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# How green product demands influence industrial buyer/seller relationships, knowledge, and marketing dynamic capabilities☆

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A B S T R A C T

This research investigates the influence of "green" products on industrial buyers' and sellers' behaviors and marketing capabilities through the lenses of procurement managers and marketing managers. The work offers a parsimonious measure for "green product demands" and applies social network theory to better understand the interplay of relational embeddedness, knowledge redundancy, and vertical competitive activity with buyers' green product demands and sellers' overall marketing dynamic capabilities. The findings suggest that relational embeddedness and knowledge redundancy are full mediators of the effect of buyers' green product demands on sellers' marketing dynamic capabilities, and vertical competitive activity may moderate the direct effects of green product demands. Findings also illuminate similarities and differences between procurement managers' and marketing managers' views of these relationships in terms of valence and magnitude. This research builds on current literature concerning green marketing and green supply chain management, as well as provides managers with insights regarding industrial buyer/seller interactions in a dynamic green market environment.

## 1. How "Green" product demands influence industrial Buyer/Seller Relationships, Knowledge, and marketing dynamic capabilities

Industrial product companies face increasing challenges related to green product demands. Ongoing research (e.g., Dangelico, 2016; Papadas, Avlonitis, & Carrigan, 2017; Papadas et al., 2019) identify "green" as increasingly commonplace and important in product specifications and standards of innovation. Schmidt, Foerstl, & Schaltenbrand (2017) point out, "stakeholder awareness and scrutiny, regarding green supply chain practices, are not only directed toward the focal firm selling branded products, but target the entire value creation process," suggesting channel members are increasingly compelled to better understand customers' green product demands and implement strategies to serve those demands.

An underlying theme in the research (e.g., Bi, Xie, & Jin, 2019; Dangelico, 2016; Zhang, Zeng, Tse, Wang, & Smart, 2020) is that green product demands differ from other market trends and customer-driven demands to which firms are accustomed to responding. Green product demands generally relate to environmental impact, but can be quite broad, e.g., waste generation during production, material sourcing from renewable sources, $CO_2$ footprint associated with distribution, hazardous component disposal, and end of life resource recovery. Further, end products and their sub-components differ from each other in terms of their potential for environmental impact, as well as differ when that impact may occur. For example, a vehicle such as the Range Rover PHEV Hybrid is comprised of components made from different materials such as metal, plastics, fluids, and textiles, each of which possess different overall and temporal environmental implications. Another key difference from other customer-driven demands is that the green product demands are not necessarily detectable, e.g., the waste generation or environmental impact of a component's production is not apparent to the buyer or the buyer's customers. Therefore, achieving green product demands requires conformance by most, if not all of the parties involved in the product's creation, suggesting the need for a higher level of assurance up and down the channel.

The growing importance, variability, and complexity associated with green product demands, compels industrial channel members to adapt their supply chain and marketing strategies. Specifically, we offer that green product demands necessarily influence knowledge exchange between buyers and sellers. In terms of knowledge exchange, green product demands motivate industrial channel members to gain knowledge and capabilities (e.g., renewable resource acquisition) which are unique and differ from what they currently possess. As such, they are compelled to acquire this knowledge and capabilities directly or obtain it through suppliers. Assuming that acquisition is not always plausible, industrial buyers must then seek suppliers that can meet technical product specifications and possess knowledge and capabilities that are unique (i.e., non-redundant) in comparison to their own knowledge and capabilities. Similarly, industrial sellers must develop value propositions

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that communicate knowledge and capabilities that complement each industrial customer's capabilities to address its downstream customers' requirements, including green product demands.

In addition to its influence on knowledge exchange, green product demands also motivate industrial buyers and sellers to form relationships that provide for verifiability and transparency, alluded to previously as "assurance," of a product's conformance. This suggests that the parties must interact in a closer and more transparent manner than historically necessary, i.e., achieve a higher level of embeddedness between the buyer and seller. That is, when acting as a buyer the firm has a more vested interest in their sellers' sellers, and so on up the channel. When acting as a seller, the firm must be acutely aware of their buyers' buyers, down the channel. It is important to note that this need for a more "embedded" relationship between buyer and seller can represent a paradigm shift for channel members which are accustomed to more competitive "arms-length" relationships. In summary, growing green product demands are dynamic and variable across industrial markets and customers. These demands introduce important behavioral implications for both buyers and sellers in terms of knowledge exchange and relationship development, however competition within industrial channels remains a key dynamic.

While it is true that green product demands are of growing importance, it is not the only market dynamic that firms face (e.g., globalization, technological development, and shifting customer needs). As articulated by Papadas, Avlonitis, Carrigan, & Piha (2019, p. 632), "there remains a perceived but unresolved tension between green marketing and competitive advantage," wherein firms continue to resist investment in green strategies. We suggest that this reluctance is tied to firms' recognition that, while growing in importance, green product demands must be considered in the context of other important market related demands. For example, should an engine manufacturer invest in technologies to enhance performance, or should it invest in cleaner manufacturing technologies to reduce its environmental impact? The answer is likely "both," but constrained resources suggest a trade-off is still inherent. Fang and Zou (2009) introduced the marketing dynamic capabilities (MDC) construct as a means of illuminating a firm's ability to create customer value in a dynamic environment. They articulated MDC as the "responsiveness and efficiency of cross-functional business processes for creating and delivering customer value in response to market changes" (Fang & Zou, 2009 pg. 744). We offer that green product demands are a strategically important market change that will require many firms to assess and invest in their cross-functional business processes, as referred to by Fang and Zou (2009). This response is in addition to the aforementioned implications for adapting new supplier and customer relationship strategies.

This study aims to contribute to the literature in three ways. First, the work introduces a parsimonious measure for assessing industrial *green product demands*, and empirically investigates the effects of those demands on knowledge exchange (i.e., knowledge redundancy) and relationship formation (i.e., relational embeddedness) between buyers and sellers. Measuring "green product demands" potentially advances the industrial market channel literature related to "green" (e.g., Melander, 2018; Papadas, Avlonitis, & Carrigan, 2017; Rothery, 1995; Xie et. al, 2019; Zhang et. al, 2020), providing a useful means of assessing and distinguishing buyers' green product demands by their *relative scope*. The measure is also managerially relevant, as it can serve as a mechanism for practitioners in industrial supply chains to characterize more succinctly and consistently the green demands of their customers. Further, through a dual study we complement ongoing research exploring the influence of ties in industrial supply chains (e.g., Badir & O'Connor, 2015; Bi et. al, 2020; Stanko et. al, 2007 Tachizawa & Wong, 2015). Specifically, we examine the moderating impact of other vertical ties (with respective competitors) possessed by buyers and sellers on the effects of green product demands on buyer/seller knowledge redundancy and relational embeddedness. In doing so we gain insights into how buyers(sellers) regard the vertical relationships possessed by potential or existing sellers(buyers), respectively, extending the rich and ongoing strength of ties research stream in industrial channels. This approach also enhances our understanding of how green product demands differ from buyer/seller relationship to relationship, and how these differences can influence the participants' regard for knowledge and relationships.

Second, the work considers industrial sellers' *marketing dynamic capabilities*, as introduced by Fang and Zou (2009) and more recently investigated by Guo et al. (2018), in the context of green products, and empirically investigates the indirect effects of green product demands on dynamic marketing capabilities, wherein knowledge redundancy and relational embeddedness act as separate co-existing mediators. Investigating the indirect effects of green product demands on firms' overall marketing dynamic capabilities illuminates the reality that firms must consider all market trends (e.g., digitalization and globalization) as well as green product demands. Doing so advances the industrial green product and green supply chain management (GSCM) literature (e.g., Bi, Xie, & Jin, 2019; Dangelico, 2016; Rauer & Kaufmann, 2015; Zhang, Zeng, Tse, Wang, & Smart, 2020) as well as the broader industrial channel stream (e.g., Dahlquist and Griffith 2017, Guo et al. 2018; Padgett, Hopkins, & Williams, 2020). The mediation model allows for further study of the individual, but related, impacts of knowledge redundancy and relational embeddedness as mechanisms for buyers and sellers engaged in exchange (e.g., Rindfleisch & Moorman, 2001), and captures the participants' views of the effects of green product demands on knowledge redundancy and relational embeddedness, and their subsequent effects on the firm's overall marketing dynamic capabilities. By contrasting knowledge redundancy and relational embeddedness in the buyer/seller relationship, we shed light on the importance of these relational mechanisms, again advancing the study of strength of ties in industrial channels.

