ATTAINING FIRM'S TECHNOLOGICAL SUSTAINABILITY DEVELOPMENT THROUGH TRANSFORMATION LEADERSHIP

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Abstract. The study aims to investigate how transformational leaders shape the attainment of firm's technological sustainability (TS) through the effect of employee innovative behaviour and their active engagement in work. The research employed positivism using survey instrument to employees working in the capital city of Malaysia and its vicinity. A total sample of 220 were examined using SPSS and Smart-PLS statistical tools. The results indicated a strong relationship between transformational leaders and firm engagement in technological sustainability (ie SDG 9). It also reaffirmed the power of mediation effect of employee's innovative behaviour and their work engagement. The findings in this study serve as a guiding framework for leaders, managers and policy makers in ensuring organisations develop and formulate strategies in line with SDG 9 in the betterment of not just the organisations' continuous improvement in technological sustainability but the benefits to community as well as society at large. To the best of our knowledge, the findings offer a novel framework, in the context of Malaysia, that encumbrance the role transformational leaders play in influencing the achievement of technological breakthroughs and knowledge. Such cohesiveness also demonstrated the important of employee contribution in terms of their innovativeness and active engagement in work.
Keywords: *technological sustainability, transformational leadership, employee innovative work behaviour, employee engagement, Malaysia*

Introduction

Sustainable development is among the main pillars of the Malaysian Code on Corporate Governance 2017. Part of this has the linkage to the 17 Sustainable Development Goals ("SDGs") which were adopted in 2015 by the United Nations (UN); with a strong economic, social, and environmental focus to strengthen the three dimensions of sustainable development and protect the planetary and human future. The same period witnessed numerous legislations and international instruments provide for the application of the agenda related to SDGs in corporations. Good corporate governance is aimed towards long-term sustainability wherein economic, environmental, and social responsibilities become integral to the company's performance. Therefore, Malaysia has created an encouraging environment to achieve SDGs through a variety of initiatives, including the establishment of the National SDG Council; holding of SDG symposiums to encourage stakeholder understanding and involvement; conducting a mapping exercise with non-government and society; developing a National SDG Roadmap; and implementing SDG initiative in the 11th Malaysia Plan (Ern, 2017).

While the Sustainable Development Goals (SDGs) agenda is applicable to the member states of the UN, many other players are also involved, such as corporations.

The primary and economic value chain activities and aims of major companies mean they will ultimately have a crucial and explicit role to play in enabling the SDGs to be attained (Buniamin et al., 2022). Thus, private companies are explicitly called upon to play their part in realizing the goals. Acknowledging their role in productivity, inclusive economic growth, and job creation, the 2030 agenda for Sustainable Development appeals to businesses to apply their creativity and innovation to solving sustainable development challenges". Only 23% of the companies (39% of the companies studied that published a sustainability report) mentioned the SDGs in their reports. Similarly, many previous works (Curtó-Pagès et al., 2021; Elalfy et al., 2021) conducted a macro- and country-level analysis of commitment to the SDGs or explored the factors that influence commitment to the SDGs.

As corporate engagement in the SDGs is a novel phenomenon, empirical studies seemingly scarce and scattered. Some studies describe the implications of the SDGs for individual companies (Fleming et al., 2017), explore sustainable accounting methods that enable SDG achievement (Bebbington and Unerman, 2018) or discuss the relevance of the SDGs for sustainable investment. There is still just scant evidence on the circumstances under which factor cause companies engage in the SDGs. Fleming et al. (2017) unfolded that in the case of the Australian aquaculture company they studied, awareness of the SDGs as well as personal and corporate values were the key driver of SDG engagement. While investigated a sample of 81 European and North American multinational companies, that they particularly engage with those SDGs, that "fall in a company's sphere of influence" and are intended to avoid harm rather than doing good. Some clues for the relevance of industry and country-differences in this context were also found. Based on this small body of research, it is nevertheless difficult to answer what drives companies to engage in the SDGs.

