty (i.e. DM9) could simply be an indication that more employees are feeling better and ready to get back to work at this specific point in time. It does not necessarily measure the company's ability to provide modified work to its returning employees. The disconnect between DM maturity and DM performance in the Company does not therefore necessarily suggest the absence of a relationship between those two aspects. It just reinforces the need to investigate other factors that would help interpret the values of the DM metrics correctly.

The lack of a direct relationship between the company's overall maturity and its DM performance metrics could also be due to the metrics not covering each of the 12 indicators. It would therefore make more sense to compare the company's DM performance metrics to the maturity of the specific indicators each metric is related to. An analysis of the relationship between the number of employees who returned back to work (i.e. DM5) and the maturity of "Return to work and accommodation" (RAP) practices shows that the average DM5 for the Company (i.e. 93.18%) was slightly above the average DM5 of all companies (i.e. 91.45%) implying thus average performance. The MS Indicator of its RAP (i.e. 3.70) was also very slightly below the average of all companies (i.e. 3.83), suggesting average performance too and thus pointing to a potential relationship between the two aspects since both are more or less at an average level. Similarly, there may be a potential relationship between the number of injuries that required case management (i.e. DM6) and the maturity of the company's CMP and PEP but not of its RAP. This is because the analysis showed that the company's average DM6 (i.e. 28.67%) was well above the average of all companies (i.e. 16.85%) over the four-year study period, implying thus worse performance. The maturity of the company's CMP and PEP (i.e. 4.00 and 3.35 respectively) were also well below the average of the four companies (i.e. 4.38 and 4.20 respectively), suggesting

also worse performance than the average and thus a potential relationship there too. Another relationship appeared to exist between the average percentage of employees that were off due to injury (i.e. DM7) in the Company and the maturity of its CMP and PEP but not of its RAP. The analysis showed that the Company's DM7 (i.e. 76.71%) was above the average DM7 of all companies (i.e. 58.50%), implying thus worse DM performance. Because the maturity of the company's CMP and PEP were also well below the companies' average as shown earlier, a potential relationship may therefore exist between the company's DM7 and the maturity of these indicators. There was also a relationship between the percentage of employees placed on modified duties (i.e. DM9) in the company and the maturity of its TPM and PEP but not RAP. The analysis showed that the company's DM9 (i.e. 74.56%) was higher than the average (i.e. 58.17%), implying worse DM performance. The maturity of the TPM and PEP of the company (i.e. 3.57 and 3.35 respectively) were also lower than the average (i.e. 3.96 and 4.20 respectively), suggesting also worse DM performance and thus a potential relationship between DM9 and the maturity of those indicators. Finally, no relationship appeared to exist between the Company's DM10 and the maturity of its TPM and PEP.

As with all other relationships, future research would need to investigate them in a much larger sample of companies. For additional information, Table 2 provides the potential opportunities identified for your company based on the assessment.

Table 2: Potential DM opportunities for Company 1 to Improve DM Performance

Practice Area	Potential Opportunity
Communication Practices	• Bring DM in the workplace to the attention of all employees and in language that can be easily understood. • Ensure employees receive regular training concerning injury management and claims • Develop and monitor communication routes • Develop a method for policy change communications • Ensure open communication with employees • Implement early intervention strategies • Assess and analyze employee knowledge on DM interventions
Case Management Practices	• Develop and implement a post-RTW monitoring and coordination plan for employees • Ensure effective initial assessment of physical and functional rehabilitation • Develop and implement occupational rehabilitation counseling and job skill retraining for employees
Return to Work and Accommodation Practices	• Conduct job needs assessment and job analysis • Conduct functional assessment for injured employees to assess which jobs would be most suitable for them • Implement job and workstation modification • Conduct vocational assessment to ensure appropriate job placement for employees unable to return to original positions • Conduct intermediate evaluation of employees as they return to work on modified duties and also intermittently as they fully rehabilitate to assess if they are ready to progress to original work or required a more suited modified work
Claims Management Practices	• Monitor claims management from initial injury to claim resolution • Evaluate long-duration claims to assess progress in order to ensure quick resolution
Disability and Injury Prevention Practices	• Develop and implement mental health and stress management programs • Promote the proper use and handling of safety equipment, materials and resources in all situations and enforce it where required • Plan for managing hazards prior to the start of projects by describing each hazard, its potential impact and suggested control mechanisms • Account for work-related tasks, as well as the promotion of safe practices when defining health and safety roles and responsibilities • Review project participants' current knowledge and understanding of health and safety practices on a timely basis • Review project participants' health and safety performance on a timely basis • Encourage project participants to implement hazard management controls and recognize them for their contribution when doing so

Transitional Program Management Practices	• Develop workplace job accommodation alternatives across the company • Develop a defined process to assess occupational training needs of injured employees and identify the skills they require to return back to work in some capacity
Program Evaluation Practices	• Track and analyze workplace incidents data to benchmark performance • Evaluate injuries which required case management to ensure due protocol was followed and determine what could be improved on subsequent cases • Develop a defined process to evaluate the cases of employees on leave due to injury to ensure their early RTW and the cases of employees on modified duty to determine the changes needed as part of their rehabilitation • Track and analyse injury and illness statistics to benchmark DM performance • Develop a defined process to implement recommended DM program modifications and improvements based on the data analysis
Recruitment and Retention Policies	• Revise recruitment polices to ensure a fair assessment of all candidates irrespective of disability • Ensure pre-employment tests and selection criteria are fair to ensure equal employment opportunity • Develop a defined process to ensure the retention and the gradual RTW of injured employees
Ergonomic Practices	• Develop a defined process to ensure jobs are designed to reduce heavy lifting • Use ergonomic principles when designing and setting up workstations and work areas • Use ergonomic principles when purchasing new tools, equipment, or furniture • Use ergonomic principles when assisting disabled employees