Technology legitimation

Technology legitimation:

a product-level examination across the technology lifecycle[1]

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Abstract

Legitimacy is an important explanatory factor for the success or failure of new products, but how individual actors engage in legitimation is not well understood. We focus on two categories of actors: the firms that develop and commercialise new technology-based products and the customers who evaluate these products and examine their legitimation behaviour across the technology lifecycle. Drawing from organisation research, innovation studies and product innovation literatures, we posit that firms' legitimacy-seeking behaviour varies across the technology lifecycle depending on the need for legitimacy in each stage, while customers' emphasis varies depending on the relative importance they ascribe to each type of legitimacy. We test these hypotheses by examining online data about products that span four stages of the technology lifecycle. We advance a micro-level understanding of technology legitimation by demonstrating that firms' efforts to seek legitimacy and customers' emphasis on legitimacy for new technology-based products are distinct phenomena underpinned by different mechanisms. We expand the scope of existing technology legitimation research by examining how firms' efforts and customers' emphases vary across the technology lifecycle.

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Keywords

Legitimation, legitimacy, innovation, technology lifecycle, technology-based innovation

Introduction

Customer acceptance is key to the success of new products and technologies (Rogers, 1995). The term *acceptance* is used in marketing and innovation literature interchangeably with *adoption*, denoting the actual purchase or use of a product by a customer or the intention to do so (Holak and Lehmann, 1990; Jeyarai et al., 2006). Drawing largely from the diffusion of innovation theory, acceptance is generally explained based on the attributes of a new product/technology and the characteristics of individual customers (Rogers, 1995). As a result, within this literature, explanations of acceptance focus on the product/technology and individual levels of analysis, downplaying the role of the wider environment which, although recognised as significant (Gatignon and Robertson, 1985), is usually reduced to a single dimension (i.e., compatibility, Holak and Lehmann, 1990) and often overlooked in empirical examinations (Jeyaraj et al., 2006). Meanwhile, institutional analyses of product/technology adoption, generally grounded in organisational studies literature, take a wider contextual perspective and find that factors in the social context in which customers operate, such as cultural and normative expectations (Kropp and Totzek, 2020; Mignerat and Rivard, 2009), play a major role in explaining customer adoption behaviour in relation to new products and technologies.

In contrast to the marketing and innovation literature, organisational studies literature conceptualises the *acceptance* of an entity — generally an organisation, but also products or technologies — by a particular audience, such as customers, as conferring *legitimacy*. Legitimacy refers to a perception of appropriateness (Deephouse *et al.*, 2017); a product

(Giesler, 2012) or technology (Markard et al., 2016) is legitimate if audiences perceive it as aligned with institutional structures in their context. Legitimacy includes both utility-based assessments, concerning whether a product or technology aligns with its audience's interests and institutional-based assessments, such as whether it is the "right type of" product, or whether it is familiar to audiences within a particular social context (Suchman, 1995).

Thus, the legitimacy lens allows us to bring together the marketing and innovation literature focus of matching customers with the attributes of a new technology or product, and the institutional research focus on considering cultural and normative expectations within the social context in which customers operate.

Both utility-based and institutional-based legitimacy are important in explaining the pursuit of new technologies (Danneels et al., 2018). We therefore posit that an important avenue for research is to explore technology-based product acceptance by customers from a legitimacy perspective, which allows for a richer understanding of both utility and institutional factors that shape customers' acceptance compared with the diffusion of innovation framework. To do this, we distinguish between firms' legitimacy seeking efforts and customers' legitimacy bestowing and examine variations in both depending on the maturity of the technology underpinning the new products.

Employing Suchman's (1995) legitimacy framework and Utterback and Abernathy's (1976) technology life cycle model, our research examines *how firms' legitimation behaviour varies across the stages of the technology lifecycle* (RQ1) and *how customers' legitimation emphasis varies across the stages of the technology lifecycle* (RQ2).

The rationale for this focus is threefold. First, current research lacks a micro-level perspective on individual actors' legitimation efforts in relation to the acceptance of new products or technologies. Instead, most research examining technology or product legitimation focuses on

macro-level phenomena, e.g., collective perceptions of legitimacy by categories of actors involved in new technology (Markard et al., 2016) or new product markets (Giesler, 2012).

Second, most research takes the perspective of actors seeking legitimacy, such as firms developing new products (Navis and Glynn, 2010) while audiences, such as target customers, are assumed to passively bestow legitimacy (Bitektine, 2011). However, individuals often take active roles in making evaluative legitimacy judgments, underpinned by different behaviours depending on the type of legitimacy involved (Bitektine, 2011). These judgments are complementary, but not identical to firms' efforts to seek legitimacy, which tend to focus on the collective level of perceived legitimacy, rather than paying attention to the micro-level, individual basis of legitimacy judgment (Tost, 2011).

Finally, most legitimacy research focuses on early-stage technologies (Binz et al, 2016). However, technology lifecycle stages are characterised by markedly different degrees of product innovation, competitive conditions (Utterback and Abernathy, 1976), and interpretations of what a technology represents (Kaplan and Tripsas, 2008). These differences are likely to influence both how firms seek legitimacy (Kaganer et al., 2010) and how customers bestow legitimacy.

In summary, the legitimacy lens affords a rich understanding of the role of social context in explaining customer acceptance of technology-based products. However, there is limited understanding of individual actors' — such as firms' and customers' — behaviour in relation to product legitimation, in particular concerning variations in such behaviours depending on the stage of the technology lifecycle.

Our work offers three important contributions. First, we develop a legitimacy-based explanation of customer acceptance of technology-based products. In contrast with existing product/technology acceptance research, which focuses either on the utility (Roger, 2003) or

the institutional (Bergek, 2008; Giesler, 2012) aspects of acceptance, our reliance on Suchman's (1995) legitimacy framework puts equal focus on both, thus enabling a finer-grained understanding of acceptance. We make a distinction among the roles that cultural-cognitive, moral-normative and pragmatic-economic expectations play in different stages of the technology lifecycle in shaping customers' acceptance of new products. To this end, we develop and apply a method to measure types of legitimacy in natural language. Second, we advance a micro-level understanding of technology legitimation. In contrast with existing studies that focus on collective actions (Markard et al., 2016), we examine legitimation efforts at the product level, which allows us to distinguish between individual firms' and their customers' emphases on distinct types of legitimacy. Third, we expand the scope of technology legitimation research by examining firms' legitimation efforts across the technology lifecycle — to which we propose the addition of a *retro* stage — and comparing them with customers' legitimacy emphases. In contrast to the prevailing focus on early-stage technologies (Hall et al., 2014), our findings underscore the need to take a temporal perspective in studying technology legitimacy.

The rest of the article is organized as follows. First, the theoretical background for legitimacy and the technology lifecycle is covered, followed by the development of hypotheses. The research methodology is described, followed by the findings. The article closes with a discussion of implications for theory and practice, limitations and directions for future research.

