Safety leadership at high-risk manufacturing sectors: achievements and consequences
Literature review

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ABSTRACT

Safety leadership is being progressively perceived as one of key factors in promoting performance across range of domains. Safety leadership concept plays a positive contribution in supporting performance and incident prevention in high-risk manufacturing sectors. In spite of the fact that examining the impact of different safety leadership styles on consequences and achievements variables has been the focus of researches over the past two decades, the understanding of this effect to date can be considered limited due to the applied methodologies and concepts (i.e. What are the most influential leadership styles? How do these influences interact with other behaviours? How does safety leadership support risk management across work systems?) A conclusive standpoint has not been reached yet by the researchers in concern of the description of outcome and performance variables of leadership within safety framework. This limitation reduces the advancement in understanding of this influence. This article aims to critically and systematically review the literature focusing on the impact of leadership on performance and outcomes of safety within high risk manufacturing sectors. This review evaluated the extent of systems thinking clearness within the literature. Concurrent aim is to advance methodological and conceptual approaches linked to safety leadership. The literature review focused on published articles in English between 1993 and 2013. The review found gaps in existing body of knowledge linked to approaches used for conceptualization and measurement of safety leadership, consequences and achievements variables, the exist design of methodological approach, and the resulting influence on applicability of outcomes. In conclusion, this study proposed the use of systems-thinking as a new approach to fill-in this gap and to examine safety leadership, which will aid in advancement of methodological and conceptual studies associated with safety and leadership and their practical implications within high-risk industries.

Keywords: Safety; Leadership; Risk; Consequences; Achievements; Systems Thinking.

1. Introduction

Leadership is being progressively perceived as one of key factors in promoting performance across range of domains [1, 2]. It has been defined as a practice of social effect in which an individual can enlist the assistance and support of others in the achievement of a common goal [3], the manifest of the characteristics that underlie the leadership approaches is both broad and varied. This has been expanded over the past two decades by both corresponding theory and research, with the investigation of different patterns and attributes as linked to the achievement of a diversity of desirable performance and outcome measures came out as a key area of focus [4, 5]. Taking all of this into consideration, it becomes essential to understand the influence of leadership on the performance and outcomes within the safety context. There is a clear support growing for the practical influence leadership plays in upholding safety performance and the avoidance of injuries and incidents [6, 7], grasping and describing this contribution presents some significant opportunities to improve the traditional component methodologies to safety and risk management [8]. In line with this, a collection of research has appeared with a concentration on understanding how different types of leadership effect safety performance and outcome in high-risk manufacturing sectors. These manufacturing sectors are considered as high-risk sectors due to the possibility of either serious accidents or minor scale incidents and occupational accidents [9]. Up to date, a considerable amount of research has been conducted within the construction and manufacturing sectors [7, 10, 11, 12]. Universal underpinning has been established for several leadership styles since they have a computable influence on a range of safety performance and outcome variables [14, 15, 16]. For instance, the literature highlights the relationship between Transactional and Transformational Leadership, and follower safety compliance and participation [17, 18, 19]. Moreover, connections have also been established for Empowering Leadership (EL) and Authentic Leadership (AL) practices since affecting those same variables [20, 21].

The above-mentioned leadership styles have similarly elucidate positive links with safety climate [7, 22, 21], with a Leader-Member Exchange (LMX) association and type likewise characterized as providing a progressive influence [23]. Although these results provide some awareness about the function various leadership styles play in underpinning improvements in safety, they too highlight some questions relevant to the exist state of knowledge within the frame of safety leadership within high-risk manufacturing sectors. Nowadays, there seems to be few consensuses about what are the most influential leadership styles? How do these influences interact with other behaviours? How does safety leadership support risk management in work systems? Additionally, current knowledge has not yet achieved a decisive standpoint with relevant to the description of achievements and consequences variables within the context of safety. Some definitions have been presented in terms of performance conceptualisation as a measure for safety related behaviours [14, 24], and outcomes as noticeable events or outcomes [7] nevertheless, the terms and theory are still applied interchangeably in the current literature. This has significant implications for the research relevant to the safety leadership in terms of measurement and conceptualisation of its influence, in particular with understanding its impact as one of the safety preventative elements and as a potential indicator of its performance.

