Distributed Leadership and Seafarers' Emergency Response in a Simulated Navigation Environment

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ABSTRACT

Merchant shipping is an occupation with a high rate of fatal injuries caused by accidents and maritime disasters. Human error plays a massive role in accidents; however, the shipping industry lacks substantial human factors research. A human factor, particularly leadership, has been implicated in numerous maritime disasters. However, there is a tendency for most research to focus on holders of formal positions. A lot of previous work on leadership has been carried out on the assumption that leadership rests with a single leader. The current study adopts a practice-based perspective to examine distributed leadership among seafarers. A simulation is used to investigate the relationship between one form of distributed leadership i.e., planfully aligned leadership, and the emergency response of the team members in a simulated navigation environment. The results showed that planfully aligned leadership was a positive and significant predictor of the team's emergency response as compared to authoritarian leadership. This study makes a shift from the unitary view of the leader to a more practice-based perspective whereby leadership is conceived of as a collective social process emerging through the interactions of multiple actors seems to be the need of the hour. It would be worthwhile to study different configurations of distributed leadership and analyze the factors that facilitate distributed leadership.

Keywords: Distributed leadership, Planfully aligned leadership, Practice, Maritime, Emergency response, Navigation

INTRODUCTION

Accidents at sea can have devastating effects on the lives of those who are involved. A maritime accident results in the loss of human lives, loss of property, and pollution. Between 2003 and 2012, the industry's fatal accident rate was twelve times higher than that of the general workforce (Roberts et al., 2014). Maritime safety legislation and norms have seen significant advances, but accidents still occur (Schroder- Hinrichs et al., 2012; Kim et al., 2016).

Human error plays a massive role in accidents; however, the shipping industry lacks substantial human factors research. A human factor, particularly leadership, has been implicated in numerous maritime disasters (Kim et al., 2016). A recent study highlighted a lack of leadership as a contributory factor in many maritime accidents. Findings showed a lack of leadership behind the

decision-making failures, poor judgment, and improper management of the crisis (Vineet Kaur Sandhu, V.K. Lata, K., 2021). It is evident from accident reports that leadership onboard the ship is very critical. The shipping industry's long-standing authoritarian leadership AL style has been one of the main obstacles to leadership growth. On board, a strict vertical structure is in place, with the ship's Master wielding unquestionable authority and dominion. Hierarchical authority alone does not determine his ability to govern (Luke, T., 2017).

Recent research by Leithwood, K., Mascall, B., Strauss, T., Sacks, R., Memon, N., and Yashkina, A. (2007) has shown that different patterns of distributed leadership are critical in achieving organizational improvement and change. Their work reinforces the importance of planned, aligned, distributed leadership practice that is purposeful and focused. Distributed leadership practice is unique as it offers a way of rethinking the nature of leadership. While prior research has focused on styles of leadership such as transactional or transformational leadership styles, there is a need to examine leadership activity as a unit of analysis.

DISTRIBUTED LEADERSHIP

It is difficult to define what is meant by the phrase "Distributed Leadership (DL)." This phrase has been conceptualized and interpreted in various ways (Harris, 2007). The notions of shared, collaborative, democratic, and participative leadership are all examples of distributed leadership. There is some competition and disagreement among the several meanings of this phrase. Distributed leadership has a wide range of literature supporting it (Bennet et al., 2003).

Distributed leadership implies that multiple individuals at different levels within an organization are involved in decision-making instead of a single leader at the top (Leithwood et al., 2009). Leadership practice will emerge based on the relationships among people rather than organizational boundaries (Harris 2009).

Leithwood et al.'s Framework of Distributed Leadership

Recent research by Leithwood et al. (2007) has shown that different patterns of distributed leadership are critical in achieving organizational improvement and change. Leithwood and his colleagues (Leithwood et al. 2006b) conceptualized leadership distribution; they focused on the extent to which the performance of leadership functions is consciously aligned across the sources of leadership.

Planful Alignment

In this configuration, the tasks or functions of those providing leadership have been given prior, planful thought by organizational members. Agreements have been worked out among the sources of leadership about which leadership practices or functions are best carried out by which source. Planfully aligned leadership (PAL) encompasses three distinct dimensions:

1. *Setting Direction (SD):* Leading a team to a shared understanding of the actions and goals of the group is an important factor that can promote a feeling of purpose or vision (Hallinger & Heck 2002).

2. *Developing People (DP):* Individual assistance and intellectual stimulation, as well as setting an example for others, are all part of the process of cultivating others' potential and increasing their sense of purpose and commitment to the team (Leithwood & Jantzi, 2006).