In spite of this, the scholarly literature based on empirical studies is at a very early and underdeveloped stage. Practitioners and scholars have highlighted the lack of knowledge about the specific role organizations play in addressing SDGs and the real impact of this initiative on their practice. A report by Oxfam commented on the lack of "reliable information on how companies are working to contribute to the SDGs" (Mhlanga et al. 2018). Bebbington and Unerman (2017) noted the lack of empirical studies and general understanding of corporate commitment to the SDGs, particularly focusing on one or two SDGs. Considering both the practitioner and scholarly literatures, the present work aims to shed light on the antecedents of how employees engage in and contribute to the SDG, in particular, in the context of industry innovation and infrastructure from the Malaysian perspective, either through the analysis of their sustainability reports or questionnaires completed by companies' employees. Thus, our study intended to investigate further how transformational leadership, employee innovative work behaviour and employee engagement could possibly have the impact on technological sustainability (ie: SDG 9).

To-date, there is no empirical evidence affirming that transformational leadership is related to SDGs. Furthermore, it is also important to highlight the insufficient inspection and understanding of the relationship between innovative work behaviours and SDGs (Wang et al., 2022). There is also research studies revealed that employees play a vital role in achieving SDGs within organization, such as employee well-being, employee job performance and employee job satisfaction. As such, prior research studies pay little attention to employee engagement which is also the main pillar in achieving SDGs within organization. Consequently, there is a paucity of studies investigating the factors

that motivate firm to engage in SDGs especially in a time of crisis. As such, the current study aims to fill the gap by investigating the effect of transformational leadership, innovative work behaviour and employee engagement on corporate engagement in technological sustainability through empirical investigation. We then set out our research question as "what are the impacts of transformational leadership in achieving technological sustainability (SDG9)?" Our study aims to determine the direct and indirect relationships between transformational leadership, employee innovative work behaviour and employee engagement and how these contribute to achievement of SDG9. The next section, we delved into some relevant prior research which we did extensively on the relationship between transformational leadership and technological sustainability, employees innovative work behaviour and employee engagement. With this, we established how this relationship was tied to the research bottom-line, i.e: sustainability development goals. Further, we developed our proposed theoretical model (*Figure 1*) and the hypotheses as follows:

H1: Transformational Leadership has positive effect on attaining technological sustainability.
H2: Transformational Leadership does have a positive impact on employee innovation work behaviour (EIWB).
H3: Transformational Leadership is positively correlated with employee engagement (EE).
H4: Employee Innovative Work Behaviour tends to have a positive impact on technological sustainability.
H5: There is a positive relationship between employee engagement and corporate involvement in technological sustainability.
H6: Employee Innovative Work Behaviour mediates the relationship between transformational leadership and technological sustainability.
H7: Employee Engagement mediates the relationship between Transformational Leadership and Corporate Involvement in technological sustainability.