Conceivably most considerably nevertheless, research to date has a tendency to significantly focus on the effect of leadership at the 'sharp end' (i.e., the level of frontline supervisory), with diminished examination within the context of larger organisational [25], or system of work entirely. In addition, these interactions have mostly been investigated through the use of questionnaires and surveys as the predominant data capture approach, with slightly examination of additional factors and elements across the systems of the organisations (i.e., polices, procedures, processes and systems) which may also provide significant influence. Furthermore, these methods further restrict understanding of how various leadership patterns at diverse levels within an organisational and work system form desirable achievements and consequences; a central emerging piece of the issue [1, 5]. These are considered to be one of the significant limitations. Within the last 2 decades, the research within the safety science has seen a remarkable change to a systems approach in the view of safety and safety management [26]. Therefore, it is being accepted that safety and safety compromising accidents are developing properties of the overall work system (e.g., [26, 27, 28, 29, 30, 31, 32]), which is accidents are caused by the behaviours, decisions and actions of actors through all levels of the systems of work, up to and including the government and regulatory bodies.

Existing research indicate a lack of systems-thinking not only in association to safety leadership approaches, but also the concepts studies and corresponding theory. As such, how leadership within the safety concept supports risk management and safety may not yet be fully comprehend. The critically review pointed out a shortness linked to the exist body of knowledge related to the measurement and conceptualisation of safety leadership, variables of outcomes and performance, the existing design of methodologies and approaches, and the findings applicability. This article aims to critically review the literature focusing on the effect of leadership within the safety concept on achievements and consequences of high-risk manufacturing sectors to determine the range of evidence of systems thinking within the literature. Concurrent aim is to advance methodological and conceptual approaches linked to safety leadership.

2. Methodology

Different electronic library directory systems were used to search for literature which included Social Science citation Index, PsycINFO, Scopus, OneFile, SafetyLit, Science Direct, MedLine, Ingenta Connect and Wiley Online Library. Searching terms were initially used that included 'Safety', 'Leadership', 'Risk', 'Consequences', 'Achievements' and 'Systems Thinking', with applying of 'safety' in the filter. These terms were subsequently refined with 'systems', 'systems-approach' and 'systems-thinking' which yielded in removing of the greatest number of hits. The literature review focused on published articles in English between 1993 and 2013, which produced the maximum number of hits (n = 267 articles). A screen reading for articles' title and abstract was conducted for each article to ensure it meets with inclusion eligibility, for final review list. First, articles which did not concentration on high-risk manufacturing sectors were excluded. As such articles focus on financial, education or food safety sectors were not included in the list since they

did not meet high-risk manufacturing sectors definition [9] specified for this review. Secondly, articles had to prove original research, either quantitative, qualitative, methodological or theoretical in nature, hence excluding items alike technical reports, book reviews, editorials and letters since they were not believed to be practical to include them in the current review. Lastly, the key focus of the article needed to be safety leadership rather than being as a second variable of interest in the research. Then, the text of the article was reviewed fully, any article failed to meet with selection criteria was removed. 35 articles resulted from this filtration process. Data which was extracted from these 35 articles examined to ensure that there is a link with leadership style, the findings relevant to outcome and performance variables were measured, and the design of the methodology was adopted.

Section 3 presents a critical review of the articles. This review demonstrates the results linked to the evaluation of the leadership style, measurement of the conceptual outcome and performance variables, and the central point of methodological design.

3. Review findings

3.1 Styles of Safety leadership

The study revealed five prominent leadership styles in the concept of safety which have effect on the outcomes and performance of safety, particularly Transactional Leadership (TRSL), Transformational Leadership (TRFL), EL, LMX, and AL. Each style has been described and characterised in the reviewed articles since having a variety of attributes, dimensions and supporting behaviours, established on the person and task-focused interactions, a mix of interactions focused on social exchange, as well as the interactions of follower-centric and neo-charismatic-based [33, 34, 35, 36].

The key behaviours and attributes supporting each of the five leadership patterns and found in the review have been illustrated in the Figure 1[33, 35, 37, 38].