Theoretical background

Legitimacy framework

Legitimacy is defined as a *"generalized perception or assumption that the actions of an entity are desirable, proper or appropriate within some socially constructed system of norms, values, beliefs and definitions"* (Suchman, 1995, p.574). Three types of legitimacy can be

distinguished depending on the behavioural basis for bestowing legitimacy (Suchman, 1995). *Pragmatic legitimacy* is based on stakeholders' calculations about the degree to which an entity aligns with their interests, whether immediate, such as the economic value gained, or remote, such as the assumption that the entity has their "best interests at heart". *Moral legitimacy* involves stakeholders' evaluations about whether an entity aligns with wider societal values and norms. *Cognitive legitimacy* concerns stakeholders' evaluations of how an entity aligns with their mental models and focuses on comprehensibility (Molecke and Pinske, 2020). Thus, pragmatic legitimacy involves evaluations based on utility (Golart and Sillince, 2007), which is consistent with strategic explanations of acceptance such as those based on the diffusion of innovation model. Moral legitimacy involves alignment with normative beliefs and is partially recognised in the diffusion of innovation model as compatibility with existing norms. Cognitive legitimacy entails alignment with cultural models. Moral and cognitive legitimacies are the primary focus of institutional explanations of new product/technology acceptance (Kropp and Totzek, 2020; Markard et al., 2016).

Suchman's typology implies that utility-based assessments of whether a new technology or product satisfies customers' needs — for example, calculations of relative advantage or usefulness — as well as normative evaluations of whether it is the "right thing to do" and cognitive assessments of whether it is comprehensible are equally important to explain acceptance. In contrast, the diffusion of innovation model reduces normative evaluations to a single dimension (Holack and Lehman, 1990), emphasising instead utility-based assessments based on matching individual adopters with technology. Similarly narrow is most institution-based acceptance research that either treats legitimacy as a homogenous concept (Bergek, 2008; Giesler, 2012) or focuses only on its moral/normative and cognitive bases, ignoring the economic behaviour that gives raise to pragmatic legitimacy (Markard et al., 2016; Humphrey, 2010) (for an exception, see Danneels et al., 2018). Thus, Suchman's legitimacy framework

allows for a richer understanding of both utility and institutional factors that shape customer acceptance within a single framework.

Innovation and marketing research has shown that legitimacy is a central explanatory factor for the success of a new technology (Bergek et al., 2008) or product category (Giesler, 2012). However, such studies examine collective efforts to gain legitimacy, ignoring the perspective of individual actors who seek and bestow legitimacy — such as individual firms producing new technology-based products, and customers who evaluate these products (Binz et al., 2016). Our focus on the legitimacy of specific products — rather than technologies — is justified by our interest in micro-level phenomena, namely the actions of individual actors.

Moreover, existing research examines legitimacy-seeking actors, such as firms commercialising new products (Giesler, 2012) and developing (Kaganer et al., 2010) and promoting (Hall et al., 2014) new technologies. The way in which audiences, such as customers, render legitimacy (Bitektine, 2011) is overlooked, with only a few exceptions (Fisher et al., 2016). However, individuals play an active role in legitimation (Bitektine, 2011) and their judgments and perceptions are the "micro-motor" that guides their legitimacy behaviours, as distinct from the collective perception of legitimacy within a group, which underpins firms' efforts to seek legitimacy (Tost, 2011). The importance of customers' legitimation evaluations in shaping their assessment of products is also recognised in marketing research as a distinct phenomenon from firms' efforts to seek collective legitimacy (Clauzel *et al.*, 2019; Humphreys and Latour, 2013). This research highlights the need to distinguish between firms' legitimacy seeking efforts and customers' legitimacy bestowing and justifies our approach of examining both how firms seek to legitimise their new technology-based products, and how customers bestow legitimacy on these innovations.

Technology lifecycle

We focus on new technology-based products and consider the stage of maturity of their underlying technologies. We use the term *product* in the tradition of the technology lifecycle literature, to refer to the physical embodiment of a technology at different stages of its evolution (Kaplan and Tripsas, 2008). We are thus concerned with the lifecycle of the technology (Pelroniemi, 2011) rather than of the product itself (Cao and Folan, 2012).

Technology legitimacy research predominantly examines early-stage technologies (for an exception, see Markard et al., 2016). Early-stage technologies are still developing and lack an established market and dominant design (Anderson and Tushman, 1990). New products based on early-stage technologies contradict established norms, have unproven benefits and are unfamiliar to their audiences, thus lacking legitimacy (Bergek et al., 2008). However, legitimacy-seeking is also relevant for mature technologies, for example, end-of-life technology-based products are often misaligned with performance expectations as consumers have moved to newer, more performant technologies (Markard, 2020). Similarly, research highlights how the rapid expansion of established technologies, in the absence of a comparable adaptation of regulatory contexts leads to legitimacy loss (Markard et al., 2016). Since establishing legitimacy is relevant for new products based on technologies across their entire lifecycle, we examine changes in legitimation behaviour over the technology lifecycle.

We draw from the technology lifecycle model, which considers both patterns of technology innovation and industry competition (Peltoniemi, 2011), accounting for changes both in the technology, and in the wider context in which technology happens (Kaplan and Tripsas, 2008). Based on our interest in the social context in which technology-based product legitimation happens, we adopt the industry/technology lifecycle model (Abernathy and Utterback, 1978; Utterback and Abernathy, 1976). Underlying this model is the notion that new technological

opportunities — in the shape of technology discontinuities — lead to the emergence of new industries (Peltoniemi, 2011). Abernathy and Utterback (1978) distinguish three stages of technology evolution. The cycle begins as a new technology opportunity emerges during the *fluid stage*, leading to firms experimenting around a new technology by engaging in radical product innovation and emphasising performance maximisation. Gradually these experiments converge around a dominant design during the *transition stage* as the characteristics of the products involved stabilise, and the focus shifts towards incremental innovations and sales maximisation. As the technology matures further, incremental innovation becomes dominant during the *specific stage* and competition focuses on cost reduction and improving productivity.

Abernathy and Utterback's model implies that as the specific stage ends, the technology is replaced by a new technology of superior performance, giving rise to a new industry, and a new technology lifecycle. The model is concerned with the lifecycle of a single industry, and ignores what happens after the specific stage, as technologies, and the associated industries, are replaced. Follow-up models such as technological discontinuities and dominant design (Anderson and Tushman, 1990) and disruptive innovation (Christensen, 1997) pick up where Abernathy and Utterback leave off and consider what happens during generational changes, as mature technologies are replaced with new generations, and new industries emerge. For example, Christiansen's (1992) work on disruptive innovation and the S-curve model posit that even after the emergence of a new, more performant technology, mature technologies can continue to be exploited to develop competitive products. Other work on the evolution of technological change and competition confirms that some mature technologies survive well beyond the natural limits of their lifecycle, competing alongside products based on new superior technology (Adner and Snow, 2010; Henderson, 1995). Hence, we propose a fourth stage of the technology lifecycle — the *retro stage* — in which we find mature technologies, which despite having been replaced by new technologies in mainstream markets, maintain their

competitiveness as niche products. Our proposed addition of this new stage extends the Abernathy and Utterback model to consider patterns in product innovation and competition following generational technology changes within an industry. For products based on retro stage technologies, the pace of incremental innovations accentuates (Adner and Snow, 2010) and competition shifts back from cost to differentiation. These products offer a combination of valuable features (Foucart *et al.*, 2018), e.g., Bluetooth interfaces in vinyl turntables, and often nostalgic value (Brown *et al.*, 2003), e.g., rotary dials on telephones. In consumer markets, nostalgia often plays a key role in driving consumption (Davis, 1979).