3. *Building Trust (BT):* Here trust is invested in role and status with a presumption of competence until proved otherwise (Bottery, 2002).

The below three dimensions of planfully aligned leadership were identified, measured, and validated as a part of a previous qualitative study, the purpose of which was to explore the phenomenon of distributed leadership among seafarers. Analysis of the transcripts revealed three distinct dimensions.

Figure 1 above depicts a framework for distributed leadership in the maritime domain. Organizational members have given careful consideration to the roles and responsibilities of people in positions of authority. This agreement was reached among the sources of leadership about which source best carries out leadership practices or functions. Trust in one's leadership colleagues' motives, well-founded assumptions about one's leadership colleagues' capabilities, and a preference for cooperation over competition as a way to increase productivity are some of the shared values and beliefs that seem likely to be associated with planful alignment.
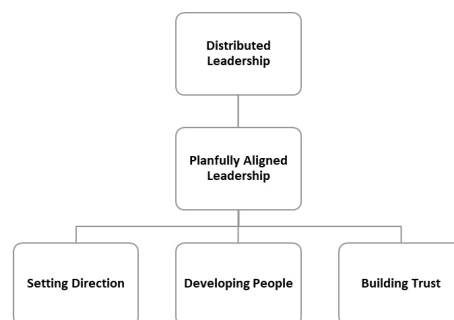

Figure 1: Framework of distributed leadership.

AUTHORITARIAN LEADERSHIP

Traditionally leadership has been understood and conceptualized as a phenomenon that involves a single person taking the lead (Hunter, Bedell-Avers, & Mumford, 2007). Khan et al. (2015) reviewed the different leadership styles among project managers and their influence on team outcomes. Style may also be considered as the leader's behaviour. Every leader has a unique style of leading others. One of the styles of leadership is what is called the authoritarian style. There has been a lot of change in perception among management experts in how leadership is defined and understood from a very autocratic to a very participative approach. There is agreement among researchers that

different styles are required in different situations, and a leader needs to adapt to the problem and understand when to (Khan et al., 2015).

The shipping industry's long-standing authoritarian leadership (AL) style has been one of the main obstacles to leadership growth. On board, a strict vertical structure is in place, with the ship's Master wielding unquestionable authority and dominion. The ship's officer must adapt to the ship's unique circumstances and inspire and motivate his crew. Hierarchical authority alone should not determine his ability to govern (Luke, T., 2017). Comperatore (2005) states that authoritarian leadership is one of the stressors that are prevalent in the maritime environment. This stressor combines with other stressors such as extreme temperatures, long working hours, mental and physical workload, isolation, and other stressors. This system of stressors affects the ability of crew members to remain alert and perform.

EMERGENCY RESPONSE

Emergency management was institutionalized in 1979 with the creation of the Federal Emergency Management Agency (FEMA). Emergency management involves four phases: mitigation, preparedness, response, and recovery. Table 1 below briefly describes each of these phases. (Bullock, J. A., Haddow, G. D., and Coppola, D. P., 2013).

Each step of emergency management is distinct, yet they frequently overlap in execution. Response is the second part of emergency management. During and immediately following an emergency, this phase calls for action to be taken. Put your plans into action in this phase. Whilst preparation is essential to all emergency management stages, the current study examines the second stage, i.e. "emergency response" (ER).

Table 1. The four phases of emergency management.

PHASES	
Mitigation:	• This involves taking action to prevent any emergency or reduce the chances of an emergency. It also includes actions taken to minimize the adverse effects of crises.
Preparedness:	• This involves planning and preparing to handle any emergency. Preparedness activities take place before an emergency occurs.
Response:	• This involves responding safely to an emergency. It includes taking actions to prevent damage and steps taken to save lives. Response activities take place during an emergency.
Recovery:	• This involves taking action to come back to a safer situation following the emergency.

METHOD

For the current study, a simulation was designed and conducted to examine whether planfully aligned leadership predicts emergency response. The TRANSAS NT – PRO 5000 full mission bridge configuration consists of the complete range of navigational controls found on the ship's bridge.

Figure 2: Navigation simulator (TRANSAS NT- PRO 5000).

This includes radar displays, Electronic Chart Display Information System (ECDIS), Navigational aids, real vessel controls, and navigational sensors; all of these are built into consoles.

The Study Participants

The study participants of this phase were sailing officers. A typical team of sailing officers called the Bridge Team (in Figure 3 below) consisted of the formal leader (Ship Master), Officer of the Watch (OOW), Lookouts man, and an Able Bodied Seaman (AB). 30 planfully aligned leadership groups and 30 authoritarian leadership groups participated in the simulation. The study employed a between-groups, independent measures design.

