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Ogbeibu, Samuel; Burgess, John; Emelifeonwu, Jude; Pereira, Vijay

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Title: How Green HRM and Technological Turbulence Predicts Green Product Innovation: A STARA Tale

1st and Corresponding Author: Dr. Samuel Ogbeibu
Curtin University, Malaysia, Faculty of Business,
CDT 250, 98009 Miri, Sarawak, Malaysia.
samuel.ogbeibu@curtin.edu.my

Co-Authors:
Prof. John Burgess
RMIT University, Australia.
Email Address: john.burgess@rmit.edu.au

Dr. Jude Emelifeonwu
University of Brighton, United Kingdom,
Email Address: J.Emelifeonwu@brighton.ac.uk

Associate Prof. Vijay Pereira
Khalifa University, Abu Dhabi, United Arab Emirates.
vijay.pereira@port.ac.uk
How Green HRM and Technological Turbulence Predicts Green Product Innovation: A STARA Tale

Abstract
Challenged by constant technological advancements in smart technology, artificial intelligence, robotics, and algorithms (STARA) amid global warming concerns; several organisations in developed and emerging economies are probing into future oriented avenues for engendering green product innovations (GPI). With rising governmental demands for emerging economies like Malaysia to go green, and develop organisational human capital to drive GPI, organisations’ human resource management (HRM) programs are required to support the workforce in realising environmental objectives. Research therefore, suggests complementary Green HRM (GHRM) programs to constantly develop STARA related leader competencies. This research investigates how GHRM, technological turbulence and leader STARA competence (LSC) acts to predict GPI. Results indicate that technological turbulence negatively predicts GPI and reinforces the positive relationship between GHRM and GPI. While GHRM positively predict GPI, LSC’s prediction of GPI is insignificant. However, LSC amplifies the positive relationships between GHRM, technological turbulence and GPI. Policy implications are subsequently discussed.

Keywords: Leader STARA Competence; Technological Turbulence; Green Human Resource Management; Green Product Innovation
Introduction

The developments in technological advancements in smart technology, artificial intelligence, robotics, and algorithms (STARA) amid global warming concerns, have provoked global calls for manufacturing organisations to explore more cutting-edge avenues for producing environmentally friendly innovations (Ogbeibu et al., 2020; Oosthuizen, 2019). Recent research argues that today’s global warming is a consequence of technological turbulence (Chen et al., 2018; Ogbeibu et al., 2020). Technological turbulence is the constant change in technology and consequent disruption that renders prevailing technologies outdated (Schumpeter, 1934). Technological turbulence is the result of intense efforts by manufacturing organisations to maintain competitive edge in the wake of a hypercompetitive business environment (Chavez et al., 2015). Similarly, whilst taking into consideration the need to maximise profits for shareholders, organisational leaders are also under pressure to address other stakeholder concerns linked to longer term sustainability, reduce reputational risk and meet changing market, regulatory and consumer expectations (Abdulaziz, et al., 2017). Organisational leaders across developed and emerging economies are beginning to initiate future oriented strategies for deploying radical technologies that fosters green product innovations (GPI) (Berrone, et al., 2013; Chan, et al., 2016). Chan et al. (2016) accentuate that GPI is the implementation and enhancement of innovative, refashioned or substantively advanced goods that are fundamental to environmental sustainability.

Prior research indicates that due to technological turbulence, organisations explore newer scientifically advanced methods by which GPI may be engendered (Cuerva, et al., 2014). Hall and Rosson (2006) posit that the drive to produce more environmentally sustainable goods is fuelled by the impact of technological turbulence in the business environment. Research indicates that technological turbulence does have a positive influence on GPI (Chen et al., 2018; Ogbeibu et al., 2020). Ogbeibu et al. (2020) stressed that technological turbulence has a positive association with GPI. Extant research also highlight the challenges associated with technological turbulence including high operational costs, operations process disruptions, and displacement of established organisational priorities (Chavez et al., 2015). Technological turbulence could also result in increased labour turnover and the loss of human capital to the organisation (Chen et al., 2018). Studies thus, indicate that technological turbulence also has potential negative effects on GPI (Chavez et al., 2015; Kaivo-oja and Lauraeus, 2018). Given the uncertainty regarding the relationship, this study examines the relationship between technological turbulence and GPI.