Transformational Leadership	**Idealised Influence:** Leader demonstrates determination to maintain a safe working environment, and behaves in a way that displays commitment to a safe work place. **Inspirational Motivation:** Leader talks about his/ her values and beliefs of the importance of safety, providing continuous encouragement to others to do their jobs safely. **Intellectual Stimulation:** Leader suggests new ways of doing tasks more safely, and encourages team members to express ideas and opinions about safety at work. **Individualised Consideration:** Leader listens to individual concerns about safety on the job and actively spends time demonstrating to team members the safest way to complete tasks.
Transactional Leadership	**Contingent Reward:** Leader expresses satisfaction when team members perform jobs safely and ensures that appropriate recognition is received for achieving safety targets. **Management by Exception:** Leader only intervenes to provide corrective direction when team members do not meet acceptable performance levels.
Leader-Member Exchange	**Trust:** Leader develops effective working relationships with team members, recognising and developing followers' potential. Leader demonstrates confidence in team members' capabilities. **Obligation:** Leader demonstrates understanding of team members job problems and needs, and uses their power positively to help followers solve problems in their work. **Respect:** Leader demonstrates satisfaction with team members so they 'know where they stand'.
Empowering Leadership	**Leading by Example:** Leader sets high performance standards and a good example by the way he/ she behaves. **Participative Decision Making:** Leader encourages team members to express ideas and suggestions, giving all followers the chance to voice their opinions. Leader listens to suggestions and ideas and uses them to inform decisions that affect the work group. **Coaching:** Leader fosters collaboration between team members, encourages exchange of information, and group problem solving. Leader suggests ways to improve team performance and praises teams when they perform well. **Informing:** Leader explains company decisions and goals, and how the team fits into the company. Leader clearly explains own decisions and actions, and rules and expectations to the work group. **Showing Concern/ Interacting with the Team:** Leader takes the time to discuss team members' concerns patiently, and shows concerns for members well-being. Leader treats team members with honesty and fairness.
Authentic Leadership	**Self-Awareness:** Leader seeks feedback to improve their interactions with others and demonstrates ability to accurately describe how others view his/ her capabilities. **Relational Transparency:** Leader says exactly what he/ she means and is willing to admit mistakes when made. **Internalised Moral Perspective:** Leader demonstrates beliefs that are consistent with actions and makes decisions based on his/ her core beliefs. **Balanced Processing:** Leader solicits views that challenge his/ her deeply held positions and carefully listens to different points of view before coming to conclusions.

Figure 1: Behaviours and attributes of identified styles of leadership

57.1 % of the review studies (n=20) concentrated on the investigation of TRSL and TRFL [7, 10, 16, 17, 18, 25, 39, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51], with 31.4 % of the articles (n=11) accomplished within the construction and manufacturing sectors. The rest of the studies, a comparatively lesser number investigated LMX [12, 13, 21, 23, 40, 52, 54, 55, 57, 58] and AL [20, 22, 62, 59] across a variety of sectors (e.g., nuclear power generation, process industry and rail). Particularly, one study was revealed by the review to be performed in the mining sector, with no research recognised in the aviation sector. The common concentration on investigating TRSL and TRFL with the reviewed literature is considered a remarkable restriction to advancing understanding. Focusing only on these two leadership styles restrict the consideration of any other potential leadership styles [53, 60] which can yield bigger insight and robust links between improved outcomes and performance and leadership style. Moreover, in comparing the supporting attributes and behaviours of each style of leadership which was examined, it becomes clear that considerable overlap exists. Despite each pattern is quoted as evaluating empirically distinct constructs, the matches evident between attributes and behaviours raises critical questions relevant to convergence of styles of leadership within safety context. For instance, the EL model demonstrates substantial overlap with TRFL through a number of dimensions, with the Leading by Example, the EL dimension presenting similarity with that of idealized Influence (TRFLs). When reviewing the AL literature, extra questions emerged linked to empirical distinction [36]. A high level of overlap is acknowledged with relevant to TRFL [78], with AL also emphasizing social and personal identification process [53, 56, 61], hence providing confirmation of extra overlap with the core supporting of the theory of LMX.

