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Social media, open innovation & HRM: Implications for performance

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ABSTRACT

Firms are increasingly leveraging social media tools to access knowledge from external actors, particularly customers and other users, to facilitate the innovation process and firm performance. Yet empirical research investigating the impact of external knowledge sourced via social media tools is scant; empirical studies that do exist are mixed, leading to calls for research into the conditions under which knowledge flows via social media from external actors contribute to innovation and firm performance. Using a large-scale survey of firms in Tasmania, Australia, this study examines how external knowledge flows from market-based actors sourced by social media influence innovation and business performance, and the extent to which modern human resource management (HRM) practices moderate this relationship. We find that while knowledge flows from market-based actors are positively related to innovativeness, the relationship between external knowledge flows via social media and innovativeness depends on the importance a firm places on modern HRM practices: a significant positive relationship exists between knowledge sourced via social media and innovativeness when firms attach high importance to modern HRM practices. In contrast, there is no significant relationship in firms in which modern HRM practices are of low importance.

The study also shows that social media serves as a mediator for the effect of external knowledge flows on firm innovativeness when firms attach high importance to modern HRM practices. Furthermore, while the results demonstrate that innovativeness and firm performance are positively related, innovativeness does not translate into improved firm performance in firms that attach low importance to modern HRM practices. Taken together, the findings underscore the importance of modern HRM practices to enable knowledge inflows via social media to influence innovativeness, and innovativeness to translate into productivity benefits.

1. Introduction

In recent years, social media has attracted significant attention, with its adoption moving beyond personal use, as businesses and institutions in the public sector (i.e., governments and NGOs), the education sector, and the commercial sector increasingly adopt social media for a range of purposes (Lam et al., 2016; Ngai et al., 2015). These include sales and marketing; customer service and customer relationship management; internal and external communication and collaboration, particularly inter-firm collaboration and supply chain management; and information and knowledge sharing, especially in respect of idea generation and new product development (refer to Table 1 for examples that illustrate these uses of social media).

As outlined above and illustrated in Table 1, a key trend in recent literature is the use of social media to allow users internal and external to the organisation to communicate and collaborate in the innovation process (Marion et al., 2014; Ooms et al., 2015; Roberts and Candi,

2014). Social media refers to “a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user generated content” (Kaplan and Haenlein, 2010, p. 61). Examples include wikis, weblogs, social networking sites and file sharing sites. While the social media phenomenon has attracted significant practitioner and scholarly interest in recent times (Papagiannidis and Bourlakis, 2015), there is a dearth of research examining what influence these new tools have on innovation and business performance (Roberts and Candi, 2014). Empirical work that does exist on outcomes, particularly on new product development (NPD) outcomes, appears equivocal at best regarding their impact. For example, while Durmusoglu et al. (2006) found no relationship between information technology tools and NPD outcomes, Barczak et al. (2007) report that information technology usage impacted some performance measures (e.g., the performance of the new product in the marketplace), but not others (e.g., speed-to-market). Similarly, Roberts and Candi (2014) found that, on the one hand, the

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Table 1
Social media uses: some illustrations.
Source: Lam et al. (2016, p. 3).

Social media uses	Examples
<p><i>Sales and marketing.</i> Social media is a marketing tool and a central element of firms' and institutions' strategies for integrated marketing communication (Mangold and Faulds, 2009); in particular, social media is considered as a new component in the marketing promotional mix (Ngai et al., 2015).</p>	<p>The Walt Disney Corp. developed an application (Disney Tickets Together) available to Facebook users to purchase tickets, as well as to harness the power of social networking, with users communicating, sharing experiences and recommending other users to also buy tickets.</p>
<p><i>Customer service and customer relationship management (CRM).</i> Firms and institutions adopt social media to manage and improve their interactions and relationships with current and potential customers.</p>	<p>The Royal Bank of Scotland (RBS) used social media to help implement its 'helpful banking' positioning, via a social CRM initiative that allows customers to provide feedback on its banking services</p>
<p><i>Collaboration and communications.</i> Organisations increasingly utilise the superior communication and interaction features of social media to enhance collaboration and communication both within the organisation as well as between companies and other external actors (Lam et al., 2016; Ngai et al., 2015).</p>	<p>Unisyn Corp. launched an internal equivalent (My site) of Facebook in which its employees globally – including top management – have the opportunity to discuss their work, ask questions and share best practices.</p>
<p><i>Information and knowledge sharing, especially in new product development/idea generation.</i> Social media contributes to, and facilitates the sharing of information and knowledge in online communities, especially knowledge related to product information and/or customer experiences.</p>	<p>Starbucks, the international coffee house chain, uses social media (My Starbucks Idea) to transform customers from passive recipients into active contributors of ideas and participate in new product development (Chua and Banerjee, 2013). Social media can also be used to distribute and share information with users in emergency situations, with the Haiti earthquake in January 2010 illustrating how the responsibilities of traditional public relations to share information are distributed to social media users (Smith, 2010).</p>