Moreover, Ogbeibu et al. (2020) and Arulrajah et al. (2015) advocate that in the context of technological turbulence and pursuit of organisations’ GPI, it is important for organisations’ human resource management (HRM) to pay attention to their “green” human capital development. While the traditional HRM practices mirror functions that help organisations improve their overall performance, the focus however, does not allow for a broad accommodation of cleaner production or environmental sustainability tenets (Ahmad, 2015). Green values are of less or no importance as organisational expectations are usually established on profit maximization (Renwick et al., 2013). Organisational members are mostly selected and recruited, trained and developed, compensated and evaluated with benchmarks that ground their attention to basic routines which have less or no association with cleaner production (Jabbour, 2013). Hence, team members’ respective work ethics under the traditional HRM, are aligned with objectives that impedes or accords less regard for environmental sustainability (Renwick et al., 2016). In an effort to help close this gap, Ogbeibu et al. (2020) advocates a need for organisations’ HRM to imbibe the tenets
of the stakeholders’ theory. The stakeholders’ theory (which underpins this current research), contends for organisations to go beyond just focus on profit maximization and towards an adoption of corporate social responsibilities that aligns organisations’ objectives with people and environmental sustainability (Clarkson, 1995). To help foster environmental sustainability, organisations’ HRM are consequently pressured to go green – thus, birthing the concept of green HRM (GHRM) (Renwick et al., 2013).

According to Ogbeibu et al. (2020, p. 3), GHRM is a “set of guidelines and initiatives that inspire environmentally focused behaviours among employees so that they use their creativity to achieve green innovation outcomes, thus aiding the global cause to engender environmental sustainability”. Yong et al. (2019) argue that human capital development should be guided by green centred values, as this could aid to foster objectives that identify with GPI. Prior research suggests that by going green and driving green values within the workforce, GHRM practices are more likely to positively influence GPI (Ahmad, 2015). Jackson et al. (2011) emphasise that GHRM is pertinent for fostering organisational objectives to become more closely aligned with the United Nations global compact (UNGC) environmental sustainability principles. However, by overlooking GHRM practices, implementation of set objectives for achieving GPI could be impeded (Jabbour, 2013; Ogbeibu, et al., 2020). Studies consequently conjecture a negative or insignificant association between GHRM and GPI (Arujrajah et al., 2015; Yong, et al., 2019b). The existence of conflicting views of previous research indicates the need for GHRM to be given a closer attention, given recent global warming concerns and how the future of work may be impacted (Chams & García-Bland, 2019). Similarly, our study contributes through assessing how GHRM predicts GPI.

Research also suggests that the future of work is becoming more rooted in work practices driven by the STARA phenomenon (Brougham and Haar, 2018; Oosthuizen, 2019). To simultaneously engender environmental sustainability, meet organisational objectives, meet stakeholder expectations amid constant technological disruptions, studies advocate the need for development of leader competencies that closely capture skillsets associated with STARA (Chen, et al., 2018; Li, et al., 2019; Lu, 2019). While the debate rages on around whether STARA is a “portent” or a “silver spoon”, the discourse tends to overlook how it may be exploited as a tool by organisational leaders (Brougham and Haar, 2018; Parker and Grote, 2019). Tussyadiah and Miller (2018) suggest that equipping leaders with STARA competencies could prove promising for organisations. Parker and Grote (2019) and Li, et al. (2019) argue that leaders equipped with STARA competencies are more likely to be able to further catalyse momentum, meet deadlines, implement and achieve objectives fundamental to overall organisational success. Leader STARA competence (LSC) is described as the requisite knowledge and ability of a leader to adopt and demonstrate expertise fundamental to philosophies of smart technology, artificial intelligence, robotics, and algorithms in ways that are acceptable, and adequate for achieving organisational set objectives (Brougham and Haar, 2018; Oosthuizen, 2019). Though research suggests that LSC can positively influence job control as leaders become more equipped with precepts important for combatting and managing technical risks associated with executing green related initiatives (Tussyadiah and Miller, 2018). To date, it is not clear how LSC acts to predict GPI and how LSC influences technological turbulence, and GHRM on GPI respectively. Based on prior debate (Ivancic et al., 2019; Tussyadiah and Miller, 2018; Vishwanath et al., 2019), we thus, anticipate that LSC would aid to further engender green initiatives to support global sustainable development
goals (SDG), foster more effective compliance to the UNGC sustainability tenets and satisfy diverse stakeholders’ demands.

This research therefore, seeks to contribute to prior literature, address the contextual issues identified and consequently provoke novel insights by examining how GHRM, LSC, technological turbulence really acts to predict GPI. This research further seeks to contribute by stretching prior contemporary and theoretical postulations to help offer meaningful and substantive insights into how technological turbulence and LSC moderates the relationship between GHRM and GPI and to determine the probable moderating influence of LSC on the association between technological turbulence and GPI. Considering the constant global warming, future of work, and technological turbulence concerns, findings of this study would be relevant for helping organisations reinforce their human capital with competencies that can foster continuous relevance in the long term, competitive advantage and catalyse achievement of the SDG related expectations.