Following from Utterback and Abernathy's pioneering work, empirical research has demonstrated the robustness of the industry/technology lifecycle model in a variety of settings, from PCs to typesetters and from radios to TVs (Peltoniemi, 2011). The vast majority of this work focuses on the role that firms — as producers of products that embody a particular technology — play in shaping technology evolution. Only a few studies have attempted to consider other key actors who may influence technology evolution, such as customers (Adner and Levintal, 2001), or users (Kaplan and Tripsas, 2008). Such research highlights that while the technology lifecycle model offers a robust approach to examine changes in a product during the evolution of its underlying technology, it is important to take into consideration both producer and customer perspectives in explaining these changes. Indeed, we adopt this approach to examine the perspectives of both firms and customers.

Hypotheses

We develop two sets of hypotheses that link the intensity of legitimation emphases in relation to new technology-based products to the maturity of their underlying technology. The first set of hypotheses focuses on firms' efforts to seek legitimacy while the second set concerns customers' legitimation emphases.

Firms' legitimacy-seeking efforts and the technology lifecycle

Most legitimacy research examines firms' legitimacy-seeking behaviour as driven by an absence or shortage of legitimacy (cf. Suchman, 1995). Indeed, *the need for legitimacy* argument — whether to gain, preserve or repair legitimacy (Suchman, 1995) — is widely prevalent in both technology (Hall et al., 2014) and product innovation studies (Dougherty and Heller, 1994). This is the logic that we follow in examining firms' legitimacy seeking behaviour across the stages of the technology life cycle, as discussed below. Firms seek legitimacy in many ways for different purposes, but when it comes to gaining legitimacy for new products, we can expect them to proactively communicate about their products — or craft narratives about them — and emphasize how the products can be viewed as legitimate (see also Giesler, 2012; Lee et al., 2003).

The **fluid stage** of the technology lifecycle is characterised by radical product innovation (Abernathy and Utterback, 1978), which is both unfamiliar to customers and represents a new class of products for which no standard exists. Institutional research on technological legitimacy finds that since new technologies lack legitimacy, the emphasis on gaining social-normative (moral) and cognitive legitimacy during the early technology stage is critical to mobilize resources and ensure success (Hall et al., 2014). This suggests that to be accepted, product innovations in the fluid stage need moral and cognitive legitimacy to a larger extent than the incremental innovations (cf. Dougherty and Heller, 1994) that characterise products in the later stages of the technology lifecycle. An emphasis on moral and cognitive legitimacy-seeking for products in the early stage of technology development is also supported by organisational research on firm legitimacy. For example, Carayannopoulos (2009) suggests that a new venture launching a radical product is likely to face a higher need to acquire cognitive legitimacy than a new venture launching an incremental product, where it is possible to acquire cognitive legitimacy by claiming similarity with an existing product class. Similarly,

research on new ventures developing radical products, which are both unique and unfamiliar to customers, finds that they seek to gain moral legitimacy by highlighting product distinctiveness, which may align with the expectations of their novelty-seeking customers (Taeuscher et al., 2020). Based on the heightened need for moral and cognitive legitimacy for products in the very early stages of technology, we expect that efforts to gain cognitive and moral legitimacy will be higher in the fluid stage than in the other stages.

In the **transition stage,** a dominant design (Abernathy and Utterback, 1978) describing the specifications for an entire product category, becomes the standard choice for customers, denoting expectations about the quality, compatibility, adaptability and connectivity of products in the category (Srinivasan *et al.*, 2006). During this stage, "*products that comply with the requirements of the category to which they claim membership are seen as legitimate members, whereas products that do not comply see their categorical claims questioned"* (Suarez *et al.*, 2015, p.439). Technology lifecycle research finds that the convergence of expectations around a dominant design diminishes the need for firms to demonstrate that new products are relevant and valuable (i.e., to seek moral legitimacy), as they can now be positioned as part of an established product category (Suarez *et al.*, 2015). We thus expect the need for moral legitimacy — and therefore also firms' emphasis on securing moral legitimacy — to be at its lowest for products during the transition stage.

The **specific stage** is characterised by the prevalence of incremental product innovation (Abernathy and Utterback, 1978). In contrast to fluid stage products, specific stage products are well-understood and familiar within their target market and both customers' preferences and their cognitive interpretations of the product have become relatively stable (Kaplan and Tripsas, 2008). Thus, the need for moral and cognitive legitimacy in the specific stage will be low (Dougherty and Heller, 1995). Specific stage products also offer established levels of

technological performance, meaning that competition among such products focuses on cost reductions rather than performance improvements (Utterback and Abernathy, 1975). Thus, in the specific stage there are likely to be stable expectations for well-established performance benefits at lower cost (i.e., pragmatic legitimacy) compared with products in the other stages of the technology lifecycle. We thus expect efforts to seek pragmatic legitimacy to be lower in the specific stage than in other stages.

Finally, **retro stage** products are based on mature technologies that survive beyond their expected lifecycles, thus often performing worse than the corresponding products in the specific stage (e.g., although vinyl is fully analogue and, therefore, fully lossless, the technical sound quality of CD players is higher). Moreover, being based on a mature technology and often trading on customers' nostalgic leanings, products in this stage are likely to be familiar to customers, who associate these products with a time where the world was seen as being more comprehensible, even where direct experience of the technology is lacking (Brown et al., 2003). Familiarity implies there will be a low need to establish cognitive legitimacy. Therefore, the biggest challenge in this stage is demonstrating product benefits, such as performance improvements (e.g., Schiavone, 2013), rather than cognitive alignment. We thus expect that in the retro stage efforts to seek cognitive legitimacy will be lower than in the other stages, and efforts to seek pragmatic legitimacy will be higher.

In summary, we hypothesize as shown in Table 1 about firms' relative emphases on securing different types of legitimacy across the technology lifecycle.

Table 1. Hypotheses 1, 2 and 3 about firms' legitimation emphases when describing new technology-based products.