Finally, the investigation enhances our understanding of potential differences in the perspectives of industrial channel members considering their inevitable shifting role as both a buyer and a seller. Through this dual study (Study 1: industrial procurement managers, Study 2: industrial marketing managers) we can expose potential differences of perception when a channel member is thinking and acting as a buyer, versus thinking and acting as a seller. This comparative analysis is accomplished by empirically testing a model (Fig. 1) incorporating green product demands, knowledge redundancy, embeddedness, competitive vertical activity, and marketing dynamic capabilities. In doing so we advance the literature (e.g., Badir & O'Connor, 2015; Bi et. al, 2020; Dahlquist & Griffith, 2017; Padgett, Hopkins, & Williams, 2020; Stanko et. al, 2007) demonstrating variations in the perspectives of industrial buyers and suppliers and how firms' perspectives can be influenced by their positioning in the buyer/seller dyad. Combined, the contributions also provide industrial practitioners with insights regarding the growing global trend for green product demands, how to better characterize these demands, as well as better understand buyer/seller relationships up and down their respective channels.

## 2. Theoretical development

### 2.1. Green product demands

"Green" research within the industrial market context is broad. Early works (e.g., Miles, Munilla, & Russell, 1997) investigate its effects on product design, firm behavior, and regulatory compliance. More recent works (e.g., Dangelico, 2016; Papadas, Avlonitis, & Carrigan, 2017; Papadas, Avlonitis, Carrigan, & Piha, 2019; Xie, Huo, & Zou, 2019; Zhang, Zeng, Tse, Wang, & Smart, 2020) explore green product firms' relative levels of innovation and capabilities to develop green product knowledge and expertise, and provide evidence of green practices in product design, sourcing, manufacturing, and marketing, provision for end-of-life product disposition, and compliance with environmental regulations. While informative, the research does not offer a consistent

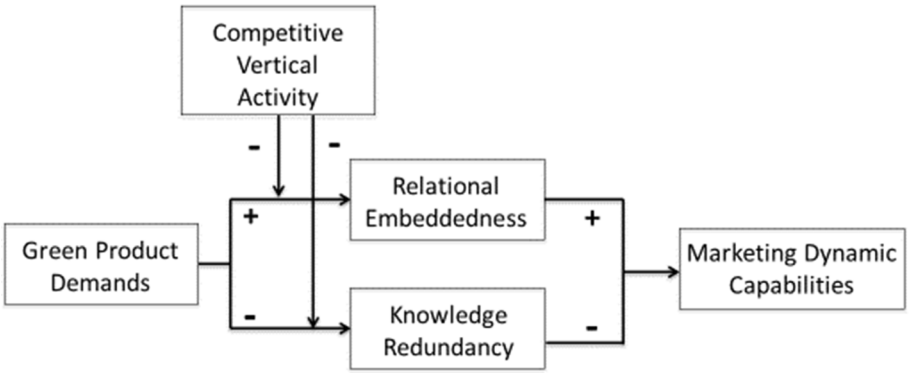


**Fig. 1.** Conceptual Model.

clarification of what distinguishes a "green" product from other products in the context of industrial buyers and sellers. Arguably, all products have some environmental impact, suggesting a need for some way to differentiate green product demands.

The Commission of the European Communities (2001) defined "green products" as "products that use less resources, have lower impacts and risks to the environment and prevent waste generation already at the conception stage." This articulation is informative and suggests that environmental impact should be considered at the "conception" of a product, but the terms "less" and "lower" are less specific, suggesting a relative assessment to, presumably, the current standard or state of the art. ISO 14,000 refers to the lifecycle assessment of a product's environmental impact resulting from its design, procurement, production, distribution, consumption, and disposition (ISO.org, 2020). Combined, we suggest that these characterizations serve as a starting point for clarifying the unique demands that green products place on industrial buyers and sellers, i.e., green product demands. It is important to note, however, that there are industries and product categories wherein short- and long-term implications for the environment are apparent, substantive, and global (e.g., rare earth metals or petroleum-based plastics), and therefore compelling to buyers, sellers, end users, and other stakeholders associated with those supply chains. Conversely, there are other industries and product categories wherein the short- and long-term implications for the environment are not so apparent nor substantive (e.g., clothing and textiles). Assuming all products fall somewhere on a continuum of environmental impact, we offer the green product demands measure as a general assessment intended to illuminate more specific and meaningful demands, within industries and product categories. That is, the "green" in green product demands, is a general standard referring to the short-and long-term impact of a product (i.e., the product's design, procurement, production, distribution, consumption, and disposition) on the environment. Further, within industries and product categories, "short," "long," and "impact" are unique, and thus defined by participants, end users, and stakeholders. Specifically, we define *green product demands (GPD) as the degree to which customers require sellers to provide information and meet standards for the short- and long-term environmental impact of their products in terms of procurement, design/production, distribution, and consumption/disposition.*

### 2.2. Strength of ties

The foundation of social network ties literature focused on the nature of the relational bonds between social actors, and the effects of those bonds on knowledge and information sharing between the actors (Granovetter, 1973). In the original conceptualization Granovetter referred to relationships among individuals, wherein strong ties are different from weak ties in terms of structure and motivation. More specifically, Granovetter viewed "strong ties" as social networks structured by a high level of redundant information (i.e., knowledge redundancy) and motivated by a high level of emotional closeness and reciprocity (i.e., relational embeddedness). Thus, close friends possessed a high degree of redundant information and embeddedness, whereas casual friends possessed lower degrees of each. The utility of this theory for social researchers allowed for understanding the dynamics and benefits of different types of relationships and their effects on individuals.

Strength of ties was adapted by interorganizational researchers to better understand knowledge and information flow in interorganizational settings (e.g., Rindfleisch and Moorman, 2001; Tachizawa & Wong, 2015; Uzzi, 1999). In the interorganizational context, the strength of ties concept has been debated. For example, in an alliance between two firms it would be highly plausible that they have high degrees of organizational embeddedness, but low degrees of knowledge redundancy. In fact, the point of forming the alliance is presumably to obtain new knowledge. The relative positions of two firms in the channel (e.g., horizontal versus vertical, competitor versus buyer/seller) also introduces a complexity that the original conception of strength of ties could not anticipate. For example, Rindfleisch and Moorman (2001) point out that competitors (i.e., horizontal) in an alliance setting, would be "characterized by a low degree of relational embeddedness and a high degree of knowledge redundancy." Whereas vertical alliances (e.g., buyer/seller) are "characterized by a high degree of relational embeddedness and a low degree of knowledge redundancy." In this research we focus on the industrial buyer/seller context, wherein the relationships are primarily vertical and the potential hesitancy of sharing sensitive information with a competitor is reduced. It is important, however, to point out that the buyer/seller relationships in an industrial channel are not exclusive, thus we also consider the effects of "other relationships" possessed by the parties. Consistent with extant interorganizational research we define *relational embeddedness between a buyer and seller as the level of mutual interdependence, organizational cooperation, reciprocity, and tendency for information sharing.* Knowledge redundancy is generally perceived as the degree of commonality in the knowledge base between two or more social actors (Burt, 1992). Consistent with extant interorganizational research we define *knowledge redundancy as the commonality of information, technologies, skills, and resources between a buyer and seller.*