3.2 Leadership influence on safety outcomes and performance

72 variables linked to outcome and performance were extracted from the reviewed literature. Of that, the 5 styles of leadership were found to have a significant influence over 45 variables, with safety climate evolving as the most frequently reviewed variable across all styles of leadership (n = 12 studies). Participation of safety (n = 6 studies and compliance of safety (n = 7 studies) also appeared as prominent. The remaining identified variables comprise a disparate mix of both group and individual variables, which revealed a seemingly arbitrary method to the choosing of variable of interest. The underneath section demonstrates the results of the review in term of style of leadership and reported relations with the outcome and performance variables identified.

3.2.1 Transactional and transformational leadership

The TRSL and TRFL were the most repeatedly researched styles of leadership, with TRSL rule only researched in combination with TRFL, and not in separation. Figure 2 illustrates an overview of the affirmative links found between TRSL, TRFL and a range of outcome and performance variables. Safety climate stand out as the most repeatedly studied variable (n = 8 studies) for both styles of leadership, with safety compliance and safety participation also emerging as prominent (n = 3 studies).

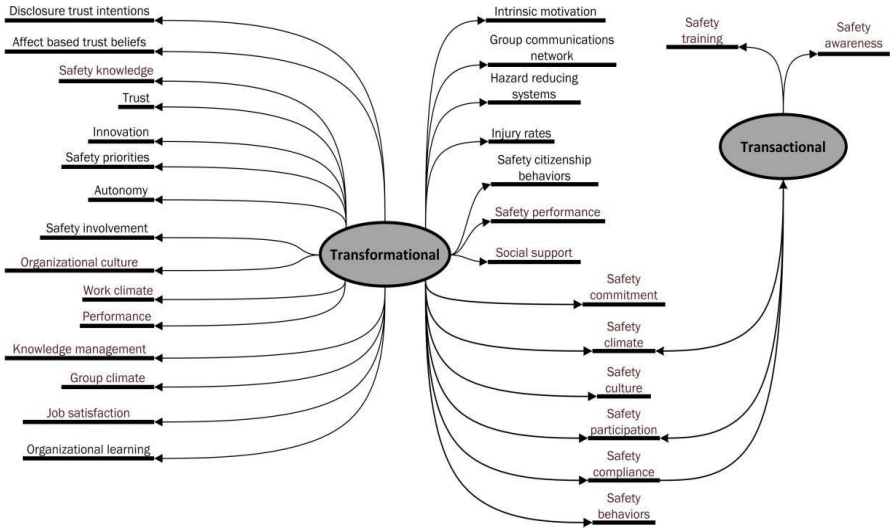

Figure 2: TRSL and TRFL overview influence on safety outcome and performance variables.

The review specified TRFL practices to present positive relationship over a range of variables, for instance, trust [10, 41, 42], as well as safety participation and compliance [18, 19, 43]. TRSL and TRFL practices were as well positively linked to a range of contextual factors such as culture of organisation [50], performance and innovation [48].

3.2.2 Exchange OF Leader-Member

6 articles reviewed indicated a positive relationship between a range of variables and LMX. Figure 3 demonstrates an overview of the identified relationships.

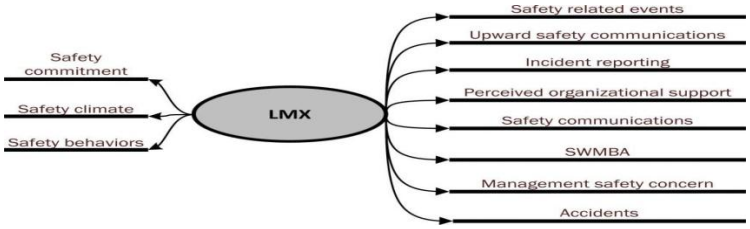

Figure 3: Outline of LMX impact on variables of safety outcome and performance.

Comprehensive support was established for the foundation of developed quality LMX links as having a positive effect on outcomes and performance. LMX relationships showed higher quality to have a significant influence on safety commitment and communications [12], meanwhile it reduces safety and accidents lined events [13]. In addition, the function of wider contextual variables like the perceived support of organisation and ethics were found to effect the association between individual employee's behaviours and safety knowledge and LMX [40, 52].