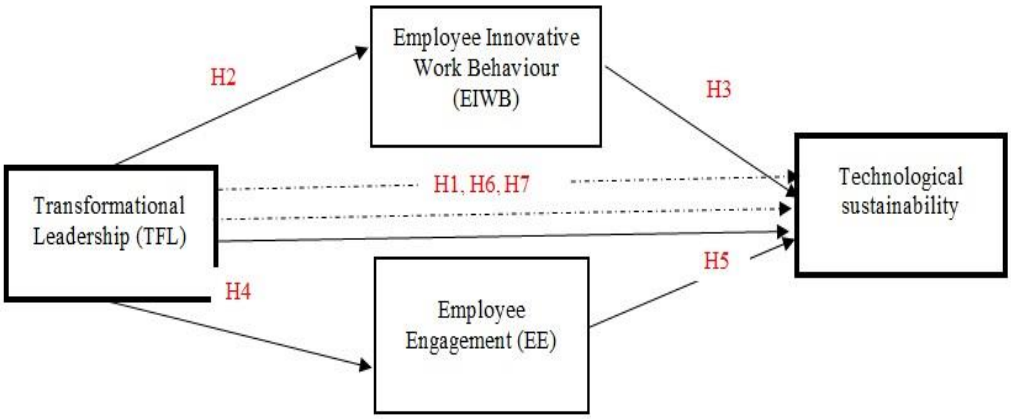

Figure 1. *Proposed conceptual framework.*

Materials and Methods

Research design and sampling

The study adapts a deductive approach which works from the top-down, from theory, literature review, then hypotheses, subsequently collect data to test the formulated theory where the result might add or contradict the theory (Creswell and Clark, 2017). The research employed cross-sectional and positivist paradigm using survey method. Each construct consists of a different number of items and is measured by 7-points Likert scales ranging from "1=Strongly disagree, 2=Disagree, 3=Somewhat disagree, 4=Neither agree or disagree, 5=Somewhat agree, 6=Agree, and 7=Strongly agree". This scaling helps to avoid respondents from choosing the mid-point compared to the 5-point scale (Churchill Jr and Peter, 1984). The 7-points Likert scale has shown to have higher accuracy, convenience and shows a better reflection of a respondent's true evaluation (Finstad, 2010). Thus, referring to the justification, using the 7-point Likert scale in this research is deemed to be appropriate. After completion of the pilot test, the revised version of the questionnaire items evaluating each construct is then integrated into a virtual network (i.e., Google Form). The web links to the questionnaire are then submitted to the accountant firms in Malaysia through e-mail. The human resource staff and the Head of the Department of Accounting for each organisation are the reference persons for this study. Contact email addresses are provided from their company website. A personalized email is transmitted to the contact person to the accountants of their respective departments via an online survey tool. The study used snowballing and convenience sampling in administering the survey instrument which lasted a period of three months consecutively. Previous similar studies had a sample size of 200 (Yuan et al., 2021). The final sample size for this research is 205 respondents.

Data analysis

The IBM Statistical Package for Social Sciences (SPSS) (Version 25.0) and Partial Least Square-Structural Equation Modelling (PLS-SEM) software are used in this study (SmartPLS 3.0) (Ramayah et al., 2018). The reason for adopting SPSS software in data analysis is due to its straightforward in clarifying the analysis of data compared to the 61 other software and it is widely used among researchers for complex statistical data analysis (Cohen et al., 2002). In view of the shortfall of SPSS where it does not offer structural equation modelling (SEM) techniques, the SmartPLS is adopted on top of SPSS to execute PLS-SEM analyses in the research. It enables researchers to estimate complex models with many constructs, indicator variables and structural paths without imposing distributional assumptions of data.

Results and Discussion

Respondent's demographic profile

Respondents' demographic profile is essential to describe the population of survey respondents, illuminate potential disparities, and have a better analysis of data. Section A of the questionnaire developed for this research comprises demographic variables including gender, age group, highest educational level, working experience and current job level. The frequency and percentage distribution of the data collected are analysed via SPSS, and the results are exhibited in *Table 1*.

Table 1. *Descriptive analysis of respondent profile.*

Category	Frequency (N=220)	Percentage (%)
Gender		

Male	92	41.8
Female	128	58.2
Age group		
<20 years old	11	5.0
21-30 years old	84	38.2
31-40 years old	88	40.0
41-50 years old	28	12.7
>51 years old	9	4.1
Higher education level		
Certificate (High school-SPM/Vocational institution/Technical colleges)	13	5.9
Diploma	26	11.8
Bachelor degree	134	60.9
Postgraduate degree (Mster/Doctoral)	47	21.4
Others (Please specify)	0	0
Working experience		
<1 year	15	6.8
1-2 years	62	28.2
3-4 years	57	25.9
>5 years	86	39.1
Current job level		
Owner/executive	21	9.5
Senior management	53	24.1
Middle management	71	32.3
Entry level	75	34.1

Correlation coefficient

In this study, the Pearson product-moment correlation coefficient is used to assess the direction and significance of the relationship between the constructs. A value of +1.00 indicates a perfectly positive correlation; a value of -1.00 indicates a perfectly negative correlation; while a value of 0 indicates that no relationship exists. Cohen (2013) provides further guidelines on the strength of association, in which $0.10 \leq r < 0.30$ indicates weak strength of association; $0.30 \leq r < 0.50$ indicates moderate strength of association; and $r \geq 0.50$ indicates strong strength of association. *Table 2* exhibits the correlations between the constructs of transformational leadership (TL), employee innovative work behaviour (EIWB), employee engagement (EE), and firm engagement with Sustainable Development Goal 9 (FTSIII). The result in *Table 2* shows that FTSIII has significant strong positive correlations ($r \geq 0.50$) with TL, EIWB and EE where r=0.712, 0.870 and 0.751 respectively, Furthermore, EE has significant strong positive correlations with TL and EIWB where r=0.669 and 0.740 respectively. Additionally, EIWB has significant positive correlations with TL where r=0.755. The results imply that TL, EIWB, EE and FTSIII may move in the same direction. In other words, the correlations indicate that a greater level of TL (M=5.22, SD=0.952), EIWB (M=5.14, SD=1.206), and EE (M=5.05, SD=1.152) signifies a greater level of FTSIII (M=5.10, SD=1.368).