### 2.3. Marketing dynamic capabilities

A number of works (e.g., Barney, 1991; Rauer, & Kaufmann, 2015; Teece, Pisano, & Shuen, 1997) explore a firm's dynamic capabilities, often articulated as a firm's ability to build, integrate, and reconfigure internal and external competencies to address rapidly changing environments. Fang and Zou (2009) extended the research in dynamic capabilities by introducing the marketing dynamic capabilities (MDC) construct and examining how firms gain access to resources and knowledge. To focus on a firm's ability to create customer value in a

dynamic environment, they articulate MDC as the "responsiveness and efficiency of cross-functional business processes for creating and delivering customer value in response to market changes" (Fang & Zou, 2009 pg. 744). Other more recent works refine the articulation of dynamic capabilities as static, dynamic, and adaptive (Guo et al., 2018) or sensing, alignment, and resilience (Rauer & Kaufmann, 2015) capabilities. We suggest that the growing prominence of green product demands qualify as a market dynamic as envisioned by Fang and Zou (2009) and Teece, Pisano, and Shuen, (1997) in the context of other important dynamics such as globalization and digitalization. Further, green product demands compel industrial buyers and sellers to change their behavior to enhance their overall market capabilities. As such, we characterize industrial buyers' and sellers' MDC as previously articulated by Fang and Zou (2009) and, more recently, Guo et al. (2018). In summary, *MDC include cross-functional process across areas of 1) customer relationship management (*i.e.*, learning about needs and how to satisfy them), 2) product development management (*i.e.*, developing products that maximize customer value and experience), and 3) supply chain management (*i.e.*, designing, managing and integrating own supply chain with both suppliers and customers)*.

## 3. Hypotheses development

### 3.1. Indirect effects of GPD on MDC

Consistent with the research, we argue that increasing GPD requires industrial channel members to seek suppliers that can support the green demands of their mutual down-stream customers. Whether the motivation for GPD is compliance with national and international environmental impact requirements (Clemens & Douglas, 2006; Zhang et al., 2020) or the expectation of improved market performance (Papadas, Avlonitis, & Carrigan, 2017; Papadas, Avlonitis, Carrigan, & Piha 2019; Xie, Huo, & Zou, 2019), buyers and sellers are increasingly compelled to form relationships that provide for verifiability and transparency of a product's short- and long-term environmental impact (Lee & Kim, 2011). The degree of verifiability and transparency required to establish, communicate, and guarantee conformance with customers' GPD necessitates a higher level of relational embeddedness between the buyer and seller. Optimizing buyer/seller relationships in green supply chains necessitates higher levels of embeddedness (i.e., mutual interdependence, cooperation, reciprocity, and information sharing) (Handfield & Bechtel, 2002; Liu et al., 2018; Rindfleisch & Moorman, 2001; Tachizawa & Wong, 2015). More formally, the previous argumentation suggests the following hypothesis.

$H_{1a}$: Green product demands positively influences buyer/seller relational embeddedness.

MDC are comprised of 1) customer relationship management (i.e., learning about needs and how to satisfy them), 2) product development management (i.e., developing products that maximize customer value and experience), and 3) supply chain management (i.e., designing, managing and integrating own supply chain with both suppliers and customers). As defined, relational embeddedness captures the elements of mutual interdependence, cooperation, reciprocity, and information sharing. Previous research (e.g., Fang & Zou, 2009; Liu et al., 2018; Rindfleisch & Moorman, 2001) investigated of the effects of the same or similar relational characteristics such as asset specificity, goodwill reciprocity, learning culture, and goal congruency as positive antecedents (both directly and as moderators) to a variety of dependent variables including trust, MDC, and firm performance. Similarly, we suggest that relational embeddedness has a positive effect on the ability of buyers and sellers to build higher marketing dynamic capabilities in the context of green market demands. More formally.

$H_{1b}$: Buyer/seller relational embeddedness positively influences the participant firms' MDC.

Buyers' growing need to anticipate the green product demands of its customers necessitates it to seek knowledge and skills that the buyer does not possess internally (i.e., non-redundant) or that complements the buyer's own knowledge or skills. For example, a buyer may be knowledgeable about designing their product for low environmental impact in production but may be unfamiliar with sourcing strategies that reduce the product's environmental impact after it has been consumed/disposed. Thus, motivated by growing green product demands, buyers are compelled to seek and form relationships with sellers that will enhance the buyer's capabilities through the knowledge and skills they possess. Given the breadth of potential green product demands (i.e., procurement, design/production, distribution, and consumption/disposition), we suggest that buyers necessarily seek sellers possessing non-redundant knowledge, rather than sellers with an abundance of common knowledge. Similarly, sellers seek buyers that may benefit from their unique knowledge. More formally, the previous argumentation suggests the following hypothesis:

$H_{2a}$: Green product demands negatively influences buyer/seller knowledge redundancy.

Like Fang and Zou's (2009) finding that resource complementarity positively influences MDC, we suggest that knowledge redundancy (i.e., lower levels of complementarity) would actually diminish the MDC of each participant firm. In effect, the combined knowledge and potential for MDC is enhanced when there is less, rather than more common knowledge between the buyer and seller. The influence of non-redundant knowledge (between a buyer and seller) and innovation has been shown to be positive (e.g., Melander, 2018). Similarly, we assert that knowledge redundancy between the buyer and seller would thus have a negative influence on the MDC of each participant; buyers and sellers seek relationships that possess non-redundant information to enhance their respective MDC.

More formally.

$H_{2b}$: Buyer/seller knowledge redundancy negatively influences the participant firms' MDC.

### 3.2. Effects of competitive vertical activity

In $H_{1a}$ we hypothesized that green product demands positively influences relational embeddedness. Building on this, we contend that while buyers and sellers in an industrial channel may seek more embedded relationships, they are not exclusive to each other; buyers often buy from competitive sellers, and sellers often sell to competitive buyers. This network of buyers and sellers acting in self-interest introduces an additional dynamic to the relationships they form. As observed by Padgett, Hopkins, & Williams (2020), companies maintain relationships based on several factors including the relationship value and switching costs. Interorganizational research has extensively investigated the effects of self-interest on governance in interfirm relationships (e.g., Dahlquist & Griffith, 2017), and for the purpose of this investigation, we assume that (in the green product context) buyers and sellers continue to employ formal and informal governance mechanisms. In addition, however, we suggest that competitive "tensions" between horizontal competitors in the channel, as referred to by Rindfleisch and Moorman (2001), may curb the motivation for a buyer(seller) to form a highly embedded relationship with a seller(buyer) that already possesses relationships with competitive parties; the level of competitive buyer/seller activity (i.e., competitive vertical activity) engaged by each buyer and seller moderates the effect stated in $H_{1a}$. Specifically, we argue that GPD and competitive vertical activity interact negatively to influence relational embeddedness. More formally.

$H_3$: The positive effect of green product demands on relational embeddedness is increasingly lower as competitive vertical activity increases.

In $H_{2a}$ we argued that green product demands negatively influences knowledge redundancy. We suggest that the same motivations and competitive "tensions" between horizontal competitors in the channel referred to previously may also curb the motivation for a buyer(seller) to seek(provide) unique information to the other party, particularly when

that party that already possesses relationships with competitive buyers (sellers); the number of competitive buyers and sellers engaged by each buyer and seller moderates the effect stated in $H_{2a}$. Specifically, we argue that green product demands and competitive vertical activity interact negatively to influence knowledge redundancy. More formally.

$H_4$: The negative effect of green product demands on knowledge redundancy is increasingly lower as competitive vertical activity increases.

### 3.3. Differing Buyer/Seller perceptions

Buyers and sellers in an industrial channel effectively embody both roles, however, the role functions are most often not performed by the same individuals within the firm.; buying is conducted by procurement, whereas selling is conducted by marketing. This organizational reality introduces some potentially significant differences in how a firm "behaves" toward its sellers versus its buyers, in part because the organizations responsible for the activity may have substantially different goals and objectives driving that behavior. Procurement is more often motivated to strategically manage suppliers in ways that ensure supply, minimize inventory, and improve profitability through cost controls; Closs, Speier, & Meacham (2011) point out, the traditional role of supply chain management in a firm has been "viewed as primarily operational, with a major focus on reducing cost." Marketing is alternatively focused to strategically deliver a value proposition to current and future customers, remaining responsive and adaptable to a changing competitive market. The research, however, tends to treat suppliers and customers (i.e., buyers and sellers) as uniform in their perceptions of market demands such as green product demands.