	Fluid stage	Transition stage	Specific stage	Retro stage
H1: Firms' emphasis on gaining **pragmatic legitimacy** when describing new products differs among the stages of the technology lifecycle.				
H1a: Firms' emphasis on gaining pragmatic legitimacy when describing new products is higher in the retro stage of the technology lifecycle than in other stages.				Highest (H1a)
H1b: Firms' emphasis on gaining pragmatic legitimacy when describing new products is lower in the specific stage of the technology lifecycle than in other stages			Lowest (H1b)	
H2: Firms' emphasis on gaining **moral legitimacy** when describing new products differs among the stages of the technology lifecycle.				
H2a: Firms' emphasis on gaining moral legitimacy when describing new products is higher in the fluid stage of technology lifecycle than in the other stages.	Highest (H2a)			
H2b: Firms' emphasis on gaining moral legitimacy when describing new products is lower in the transition stage of technology lifecycle than in the other stages		Lowest (H2b)		
H3: Firms' emphasis on gaining **cognitive legitimacy** when describing new products differs among the stages of the technology lifecycle.				
H3a: Firms' emphasis on gaining cognitive legitimacy when describing new products is higher in the fluid stage of the technology lifecycle than in other stages.	Highest (H3a)			
H3b: Firms' emphasis on gaining cognitive legitimacy when describing new products is lower in the retro stage of the technology lifecycle than in other stages.				Lowest (H3b)

Customers' legitimacy-bestowing emphases and the technology lifecycle

Fisher *et al.*'s (2016) is one of the few empirical studies to consider audiences' interests and expectations and to link these with firms' legitimacy-seeking efforts. Their study finds that investors emphasise different criteria to evaluate the legitimacy of a firm depending on *what kind of legitimacy is important for them*. For example, investors in early-stage academic-based ventures seeking novel scientific developments emphasise moral legitimacy criteria such as academic reputation and compliance with academic norms, while investors in growing ventures looking for financial returns emphasise pragmatic legitimacy criteria such as financial performance and demonstrable product success (Fisher *et al.*, 2016). In developing our

hypotheses about variations in customers' legitimacy evaluation judgements across the stages of the technology lifecycle, we follow Fisher *et al.*'s (2016) suggestion that audiences' legitimacy evaluation judgments vary depending on their perception of the importance of different types of legitimacy.

Products in the **fluid stage** are based on new unproven technology (Abernathy and Utterback, 1978), meaning customers experience a much higher degree of uncertainty in engaging with such products compared with those in the later stages of the technology lifecycle (Lee and O'Connor, 2003). Research on product innovation finds that higher uncertainty means customers of radical new products have more difficulties in articulating their needs (Dougherty, 2001) and in understanding product benefits (Griffin et al., 2014). As the performance attributes of radical products are incongruent with customers' existing knowledge structures, customers have difficulties in evaluating these products' performance compared with incremental products (Mugger and Dahl, 2013). This suggests that customers' emphasis on performance evaluation — and, hence, on pragmatic legitimacy — is likely to be at its lowest for products in the fluid stage.

Product innovation research finds that for the radical products characterizing the fluid stage, lack of understanding of how they operate (i.e., cognitive legitimacy), and uncertainty about their benefits and risks (i.e., lack of a standard reference product — i.e., moral legitimacy) influence customers' evaluations of these new products (Veryzer, 1998). Lee and O'Connor (2003) suggest that for such products to overcome customers' fear of unproven technology, they need to be both distinctively novel — thus aligning with customers' normative expectations for novelty in radical new products (Taeuscher et al., 2020), and easy to comprehend (thus aligning with customers' expectations for comprehensibility). This suggests

that cognitive and moral legitimacy are important criteria customers rely on to evaluate products in the fluid stage.

During the **transition stage**, the dominant designs that emerge are in large part driven by socio-cognitive forces (Tripsas, 2008) as a common set of beliefs about the industry develops (Rosa et al., 1999). As an industry stabilises around a dominant design (Anderson and Tushman, 1990) encapsulating customers' expectations (Srinivasan *et al.*, 2006), customers begin to focus on individual products, instead of product categories (Rosa et al., 1999). Thus, we expect customers' emphasis on moral legitimacy to be at its lowest during the transition stage.

Incremental products, which are typical of the **specific stage**, are both familiar and certain (Lee *et al.*, 2003). They are based on well-established product models and represent performance improvements that can be easily assessed by customers (Mugge and Dahl, 2013). Thus, it is likely that customers will emphasise performance rather than degree of familiarity or uncertainty. Hence, we expect customers to emphasise pragmatic legitimacy the most for products in the specific stage.

There is limited evidence suggesting where customers' emphasis on cognitive legitimacy is likely to be lowest. We know for example that products in the **retro stage** are already familiar to customers (Brown et al., 2003), but so are incremental products in the specific stage. Nevertheless, for nostalgia-leaning customers, familiarity and thus comprehensibility is important for products in the retro stage (Brown et al., 2003), as they associate familiarity with these products being better than current products (Davis, 1979). In contrast, competition in the specific stage tends to focus on cost, so that customers focus on utility-based assessments around performance rather than familiarity with specific stage products. Moreover, research indicates that for incremental products in the specific stage, the novelty of product design — which is associated with familiarity — is least influential to customers' evaluations (Mugge

and Dahl, 2013), thus suggesting that familiarity is not an important criterion for customers to evaluate products in the specific stage. Thus, we expect that customers' emphasis on cognitive legitimacy will be lower in the specific stage than in other stages.

In summary, we hypothesize as shown in Table 2 about customers' relative emphases on different types of legitimacy across the technology lifecycle.

Table 2. Hypotheses 4, 5 and 6 about customers' legitimacy emphases with regards to new technology-based products.

	Fluid stage	**Transition stage**	**Specific stage**	**Retro stage**
H4: Customers' emphasis on **pragmatic legitimacy** of new products differs among the stages of the technology lifecycle.				
H4a: Customers' emphasis on pragmatic legitimacy of new products is higher in the specific stage of the technology lifecycle than in other stages.			Highest (H4a)	
H4b: Customers' emphasis on pragmatic legitimacy of new products is lower in the fluid stage of the technology lifecycle than in other stages.	Lowest (H4b)			
H5: Customers' emphasis on **moral legitimacy** of new products differs among the stages of the technology lifecycle.				
H5a: Customers' emphasis on moral legitimacy of new products is higher in the fluid stage of the technology lifecycle than in other stages.	Highest (H5a)			
H5b: Customers' emphasis on moral legitimacy of new products is lower in the transition stage of the technology lifecycle than in other stages.		Lowest (H5b)		
H6: Customers' emphasis on **cognitive legitimacy** of new products differs among the stages of the technology lifecycle.				
H6a: Customers' emphasis on cognitive legitimacy of new products is higher in the fluid stage of the technology lifecycle than in other stages.	Highest (H6a)			
H6b: Customers' emphasis on cognitive legitimacy of new products is lower in the specific stage of the technology lifecycle than in other stages.			Lowest (H6b)	

Research methodology

Our methodology involves content analysis of online data. This aligns with the growing trend of exploiting the vast stocks of data freely available online for academic research (Sena et al., 2019) to study previously elusive phenomena (Feldman et al., 2015). Studying "digital traces"

(p.78) of people's attitudes is more effective in predicting behaviour than methods such as surveys (Corritore, *et al*., 2020), hence evidence about how firms seek legitimacy is better sought right where firms seek legitimacy than by surveying managers. Similarly, opinion-rich data sources such as online reviews afford better opportunities to understand customers' opinions than asking them directly (Pang and Lee, 2008), hence evidence about how customers bestow legitimacy is better sought where they communicate their assessments than in, for example, hypothetical experiments. Therefore, we sought data that would allow us to answer the research questions in firms' descriptions of their new products on their websites and customers' online reviews of the same products on Amazon. Customers' Amazon reviews are increasingly used by scholars to examine customer behaviour, for example to examine how reviews impact sales (Chevalier and Mayzlin, 2006; Forman et al., 2008; Sonnier et al., 2011), to understand customers' responses to product design (Candi et al., 2017) and to test the relationship between online reviews and stock performance (Tirunillai and Tellis, 2013).

