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EVALUATING DISABILITY MANAGEMENT PERFORMANCE IN THE CONSTRUCTION INDUSTRY USING METRICS

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Abstract: The risk of a major injury or fatality in the construction industry is two and a half times and five times higher respectively than that in the manufacturing industry. The resulting costs of injuries and fatalities in the form of productivity losses, workers' compensation insurance and other direct and indirect costs affect the profitability of construction organizations. This reinforces the need for effective health and safety disability management and the need to quantify safety and disability management performance. A research study has been initiated by the University of Manitoba Construction Engineering and Management Group and funded by the Workers' Compensation Board of Manitoba (WCB) for that purpose. The study aims to evaluate DM in the construction industry and its relation to safety performance using leading and lagging indicators of performance. This paper specifically aims to propose and assess new disability management metrics specific to construction. The research entailed collecting disability management data from 4 Manitoban construction companies and assessing their performance. In all 12 disability management metrics were proposed, 5 of which were assessed in regards to the companies. In all, companies recorded high percentiles in their retuned to work rates for injured workers, with few unaccounted absences and gaps. The identification of such gaps in performance is critical in creating awareness and ensuring necessary solutions. The findings reiterate the need to better integrate disabled workers in the construction workplace to improve the safety of the overall organization. It also justifies further investments in DM to ensure related practices effectively accommodate disabled workers on site and in the field.

Keywords: Safety performance, Metrics, Disability management, Lagging indicator

1 INTRODUCTION

In the past 40 years, workplace injuries and fatalities have decreased significantly (Workers Compensation Board of Manitoba 2016). Despite the fact that 6–8% of the Canadian workforce are employed in construction, the industry still accounts for 17% of all fatalities. In fact in Manitoba, fatality and disabling injuries among construction workers are one and half times greater than the all-industry average which stood at 5.9 in 2016 and 6.0 in 2015 (Workers Compensation Board of Manitoba, 2016). Rajendran and Gambatese (2009) in their study asserted that, proactive efforts especially in safety management have a strong, positive influence on performance. Researchers have examined the relative effectiveness of different strategies in reducing construction-worker injuries. For example, Jaselskis et al. (1996) studied the relationship of selected safety elements on the experience modification rate, Tam and Fung (1998) focused on management schemes and their effectiveness in reducing company injury rates and Sawacha et al.

(1999) conducted a factor analysis to identify the most influential practices driving safety performance. Notably, all these studies focus in on safety performance and very rarely on disability management (DM). There has been little work done in regards to DM in construction, with no studies focusing on developing DM metrics and using them to benchmark performance. The most recent study that have been done focuses on barriers to the employment of young people with disabilities (Omerod and Newton 2013).

A study was commissioned which sort to investigate DM in the Manitoban construction industry and its relation to safety performance. This study was conducted by the Construction Engineering Management group at the University of Manitoba and supported and funded by the Workers Compensation Board of Manitoba. This paper, which is one in a series of papers, reports on the third part of the study. The first part of the study formulated and validated DM indicators of performance. From this, the second part of the study developed and validated a maturity model using the DM indicators which evaluates the maturity of construction organizations' DM practices. The validation process for the maturity model entailed using analytical hierarchy process to determine the weights of importance of the 12 model indicators and surveying participating companies. Against this contextual backdrop, the aim of this paper is address the lack of specific metrics which benchmarks DM performance in construction. The paper proposes new DM metrics to address the limitations of existing performance metrics in measuring DM performance. By collecting data from construction companies, the assessment system is tested for its validity and applicability. Although the sample size is not sufficient enough to be enable statistically significant results, it provides a foundation from which future studies can investigate the comparability of the DM metrics on a larger sample. The findings are meant to encourage both further study and investment in disability and injury management and be of interest to researchers as well as practitioners and construction firms.

2 LITERATURE REVIEW

This section reviews DM performance benchmarking using leading and lagging indicators of performance.