***Table 2**. Pearson Product-Moment correlation coefficient between constructs.*

Constructs	Mean (M)	Std. Deviation	Pearson Correlation			
			TL	EIWB	EE	FTSIII
TL	5.22	0.952	1			
EIWB	5.14	1.206	0.755**	1		
EE	5.05	1.152	0.669**	0.740**	1	
FTSIII	5.10	1.368	0.712**	0.870**	0.751**	1

*Note: TL=Transformational Leadership; EIWB=Employee Innovative Work Behaviour; EE=Employee Engagement; FTSIII (Firm Technological Sustainability-Industry, Innovation and Infrastructure; **Correlation is significant at the 0.01 level (2-tailed).*

Test of convergent validity

Convergent validity supports that items under the same or similar constructs should be highly correlated (Michalos, 2014). Generally, an indicator's outer loadings should be above 0.708 and the average variance extracted (AVE) should be above 0.500 (Leguina, 2015). Referring to *Table 3*, majority of the outer loadings are above the rule of thumb of 0.708, except for TL1 (0.671), TL2 (0.632), TL3 (0.587), TL4 (0.574), TL5 (0.652), TL7 (0.638), EIWB1 (0.669) and EE1 (0.696). However, outer loadings of ≥0.700 (Leguina, 2015) and ≥0.630 (Comrey and Lee, 2013) are still acceptable as they are close to 0.708. Instead of automatically eliminating indicators when their outer loadings are below 0.708, researchers should carefully examine the effects of item removal and only remove them if doing so will substantially increase the AVE (Leguina, 2015). Referring *Table 3*, the value of 0.496 is acceptable due to condition that if AVE value is less than 0.5, but composite reliability is higher than 0.6, the convergent validity of the construct is still adequate (Fornell and Larcker, 1981). Overall, all constructs are deemed to have passed the convergent validity test in the first-order measurement order.

***Table 3**. Convergent validity of first-order measurement model.*

Constructs	Items	Loadings	AVE
TL	TL1	0.671	0.496
	TL2	0.632	
	TL3	0.587	
	TL4	0.574	
	TL5	0.652	
	TL6	0.727	
	TL7	0.638	
	TL8	0.701	
	TL9	0.825	
	TL10	0.805	
	TL11	0.795	
	TL12	0.719	
	TL13	0.740	
	TL14	0.772	
	TL15	0.685	
	TL16	0.685	
EIWB	EIWB1	0.669	0.724
	EIWB2	0.829	
	EIWB3	0.904	
	EIWB4	0.845	
	EIWB5	0.856	
	EIWB6	0.847	
	EIWB7	0.843	
	EIWB8	0.859	
	EIWB9	0.916	
	EIWB10	0.913	
EE	EE1	0.696	0.706
	EE2	0.850	
	EE3	0.886	
	EE4	0.814	
	EE5	0.887	
	EE6	0.894	
	EE7	0.840	
FTSIII	FTSIII1	0.931	0.785
	FTSIII2	0.905	
	FTSIII3	0.833	
	FTSIII4	0.910	
	FTSIII5	0.849	

Note: TL=Transformational Leadership; EIWB=Employee Innovative Work Behaviour; EE=Employee Engagement; FTSIII (Firm Technological Sustainability-Industry, Innovation and Infrastructure.