**Literature Review and Hypothesis Development**

The influence of GHRM on GPI is likely to be unpredictable in a context of extensive technological advancements (Cuerva, et al., 2014). Extant research stress that technological turbulence can impact how GHRM practices and objectives are implemented to engender GPI (Ogbeibu, et al., 2020). Technological turbulence tends to create a level of uncertainty that threatens and forces programs linked to realising GHRM objectives to face re-evaluation (Chen, et al., 2015). This generates a demand for developing competencies in organisational leaders who are tasked with the responsibilities of realising green initiatives. The works of Jabbour et al. (2013) and Chen et al. (2018) suggests that nurturing and equipping leaders with required competencies can help organisations’ workforce to mitigate and navigate the varying effects of technological turbulence.

On the other hand, the work of Vishwanath et al. (2019) suggests that LSC could help to reduce job complexities endemic in green initiatives. With the help of smart technologies leaders could create algorithms pertinent for further simplifying complex processes embedded within defined green initiatives (Horton, 2017). LSC is also important as it allows for better deployment of technical knowledge needed to manage and control job-repetitions involving robotic process automation (Ivancic et al., 2019). These competencies are essential and are needed for further augmenting the engenderment of GPI (Yong, et al., 2019a). LSC could also help foster more active participation of employees who are given opportunities to adopt relative STARA skills from their leaders and from the organisation (Jabbour et al., 2013; Li, et al., 2019). Deploying LSC could also be useful for reducing pressures that might have increased stress and work-life balance conflict in leaders and employees who are not equipped with STARA competencies (Tussyadiah and Miller, 2018).

Research suggests that due to constant struggle to bolster environmental sustainability, support organisational goals, build and maintain competitive edge, manufacturing organisations ought to adapt to advanced technologies needed to accommodate the future of work (Khallash and Kruse, 2012). This mirrors a promising avenue for organisations that may be more likely to survive the growing technological turbulence and global warming challenges influencing the business environment (Frey and Osborne, 2017; Makridakis, 2017). This challenge applies across economies, regardless of their development status, as the issues are global and require support
from LSC and GHRM human capital development for GPI associated with the UNGC network and Kyoto Protocol (Chams and García-Bland, 2019; Shyu, 2014).

The context for this research is Malaysia, where several manufacturing organisations are striving to improve their GHRM practices in ways that closely identifies with the assumptions of the stakeholder view of the firm (Donaldson, 1995; Yong, et al., 2019b). This mirrors a situation where the ethical, mutually supportive and normative interaction of organisations and stakeholders (governments, customers, suppliers, employees, communities, trade associations and political groups) coalesce towards the accomplishment of their collective needs and expectations (Donaldson, 1995; Kawai et al., 2018). However, to date there is an absence of evidence on the link between GHRM and GPI via the stakeholders’ theoretical lens (Ogbeibu et al., 2020). We contribute by investigating the predictive powers of LSC, GHRM and technological turbulence on GPI within the context of the Malaysian manufacturing sector.

Extant research suggests that there are challenges concerning the driving of GHRM initiatives of manufacturing organisations in Malaysia towards the achievement of the SDG (Nejati et al., 2017; Yong et al., 2019a). While GHRM of manufacturing organisations in Malaysia have acknowledged human capital development as a relevant factor influencing GHRM initiatives and performance (Chen, et al., 2015), green principles are to date underdeveloped within GHRM programs (Ogbeibu et al., 2020). For example, Ogbeibu et al. (2020) found that entry-level employees’ job descriptions of several manufacturing organisations in Malaysia lacked green criteria. Developing and supporting green credentials for employees through recruitment and training programs remains a challenge (Yong, et al., 2019b; Yusliza, et al., 2017). Moreover, performance management systems were found to ignore green performance criteria as a part of key performance indicators, and consequently pay and rewards systems are yet to be designed to support green initiatives (Yusliza, et al., 2017; Zailani, et al., 2015).