In the context of growing green product demands, industrial buyers and sellers are motivated to seek "more" from each other in terms of knowledge and relationship development, suggesting a change of behavior both externally and internally. The notion of MDC put forth by Fang and Zou (2009) is echoed by Closs, Speier, & Meacham (2011, p. 1), when they state that firms should consider "cross-functional marketing and supply chain interactions of value-added processes." However, many industrial channel participants have not yet adopted such a strategy. Thus, acting as a buyer, the firm is much more likely to follow more traditional approaches to procurement and be less inclined to form more embedded relationships with sellers. Acting as a seller, however, the same firm is more inclined to seek more embedded relationships with buyers. Further, we suggest that this bias also prevails in the case of the influence of relational embeddedness on MDC. We argue procurement and marketing managers may agree on the valence of the relationships theorized in our model (e.g., green product demands positively influences relational embeddedness) but not necessarily on the magnitudes (i.e., effect size differences). More formally, the previous argumentation suggests the following hypotheses:

$H_{5A}$: The positive relationship between GPD and relational embeddedness is weaker as perceived by procurement managers than it is by marketing managers.

$H_{5B}$: The positive relationship between relational embeddedness and MDC is weaker as perceived by procurement managers than it is by marketing managers.

Conversely, we do not theorize a difference in perspective as it relates to the effect of GPD on knowledge redundancy, hypothesized in $H_{2A}$ as negative; greater GPD lead to lower levels of knowledge redundancy between the buyer and seller. Whereas the procurement and marketing functions in a firm may differ as it relates to the desired level of relational embeddedness with sellers and buyers respectively, there is no apparent reason to assume that they regard the significance of knowledge acquisition differently. Regardless of the level of internal integration between the two functions, each is largely accustomed to seeking and providing information to sellers and buyers, as necessary. We make the same argument for their relative perception of the relationship between knowledge redundancy and MDC. Both procurement and marketing would seem to have the same view of the impact of knowledge redundancy on their firm's MDC. More formally:

$H_{6A}$: The relationship between GPD and knowledge redundancy is similar as perceived by procurement managers and marketing managers.

$H_{6B}$: The relationship between knowledge redundancy and MDC is similar as perceived by procurement managers and marketing managers.

## 4. Methodology

We test our hypotheses through a dual cross-sectional survey study (Study 1: industrial procurement managers, Study 2: industrial marketing managers). We first test the effects of green product demands on MDC subject to the mediating effects of relational embeddedness ($H_{1a}$ *and* $H_{1b}$) and knowledge redundancy ($H_{2a}$ *and* $H_{2b}$), using data from Study 1 and Study 2. We test the moderating effects of competitive vertical activity on the influence of green product demands on relational embeddedness ($H_3$) and on the influence of GPD on knowledge redundancy ($H_4$), again using data from each study. Finally, we relate the analyses of the two studies to assess how buyers and sellers might differ in their viewpoints of: 1) the relationships between green product demands, relational embeddedness, and MDC ($H_{5A}$ *and* $H_{5B}$); and 2) the relationships between green product demands, knowledge redundancy, and MDC ($H_{6A}$ *and* $H_{6B}$).

### 4.1. Questionnaire development

Two surveys (Appendix A) were generated building on previous research and field practitioner interviews. Each survey was pretested with 30 industrial market channel managers to obtain feedback on the relevance, response formats, and understandability of the questions. Managers varied in seniority and were from 30 different industrial companies operating in industries such as general manufacturing, industrial machinery manufacturing, and industrial controls. After pretesting, questionnaire items were finalized and formatted for implementation. Constructs were operationalized using multi-item reflective scales and primarily employed (where applicable) Likert-type scales ranging from 1 ("strongly disagree") to 7 ("strongly agree").

### 4.2. Measures

**Green product demands.** This is a new construct and measure adapted from characterizations of green products by ISO 14,000 (ISO.org, 2020 and the Commission of the European Communities, 2001). We seek to capture the typology and level of importance through the lens of the customer placing green product demands on its suppliers. More specifically, the degree to which customers require sellers to provide information and meet standards for the short- and long-term environmental impact of our products in terms of their procurement, design/production, distribution, and consumption/disposition. Respondents reported on customer demands with a four-item, seven-point Likert-type scale that assessed their relative agreement with statements describing the existence of green product demands by customers in terms of each of the four dimensions.

**Relational embeddedness.** This measure is adapted from Rindfleisch and Moorman (2001), Handfield and Bechtel (2002), and Granovetter (1977), and intended to capture the level of mutual interdependence, organizational cooperation, reciprocity, and tendency for information sharing. Respondents reported on their buyer/seller relationships with a four-item, seven-point Likert-type scale that assessed their relative agreement with statements describing the existence of relational embeddedness in terms of each of the dimensions.

**Knowledge redundancy.** This measure is adapted from Rindfleisch and Moorman (2001), and Granovetter (1977), and intended to capture the commonality of information, technologies, skills, and resources between a buyer and seller. Respondents reported on their buyer/seller relationships with a four-item, seven-point Likert-type scale that

assessed their relative agreement with statements describing the existence of knowledge redundancy in terms of each of the dimensions.

**Marketing Dynamic Capabilities (MDC):** This measure is directly consistent with Fang and Zou (2009) and focuses on cross-functional process across areas of 1) customer relationship management (i.e., learning about needs and how to satisfy them), 2) product development management (i.e., developing products that maximize customer value and experience), and 3) supply chain management (i.e., designing, managing and integrating own supply chain with both suppliers and customers). Respondents reported on their company's MDC with a three-item, seven-point Likert-type scale that assessed their relative agreement with statements describing the existence of each of the dimensions. Please see Appendix for a detailed description.

**Competitive vertical activity**. This is a new measure based on the discussion of tie-based activities by Granovetter (1973) and Rindfleisch and Moorman (2001), as well as practitioner interviews. We attempt to capture an assessment of the level of "activity" between the respondent firm's suppliers(customers) and its competitors characterized as doing business, establishing strong relationships, and sharing proprietary information. This is to assess the possible effects of competitive "tensions" between horizontal competitors in the channel. We use a three-item (one reverse coded), seven-point Likert-type scale that assessed their relative agreement with statements describing this activity.

**Control.** Because the respondents are either procurement managers or marketing managers, we wanted to control for the possibility of a pareto distribution (i.e., 80/20) with suppliers(customers). The survey items were intentionally designed for the respondents to describe their suppliers(customers) in broad terms, not focusing on one specific customer. As such, we felt it appropriate to control for the potential of pareto distribution using a single-item, seven-point Likert-type scale that assessed their relative agreement with a statement describing a pareto distribution of their suppliers (customers). In addition, we controlled for the firm size indicated by respondents. Firm size was coded on a 1 to 6 scale for the size ranges provided in the survey (Table 1).

### 4.3. Data collection

**Sampling procedure.** We then administered two independent separate cross-sectional surveys, one with procurement managers in B2B industrial companies (Study 1) and one with marketing managers in B2B industrial companies (Study 2). All respondents were identified by an international panel survey firm given a set of criteria provided by the authors, the primary being respondents reporting to be managers employed in firms participating in manufacturing, NAICS two-digit Codes 31–33 or ISIC Codes 10–32. Once initially qualified by the research company, respondents are contacted and given the opportunity to participate in surveys such as the ones developed in this work.