Guided by our focus on new products across the technology lifecycle, we selected fourteen recently launched technology-based products from the four stages of the technology lifecycle as our empirical context (see Table 3). To differentiate among stages, we considered the emergence of a new technology opportunity, which pre-figures the fluid stage, and the establishment of a dominant design, which distinguishes between the transition and specific stages (Abernathy and Utterback, 1978). Following the widely popularised but ultimately commercially failed Google glasses prototype first launched in 2013, and based on the convergence of the Internet of Things with efforts to miniaturise hardware in order to develop augmented reality wearable devices, smart glasses were selected to represent the *fluid stage*. Activity trackers, introduced in the early 1990s as wearable computers to monitor activity, represent the *transition stage*. Although there is still quite some product variety within the activity trackers market, since the emergence of the Fitbit in the late 2000s there is also

convergence on key defining features. Based on decades-old technology, digital radios represent a well-established product category in the *specific stage* where there is little differentiation among products. Finally, for the *retro stage*, we selected audio turntables as a representative product category based on a mature technology already a few generations behind (replaced with magnetic tape in the 70s, CDs in the 90s, and online streaming in the 00s), which re-emerged in a niche market.

Table 3: Products included in the study.

Product name	Product category	Firm	Stage in technology lifecycle
Bose Frames Audio Sunglasses	Smart glasses	Bose	Fluid
OhO Bluetooth Sunglasses	Smart glasses	OhO	Fluid
WGP Smart Audio Glasses	Smart glasses	WGP	Fluid
Fitbit Charge 3	Activity trackers	Fitbit	Transition
Garmin Forerunner 35	Activity trackers	Garmin	Transition
Samsung Gear Fit2	Activity trackers	Samsung	Transition
Polar M430 with GPS	Activity trackers	Polar	Transition
Pure Siesta Rise S	Radios	Pure Siesta	Specific
Roberts Zoombox 3	Radios	Roberts	Specific
VQ Christie	Radios	VQ Christie	Specific
Ion Air LP	Turntables	Ion Air	Retro
Pioneer PL-990	Turntables	Pioneer	Retro
Sony PS-LX300USB	Turntables	Sony	Retro
Denon DP-200USB	Turntables	Denon	Retro

Two researchers working independently analysed the fourteen products' descriptions on their firms' web sites for evidence of emphasis on types of legitimacy. First, the full text of each product description was segmented into blocks containing one sentence or, where sentences were longer, a part of a sentence (Berger at al., 2020). Each coder assigned one of four codes to each block: pragmatic legitimacy emphasis, moral legitimacy emphasis, cognitive legitimacy emphasis, or no legitimacy emphasis. Agreement among coders was high (84%), and in cases of disagreement, agreement was reached through discussion.

To obtain numerical scores for each type of legitimacy, we summed the number of blocks of text coded for each type of legitimacy. For comparability among product descriptions, which varied in length, these sums were divided by the number of characters in each product description. To ensure comparability among legitimacy types, the score for each type of legitimacy was standardized by subtracting the average score across all products and dividing by the standard deviation.

The 100 most recent customer reviews of each of the products were extracted from Amazon's web site using web scraping software. To ensure that the reviews were written by actual customers, we only included reviews classed as "verified purchase". This is a tag set by Amazon based on a match between a customer who has purchased a product and that customer's review.

With 1400 reviews to code, manual coding — as employed for the firms' product descriptions — was not practical. Instead, we used a natural language processing (NLP) method based on a combination of manual "training" and automated coding (Berger et al., 2020). First, we built initial lists of keywords/phrases for each type of legitimacy based on Suchman's work. For pragmatic legitimacy we included terms that express the functional value a product offers to satisfy customers' needs, such as whether it is "easy to use", of high/low "quality" or "price" and listing specific "features" that bring value to customers. For moral legitimacy we included terms that indicate alignment with generalised expectations that this is the right kind of product, such as "great product", "right", "fantastic" and "love it". We also included terms that indicated alignment with standard expectations for the product class, such as interconnectivity, as this aligns with normative expectations. For cognitive legitimacy we included terms suggesting familiarity and comprehensibility, such as "everyone" is using the product, "all the time", "easy to install" and "straightforward". All reviews were coded using the initial stock of

keywords/phrases. Two researchers working independently then coded the first ten reviews for each product manually. There was 70% agreement between the results of manual coding and automated coding. In resolving codings for which there was disagreement, additional related keywords/phrases were added, e.g., "great product" was added to "good product", and the coding was repeated. The final number of keywords/phrases was over 300.

The coding resulted in a score for emphasis on each type of legitimacy equivalent to the number of keywords or phrases found in each review. The scores were standardized for comparability.

Results

Firms' legitimacy emphases

All analyses were conducted using Stata version 17. Table 4 shows the means of the variables for firms' legitimacy emphases in each stage of the technology lifecycle.

Table 4: Firms' mean standardized legitimacy emphases in product descriptions across the stages of the technology lifecycle.

	Stage 1: fluid	Stage 2: transition	Stage 3: specific	Stage 4: retro
Pragmatic legitimacy	-1.05	-0.37	-0.04	1.19
Moral legitimacy	1.36	-0.50	-0.27	-0.39
Cognitive legitimacy	1.80	-0.34	-0.65	-0.51

Anova analysis and Bonferroni multiple-comparison tests were conducted to examine differences in emphasis on types of legitimacy in product descriptions across the technology lifecycle stages. For all types of legitimacy, differences in means were statistically significant ($p<0.01$) for all Bonferroni comparisons.

The emphasis on pragmatic legitimacy is highest for products in the retro stage, which supports H1a, but lowest for products in the fluid stage, rather than the specific stage, which was hypothesized. Thus, H1b is not supported. This seems counterintuitive as radical products in the fluid stage are based on unproven technology, whose functional performance is still developing, thus lacking pragmatic legitimacy. However, the results indicate that firms spend less effort on emphasising pragmatic legitimacy in the fluid stage compared with other stages, where the need for pragmatic legitimacy is lower as technology performance becomes better understood. This suggests that there might be other variables at play — beyond the need for legitimacy — that influence firms' legitimacy-seeking behaviour, such as the difficulty of acquiring legitimacy. Existing research suggests that firms commercialising radical products often fail in communicating their benefits to customers, as they lack understanding of their customers' needs, focusing instead on gaining credibility for their innovations through moral (e.g., expert endorsement) and cognitive (e.g., familiar brands) alignments (Aarikka-Stenroos and Lehtimaki, 2014).

For moral legitimacy, the emphasis is highest for products in the fluid stage, which supports H2a, and lowest for products in the transition stage, which supports H2b.