3.2.3 Leadership of Empowering

Empowering Leadership (EL) was as found to have substantial effect. Figure 4 presenting general relationships reported of EL. The participation of safety was found to be the most frequently researched variable (n = 2 studies).

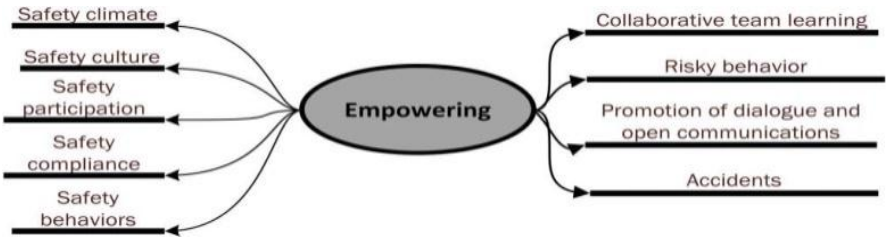

Figure 4: General view of EL effect on safety outcome and performance variables.

2 researches were reviewed discussed EL with regarding to influencing safety culture and climate. Organisational psychological notions found to contribute in the performance of the organisation and EL style can support enhanced safety climate [62]. Recently, an empirical relationship with EL behaviours creating higher safety climate among workers once there is a strong safety culture, which reflected the employee's safety behaviours [21]. These results contribute to shortness of lucidity around which style of leadership is most influence on safety climate.

3.2.4. Authentic Leadership

The review included only 4 studies related to AL. Figure 5 illustrates generally the examined outcome and performance, with again an indication that safety climate was the predominated frequently researched variable.

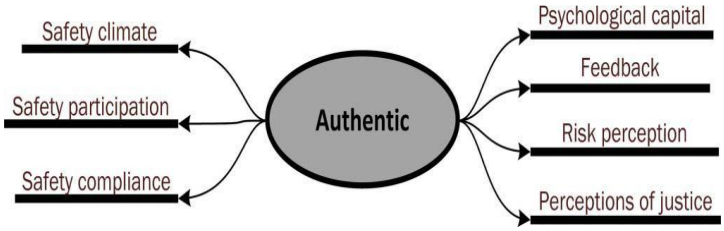

Figure 5: General view of Al effect on safety outcome and performance variables.

The results from this collection of researches add to the mounting concern with regard to the significant overlap in result found across each style of leadership examined. Moreover, there shortness of published articles tend to focus on variables at team or individual level, presenting an obvious lack of inclusion of some of important safety related notions, like system thinking, in order to understand systemic effects which may play with relevant to leadership within safety concept.

3.2.5 Consolidated findings

Figure 6 presents a general view of the 35 researches reviewed; and the positive relationships found in the reviewed literature for each style of leadership and the measured outcome and performance variables. The most frequently studied style of leadership was the TRFL, with safety climate seen as the prominent factor studied across arrange of leadership styles. The AL, El, LMX and TRSL were some the leadership styles which were studied but with lesser degree, with positive influences found in the comparatively low number of outcome and performance variables.

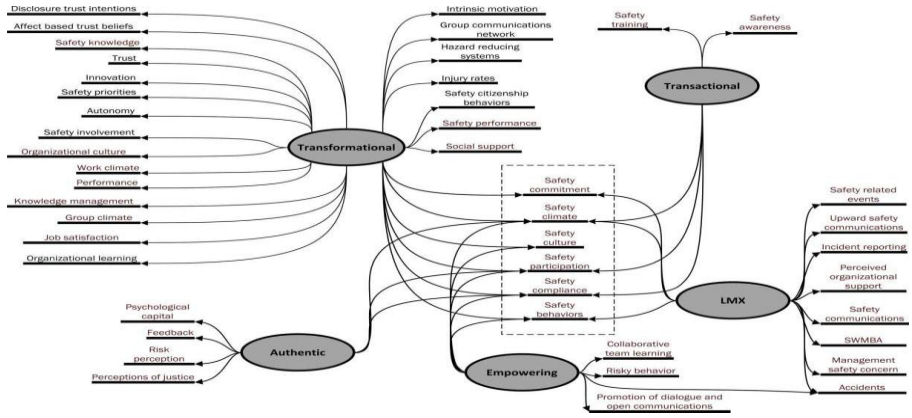

Figure 6: General integrated view for the linkage between safety outcome and performance variables and leadership style