**Table 1**
Survey Data.

| | Procurement Managers | | Marketing Managers | |
|---|---|---|---|---|
| Completed surveys | 172 | | 168 | |
| Usable surveys | 164 | | 158 | |
| Firm size (annual sales in US$) | | | | |
| < 1 Million | 12.3% | | 10.0% | |
| 1 Million to 10 Million | 15.2% | | 16.3% | |
| 10 Million to 50 Million | 24.0% | | 17.0% | |
| 50 Million to 250 Million | 26.0% | | 33.0% | |
| 250 Million to 1 Billion | 12.5% | | 17.5% | |
| > 1 Billion | 10.0% | | 6.2% | |
| | M | SD | M | SD |
| Respondent years in firm | 13.8 | 8.6 | 10.2 | 6.5 |
| Knowledge of activities | 5.8 | 1.3 | 5.9 | 1.6 |
| Knowledge of strategies | 5.3 | 1.2 | 5.8 | 1.2 |

Potential respondents were qualified based on their answers to the following questions. Question 1: "I am currently employed at a firm that may be characterized as a manufacturer of components, materials, or systems that are sold to other industrial manufacturers." An affirmative "yes" allowed them to go on to the next question. Question 2: "I am currently employed as a manager in the procurement (Study 1) or marketing (Study 2) function at my company." An affirmative "yes" allowed them to go on to the initial section of the survey. Once verified as a procurement (Study 1) or marketing (Study 2) manager at a B2B industrial manufacturer, respondents were asked to indicate (seven-point Likert-type scale; 1 = "strongly disagree," 7 = "strongly agree") the extent to which they agreed with the statements: "I am knowledgeable of the firm's activities with other firms," and "I am knowledgeable of the firm's strategies." Only respondents indicating a 4 or higher on both questions could complete the survey. Respondents were then asked general information about their firm and experience (e.g., sales and number of years as an employee), as well as a marker variable for common method variance testing. Finally, we provided both sets of respondents with a definition of "green products" as the "short- and long-term impact of a product (i.e., the product's design, procurement, production, distribution, consumption, and disposition) on the environment." Overall, 164 qualified and completed surveys were obtained from an initial panel of 949 procurement managers, and 158 qualified and completed surveys were obtained from an initial panel of 1122 marketing managers. Table 1 lists respondent and respondent firm characteristics and Table 2 provides the correlation matrix for each study.

**Nonresponse bias and common method variance testing**. We compared early and late respondents for all variables under study to assess nonresponse bias (Armstrong & Overton, 1977), T-tests resulted in no significant differences ($p < .05$) in both studies. We then used a marker variable (i.e., "I am responsible for the firm's procurement (marketing) budget") to serve as a proxy for method variance (Lindell & Whitney, 2001). The lowest positive correlation between the marker variable and one of the criterion variables were $\rho = 0.03$ for the procurement survey, $\rho = 0.04$ for the marketing survey. The correlations were partial-ed out of all other bivariate correlations to remove potential CMV effects; zero-order correlations of the other variables remained significant, suggesting CMV is minimal. In addition, we conducted a Harman's single factor test to detect the level of common method bias (Podsakoff et al., 2003). Further, exploratory factor analysis identified study constructs with respective eigenvalues

>1, the largest factor explained 18.66% of the variance, while all factors in total explained 73.57% of the variance; no individual factor accounted for a large portion of the covariance of constructs. Finally, a single-factor test using confirmatory factor analysis (Podsakoff et al., 2003) was done, resulting in a poor fit (Chi-square/d.f. = 7.73, GFI = 0.488, CFI = 0.472, TLI = 0.526, RMSEA = 0.301, suggesting no individual factor can explain the data variance.

## 5. Results

Our hypotheses were tested employing the covariance-based structural equation modeling software AMOS 25, using maximum likelihood (ML).

### 5.1. Measure assessment

Confirmatory factor analysis (AMOS 25) was used to estimate a measurement model (see Table 3). The chi-square goodness-of-fit/degrees of freedom ratio for the models were $\chi^2$ /d.f. = 2.566 for study one, $\chi^2$ /d.f. = 2.349 for study two, and $\chi^2$ /d.f. = 2.566 for the combined model, the comparative fit indexes (CFIs) ranged from 0.910 to 0.929. The standardized root mean square residuals (SRMRs) ranged from 0.047 to 0.049, and the root mean square error of approximations (RMSEAs) ranged from 0.073 to 0.075, meeting the values for a model of

**Table 2**
Measure Statistics and Correlations (Studies One and Two).

| Study 1: Procurement | M | SD | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| 1. GPD | 4.22 | 1.23 | **0.57** | | | | | |
| 2. RE | 3.98 | 1.20 | 0.35 | **0.59** | | | | |
| 3. KR | 4.26 | 1.22 | -0.15 | 0.22 | **0.68** | | | |
| 4. CVA | 4.50 | 1.29 | 0.32 | 0.06 | 0.35 | **0.66** | | |
| 5. MDC | 4.75 | 1.42 | 0.40 | 0.15 | -0.29 | 0.16 | **0.73** | |
| 6. Pareto | 3.35 | 1.22 | 0.07 | 0.17 | 0.08 | 0.07 | 0.05 | **0.67** |
| **Study 2: Marketing** | **M** | **SD** | **1** | **2** | **3** | **4** | **5** | **6** |
| 1. GPD | 4.37 | 1.20 | **0.59** | | | | | |
| 2. RE | 4.57 | 1.28 | 0.42 | **0.52** | | | | |
| 3. KR | 3.18 | 1.31 | 0.18 | 0.23 | **0.65** | | | |
| 4. CVA | 4.71 | 1.15 | 0.42 | 0.05 | 0.29 | **0.69** | | |
| 5. MDC | 4.22 | 1.40 | 0.37 | 0.25 | -0.32 | 0.15 | **0.74** | |
| 6. Pareto | 4.22 | 1.20 | 0.09 | 0.21 | 0.10 | 0.03 | 0.07 | **0.64** |

* Below the diagonal are correlations.
* On the diagonal (bold) are AVEs.
* GPD – Green Product Demands, RE – Relational Embeddedness, KR- Knowledge Redundancy, CA – Competitive Vertical Activity, MDC – Marketing Dynamic Capabilities, Par – Pareto Distribution.

**Table 3**
Measurement Model (Study 1/Study 2/Combined).

| Construct/Items | Standardized Loading | Alpha | CR | AVE |
|---|---|---|---|---|
| Green Product Demands | | | | |
| 1 Procurement | 0.82/0.87/0.85 | 0.87/ 0.85/ | 0.83/ 0.81/ | 0.57/ 0.59/ |
| 2 Design/Production | 0.77/0.75/0.73 | 0.83 | 0.84 | 0.61 |
| 3 Distribution | 0.78/0.71/0.74 | | | |
| 4 Consumption/ Disposal | 0.80/0.82/0.79 | | | |
| Relational Embeddedness | | | | |
| 1 Interdependence | 0.76/0.75/0.72 | 0.85/ 0.89/ | 0.86/ 0.85/ | 0.59/ 0.52/ |
| 2 Cooperation | 0.88/0.89/0.86 | 0.84 | 0.83 | 0.57 |
| 3 Reciprocity | 0.80/0.81/0.79 | | | |
| 4 Information Sharing | 0.77/0.79/0.81 | | | |
| Knowledge Redundancy | | | | |
| 1 Information | 0.80/0.89/0.84 | 0.91/ 0.86/ | 0.84/ 0.82/ | 0.68/ 0.65/ |
| 2 Technology | 0.79/0.72/0.80 | 0.90 | 0.83 | 0.64 |
| 3 Skills | 0.71/0.69/0.70 | | | |
| 4 Resources | 0.80/0.81/0.80 | | | |
| Marketing Dynamic Capabilities | | | | |
| 1 Customer Relationship | 0.82/0.87/0.84 | 0.79/ 0.73/ | 0.81/ 0.82/ | 0.80/ 0.75/ |
| 2 Product Development | 0.86/0.84/0.82 | 0.75 | 0.83 | 0.77 |
| 3 Supply Chain | 0.88/0.81/0.80 | | | |
| Competitive Vertical Activity | | | | |
| 1 Doing Business | 0.65/0.68/0.66 | 0.89/ 0.92/ | 0.77/ 0.78/ | 0.66/ 0.69/ |
| 2 Strong Relationships | 0.89/0.90/0.88 | 0.88 | 0.76 | 0.65 |
| 3 Share Proprietary | 0.87/0.85/0.84 | | | |

Study 1: $\chi^2$ /d.f. = 2.566; CFI = 0.913; RMSEA = 0.075; and SRMR = 0.048.
Study 2: $\chi^2$ /d.f. = 2.349; CFI = 0.929; RMSEA = 0.073; and SRMR = 0.047.
Combined: $\chi^2$ /d.f. = 2.652; CFI = 0.910; RMSEA = 0.076; and SRMR = 0.049.
Notes: Alpha = Cronbach's Alpha, AVE = average variance extracted, and CR = composite reliability.

good fit (Bollen, 1990). All constructs have good reliability (alpha coefficients exceeding 0.85) (Churchill, 1979) and composite reliabilities ranging from 0.78 to 0.85 (Fornell & Larcker, 1981), and all factor loadings provided evidence of convergent validity, ranging from 0.64 to 0.90 with t-values exceeding 2.00. Measurement invariance was further tested by equating the factor loadings in the two groups (Steenkamp & Baumgartner, 1998), resulting in a non-significant change in model fit ($\Delta\chi^2 = 6.47$; $\Delta$d.f. = 4), supporting measurement equivalence.