For cognitive legitimacy, the emphasis is highest for products in the fluid stage, which supports H3a, but lowest for products in the specific stage, rather than in the retro stage, which was hypothesised. Thus, H3b is not supported. This seems counterintuitive, as retro stage technologies have been on the market longer, and are the most comprehensible to customers. Our results suggest that firms' emphasis on legitimacy might depend also on customers' expectations about factors that shape customers' product purchasing decisions. Customers are likely to buy retro stage products based on nostalgia (Brown et al., 2003), which can lead customers to believe such products are of better quality than current alternatives (Davis, 1979).

Thus, for firms to emphasise familiarity (cognitive legitimacy) may make sense even when there is no legitimacy crisis, to trigger nostalgia among customers, which leads to an assessment of the product as being more beautiful, healthier, more exciting than current alternatives (Davis, 1979). In contrast, there might be less need to emphasize cognitive legitimacy for products based on familiar technologies in the specific stage, where competition is based primarily on cost.

Figure 1 provides an illustration of these results.

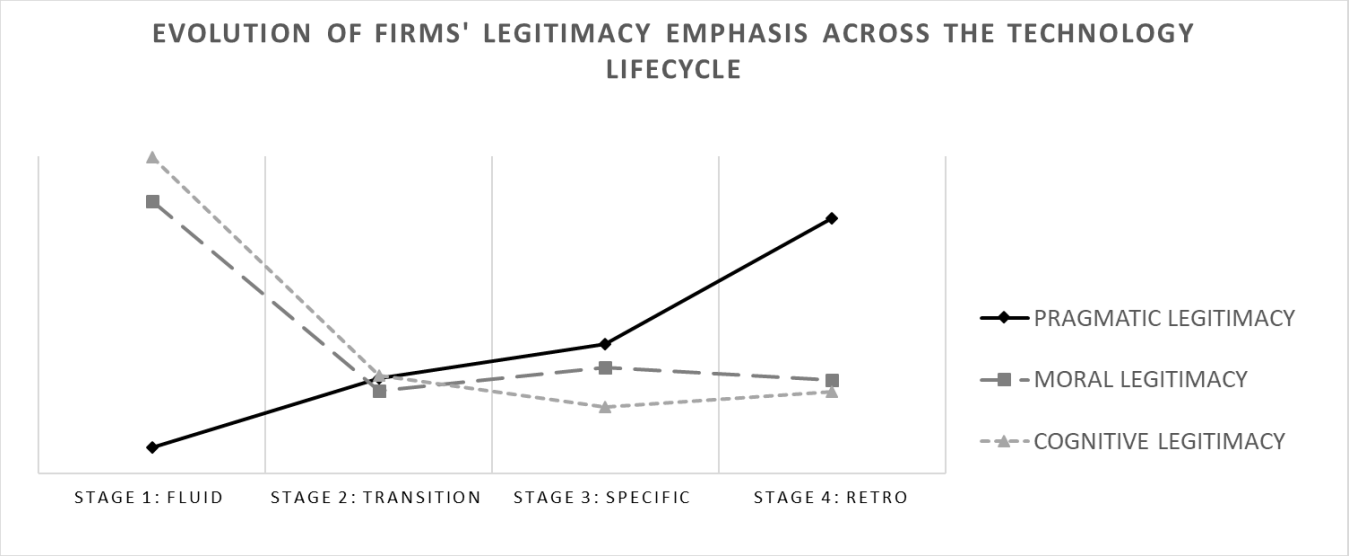

Figure 1: Summary of results of hypothesis testing for firms' legitimacy emphasis. The figure shows relative emphasis on each type of legitimacy across the technology lifecycle.

Customers' legitimacy emphases

Turning now to customers' legitimacy emphases in their product reviews, Table 5 reports the mean emphases.

Table 5: Customers' mean standardized legitimacy emphases in online reviews across the stages of the technology lifecycle.

	Stage 1: fluid	Stage 2: transition	Stage 3: specific	Stage 4: retro
Pragmatic legitimacy	-0.01	0.07	0.20	-0.20
Moral legitimacy	-0.03	-0.03	0.08	-0.01
Cognitive legitimacy	0.50	-0.12	-0.06	-0.23

Anova analysis with Bonferroni multiple-comparison tests showed that for pragmatic legitimacy there were statistically significant differences in emphasis between the fluid stage and the specific stage, between the transition stage and the retro stage and between the specific stage and the retro stage. We hypothesized that customers' emphasis on pragmatic legitimacy would be higher in the specific stage than other stages (H4a). H4a is supported by the data as regards comparisons with the fluid stage and the retro stage, but not as regards the comparison with the transition stage; the difference in emphasis on pragmatic legitimacy between the transition stage and the specific stage is not statistically significant. This suggests that product performance may be as important to customers in the transition stage — where customers begin to focus on evaluating particular products relative to each other, rather than as part of a product category (Rosa et al., 1999) — as in the specific stage, characterised by strong competition between products within well-defined product categories. Moreover, as product performance characteristics are clear and improving in both stages (Markard, 2020), customers may be better positioned to consider them in their assessments. H4b posits that customers' emphasis on pragmatic legitimacy is lowest in the fluid stage. The data indicate that customers' emphasis on pragmatic legitimacy is lowest in the retro stage and second lowest in the fluid stage; but

the difference between the two is not statistically significant. Meanwhile, the difference between the fluid stage and the specific stage is statistically significant, which lends partial support to H4b.

For moral legitimacy emphasis, no statistically significant differences were found across the stages. Thus, H5 is not supported, and we conclude that customers' emphasis on moral legitimacy does not vary across the stages of the technology lifecycle.

We hypothesized that cognitive legitimacy emphasis would be highest in the fluid stage (H6a) and lowest in the specific stage (H6b). Cognitive legitimacy emphasis was found to be highest in the fluid stage and lowest in the retro stage. The pairwise Bonferroni differences between cognitive legitimacy emphasis in the fluid stage and the other three stages are all statistically significant, thus supporting hypothesis H6a. Meanwhile, other Bonferroni differences were not statistically significant, so hypothesis H6b is only partially supported as regards the comparison between the fluid stage and the specific stage, for which there is a statistically significant difference. Low emphasis on cognitive legitimacy in the retro stage may not indicate that product familiarity does not matter in customer evaluations, but that because it matches customers' expectations (retro stage products are familiar), it is simply less emphasised in their reviews. Figure 2 illustrates the results of hypothesis testing.