Research Procedure

To better understand the relationship between the bridge team's response to an emergency and their leadership, a simulation was conducted. Each participant group was first given an explanation of the study's scope and goals. They were also briefed about safety, potential risks/benefits, the expected duration of the research, and their role in the simulation.

   On Day 1, a familiarization was carried out and took approximately 45 minutes. On Day 2, the simulation was carried out. The team members
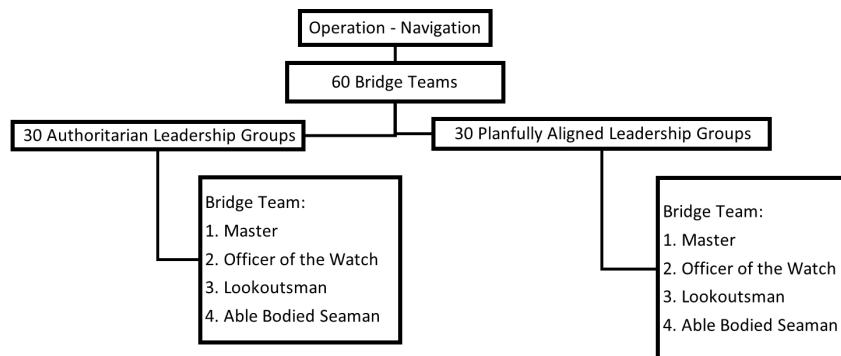

Figure 3: Bridge team composition.

were briefed. The Master was briefed separately and given a script. Doubts were clarified before entering the simulator. The Master in the authoritarian leadership group displayed authoritarian leadership, whereas the Master in the planfully aligned leadership group displayed planfully aligned leadership. The Master in every group was thoroughly briefed and was given a *small card* with simple scripted statements/actions which he had to say/do at specific intervals in the exercise.

Immediately after the simulation, the participants attempted a scale measuring planfully aligned leadership and its three dimensions – setting direction, developing people and building trust.

Event-Based Approach to Training and Assessment

The Event-Based Approach to Training (EBAT) is a methodology used to assess individual and team performance (Rosen et al., 2008). In this approach, critical events are inserted into appropriate contextualized scenarios. Behavioural assessments were carried out in real-time. This methodology was used to develop an event-based checklist for measuring emergency response of the team.

Emergency response was measured at the team level using an event-based checklist. An event-based checklist was developed after the critical events were inserted sequentially into the scenario and the script was established. the checklist is used to assess the appropriate responses as they occur. The behavioral responses or acceptable behaviors were created by reviewing standard operating procedures and also interviewing nautical faculties/programme heads.

RESULTS

Quantitative analysis is presented in the tables below. This section addresses the research questions of the study. The results of each testing are presented below.

A manipulation check was used in this study. This check helps gauge whether the manipulation has been effective in the experimental design. To check if the manipulation was successful, we conducted an Independent Samples T-test to observe the difference in perception of team behavior scores. From the scores on the planfully aligned leadership scale, it was found that the mean of the planfully aligned leadership group ($M = 4.28$, $SD = .38$) was significantly higher than that of the authoritarian leadership group ($M = 3.35$, $SD = .42$). The mean scores of all the dimensions viz. SD, DP, and BT of the planfully aligned leadership group were significantly higher than the authoritarian leadership group.

The T-test results thus indicated that team members' responses to the two types of leadership prompts in the manipulation were triggered by the manipulation.

What is the strength and direction of the relationship between planfully aligned leadership (PAL) and emergency response (ER) of the team members?

Table 2. T test for equality of means.

	t-test for Equality of Means			
			95% Confidence Interval of the Difference	
	Mean Difference	Std. Error Difference	Lower	Upper
SD	1.37778	.14828	1.08097	1.67458
	1.37778	.14828	1.07915	1.67641
DP	1.43333	.14073	1.15164	1.71503
	1.43333	.14073	1.15082	1.71585
BT	1.50833	.14263	1.22283	1.79383
	1.50833	.14263	1.22166	1.79501
PAL Mean	1.43981	.13456	1.17047	1.70916
	1.43981	.13456	1.16925	1.71038

Ordinary least square (OLS) regression was employed to determine if leadership contributed to the effective response of team members to the emergency. As Table 3 indicates, there is a positive and significant relationship between PAL and ER. Table 4 displays effect size measures ($R2$) and adjusted $R2$ for the model, and Table 6 displays pooled unstandardized regression coefficients (B) and standardized regression coefficients (β). The Ezekiel adjusted $R2$ value indicates that PAL predicted just 47.8 percent of the variability in ER.