### 5.2. Structural models

Each model was estimated using structural equation modeling (see Table 4) building covariance matrices with survey data from each study. Both models have acceptable indicators for goodness of fit (Study 1: $\chi^2$ /d.f. = 2.555, $p < .05$; CFI = 0.941; RMSEA = 0.075; and SRMR = 0.053 and Study 2: $\chi^2$ /d.f. = 2.635, $p < .05$; CFI = 0.912; RMSEA = 0.072; and SRMR = 0.051).

Indirect relationships. The results indicate a positive relationship between green product demands and relational embeddedness (Study 1: $\beta = 0.301$, t = 2.913, $p < .05$ and Study 2: $\beta = 0.406$, t = 4.301, $p < .01$), and a positive relationship between relational embeddedness and MDC (Study 1: $\beta = 0.279$, t = 2.336, $p < .05$ and Study 2: $\beta = 0.419$, t = 4.537, $p < .01$) in support of $H_{1a}$ and $H_{1b}$. There is a negative relationship between green product demands and knowledge redundancy in Study 1: $\beta = -0.426$, t = -4.731, $p < .01$, but not in Study 2: $\beta = 0.245$, t = 1.993, $p < .05$), partially supporting $H_{2a}$. Regarding the effect of knowledge redundancy on MDC, there exists a negative relationship in both studies (Study 1: $\beta = -0.349$, t = -4.201, $p < .01$ and Study 2: $\beta = -0.302$, t = -3.150, $p < .01$), supporting $H_{2b}$.

We then conducted a supplementary test for mediation to assess the indirect effects model. Consistent with MacKinnon et al. (2002), we estimated a new model that included both the hypothesized indirect paths and a direct path between green product demands and MDC. We find that the indirect relationships are significant via relational embeddedness (Study 1: $\beta = 0.215$; $p < .05$ and Study 2: $\beta = 0.335$; $p < .01$), and via knowledge redundancy (Study 1: $\beta = -0.322$; $p < .01$ and Study 2: $\beta = -0.266$; $p < .05$), but the direct association is not significant (Study 1: $\beta = 0.113$; $p > .1$ and Study 2: $\beta = 0.102$; $p > .1$), indicative that the mediated model is a more accurate portrayal of the relationships.

Latent variable interactions were tested following Ping's (1995) single-product indicant approach. The results provide minimal support for $H_3$, in that the interaction effect of green product demands and competitive activity on relational embeddedness is negative as hypothesized but insignificant ($p > .05$) for procurement managers ($\beta$ = -0.107, t = -0.930), and is positive and significant for marketing managers ($\beta = 0.166$, t = 1.852, $p < .05$). The results indicate support for $H_4$, as the interaction effect of green product demands and competitive activity on knowledge redundancy is negative for both for procurement managers ($\beta$ = -0.167, t = -2.180, $p < .05$), marketing managers ($\beta$ = –0.161, t = –1.980, $p < .05$).

**Table 4**
SEM Results and Path Comparisons.

| Path Effects | Standardized Coefficient | t-Value |
|---|---|---|
| *Procurement Manager* | 0.301* | 2.913 |
| $H_{1a}$: Green Product Demands → Relational Embeddedness (+) | 0.279* | 2.336 |
| $H_{1b}$: Relational Embeddedness → MDC (+) | | |
| $H_{2a}$: Green Product Demands → Knowledge Redundancy (-) | -0.426** | −4.731 |
| $H_{2b}$: Knowledge Redundancy → MDC (-) | -0.349** | −4.201 |
| $H_3$: Green Product Demands × Competitive Activity → Relational Embeddedness (-) | -0.107 | −0.930 |
| $H_4$: Green Product Demands × Competitive Activity → Knowledge Redundancy (-) | -0.167* | −2.180 |
| Pareto Distribution → MDC | 0.108 | 0.801 |
| Firm Size → MDC | 0.098 | 0.691 |
| $\chi^2$ */degrees of freedom* = 2.555; CFI = 0.941; RMSEA = 0.075; and SRMR = 0.053. | *$p < .05$, **$p < .01$ | |
| *Marketing Manager* | 0.406** | 4.301 |
| $H_{1a}$: Green Product Demands → Relational Embeddedness (+) | 0.419** | 4.537 |
| $H_{1b}$: Relational Embeddedness → MDC (+) | | |
| $H_{2a}$: Green Product Demands → Knowledge Redundancy (-) | 0.245* | 1.993 |
| $H_{2b}$: Knowledge Redundancy → MDC (-) | -0.302** | −3.150 |
| $H_3$: Green Product Demands × Competitive Activity → Relational Embeddedness (-) | 0.166* | 1.852 |
| $H_4$: Green Product Demands × Competitive Activity → Knowledge Redundancy (-) | -0.161* | −1.980 |
| Pareto Distribution → MDC | 0.115 | 0.906 |
| Firm Size → MDC | 0.102 | 0.793 |
| $\chi^2$ */degrees of freedom* = 2.635; CFI = 0.912; RMSEA = 0.072; and SRMR = 0.051. | *$p < .05$, **$p < .01$ | |
| Path Effect Comparative and Combined Model Fit | Model Fit | |
| $H_{5A}$: Green Product Demands → Relational Embeddedness *is Weaker for Procurement Managers* | $\Delta\chi^2 = 4.29$ | |
| $H_{5B}$: Relational Embeddedness → MDC *is Weaker for Procurement Managers* | $\Delta\chi^2 = 4.35$ | |
| $H_{6A}$: Green Product Demands → Knowledge Redundancy *is Similar for Procurement Managers and Marketing Managers* | $\Delta\chi^2 = 4.52$ | |
| $H_{6B}$: Knowledge Redundancy → MDC *is Similar for Procurement Managers and Marketing Managers* | $\Delta\chi^2 = 0.09$ | |
| $\chi^2$ */degrees of freedom* = 6.633; CFI = 0.622; RMSEA = 0.121; and SRMR = 0.090. | | |

We then tested for differences between procurement managers and marketing managers in regard to path effects. First, the data from Studies 1 and 2 were combined and used to estimate the path model. The resulting fit indices ($\chi^2$ */degrees of freedom* = 6.633; CFI = 0.622; RMSEA = 0.121; and SRMR = 0.090) indicate a poor fit. Whereas the measurement model fit for the combined data was good, the lack of path model fit indicates substantive differences between the two respondent groups. To further determine if the path effects were significantly different between procurement and marketing managers, we also used covariance-based between group structural equation modeling analysis (Qureshi & Compeau, 2009). As indicated in Table 4, structural path estimates for Studies 1 and 2 were considered, wherein $H_{5A}$ hypothesized that green product demands' influence on relational embeddedness was weaker for procurement managers ($\beta = 0.301$, $p < .05$) than with marketing managers ($\beta = 0.406$, $p < .01$). Equating this path in the two models resulted in a significant decrease in model fit ($\Delta\chi^2 = 4.29$; $\Delta$d.f. = 1), supporting $H_{5A}$. Consistent with $H_{5B}$, the effect of relational embeddedness on MDC was also lower for procurement managers ($\beta = 0.279$, $p < .05$) than with marketing managers ($\beta = 0.419$, $p < .01$); equating this path in the two models resulted in a significant decrease in model fit ($\Delta\chi^2 = 4.35$; $\Delta$d.f. = 1). We then tested for differences in the knowledge redundancy path. Contradicting $H_{6A}$, the influence of green product demands on knowledge redundancy was different in valence between procurement managers ($\beta = -0.426$, $p < .01$) and marketing managers ($\beta = 0.245$, $p < .05$); equating these paths in the two models resulted in a significant decrease in model fit ($\Delta\chi^2 = 4.52$; $\Delta$d.f. = 1). Knowledge redundancy's influence on MDC was less negative for marketing managers ($\beta = -0.302$, $p < .01$) than with procurement managers ($\beta = -0.349$, $p < .01$). Equating these paths in the two models did not result in a significant decrease in each model fit ($\Delta\chi^2 = 0.09$; $\Delta$d.f. = 1), supportive of $H_{6B}$.