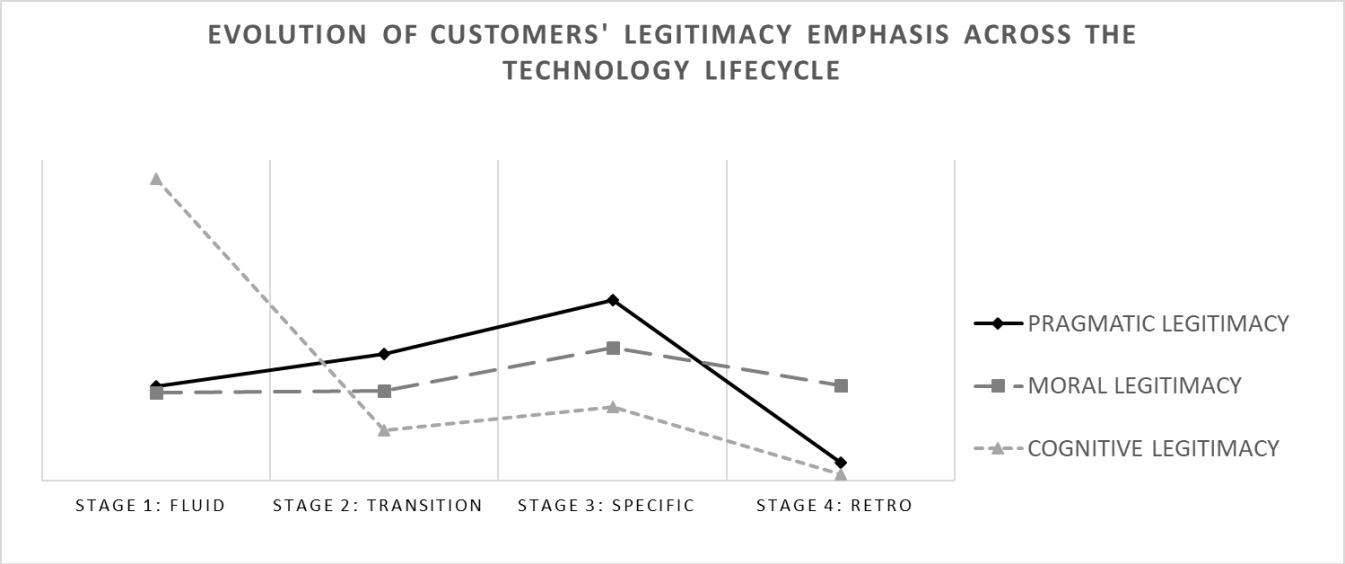

Figure 2: Results of hypothesis testing for customers' legitimacy emphasis. The figure shows relative emphasis on each type of legitimacy across the technology lifecycle.

Additional analyses

Although our choice of products was carefully deliberated, it is possible that the findings might reflect idiosyncrasies of the specific products selected. Therefore, we conducted a replication study. We undertook coding and analysis for 4 new products: Appkettle, a smart hot water kettle representing the fluid stage of the innovation lifecycle, Kindle waterproof Paperwhite, an e-reader representing the transition stage, Bose SoundLink wireless over-ear headphones representing the specific stage and a Polaroid Snap instant digital camera representing the retro stage. All 6 hypotheses were tested using the new data and the results were entirely consistent with the results reported above, which lends validity to our findings.

Since the basic premise driving this research is the notion that legitimation emphases evolve over the technology lifecycle, we conducted a longitudinal study for further validation. We selected three Fitbit activity trackers: (1) Fitbit Flex, Fitbit's first wrist-worn activity tracker launched in 2013 and arguably the activity tracker that first defined this product category, representing the fluid stage. (2) Fitbit Charge3, which was included in our main analysis as a

product representing the transition stage. The Charge3 offered substantial improvements over previous models and indications of a dominant design for activity trackers had emerged prior to its launch in 2018. (3) Fitbit Sense released in September 2020, taken as a representative product for the specific stage. The Sense aligned with the smartwatch look, which had become widely accepted at the time of its launch, but otherwise offered mostly incremental improvements over past models. Activity trackers have not yet reached the retro stage, so it was not possible to include this stage here. We scraped and analysed all the reviews for the three Fitbit products on Amazon.co.uk, and the results were consistent with those reported in Table 5 and support for hypotheses — or the lack thereof — was consistent with the main analysis. This lends further support and credence to our findings. The findings are illustrated in Figure 3.

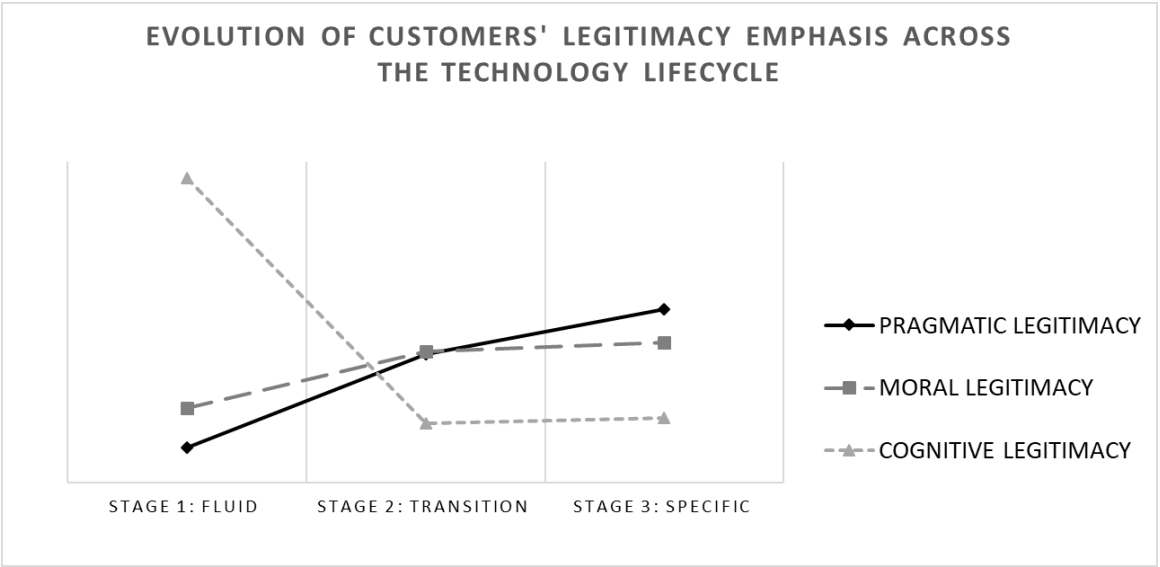

Figure 3: Results of longitudinal replication testing using three Fitbit models.

Discussion and Implications

Existing research on technology legitimation falls short of examining how individual firms seek legitimacy for their new technology-based products, how customers emphasise legitimacy

in their product evaluations, and how this varies over the technology lifecycle. We examine these questions by drawing from organization (Suchman, 1995), innovation (Bergek et al., 2008) and marketing (Giesler, 2012) literature.

Our findings indicate that while firms' emphasis on moral legitimacy varies across the stages of the technology lifecycle depending on the need for such legitimacy (highest in the fluid stage and lowest in the transition stage), customers' emphasis on moral legitimacy is not significantly different among the four stages. We also note clear differences in firms' and customers' pragmatic legitimacy emphasis with firms emphasizing pragmatic legitimacy most in the retro stage while customers emphasize it more in the transition and specific stages. These differences support our argument that firms' and customers' emphases on legitimacy in technology-based products exhibit different patterns and need to be studied as different phenomena.