What is the strength and direction of the relationship between the three dimensions of planfully aligned leadership viz. Setting Direction (SD), Developing People (DP) and Building Trust (BT)?

Table 3. PAL as a predictor of emergency response from ordinary least squares regression.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.698[a]	.487	.478	.48502	.487	55.097	1	58	.000

a. Predictors: (Constant), L Mean

Table 4. ANOVA results.

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	12.962	1	12.962	55.097	.000[b]
	Residual	13.644	58	.235		
	Total	26.606	59			

a. Dependent Variable: ERM
b. Predictors: (Constant), PAL Mean

Table 5. Coefficients results.

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	**Std. Error**	**Beta**	**t**	**Sig.**
1	(Constant)	−.297	.261		−1.140	.259
	PAL Mean	.526	.071	.698	7.423	.000

a. Dependent Variable: ERM

Table 6. SD, DP, and BT - dimensions of planfully aligned leadership as a predictor of emergency response from ordinary least squares regression.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.673[a]	.453	.444	.50083	.453	48.072	1	58	.000

a. Predictors: (Constant), SD

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
2	.710[a]	.504	.495	.47700	.504	58.936	1	58	.000

a. Predictors: (Constant), DP

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
3	.662[a]	.438	.429	.50758	.438	45.269	1	58	.000

a. Predictors: (Constant), BT

When the three dimensions of PAL were examined individually (Table 6 to 8), each dimension was strongly linked to emergency response. However, Developing People was the most potent contributor as it independently explained about 49.5% of predicted ER.

Is planfully aligned leadership a better predictor of emergency response among team members than authoritarian leadership?

We conducted an Independent Samples T-test to observe the mean difference in the emergency response of team members of the two experimental groups, i.e., PAL and AL. Tables 9 and 10 show that the mean of the PAL group ($M = 2.15$, $SD = .31$) is significantly higher than the AL group ($M = 1.0$, $SD = .36$). The p-values obtained from the independent samples t-test, are statistically significant, $p < 0.001$. It indicates that distributed leadership or PAL is a better predictor of emergency response among team members than authoritarian leadership.

Table 7. ANOVA results.

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	12.058	1	12.058	48.072	.000[b]
	Residual	14.548	58	.251		
	Total	26.606	59			

a. Dependent Variable: ERM; b. Predictors: (Constant), SD

Model		Sum of Squares	Df	Mean Square	F	Sig.
2	Regression	13.410	1	13.410	58.936	.000[b]
	Residual	13.196	58	.228		
	Total	26.606	59			

a. Dependent Variable: ERM; b. Predictors: (Constant), DP

Model		Sum of Squares	Df	Mean Square	F	Sig.
3	Regression	11.663	1	11.663	45.269	.000[b]
	Residual	14.943	58	.258		
	Total	26.606	59			

a. Dependent Variable: ERM; b. Predictors: (Constant), BT

Table 8. Coefficients results.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	−.262	.273		−.957	.342
	SD	.503	.073	.673	6.933	.000

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
2	(Constant)	−.278	.250		−1.113	.270
	DP	.528	.069	.710	7.677	.000

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
3	(Constant)	−.094	.257		−.366	.716
	BT	.474	.071	.662	6.728	.000

a. Dependent Variable: ERM

Table 9. Group statistics.

	L	N	Mean	Std. Deviation	Std. Error Mean
ERM	1.00	30	2.1567	.31479	.05747
	2.00	30	1.0033	.36102	.06591

Note: ERM:

Table 10. Independent samples test results.

		t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
ERM	Equal variances assumed	13.188	58	.000	1.15333	.08745	.97828	1.32838
	Equal variances not assumed	13.188	56.944	.000	1.15333	.08745	.97821	1.32845

Note: ERM:

CONCLUSION AND POINTERS FOR FUTURE RESEARCH

This study was an attempt to examine the relationship between planfully aligned leadership and emergency response. Quantitative analysis of the findings showed a positive and significant relationship between planfully aligned leadership and emergency response. When the three dimensions of planfully aligned leadership i.e. setting direction, developing people and building trust were examined individually, each dimension was found to be strongly related to emergency response. Developing People was the most substantial contributor as it independently explained about 49.5% of predicted ER. Lastly, the results showed that planfully aligned leadership was a better predictor of emergency response than authoritarian leadership.

This study analyses the relationship between planfully aligned leadership and emergency response and makes it worth further investigation and scrutiny. Future research could delve into how leadership is distributed and an analysis of the factors that facilitate DL. Distributed leadership provides an interesting construct for safety leadership and should be implemented in leadership research within the maritime industry.

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