## 6. Discussion

The results suggest a number of interesting insights into the complexities of the buyer/seller relationship in industrial market channels wherein green product demands are of growing importance. The findings also point to some potentially important theoretical and managerial implications which may be informative for ongoing research and practice.

### 6.1. GPD effects on relational embeddedness, knowledge redundancy, and MDC

The utility and relevance, as evidenced in the measurement and path models, of the green product demands (GPD) construct appears to advance our understanding of what "green" means in an industrial market channel context through the lenses of both buyers and sellers. As such, the construct may allow for a more rigorous and consistent approach to studies of green-related demand in industrial market channels, as well as enhance firms' abilities to better assess their customer's green-related demand. Support for $H_{1A,1B,2B}$ and partial support for $H_{2A}$ also suggests that a convergence of green-focused research (e.g., Melander, 2018; Papadas, Avlonitis, & Carrigan, 2017; Papadas, Avlonitis, Carrigan, & Piha 2019; Rothery, 1995; Xie et. al, 2019; Zhang et. al, 2020) with strength of ties interorganizational research (e.g., Badir & O'Connor, 2015; Bi et. al, 2020; Stanko et. al, 2007), and GSCM research (e.g., Rauer & Kaufmann, 2015; Schmidt, Foerstl, & Schaltenbrand, 2017; Tachizawa & Wong 2015) may advance our overall understanding of industrial buyer/seller behavior in a rapidly changing context. The findings that green product demands do not directly influence marketing dynamic capabilities also suggests that while industrial buyers and sellers confront and respond to green product demands, they remain challenged by non-green demands as well. They consider MDC in totality and their capability to respond to GPD is a subset of those capabilities. It is also interesting that GPD is considered to have a positive effect on knowledge redundancy by marketing managers ($\beta = 0.245$) but a negative effect ($\beta = -0.426$) by procurement managers, yet both suggest a negative effect of knowledge redundancy on MDC ($\beta = -0.302$ and $\beta = -0.349$). This disparity may suggest, although not tested, that sellers seek some knowledge redundancy to identify potential customers in the context of green product markets, however, too much redundancy limits their overall dynamic capabilities. Conversely, buyers seek a lack of knowledge redundancy as a qualifier for sellers in a green product market environment.

### 6.2. Moderating effects of vertical competitive activity

$H_3$ and $H_4$ hypothesized a dampening effect of competitive vertical activity (i.e., doing business, strong relationships, and sharing proprietary information) on the influence of green product demands on relational embeddedness and knowledge redundancy, respectively. The theoretical argument for these hypotheses is based on the context of a network of buyers and sellers embedded in an industrial market channel acting in self-interest. Activities between a buyer's seller and the buyer's competitor is manageable to some extent by formal and informal governance but does also introduce competitive "tension." The findings suggest that buyers generally agree with this thesis. Sellers, however, may not regard a buyer's activity with the seller's competitors as a

hinderance to forming a higher level of relational embeddedness with the buyer in a green product market. In fact, sellers may regard that activity as a signal that buyers are more able to form relationships with sellers. They do, however, agree that vertical competitive activity would dampen a negative (note lack of support for $H_{2A}$ with marketing managers) effect of green product demands on knowledge redundancy. This result seemingly supports the assertion that competitive tension between horizontal actors in an industrial market channel, as referred to by Rindfleisch and Moorman (2001), may curb sellers' willingness to share proprietary information, but not their willingness to form relationships. Buyers, alternatively, seem to regard the acts of forming relationships and sharing sensitive information similarly given a seller's relative activities with the buyer's competitors.

### 6.3. Path effect comparisons

Our findings indicate that procurement managers (i.e., buyers) and marketing managers (i.e., sellers) differentiate between the effects of relational embeddedness and knowledge redundancy as mediators between green product demands and MDC. This extends the research (e.g., Badir & O'Connor, 2015; Bi et. al, 2020; Stanko et. al, 2007) and our understanding of the role of two prominent strength of ties constructs (relational embeddedness and knowledge redundancy) in a growing research area, industrial interorganizational behavior in green product markets (e.g., Melander, 2018; Rothery, 1995; Xie et. al, 2019; Zhang et. al, 2020). Through this dual study we found potential similarities and differences of perception when a channel member is thinking and acting as a buyer, versus thinking and acting as a seller. Comparative fit testing suggests that buyers tend to place less emphasis on the GPD > relational embeddedness > MDC path than sellers. Conversely, buyers and sellers appear split on the GPD > knowledge redundancy > MDC path, wherein buyers place more emphasis and differ in the valence of effect of GPD on knowledge redundancy ($\beta$ = -0.426 versus $\beta$ = 0.245) but have similar perspectives regarding the effect of knowledge redundancy on MDC. The results suggest that even in the green-product context, industrial buyers may maintain a perspective of traditional procurement alluded to by Closs, Speier, & Meacham (2011), "viewed as primarily operational, with a major focus on reducing cost." Sellers, on the other hand, seem to regard GPD as a positive influence on both relational embeddedness and knowledge redundancy. That is, green product demands require closer relationships and some level of similar knowledge, but (paradoxically) knowledge redundancy still has a negative influence on building MDC.

### 6.4. Theoretical implications

The findings that relational embeddedness and knowledge redundancy are full mediators between a firm's perception of its customer-s'(suppliers') GPD and its MDC has theoretical implications, specifically in the dynamic capabilities research stream. First, it may imply that firms regard their MDC in terms of their familiarity with a set of customers and suppliers existing within a specific industry. This seems consistent with the notion that competitive advantage garnered from capabilities, supported by firm resources, are context dependent. The findings may also suggest that managers in both procurement and marketing do regard their market capabilities more holistically, requiring customer and supplier intensive relationships, as well as internal coordination. The nature of GPD in terms of unverifiability/need for assurance referred to previously, would seem to amplify the need for MDC development. It may also suggest that firms are less able to internalize the knowledge and capabilities associated with green product demands over a broad set of customers wherein GPD vary. Another theoretical consideration relates to MDC development; firms may perceive an ability to build on GPD experience such that its MDC are enhanced for all contexts or may alternatively consider it a "zero-sum" decision.

Strength of ties research provides the theoretical underpinning of how channel participants form relationships, with whom, and how they exchange knowledge depending on their role and relative positions. When asked to consider MDC in a green context, procurement and marketing managers deviated somewhat on the moderating effects of competitive activity, suggesting that role and context need to both be considered when applying strength of ties in industrial supply chains. In this case the context that was created specifically focused on green product demands between buyers and sellers. Other market contexts may change the parties' perspectives regarding the number and strength of competitive relationships, and type of information being shared by the other party. Interorganizational application of strength of ties e.g., Rindfleisch and Moorman (2001) asserted that vertical relationships in an industrial channel (e.g., buyer/seller) would possess a high degree of relational embeddedness and a low degree of knowledge redundancy. Badir & O'Connor (2015) argued that strong ties (i.e., high embeddedness) increase the likelihood that the firms will share sensitive information. These arguments suggest that relational embeddedness may be an antecedent to lower levels of redundancy (i.e., the sharing of non-common knowledge between the firms). In this research we treat the constructs as separate mediators, arguing that it more accurately captures the variance of buyer/seller relationships as they relate to levels of relational embeddedness and knowledge redundancy.