2.1 Benchmarking Disability Management

An approach to the development of a framework measuring the effectiveness of a disability management (DM) system is the use of measurable or qualitative performance indicators, which should allow for an on-going comparison of the existing performance level with the previously determined target level (Podgorski 2015, Franche et al. 2005). This approach is already being utilized in Occupational safety and health (OHS) benchmarking models, as provided e.g. OHSAS 18001 specifications (Podgorski 2015). However, in DM, there are no current standalone benchmarking metrics. These are to an extent deemed to be integrated in the safety management system, which as demonstrated by Lingard and Saunders (2004) are often overlooked. Within benchmarking literature, there are three distinct approaches to the measurement of performance. These are, the result-based approach, the compliance-based approach, and process-based approach (Cambon et al. 2005). The result-based approach uses lagging indicators to benchmark performance whilst the remaining two uses leading indicators. The lagging indicators usually are based on such data as the frequency of accidents at on site, loss time, but the usefulness of their application for the evaluation of performance is challenged by numerous scholars (e.g. Mearns et al. 2003, Hollnagel 2008, Juglaret et al. 2011). Within construction safety particularly, a number of lagging indicators have been developed and validated, which are widely used within the industry. However in comparison to DM, these are almost non-existent. Benchmarking performance cannot however, be only reliant on only lagging indicators. Lagging indicators in practice does not renders an appropriate in-time rapid response and the introduction of corrective actions because they are based on historical data (Podgorski 2015). In contrast, changes in leading indicators take place in advance of those in lagging indicators, allowing earlier and efficient intervention. Monitoring leading indicator' values enables the attainment of a picture of how a given system operates.

Within literature, there are some attempts to develop and implement aggregate performance indicators in the area of DM, but measurement systems referred to in the literature are based on lagging indicators, such as injury frequency rates, loss time and severity rates (Venkataraman 2008). These indicators essentially seeks to benchmark safety performance primarily and not specifically DM. 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 (Krause et al. 2001, Franche et al. 2005). This reinforces the need to develop new metrics that measures DM exclusively, and ones that would measure DM in construction in particular as those are currently missing in the literature.

3 METHODS

This section describes the methods used to review, develop and collect DM metrics to evaluate the 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.

3.1 Metrics Review and Development

The research developed new DM metrics based on the 12 DM indicators identified and validated as part of the first research phase. 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. Feedback received from experts involved in the analytical hierarchy process (AHP) and in implementing the Construction Disability Management Maturity Model (CDM3) as part of the first and second phases of the study helped validate these metrics by excluding the ones that were found to be impractical or unmeasurable and defining more relevant ones instead. Table 1 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.

Table 1: New DM Metrics Proposed

Metric	Definition	Formula	Relevance	Practices
DM1	Percentage of employees their safety representativ es 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, the higher the level of integration and communication lines between management and employees.	Communicati on, 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, the higher the level of training and awareness of employees of such issues.	Communicati on, 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, 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, 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 injuries that resulted (required) in days away, modified or restricted work) *100	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, 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, the higher the ability of the organization to bring injured employees back to work.	Return to work and accommodation, Case management, Program 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 higher the level of individual injuries and employees accommodated. A lower percentage doesn't necessarily imply lower performance. It may imply that the	Return to work and accommodation, Case management, Program evaluation

			organization had a lower number of severe injuries that required case management.	
DM7	Percentage of employees off due to injury.	(Total number of employees off due to injury/ Total number of injuries) *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, 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 overall expenditure on claims. The higher the ratio, the higher the amount of money spent on claims.	Claims management, Program evaluation
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, 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, the higher the transition rate. This is an indication that proactive measures are being taken to	Transitional program management, Program Evaluation

			ensure employees return to their original jobs or jobs that suit their abilities as their rehabilitation progresses.	
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, 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 furniture purchased taking into account ergonomic factors.	(Total number of new tools, equipment, or furniture purchased taking into account ergonomic factors/ Total number of new tools, equipment, or furniture purchased) *100	This metric seeks to measure the extent to which new tools and equipment purchased take into account ergonomic factors. Research shows that implementing an ergonomic intervention program decreases work-related health costs. The higher the percentage, the higher the number of purchased tools, equipment, or furniture purchased that are designed to ergonomic principles.	Ergonomics and Disability and injury prevention, Program evaluation

3.1 Metrics Implementation

This subsection describes the data collection and analysis methods used to implement and evaluate the DM metrics defined as part of this research.

3.2.1 Data collection

The research aimed to apply all the DM metrics defined in the previous .Of the ten companies that participated in the research, only 4 agreed to participate in the DM metrics implementation phase. Companies that took part in this phase are shown in Table 2.

Table 2: Company Breakdown: DM Metrics Implementation

Company	Area of Operation	Number of Employees	Size	Annual Revenue (in millions of $)
Company 1	Building/Non-Residential	<100	Medium	13.8
Company 3	Building/Non-Residential	0-100	Small	6.88
Company 4	Building	0-100	Small	2.54
Company 7	Building	0-100	Small	2.66

To collect the DM data that would enable the calculation of those metrics, an excel worksheet was developed and sent out electronically to these four 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. 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 to measure all 12 metrics, realistically, most companies only tracked a few of them. Moreover, although utmost confidentiality was assured, most companies were hesitant to provide data. 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. The DM data was the most difficult to collect given that only four of the ten evaluated companies tracked them. 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.