**Green human resource management (GHRM) and green product innovation (GPI)**

Extant research indicates that green values enshrined in the actions of recruiting and selecting potentially suitable green centred team members may be the key by which GHRM may satisfy stakeholders’ expectations for environmental friendly innovations (Ahmad, 2015). Studies espouse that GHRM is an effective means for ensuring that green centred job specifications are aligned with the right team members whose values support organisational green objectives (Roscoe et al., 2019; Yong et al., 2019b). Leal-Rodríguez et al. (2018) stress that this allows for increased awareness and more efficient delivery of green initiatives such as GPI. Equally, attempts to ensure standards for team members’ performance, compensation and pay schemes are integrated with green criteria, is noted as a viable indicator that GHRM could deploy to facilitate environmental sustainability (Renwick et al., 2016). Although such GHRM practices may act to positively provoke team members to be more willing to commit towards achievement of the SDG, empirical evidence of such influence is scarce (Ogbeibu et al., 2020). Adequate integration of environmental criteria into team members’ compensation and performance appraisals (auditing of green achievements or intrinsic/extrinsic rewards) could motivate them to address relative green issues that may foster environmental performance (Renwick et al., 2013).
Congruently, Teixeira et al. (2012) suggest that the giving of constructive feedback to employees should not be overlooked, as it is a way of aligning green initiatives to GPI objectives. Additionally, Jabbour et al. (2013) advocated that GHRM’s efforts deployed via training and development of team members is positively associated with environmental sustainability. Yusliza et al. (2017) argue that GHRM training and development can help engage and educate team members on the importance of cleaner production of goods, waste reduction, stifling environmental pollution diffusion and energy conservation. This is supported by Ogbeibu et al. (2020) who emphasised on the need for team members to undergo green education and training in order to be equipped and to demonstrate capabilities fundamental to GPI. Moreover, GHRM has been argued to positively and negatively influence GPI (Ogbeibu et al., 2020; Renwick et al., 2016), and has also been found to have no significant association with environmental sustainability (Yong et al., 2019b). Congruent with the conflicting findings of extant research, it is unclear how GHRM predicts GPI.

H1. GHRM positively predicts GPI.

**Technological Turbulence and green product innovation (GPI)**

In line with constant disruptions provoked by rising technological advancements, team members in organisations are being pushed to engage in green initiatives that foster the implementations of GPI (Chen et al., 2018). Studies contend that though the impacts of technological turbulence continue to render existing innovations out-dated, it conversely creates new avenues for alternative or divergent choices (Berrone et al., 2013; Wu et al., 2017). This gives team members, reason to further explore diverse ways by which environmentally friendly and cutting-edge innovations may be produced (Hall and Rosson, 2006). Likewise, Ogbeibu et al. (2020) argue that technological turbulence exacts a positive association with GPI. Despite the debate suggesting negative influence of technological turbulence, Berrone et al. (2013) and Chen et al. (2015) suggest that environmental programs provokes team members to challenge current status quo of prevalent technological frontiers. Technological turbulence has also been associated with improved inter-organisational competition, particularly in light of boosting brand image of organisations grounded in green philosophies (Cuerva, et al., 2014). Under the condition of increased technological turbulence, objectives that are fundamental to GPI becomes of high importance to green oriented organisations as they strive to facilitate the SDG achievement (Roper and Tapinos, 2016). We thus, theorise that technological turbulence would positively predict GPI.

H2. Technological turbulence positively predicts GPI.

**Leader STARA competence (LSC) and green product innovation (GPI)**

In light of recent contentions sounding the STARA underpinning, several works argue that its rise could transform the future of work, improve operations, and make for less complexity of cumbersome projects (Brougham and Haar, 2018; Khallash and Kruse, 2012). With much emphasis on a largely narrow path of tentative future outcomes, little or no focus is accorded to the possibility of empirically investigating and exploiting LSC as an efficient tool that could further drive green related initiatives towards increased GPI (Makridakis, 2017). Although, prior debate suggested that the LSC phenomenon is positively associated with GPI (Cuerva et al., 2014;
Vishwanath et al., 2019), extant research suggests that the STARA concept would otherwise lead to job losses (Brougham and Haar, 2018). Oosthuizen (2019) and Parker and Grote (2019) argue that it could also lead to increased job strain, health issues and work-life balance conflicts, as leaders are obliged to adopt, adapt and demonstrate expertise associated with newer technological advancements. Studies argue that leaders’ efforts to foster green initiatives that could engender GPI are usually impeded when faced with such related concerns (Berrone et al., 2013; Ogbeibu et al., 2020). Moreover, the works of Parker and Grote (2019) and Vishwanath et al. (2019) suggest that the development of STARA related competencies could offset its probable negative influences. However, what the literature has not established is how LSC predicts GPI. We therefore, theorise that LSC would positively predict GPI.

H3. LSC positively predicts GPI.

The moderating effect of technological turbulence

The impacts of technological turbulence are constantly driving a growing wave of change in the way organisations’ GHRM strategizes around the implementation of green related initiatives such as GPIs (Chen et al., 2018). Whilst technological turbulence might have provoked a positive push for some organisations, Ogbeibu et al. (2020) suggest that it has caused GPIs of several other organisations to become obsolete. Prior research contends that though GHRM may play a positive role to engender GPI, the unpredictable impacts of technological turbulence can create high levels of uncertainties capable of threatening overall intended GPI effects (Wu et al., 2017; Yong et al., 2019). Ogbeibu et al. (2020) and Wu et al. (2017) consequently, identify the potentially negative role of technological turbulence on GPI. Congruent with constant technological advancements, extant research accentuate that GHRM would become more pressured to also regularly re-evaluate current best practices employed to foster training and development initiatives required to engender environmental sustainability (Jabbour, 2013; Jackson, et al., 2011). Moreover, this could lead to increase in operations cost incurred by the organisation due to technological demand to constantly develop human capital that adapts or adopts cutting-edge innovations which acts to better bolster GPI (Abdulaziz et al., 2017).