Test of discriminant validity

Discriminant validity assesses how different a construct is from other constructs by empirical standards (Leguina, 2015). Discriminant validity of this research will be assessed based on Fornell-Larcker's Criterion, Cross-Loadings Criterion, and Heterotrait-Monotrait Ratio (HTMT) Criterion. Fornell-Larker's Criterion compares the square root of AVE with the latent variable correlations (Leguina, 2015). Generally, the square root of each construct's AVE should be greater than its highest correlation with any other construct (Fornell and Larcker, 1981). Based on *Table 4*, majority of the constructs have achieved the rule of thumb mentioned earlier, except EIWB & FTSIII (0.872 which is slightly greater than 0.851). Therefore, this first-order measurement model is lack of discriminant validity in terms of Fornell-Larker's Criterion. When assessing cross-loadings between constructs, the general rule of thumb is that an indicator's outer loading on the associated construct should be greater than any of its cross-loadings (i.e. its correlation) on other constructs (Leguina, 2015). Based on *Table 5*, the outer loadings of all indicators on their own constructs (i.e. EE, EIWB. FTSIII and TL) are obviously greater than their correlations with other constructs. Therefore, discriminant validity in terms of Cross-Loadings Criterion is present in this first-order measurement model.

***Table 4**. Fornell-Larcker's criterion for first-order measurement model.*

Category	EE	EIWB	FTSIII	TL
EE	0.840			
EIWB	0.756	0.851		
FEIII	0.757	0.872	0.886	
TL	0.783	0.752	0.723	0.704

Note: TL=Transformational Leadership; EIWB=Employee Innovative Work Behaviour; EE=Employee Engagement; FTSIII (Firm Technological Sustainability-Industry, Innovation and Infrastructure.

***Table 5**. Cross loadings criterion for first-order measurement model.*

Category	EE	EIWB	FTSIII	TL
EE1	0.696	0.435	0.429	0.549
EE2	0.85	0.644	0.573	0.726
EE3	0.886	0.743	0.706	0.665
EE4	0.814	0.621	0.649	0.587
EE5	0.887	0.608	0.654	0.657
EE6	0.894	0.678	0.72	0.662
EE7	0.84	0.674	0.677	0.741
EIWB1	0.662	0.669	0.683	0.563
EIWB2	0.714	0.829	0.742	0.601
EIWB3	0.638	0.904	0.772	0.672
EIWB4	0.592	0.845	0.734	0.631
EIWB5	0.689	0.856	0.799	0.615
EIWB6	0.528	0.847	0.707	0.635
EIWB7	0.536	0.843	0.691	0.647
EIWB8	0.688	0.859	0.685	0.616
EIWB9	0.721	0.916	0.789	0.736
EIWB10	0.654	0.913	0.795	0.666
FEIII1	0.696	0.785	0.931	0.652
FEIII2	0.762	0.854	0.905	0.713
FEIII3	0.494	0.779	0.833	0.621
FEIII4	0.663	0.742	0.91	0.609
FEIII5	0.724	0.689	0.849	0.597
TL1	0.614	0.459	0.518	0.671
TL2	0.448	0.343	0.361	0.632
TL3	0.605	0.465	0.457	0.587
TL4	0.497	0.363	0.365	0.574
TL5	0.516	0.525	0.469	0.652

TL6	0.512	0.483	0.631	0.727
TL7	0.517	0.43	0.422	0.638
TL8	0.761	0.54	0.528	0.701
TL9	0.546	0.561	0.521	0.825
TL10	0.614	0.59	0.622	0.805
TL11	0.556	0.548	0.579	0.795
TL12	0.599	0.652	0.624	0.719
TL13	0.541	0.702	0.593	0.74
TL14	0.606	0.622	0.468	0.772
TL15	0.433	0.563	0.447	0.685
TL16	0.331	0.488	0.4	0.685

Note: TL=Transformational Leadership; EIWB=Employee Innovative Work Behaviour; EE=Employee Engagement; FTSIII (Firm Technological Sustainability-Industry, Innovation and Infrastructure.