3.2.2 Data Analysis

The research involved using descriptive statistics and graphs to analyze the five DM metrics: DM5, DM6, DM7, DM9 and DM10 for the four companies. The graphs for these DM metrics were derived using the formulas in Table 1, and respective values were plotted for each of the four companies. The results discusses the DM performance of the sampled companies comparatively to their safety performance denoted by their recordable injury rates (RIR) and their severity rates (SR) for the same assessed period.

4 RESULTS

This section presents the results of measuring the DM performance of the sampled companies using the DM metrics developed in this research. The DM performance results are presented. This is followed by a discussion of the relevance and applicability of the DM metrics used as part of this research.

4.1 Disability Management Performance

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

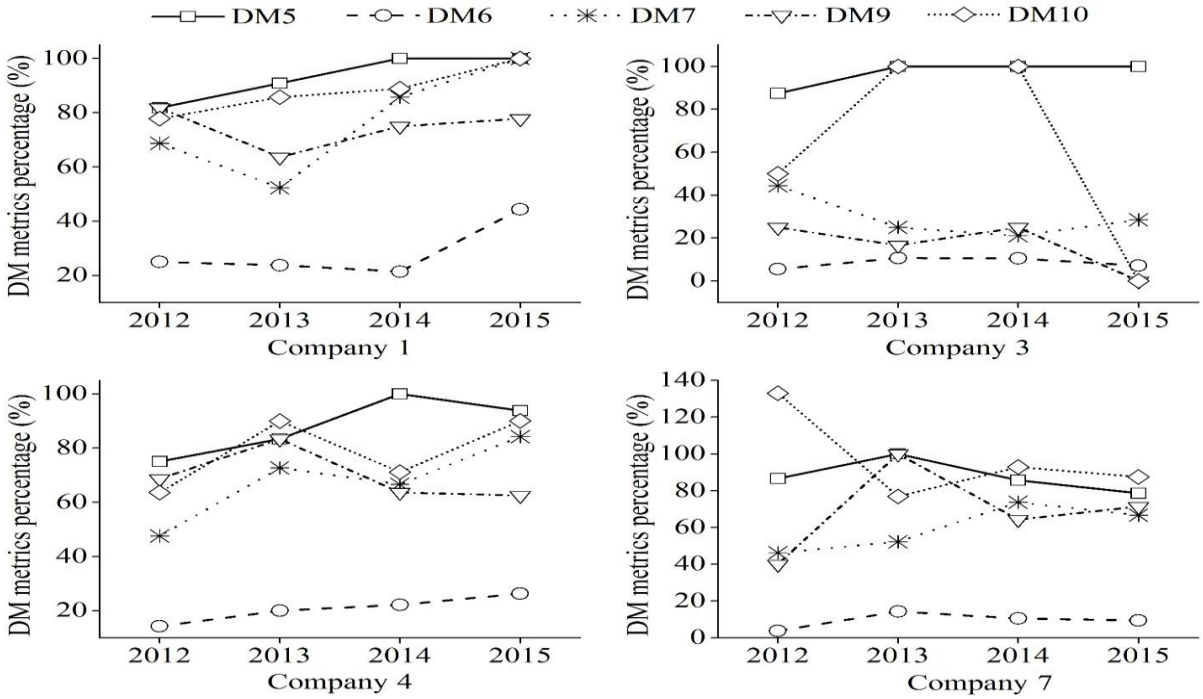

Figure 1: DM Performance Trends

Figure 1 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. 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 of 16.58 and 74 averagely for the 4 years 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, Habeck et al. 1998, 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.

4.2 Metrics Relevance and Applicability

The results indicated 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. Construction companies should start benchmarking their DM performance using the DM metrics developed throughout this paper. 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 DM data required to calculate all of these metrics. Only four out of ten companies collected this data. Moreover, only data related to five of the 12 DM metrics were collected by these four companies. 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.

5 CONCLUSION

The research entailed collecting DM metrics for the 4 participating construction companies through direct contact with these companies. As a means of addressing the lack of DM specific metrics in literature, 12 DM metrics were proposed. These metrics seeks to assess and measure DM practices such as, case management practices, return to work practices, transitional work practices, disability prevention practices, communication practices and ergonomic practices. The major contribution of this research is the development of DM performance metrics and measurement framework tailored towards DM benchmarking, which have not been fully investigated in existing construction management studies. The newly developed metrics are complimentary to the existing project benchmarking system that focuses more on process and practices at the project level.

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