H4. Technological turbulence dampens the positive relationship between GHRM and GPI.

The moderating effects of Leader STARA competence (LSC)

Research indicates that the phenomenon of LSC does mirror a positive influence on organisations’ efforts to further bolster the achievement of the SDG (Parker & Grote, 2019). Moreover, under periods of varying technological advancements and consequent disruptions, the constant adoption and development of LSC precepts could aid leaders to more easily adapt and compartmentalise operations associated with green initiatives (Vishwanath, et al., 2019). Leaders equipped with STARA competencies are thus, in better prepared positions to combat or mitigate the plausible negative influences that technological turbulence might have on green initiatives (Wu, et al., 2017). Likewise, by adopting and been able to deploy STARA associated competencies, leaders may be able to further catalyse GHRM practices and consequently drive defined tasks to more closely identify with GPI objectives (Berrone, et al., 2013; Oosthuizen, 2019). Consequently, the subsequent hypotheses are suggested:
H5a. LSC reinforces the positive association between technological turbulence and GPI.
H5b. LSC strengthens the positive association between GHRM and GPI.

The model underpinning, this study and the outlined hypotheses are presented in figure 1.

![Conceptual Framework](image)

**Figure 1. Conceptual Framework**

**Research methods**

Consistent with prior research (Ogbeibu et al., 2020), leaders and their team members from R&D, HRM and Information Technology (I&T) departments of 33 manufacturing organisations in Malaysia formed the study’s target population. To identify the organisations, we examined the listed companies on the Malaysian Stock Exchange, (Goh, et al., 2014). The identified target organisations are located in Penang and Klang Valley, which are major manufacturing hubs in Malaysia (Ogbeibu, et al., 2020). The Krejcie and Morgan (1970) determinant of sample size process was applied to obtain a stratified proportionate sampling of participants in our study. Overall, 644 copies of questionnaires were distributed and 222 completed questionnaires were returned and found useful for further analysis. This accounts for 34.5% response rate and exceeds that of relative extant literature (Yong et al., 2019). Participants’ ages ranged from 23 to 56 years and no gender has been overrepresented given the score of 46% of male respondents. Similarly, 7.7% of participants had a PhD, 32% had masters’ degrees, 37.8% had undergraduate degrees, and 22.5% had a diploma or equivalent. Five experts evaluated the questionnaire items prior to distribution. Eight research assistants (RAs) were recruited for data collection purposes. Similar to prior research, a pilot study with fifty participants was initiated (Ogbeibu et al., 2020). Using the SPSS statistical tool, initial data analysis was done to eliminate poorly loaded items, leaving a minimum of three indicators for all constructs to foster reliability (Hair et al., 2010). HR managers were contacted by RAs for actual data collection and participants were informed to seal and return
completed questionnaires to their respective HR managers to facilitate further collation by the RAs.

Moreover, as recommended by Ogbeibu et al. (2020) and Podsakoff et al. (2012), we applied a temporal separation between the predictors and target construct during the period of data collection for our study. This has aid to dampen the plausible effects of common method bias (CMB). Hence, questionnaires for GPI were distributed nine weeks after the distribution of technological turbulence, LSC and GHRM. Additionally, anonymity of participants was guaranteed and an item in the LSC construct was reverse coded to help control for CMB (Podsakoff et al., 2012). Furthermore, congruent with the collinearity evaluation recommendation by Kock (2015), the variance inflation factor (VIF) results which ranges from 1.045 to 1.758 confirms that CMB has no major influence in our study.

Measures
Questionnaire used in this study ranged from strongly disagree and strongly agree and comprised of 7-point Likert scales. Consistent with studies that have investigated GHRM as a one-dimensional predictor construct (Kim et al., 2019; Longoni et al., 2016), eight items were adapted from the work of Longoni et al. (2016) to measure GHRM. An example is “Team member selection is based on environmental standards” and Cronbach Alpha (CA) is 0.89 (Longoni et al., 2016). Four items were adapted from Ogbeibu et al. (2020) to measure technological turbulence. An example is “This industry has rapidly changing technologies” and CA is 0.95. Four items have been developed based on the works of Brougham and Haar (2018) and Oosthuizen (2019) to measure LSC. These items are “My leader has the knowledge and ability to apply smart (self-monitoring, analysing, and reporting systems) technology during operations”, “Matters related to machines that share similar qualities (reason, calculate, learn, discover) with the human mind are adequately addressed by my leader”, “My leader knows how to design and apply robots or mechanical devices during operations”, “My leader is not good at designing or applying algorithms to complete defined tasks” (Reverse coded). Four items were adopted from Ogbeibu et al. (2020) to measure GPI. An example is “When conducting product design or development, materials of product that produce the least amount of pollution is chosen by this organisation” and the CA is 0.88. Congruent with Zailani, et al. (2015), firm size, ISO certification status and firm ownership were controlled for due to their probable impacts on innovation.