Structural model analysis

Path coefficient

Path coefficient represents the hypothesised relationships among constructs (Leguina, 2015). To be statistically significant, the general rule of thumb is that the p-values should be 0.05 or below; and the t-values should be at least 1.96 for two-tailed test or 1.645 for one-tailed test under the bootstrapping procedure (Leguina, 2015; Fisher, 1928). There are 5 direct hypotheses (i.e H1, H2, H3, H4 and H5) in this research. To test their level of significance, complete bootstrapping procedure with 5,000 bootstrap sub-samples was conducted via PLS-SEM. Based on *Table 6*, all 5 direct hypotheses were found to be statistically significant as their p-values were below 0.05 and their t-values were at least 1.645 (one-tailed). Specifically, TL to FTSIII (i.e. H3) (β=0.723; t=27.350; p=0.000), EIWB to FTSIII (i.e. H4) (β=0.678; t=12.298; p=0.000), and EE to FTSIII (i.e. H5) (β=0.200; t=2.979; p=0.000) were found to have positive direct effect. Furthermore, TL to EIWB (i.e H1) (β=0.752; t=29.850; p=0.000) and TL to EE (i.e. H2) (β=0.783; t=33.925; p=0.000) were found to have positive direct effect. Hence, the hypotheses are supported.

Table 6*. Assessment of path voefficient.*

Hypothesis	Relationship	Std. Beta	Std. Error	t-value	Decision
H1	TL → EIWB	0.752	0.025	29.850**	Supported
H2	TL → EE	0.783	0.023	33.925**	Supported
H3	TL → FTSIII	0.723	0.026	27.350**	Supported
H4	EIWB → FTSIII	0.678	0.055	12.298**	Supported
H5	EE → FTSIII	0.200	0.067	2.979**	Supported

*Note: TL=Transformational Leadership; EIWB=Employee Innovative Work Behaviour; EE=Employee Engagement; FTSIII (Firm Technological Sustainability-Industry, Innovation and Infrastructure; **p-value (<0.05).*

Analysis of mediating effect

There are two mediation hypotheses (i.e. H6 and H7) in this research to investigate the indirect effects of employee innovative work behaviour (EIWB) and employee engagement (EE) between transformational leadership (TL) and firm engagement in TS (SDG9)-Industry, Innovation, and Infrastructure (FTSIII). Bootstrapping procedure with 5,000 bootstrap sub-samples via PLS-SEM was conducted to obtain the results (Leguina, 2015). Mediation arises when a third mediator variable intervenes in the relationship between two related constructs (Leguina, 2015). The rule of thumb of mediation effect is that the specific indirect effect should be significant (i.e. t-value>1.96; p-value<0.05), and the confidence interval bias corrected does not straddle

a 0 (Ramayah et al., 2018). Based on *Table 7*, both indirect effects H6 (β=0.510; t=10.615, p=0.000) and H7 (β=0.157; t=2.954, p=0.003) are significant as their t-values are above 1.96 and their p-values are lesser than 0.05. Furthermore, both indirect effects' 95% bootstrapping confidence interval bias-corrected: H6 (LL=0.425; UL=0.614) and H7 (LL=0.044; UL=0.253) do not straddle a 0 in between, indicating that there is mediation. In short, the mediation effects of H6 and H7 are statistically significant. The overall analyses of direct and indirect relationships lead us to the following framework (*Figure 2*).

***Table 7**. Hypotheses testing on mediation.*

Hypothesis	Relationship	Std. Beta	Std. Error	t-value	Confidence interval	Decision
H6	TL → EIWB → FTSIII	0.510	0.048	10.615**	0.425	0.614
H7	TL → EE → FTSIII	0.157	0.053	2.954**	0.044	0.253

*Note: TL=Transformational Leadership; EIWB=Employee Innovative Work Behaviour; EE=Employee Engagement; FEII (Firm TS (SDG 9)-Industry, Innovation and Infrastructure; **p-value (<0.05)*