4. Discussion

The aim of this paper was to conduct a critical literature review investigating the influence of leadership within the safety concept on the outcomes and performance of high-risk manufacturing sector to identify the degree to which systems thinking is obvious within the current literature. This review highlighted some shortness in the use of conceptual and methodological approaches for examining safety leadership, additionally, it identified gaps within the exist knowledge base. It proposed a conceptual and methodological advancement linked to the research of safety leadership.

5 styles of leadership were examined related to their effect on the safety outcome and performance in high-risk manufacturing sectors; EL, LMX, AL, TRSL and TRFL.

	Transformational	Transactional	LMX	Empowering	Authentic
Government					
Regulatory agencies					
Company					
Management	**Questionnaires Safety Incident Data** (Supervisor – Superior dyad) (Manager level)		**Questionnaires Safety Incident Data** (Supervisor – Superior dyad)	**Safety Incident Data**	
Staff	**Questionnaires Observational Assessment Focus Groups Interviews**	**Questionnaires** (frontline leader – follower dyad)	**Questionnaires Observational Assessment**	**Questionnaires Observational Assessment**	**Questionnaires** (frontline leader – follower dyad)
Work	(Frontline leader – follower dyad)		(Frontline leader – follower dyad)	(Frontline leader – follower dyad)	

Figure 7: General view of the leadership style, work system level investigated method of assessment on the Rasmussen's Risk Management Framework.

It becomes clear enough after the critical review that there is substantial intersection concerning the various leadership styles and attributes reviewed. This fact points out essential questions not only relevant to the discrete measurement of each style of leadership, but their particular contribution to the measured outcome and performance variables. Hence, additional research is highly needed to specify whether the attributes and constructs of the 5 styles of leadership identified are empirically different within safety context. This research would either obviously

establish empirical difference and therefore, insight into what attributes and styles are reflected to be the most influential, or identify whether the examined attributes and styles of leadership potentially all contribute to evaluation of a greater form of leadership style particularly for the safety context. With linkage to the intersection in the attributes of leadership, a significant limitation found lies in the examined conceptualization of safety outcome and safety performance variables. The apparently arbitrary nature of the examined variables, and their reviewed impact in terms of noticeable improvements in safety, is extremely questionable. This appointed out as a concern when considering the reviewed effect of multiple styles of leadership on the variables of safety commitment, safety behaviours, safety compliance, safety participation, and safety culture and safety climate. Despite intersection in results is not surprising given the similarities found in the styles of the leadership, the concern around these results is pointed out when considering the reported noticeable benefits these outcome and performance variables present to improvement of safety. Moreover, the emphasis on investigating safety participation and compliance, safety climate, and the degree to which these are considered to be the most important safety concepts linked to safety influence and leadership, is alarming. Such an emphasis does not reveal incorporation of tangible, more robust, wider safety outcome and performance variables, hence offering the importance of these results is questionable. Furthermore, no robust linkage was found between accident causation and safety leadership practices, which indicates further concerns with regard to contribution of the exist research base.

5. Conclusions

This critical review concluded a crucial chance exists to enhance understanding of the impact of safety leadership on outcomes and performance over the systems thinking application. The application of the systems based method to future studies agendas would seek to fill in the identified gaps by expanding the methodological and conceptual approaches used to investigate safety leadership over all work system levels. It would also provide insight into the less investigated distal and proximal system influences that determine a series of effects on safety outcomes and performance. In addition, these approaches would allow investigation of the existence of a range of leadership styles within multiple safety system levels, and their effect on key system outcome and performance measures. The results of this research shall be taken into consideration when advancing future studies endeavours to investigate the influence of safety leadership on achievements and consequences at high-risk manufacturing sectors.

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