Analysis
Due to the causal-predictive nature of this study, the variant based structural equation modelling (VB-SEM) technique has been employed and SmartPLS3 software used for subsequent analysis. This is also in light of VB-SEM’s soft distributional assumptions, model specification, complexity and interpretation ease, and as a recommended path for prediction-oriented studies (Ogbeibu et al., 2020).

Results
Results from descriptive statistics shows that values of standard deviation (SD) (1.1-1.6), mean (5.1-6.0), Kurtosis (-1.2 to 1.728), skewness (-1.812 to 1.004) suggests no major difference among examined constructs and a normal distribution of data (Hair et al., 2010). Figure 2 suggests that all measurement items contribute substantially to their individual constructs (Hair et al., 2010; Ogbeibu et al., 2020). In Table 1, rhoA and composite reliability values confirms internal
reliability and validity for all constructs, and AVE values indicate sufficient convergent validity (Ringle et al., 2018). Likewise, values of Heterotrait-Monotrait Ratio (HTMT) in Table 2 confirms the discriminant validity of all constructs (Ringle et al., 2018). For model fit considerations, Hair et al. (2019), Ringle et al. (2018) and Ogbeibu et al. (2020) strongly emphasise against the use of model fit indices especially for prediction oriented studies. The authors advocate that assessments’ measures are yet inconclusive, tentative and of questionable value to VB-SEM. Congruently, researchers should rely on model’s predictive accuracy, relevance and power (Ogbeibu et al., 2020; Ringle et al., 2018).

Figure 2: Measurement of outer model
Table 1: SmartPLS3 Measurement Model Analysis, Reliability, Validity and Prediction Oriented Assessments

<table>
<thead>
<tr>
<th>Construct</th>
<th>Composite reliability (CR)</th>
<th>VIF Values</th>
<th>rho_A</th>
<th>AVE</th>
<th>PLS PREDICT RMSE</th>
<th>LM RMSE</th>
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<tr>
<td>FIRM SIZE</td>
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<td>1.000</td>
<td>1.000</td>
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<tr>
<td>GREEN HUMAN RESOURCE MANAGEMENT</td>
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<td>1.045</td>
<td>0.899</td>
<td>0.641</td>
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<tr>
<td>GREEN PRODUCT INNOVATION</td>
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<td>0.917</td>
<td>0.741</td>
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<tr>
<td>• GPI1</td>
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<td></td>
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<td></td>
<td>0.613</td>
<td>0.629</td>
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<tr>
<td>• GPI2</td>
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<td></td>
<td></td>
<td></td>
<td>0.631</td>
<td>0.649</td>
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<tr>
<td>• GPI3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.632</td>
<td>0.666</td>
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<tr>
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<td>1.000</td>
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<tr>
<td>TECHNOLOGICAL TURBULENCE</td>
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<td>1.066</td>
<td>0.909</td>
<td>0.780</td>
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Note: AVE (Average variance Extracted); VIF (Variance Inflation Factor)

Table 2: Heterotrait-Monotrait Ratio (HTMT) – Discriminant Validity Check

<table>
<thead>
<tr>
<th></th>
<th>FO</th>
<th>FS</th>
<th>GHRM</th>
<th>GPI</th>
<th>IC</th>
<th>LSC</th>
<th>TT</th>
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<tr>
<td>FIRM OWNERSHIP (FO)</td>
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<td>FIRM SIZE (FS)</td>
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<td>GREEN HUMAN RESOURCE MANAGEMENT (GHRM)</td>
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<td>GREEN PRODUCT INNOVATION (GPI)</td>
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<td>LEADER STARA COMPETENCE (LSC)</td>
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<td>0.052</td>
<td>0.146</td>
<td>0.122</td>
<td>0.199</td>
<td>0.125</td>
<td>0.210</td>
<td></td>
</tr>
</tbody>
</table>
As a point of departure, the structural model has been estimated using the basic PLS bootstrapping preference, and statistical test of 5000 subsamples. $R^2$ value of 0.210 in Figure 2 suggests a relatively weak degree of variance explained in GPI by other predictors and this is similar to extant research (Ogbeibu et al., 2018). Hair et al. (2013) accentuate that acceptable $R^2$ is often contingent on the type of investigation and in comparism with similar extant research. Therefore, given the statistically significant $R^2$ result ($t = 4.848, p \le .000$) of our study, it can be concluded that all the predictors relay significant explanations in the variance explained in GPI.