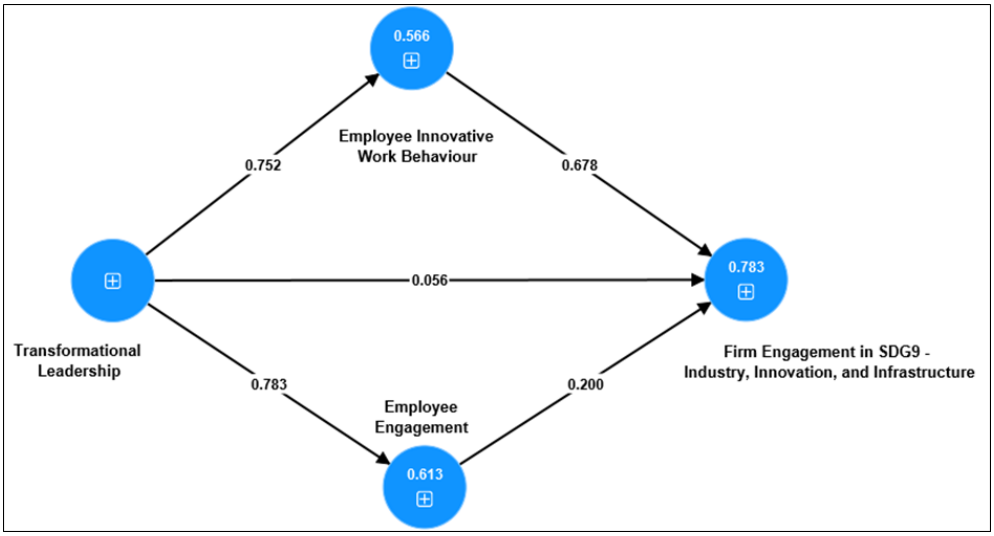

***Figure 2.** Structural Model (Loadings Value).*

The study examined seven hypotheses in terms of the constructs direct and indirect relationship. H1 and H2 were formulated to investigate the respective relationships between transformational leadership, employee innovative work behaviour and employee engagement. H1 investigates the relationship between transformational leadership and employee innovative work behaviour. The result of H1 confirms that there is a significant positive direct relationship between transformational leadership and employee innovative work behaviour (β=0.752, t=29.850, p=0.000). Hence, H1 is supported. This is consistent with the social exchange theory and previous studies in which the researchers found that transformational leadership is positively related to employee innovative work behaviour (Afsar et al., 2019; Lee et al., 2018). Furthermore, this environment of mutual trust breeds intrinsic motivation among employees to innovate frequently.

H2 investigates the relationship between transformational leadership and employee engagement. The result of H2 confirms that there is a significant positive direct relationship between transformational leadership and employee engagement (β=0.783,

t=33.925, p=0.000). Hence, H2 is supported. This is consistent with the social exchange theory and previous studies in which the researchers found that transformational leadership is positively related to employee engagement. In accordance with Boselie and Van Der Heijden (2024) study, there is a growing awareness of the importance of transformational leadership from the line manager in the shaping of human resource functions, including employee development. Boselie and Van Der Heijden (2024) state that transformational leaders develop followers' potential. The direct supervisor plays an essential role in the engagement 31 of an employee with specific reference to knowledge, skills, and abilities (Boselie and Van Der Heijden, 2024). Therefore, this research has confirmed that transformational leadership plays a crucial role in affecting employee engagement.

H3, H4 and H5 were developed to investigate the respective relationships between transformational leadership, employee innovative work behaviour, employee engagement and firm engagement in technology (SDG 9). H3 investigates the relationship between transformational leadership and firm engagement with SDG9, which is industry, innovation and infrastructure. The result of H3 confirms that there is a significant positive direct relationship between transformational leadership and firm engagement with SDG9 (β=0.723, t=27.350, p=0.000). Hence, H3 is supported. This is consistent with transformational leadership theory. This is consistent with transformational leadership theory. Transformational leaders build commitment to the organization's objectives and empowered followers to achieve those objectives

H4 investigates the relationship between employee innovative work behaviour and firm engagement in industry, innovation and infrastructure. The result of H4 confirms that there is a significant positive direct relationship between employee innovative work behaviour and firm engagement in SDG9 (β=0.678, t=12.298, p=0.000). Hence, H4 is supported. This result is in line with prior studies in which the researchers found that employee innovative work behaviour is positively affects firm engagement with long term goals (i.e. SDG9) and also the adaption to green technology, transportation and innovation as SDG9 highlights the importance of innovative sustainable technologies. H5 investigates the relationship between employee engagement and firm engagement with SDG9, which is industry, innovation and infrastructure. The result of H5 confirms that there is a significant positive direct relationship between employee engagement and firm engagement with SDG9 (β=0.200, t=2.979, p=0.000). Hence, H5 is supported. This result is in line with prior studies in which the researchers found that employee engagement is positively affects firm engagement with long term goals (i.e. SDG9), especially in green technologies and innovation.