### 6.5. Managerial implications

The measurement assessment suggests that procurement managers and marketing managers in industrial channels recognize an operationalization for green product demands (i.e., procurement, design/production, distribution, and consumption/disposition) with some consistency (Standardized loadings: 0.73 to 0.87, Alphas: 0.83 to 0.87, Construct Reliability: 0.81 to 0.84, and AVE: 0.57 to 0.61). The GPD construct may provide industrial managers with an effective means of assessing and distinguishing their customers' green product demands, as well as their firm's potential to address those demands. Further, the mediation model potentially provides managers with greater insights as to the necessary antecedents (e.g., relationships and knowledge acquisition) of MDC in unique market environments defined by customers' green product demands. Similarly, the GPD construct may be useful for industrial buyers in assessing the green product capabilities of potential and existing sellers, as well as their ability to articulate their green product demands to sellers.

The findings also provide broader internal and external implications for industrial buyers and sellers. Internally, firms aspiring to increase their level of MDC and the realize its potential benefits, as articulated by Fang and Zou (2009), should assess their procurement and marketing strategies, and the cross-functional alignment between supply chain and marketing functions. As suggested by the findings and previous research (e.g., Closs, Speier, & Meacham, 2011), there is a reasonable likelihood that there are differences in the way the firm's procurement managers and marketing managers regard knowledge exchange and its importance to their own MDC; firms seeking to improve their MDC should pursue cross-functional marketing and supply chain focus interactions on MDC enhancement. Externally, the findings shed light on differing perspectives of buyers and sellers, and challenges industrial channel members to assess their ability to form more effective relationships, reinforcing Zhang et al. (2020) findings that the interplay between formal control and social control in relation to green supply chain collaboration is critical to success in a growing green product marketplace. Similarly, it illuminates the importance of understanding the level and type of knowledge the buyer and seller bring to a potential vertical relationship. Finally, the interaction effects of competitive vertical activity suggest that buyers and sellers are aware of, and sensitive to the activities of their sellers and buyers (respectively), relative to competitors. It appears that sellers, perhaps as might be expected, are less concerned about a buyer forming relationships with competitive sellers. The mutual uneasiness (i.e., negative interaction) of vertical competitive activity on

the green product demands > knowledge redundancy path is informative, suggesting that both parties may seek other means of governance and be less willing to share nonredundant (i.e., proprietary or sensitive) information.

## 7. Limitations and Further research

This work advances the literature in industrial market channel relationships and green products, but there are several limitations. First, the definition of "green product demands" is quite narrow considering the breadth of demands alluded to previously and observed in the green product literature. So, while we feel that the construct is potentially useful, it is also just a starting point for a better articulation of what "green" means in industrial market channels. Similarly, the measures for GPD, Relational Embeddedness, Knowledge Redundancy, and Competitive Vertical Activity are intentionally parsimonious. As such, the measures may not adequately capture the complexity of the constructs or their inter-relationships. As noted, the theoretical underpinning of strength of ties lies within interpersonal, not inter-organizational behavior. Although there is substantive application of the theory in inter-organizational research, it may have its limitations. This potential is in part tied to the nature of how respondents consider references to "customers" and "suppliers" in the construct measures. Some may be oriented at the individual level, while others may be oriented at the firm level. Further research refining the green product demands construct would be informative and extend our knowledge. Our model is effective in demonstrating the influence of relational embeddedness and knowledge redundancy as mediators. There are, however, other potential mediators (e.g., complexity and volume of knowledge, tacit versus nontacit knowledge, trust, etc.) that are important to consider when assessing the path(s) between customers' green product demands and a firm's MDC. As such we suggest models incorporating other constructs as mediators and/or moderators should be pursued with the objective of better understanding the complexities of green product demand and innovation, when confronted by buyers and sellers. Similarly, this research examines interfirm behavior in an industrial channel context, wherein the data are derived from disparate procurement and marketing managers. Respondents originate in a wide breadth of industry codes. We consider this both a strength and weakness of the work. The breadth of the sampling allows for a broad view of industrial supply chains, however, as indicated in the work there are industry specific considerations when exploring the effects of green product demands. In addition, the respondents were not nested as a pair of managers within the same firm, nor were they necessarily in the same industry or at similar levels in their respective industrial supply chains. While we feel this may enhance the generalizability of the findings, it also introduces limitations that cannot be controlled for in the research design. We used a single control for a Pareto distribution (80/20) of customers (suppliers), as well as firm size in an effort to account for the different characteristics represented in the sampling. These controls were found to have an insignificant effect on MDC. As such, while somewhat informative, a more granular assessment of customer (supplier) size would provide greater insight. In summary, the implications of the work are substantive, but the specific findings should not be generalized without consideration of these limitations. Future research investigating data internal to existing organizations' cross-functional activities (e.g., between procurement and marketing) and the same firms' external buyer/seller relationships would substantially improve understanding and managerial relevance.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix A:. Operational measures of constructs

**Green Product Demands**, Seven-Point Likert-type Scale (1 = "strongly disagree," 7 = "strongly agree")
Our customers frequently require us to provide information and meet standards for the short- and long-term environmental impact of our products in terms of their...
… procurement of sub-components or materials. (1)
… design/production processes. (2)
… distribution. (3)
… consumption and disposal. (4)

**Relational Embeddedness,** Seven-Point Likert-type Scale (1 = "strongly disagree," 7 = "strongly agree")
Our relationships with important suppliers(customers) can be described as possessing ...
… mutual interdependence and reliance on the other. (1)
… organizational cooperation. (2)
… reciprocity and responsiveness. (3)
… a tendency for information sharing. (4)

**Knowledge Redundancy,** Seven-Point Likert-type Scale (1 = "strongly disagree," 7 = "strongly agree")
Relative to our company, our important suppliers(customers) can be described as possessing ...
… similar information. (1)
… similar technology. (2)
… similar skills. (3)
… similar resources. (4)

**Marketing Dynamic Capabilities,** Seven-Point Likert-type Scale (1 = "strongly disagree," 7 = "strongly agree")
We are efficient and responsive to market changes in the following areas:

1) Customer relationship management: The cross-functional process across areas of acquiring and leveraging customer information, establishing and maintaining relationships with customers and channel members, and providing after-sales service and support of managing relationships with customers, with the objective of learning about their needs and how best to satisfy them.
2) Product development management: The cross-functional process areas of ascertaining customer needs, designing tentative new product solutions and prototypes, manufacturing, and coordinating departmental relationships, with the objective of developing and engineering the product that enables the customer to experience maximum value and benefits.
3) Supply chain management: The cross-functional process area of selecting and qualifying desired suppliers, establishing, and managing inbound and outbound logistics, and designing managing, and integrating our own supply chain with that of both suppliers and customers.

**Competitive Vertical Activity,** Seven-Point Likert-type Scale (1 = "strongly disagree," 7 = "strongly agree")
To better understand your supplier(customer) relationships, please indicate your agreement with the following descriptions of your suppliers'(customers') activities with your competitors.
Our important suppliers(customers) do business with very few of our competitors. (1 – reverse code)
Our important suppliers(customers) have strong relationships with many of our competitors. (2)
Our important suppliers(customers) share proprietary information with many of our competitors. (3)

**Control,** Seven-Point Likert-type Scale (1 = "strongly disagree," 7 = "strongly agree")
Our firm's suppliers(customers) generally fall into a pareto (80/20) distribution. (1)

**Marker Variable,** Seven-Point Likert-type Scale (1 = "strongly disagree," 7 = "strongly agree")
I am responsible for my firm's procurement(marketing) budget. (1)

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