Results from Figure 3 indicate that GHRM positively predict ($\beta = 0.159, p \le 0.01$) GPI and technological turbulence negatively predicts ($\beta = 0. -0.212, p \le 0.01$) GPI. LSC is however, statistically non-significant ($\beta = 0.055, p \le 0.543$). While H1 is consequently supported, H2 is significant, but contradicts the initial postulation evidenced in H2, and is therefore unsupported. However, H3 is unsupported as it is statistically insignificant ($\beta = 0.055, p \le 0.543$). Effect sizes ($f^2$) for GHRM (0.031), technological turbulence (0.054), firm ownership (0.130), firm size (0.060), ISO certification (0.052), and LSC (0.003) suggests small, small, relatively medium, small, small effects and no meaningful effect respectively (Ringle et al., 2018). While firm ownership exhibits a positive influence on GPI, firm size and ISO certification is shown to have negative influences respectively.

Figure 3: Measurement of inner model
Moderation results indicate that technological turbulence reinforces \( \beta = 0.104, t = 1.760, p \leq 0.1, f^2 = 0.013 \) the positive relationship between GHRM and GPI with a relatively small effect size. Equally, LSC amplifies the positive impacts of GHRM \( \beta = 0.246, t = 3.960, p \leq 0.01, f^2 = 0.042 \) and technological turbulence \( \beta = 0.195, t = 2.162, p \leq 0.05, f^2 = 0.040 \) on GPI with small effect sizes respectively. Thus, H4 is significant but also not supported as the finding contradicts the prior highlighted postulation. Nevertheless, H5a and H5b are supported. Consistent with prior research (Ogbeibu et al., 2020), the \( Q^2 \) result (0.125) provides support for our model’s predictive accuracy and suggest an acceptable level of predictive relevance. Similarly, results of PLS PREDICT RMSE and LM RMSE in Table 1, indicates a high predictive power of our model (See Shmueli, et al., 2019).

**Discussion and Conclusion**

Consistent with prior debates, our study demonstrates that GHRM is a positive predictor of GPI (Ogbeibu et al., 2020; Yusliza et al., 2017). This finding is supported by the debate of prior research which espouse that HRM initiatives such as training and development, compensation and performance or recruitment and selection that are grounded in green centred values can positively foster GPI (Roscoe et al., 2019; Yong et al., 2019b). Nevertheless, our study stands in dissonance to prior debate that emphasise that GHRM has no significant impact on environmental sustainability tenets (Yong et al., 2019b; Yusliza et al., 2017). Likewise, our study is consistent with the contentions of prior research that suggests that technological turbulence is a negative predictor of GPI (Berrone et al., 2013; Chen et al., 2015). These findings are nevertheless contrary to our initial postulations. It makes sense that technological turbulence would negatively predict GPI especially in small or medium sized organisations (SMSOs) where required human capital needed to combat and help mitigate the plausible impacts of technological turbulence are scarce or insufficient (Chavez et al., 2015). SMSOs may not have sufficient resources to combat or mitigate constantly unpredictable threats that might arise from radical changes in technology (Chen et al., 2015). Consequently, initiatives associated with GPI could be hampered as team members are compelled to constantly re-evaluate GPI objectives and milestones to better align with the changes evoked by technological turbulence (Chen et al., 2018). This process might cause an upsurge in cost for SMSOs that are in need of procuring required resources to engender GPI (Cuerva et al., 2014). Cuerva et al. (2014) and Goh et al. (2014) argue that team members often struggle to drive or achieve sustainable business growth, especially team members in manufacturing organisations. This is further supported by the negative influence of firm size on GPI evidenced in our study.

Conversely, our study shows that technological turbulence is not totally detrimental. We provide evidence that shows that technological turbulence can be a catalyst for good in manufacturing organisations. Our findings thus, show that technological turbulence strengthens the positive relationship between GHRM and GPI. This finding has also been unexpected as it contradicts prior expectations. As an emerging economy, manufacturing organisations in Malaysia are subject to intense competition within the local and international business environment (Zailani et al., 2015). Due to the challenging business environment, green centred organisational team members are constantly expected and pressured to implement green initiatives that can aid organisations to combat technological changes and to engender GPI (Ogbeibu et al., 2020). Congruently, the volatility of technological turbulence becomes the push GHRM needs to drive initiatives that
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engenders GPI, and this is in turn a pull that organisations could exploit to foster environmental sustainability (Abdulaziz et al., 2017; Chen et al., 2018). With adequate organisational support via GHRM tailored practices, team members can explore radical technological changes that may have emerged as plausible threats, investigate and proffer solutions that can further provoke new opportunities for cleaner production.