H6 investigates the mediating effect of employee innovative work behaviour on the relationship between transformational leadership and firm engagement with SDG9. The result of H6 confirms that employee innovative work behaviour is found to have a significant mediation effect on the relationship between transformational leadership and firm engagement with SDG9 (β=0.510, t=10.615, Confidence Interval BC=[0.425, 0.614], p=0.000). Hence, H6 is supported. This is in consistent with previous studies in which the researchers found that employee innovative work behaviour positively mediates transformational leadership and firm engagement with long term goals (i.e. SDG9), especially achievement in green technologies and innovation (Jaroliya and Gyanchandani, 2022; Holden et al., 2017). H7 investigates the mediating effect of employee engagement between transformational leadership and firm engagement with SDG9. The result of H7 confirms that employee engagement is significantly and

positively mediates the relationship between transformational leadership and firm engagement with SDG9 (β=0.157, t=2.954, Confidence Interval BC=[0.044, 0.253], p=0.003). Hence, H7 is supported. This result is in line with employee engagement theory where the author posits that in employee engagement theory, when in engagement, people employ and express themselves physically, cognitively, and emotionally during role performances and allow employees to bring "full selves" into the workplace.

Conclusion

The present study lends its support to the research literature in several ways. Firstly, little empirical research has been confirmed on the determinants and way to improve firm engagement with sustainable development goals. When investigating corporate involvement or firm engagement in SDG previous studies have largely focused on content analysis, which using secondary data such as corporate reports or limited case studies to examine how US firms engage in attaining SDGs (Nylund et al., 2022). The relationships presented in this study play a significant role in understanding the forces which drives the improvement of firm engagement in technological innovation and infrastructure. From the result, we suggest corporate leaders could be given sufficient training in transformational leadership style. This would help with employee engagement, which is an asset to the organization and employee innovative behaviour that can be fostered under influence of transformational leaders (Afsar et al., 2014). Furthermore, this research highlights the importance of transformational leadership and firm engagement with SDG9 (long term goals) as transformational leadership leads employees move out from comfort zones and embrace ways of working, thinking and building sustainable infrastructure together. By promoting employee engagement, organizations could create a culture of sustainability that supports the achievement of SDG9. Besides, organizations could assess the impact of employee engagement on sustainable practices, such as energy efficiency, waste reduction, and pollution prevention. By measuring the impact of employee engagement on sustainable practices, organizations can identify areas for improvement and develop targeted interventions to support the achievement of SDG9.

Lastly, this research draws special attention to the mediation effect of employee innovative work behaviour and employee engagement on the relationship between transformational leadership and firm engagement in SDG 9. This also would likely to embed such culture of innovation and sustainability that supports sustainable industrialization and innovation (Wang et al., 2022; Iqbal et al., 2021). This study does have some limitations. The study collected data from employees in Malaysia irrespective of industry or job position, hence, the results may be too broad and not specific enough. While the sample represents employees in Malaysia, the findings may not apply to all industries in the country. Therefore, future research could focus on a particular industry to obtain industry-specific results. The measures used in the study have been widely tested, reducing the chances of common method bias due to item characteristics and context. Other than using some procedural remedies, statistical methods could also be used to find potential effects of analysis. Harman's single-factor test was administered to find out the common method variance in the study and 48.369 percent variance was explained against the maximum limit of 50 percent which might potentially affect the accuracy of measurement. Finally, future researchers could

endeavour to improve on this research's proposed nomological network by further explaining the relationship between transformational leadership and firm engaging in technological innovation with a more complete mechanism. Future studies may also consider employing mixed-method as well, which helps to triangulate the research approaches and perhaps exploring a more comprehensive understanding of a phenomenon without compromising the validity and accuracy of the research methods.

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Conflict of interest

The authors confirm that there is no conflict of interest involve with any parties in this research study.

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