Furthermore, as expected, we find that firms' emphasis on gaining legitimacy varies across the technology lifecycle largely depending on the need for legitimacy. However, our results suggest that when the need for pragmatic and cognitive legitimacy is low, other factors may drive firms' efforts to gain legitimacy, such as the ease with which firms can acquire legitimacy (for pragmatic legitimacy), and their expectations about what matters for their customers (for cognitive legitimacy).

Finally, we find support for the notion that customers' emphasis on pragmatic and cognitive legitimacy varies across the technology lifecycle, while moral legitimacy emphasis does not. It is also interesting to note that on the customer side, cognitive legitimacy is most important in the fluid stage, indicating that for customers it is important to first understand the technology underpinning new products, before they can evaluate alignment with their interests or beliefs.

Implications for theory

Our work offers three contributions to theory. First, most existing research tends to examine new product/technology acceptance either by emphasising the strategic, utility driven assessment matching technology characteristics with individual needs (Roger, 2003), or the institutional based assessment of a new product/technology vis-à-vis societal norms and mental models (e.g. Bergek, 2008; Giesler, 2012). We bridge the strategic and institutional aspects of acceptance within a single coherent framework. We thus address a key criticism levelled at diffusion of innovation approaches which, despite early recognition that social context matters (Gatignon and Robertson, 1985), have tended either to reduce this to one dimension only (i.e. compatibility with social norms, Holack and Lehmann, 1990), or to rely on complementary theories to account for it (Jeyaraj et al., 2006). Instead, our reliance on Suchman's legitimacy framework (1995) allows for a finer-grained understanding of the role of both individuals — which emphasise pragmatic evaluation in terms of alignment with their interest — and the wider social context in which such acceptance takes place — which highlights the role of cognitive and normative expectations. Furthermore, we develop a new method for detecting emphases on the three types of legitimacy proposed by Suchman in natural language.

Second, prior technology legitimation studies focus on the macro level — fields, institutions or technology systems — and consider collective efforts to seek legitimacy (Bergek et al., 2008). In contrast, we consider individual actors' legitimation efforts, focusing on firms and their customers. Our analysis demonstrates that firms' legitimacy-seeking (Suchman, 1995) and customers' legitimacy-bestowing (Tost, 2011) are distinct phenomena, underpinned by different mechanisms and need to be treated differently. Firms' legitimation behaviour is mostly driven by the need for legitimacy (Markard et al., 2016). Customers' legitimacy emphases follow different patterns which, drawing from product innovation and marketing research, we link to the relative importance customers ascribe to types of legitimacy. The

findings partially support our hypotheses for pragmatic and cognitive legitimacy, but not for moral legitimacy. In addressing those hypotheses not (fully) supported, we point to other potential factors that may be at play when emphasis on legitimacy is low, such as the ease of acquiring legitimacy, firms' expectations about what shapes their audiences' product evaluation, and firms' efforts to explain products. Our approach demonstrates the value of bridging between technology and product innovation research in enhancing our understanding of micro-level phenomena involved in technology innovation in general, and legitimacy in particular.

Third, we highlight the need for research to go beyond examining legitimacy during the early stage of the technology lifecycle (Hall et al., 2014) as firms seek not only to gain, but also to maintain or repair legitimacy during the entire technology lifecycle (see also Markard et al., 2016). Our findings demonstrate that firms' efforts to seek legitimacy for their technology-based product innovations, as well as customers' legitimacy emphases, vary across the lifecycle of the technology underpinning these products. We thus advance the understanding of legitimation behaviour of individual actors in relation to technology-based product innovations by tracing variations in such behaviour over time and linking these temporal patterns to changes in the need for legitimacy and importance of legitimacy for customers' product evaluations. Finally, in the spirit of extending legitimation inquiry beyond the early stage of a technology, we also propose a fourth stage of the technology lifecycle, namely the retro stage.

Implications for practice

For managers, understanding how customers bestow legitimacy on new technology-based products, how this differs from firms' own inclinations to seek legitimacy, and how both change over the technology lifecycle can help better target new product launch strategies. Our findings suggest that to facilitate the adoption of new technology-based products, firms should

emphasise cognitive legitimacy in the fluid stage of the technology lifecycle, pragmatic legitimacy in the transition stage, and moral legitimacy in the retro stage to align with their customers' emphases.

Our findings indicate that when describing new products based on technologies in the fluid stage of the technology lifecycle, firms are likely to emphasize moral legitimacy over other types of legitimacy while customers emphasize cognitive legitimacy. Thus, managers are advised to shift their efforts to establishing alignment between their new products and what their customers are familiar with, instead of appealing to customers' opinions of what is "right". When describing new products based on technologies in the transition stage, firms emphasize cognitive legitimacy, but customers emphasize pragmatic legitimacy. Thus, here managers are advised to highlight the features, functionality and convenience of their products, rather than familiarity to customers. When describing new products based on technologies in the specific stage, both firms and customers emphasize pragmatic legitimacy, so this seems to be the stage where firms are best aligned with customers. Indeed, launching new products based on specific stage technologies is common and methods to gain legitimacy can be expected to be well established. Finally, in the retro stage, our findings indicate that firms tend to emphasize pragmatic legitimacy, while customers emphasize moral legitimacy. Firms may over-estimate the need to prove that their new products based on technologies in the retro stage work properly while their customers are more concerned with these products being aligned with their values and norms.

Limitations and future research

The method we use to measure legitimacy in online reviews is novel, but it also has limitations. First, the decisions made about which terms to define as representative of each type of legitimacy were unavoidably biased by the content of the review texts analysed and, therefore,

they may not translate well to other empirical contexts. Secondly, although the terms were carefully deliberated, there is a possibility of overlap. Future research should endeavour to develop more precise measures of legitimacy in natural language that have broad applicability. Furthermore, there may be overlaps between assessments of the social impact of innovations (Molecke and Pache, 2019) and legitimacy, particularly moral legitimacy. Hence, there could be promising avenues for future research that bring social responsibility/innovation perspectives to the discourse on technology-based product legitimacy.

Different groups of customers may have different needs (Adner and Levinthal, 2001) and may operate in different contexts. Hence their pragmatic, normative and cognitive evaluations of a product may differ. For example, customers' ability to understand a product within a particular cognitive frame may shape their product evaluations, which might explain why we found somewhat counterintuitive results for products in the retro stage. Furthermore, a potential self-selection bias for writing online reviews cannot be disregarded (Li and Hitt, 2008) nor people's motivations for providing online reviews (Roberts et al., 2017). Examining the range of factors that influence how different categories of customers emphasise legitimacy in their product evaluations is important, as this can point towards ways in which firms can actively shape these evaluations. Future research could examine whether legitimacy emphases vary across types of customers groups, their motivations, and between those that do and do not write online reviews.

Legitimacy is important because it is associated with the success of a new technology (Bergek et al., 2008). An important avenue for future research would be to consider how the variations observed in firms' and customers' legitimacy emphasis are related to technology/product success. This is important, as presumably success depends not only on whether, but also on how, legitimacy it is sought or bestowed.

Finally, our proposal to add a retro stage to the technology lifecycle calls for further empirical research and theoretical development to better understand what happens after the specific stage of the technology lifecycle.

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