Congruent with our prior postulations, our study shows that LSC amplifies the varying positive influences that technological turbulence and GHRM has on GPI. This finding is congruent to the debate of extant research that has stressed on the positive effects of LSC and the need for leader to be able to demonstrate expertise that is fundamental to STARA (Berrone et al., 2013; Oosthuizen, 2019). By cultivating the need for leaders to inculcate and adopt STARA competence, organisations may thus, be in better positions to combat probable impacts of technological turbulence and thus, easily drive GHRM initiatives that would have otherwise been cumbersome if related objectives completely depended on leaders with less or no STARA competence (Makridakis, 2017). This notion is also supported by the debate of studies which emphasise on the capabilities of STARA and how it could transform the future of work, and also how it can aid to reduce rigorous demands of complex green related initiatives (Parker & Grote, 2019; Vishwanath, et al., 2019).

Implications for theory and practice on sustainability

The study investigated emerging environmental sustainability conceptualisations that capture a novel interdisciplinary framework for advancing the tenets of cleaner production in manufacturing organisations. Although the literature has investigated the nexus between HRM and innovation, there is limited research into the association between GHRM and GPI. Equally, while recent results remain inconclusive, our study contributes by developing insights into how GHRM actually predicts GPI. We thus, contribute to the literature by complimenting prior conceptualisations that have advocated a positive relationship between GHRM and GPI. Policymakers and organisational leaders can thus, endeavour to intensify and strengthen their GHRM strategies to better support initiatives fundamental to GPI.

Contrary to prior expectations, we provide evidence that suggests that technological turbulence does positively predict GPI. We also indicate that technological turbulence can pull organisations closer towards engendering cleaner productions that identifies with the UNGC call for environmental sustainability. This is evidenced in our study by the finding that technological turbulence reinforces the relationships between GHRM and GPI. Consequently, policymakers and practitioners ought to consider instituting GHRM practices such as training, development, compensations, performance, recruitment and selection that identify with green centred values. Equally, policymakers should consider strengthening the demands for organisations to set up initiatives that can more closely monitor the green practices and ensure green values are not undermined but consistently instilled. By investigating a timely and novel concept such as LSC, our findings consequently do not only challenge, but extends prior stakeholder theoretical conventions for cleaner production. We advance prior insights by demonstrating that although LSC does not have a direct significant association with GPI in our study, it does however, significantly amplify the positive impacts technological turbulence and GHRM has on GPI. Therefore, policymakers and practitioners may take comfort in the knowledge that the plausibly
overwhelming threats advocated by the STARA age doesn’t mainly infer disaster for team members and organisations but is actually another avenue that can be exploited to foster environmental sustainability. Policymakers may thus, want to consider allocating adequate resources to ensure leaders are trained to adopt and share STARA knowledge and continuously develop their STARA competencies. Our study shows that this is a relevant and timely strategy that organisations may deploy to aid their efforts in achieving the expectations of the SDG. Furthermore, policymakers should develop strategies which would help ensure that organisations driven by green centred values are constantly concerned with engendering their GPI not just for profiteering and boosting competitiveness, but for fostering cleaner production tenets and environmental sustainability.

**Limitations and future research directions**

We have attempted to offer team based evidence in this study, thus, organisational-level implications should not to be concluded. Though, this does provide room for future research to replicate our study from an organisational point of analysis. Equally, we have not investigated GHRM from a multidimensional perspective in our study. This may have prevented deeper insights into how each GHRM practices act to directly predict GPI. Although, our conceptualisation of the GHRM underringd resonates with the practice of similar extant research and also compliments several literatures that have investigated GHRM from a multidimensional viewpoint. We therefore, call on future research to examine the multidimensional nature of GHRM and how they act as predictors of GPI. Equally, our study though implicitly enshrined in the stakeholders’ theory, have not investigated the role of other stakeholders like customers, suppliers and others. Moreover, doing this would have thrown us off course from the prime aims of our study. We also call on future researchers to include concepts that captures other stakeholders in their relative investigations. While our research may have produced significant findings, it may be limited as its insights is grounded in a time-gap cross-sectional data that has exemplified the Malaysian experience. However, our findings are substantive, timely and relevant to other emerging economies that share similar issues and have relative contexts. Therefore, in the future, it is important for a cross-national and or a longitudinal investigation to be carried out to further strengthen the generalisability of our research findings.

**References**


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