use of social network sites for market research for NPD contribute negatively to market growth and profitability, and on the other, the use of social network sites for customer collaboration contributed to innovation, but did not translate into financial benefits. Roberts and Candi (2014) conclude that the benefits of utilising social network sites in NPD are on the whole not being achieved by enterprises, a finding shared by Marion et al. (2014). Yet research by Markham and Lee (2013) demonstrated that high performing businesses utilise a range of IT tools to speed time-to-market of new products. Thus questions pertaining to the effect of social media on innovation and business performance remain, with researchers increasingly investigating the circumstances under which the use of social media in the innovation process improves firm performance (Marion et al., 2014; Ooms et al., 2015; Roberts and Candi, 2014).

In the open innovation literature, attention is increasingly focusing on internal organisation – particularly the so-called modern human resource management (HRM) practices – as a key factor explaining why some firms outperform others when sourcing knowledge externally (Chesbrough and Brunswicker, 2013; Foss et al., 2010; Foss et al., 2011; Ihl et al., 2012; Laursen and Foss, 2013; Lazzarotti et al., 2015; Ooms et al., 2015; Petroni et al., 2012; Pisano and Verganti, 2008). Foss et al. (2011) posit that in the innovation context, in order to leverage user and customer knowledge, firms must design an appropriate internal organisation, and specifically, use modern HRM practices involving intensive levels of vertical and lateral communication, provide rewards for employee acquisition and sharing of knowledge, and delegate decision rights. Based on the results of a survey of 169 large firms in Denmark, Foss et al. (2011) conclude that a necessary condition for strong innovative performance is combining customer interaction with modern HRM practices. In their absence, high levels of innovative performance do not appear to be attainable (Brunswicker and Vanhaverbeke, 2011; Chesbrough and Brunswicker, 2013; Ihl et al., 2012). However, to date, empirical research has tended to focus on the activities of large organisations (Foss et al., 2011; Ooms et al., 2015), leading to calls for more empirical work on firms' internal context in explaining the success or failure of open innovation (Dahlander and Gann, 2010; Lazzarotti et al., 2015; van de Vrande et al., 2009).

Furthermore, despite recognition that the communication channel is pivotal in enabling the (customer) co-creation process, empirical research investigating the influence of communication channels, particularly social media /Web 2.0 technologies, is limited (Mahr et al., 2014). As outlined above, research that does exist is mixed. This lack of research is surprising, given that the use of social media technologies as knowledge transfer mechanisms is rapidly gaining momentum, and is a

potentially useful tool for encouraging knowledge transfer and collaboration beyond firm boundaries (Murphy and Salomone, 2013). Moreover, qualitative research indicates that it is not simply the introduction of these applications that drive collaborative success, rather, organisations need to take a more holistic approach and consider how these technological tools impact how people work (Murphy and Salomone, 2013). In particular, Dutta and Fraser (2009) and others (Roberts and Candi, 2014) note the need for organisational change in order to enable technologies to be adopted. This accords with recent work in the HR literature that attributes a key role to internal organisation.

The purpose of this study is to address these gaps, by investigating the relationships between external knowledge sourced from market-based actors via social media, modern HRM practices, innovation and firm performance. The research addresses the following research questions:

How does external knowledge flows from market-based actors sourced by social media influence innovation and business performance? Do modern HRM practices moderate the relationship between external knowledge flows from market-based actors sourced via social media and innovativeness?

We focus on market-based actors comprising customers, suppliers and business consultants, as research in both the innovation and marketing literatures (Baldwin and von Hippel, 2011; Bogers and West, 2012; Laursen and Salter, 2006; Randhawa et al., 2016) highlights that value chain partners such as suppliers and customers tend to be the most accessed source for knowledge in open innovation, particularly when sourced via social media (Aral et al., 2013; Mount and Martinez, 2014). While customer interaction has always been important in new product development (NPD) (Urban and Von Hippel, 1988), social media has greatly enhanced the ability of firms to collaborate with customers in the NPD process (Dahan and Hauser, 2002). Yet despite an early focus on customer co-creation aspects of open innovation, these topics are not prominent in recent open innovation research, leading to calls for further work (Randhawa et al., 2016). The practical importance of collaborating with supply-chain linkages (i.e. with customers and suppliers) via social media, together with the fact that the role of users as external sources of innovation remain relatively under-researched (Randhawa et al., 2016), warrants further investigation. We also include business consultants. Business consultants are providers of specialised knowledge that they offer on the market (Tether and Tajar, 2008). Richter and Niewiem (2009) show that the involvement of consultants in open innovation activities is determined by the knowledge requirement of the firm, emphasising the permeability of the

boundaries between an innovating firm and their business consultants. Moreover, firms purchase specialised knowledge from their consultants which the consultant can pool and apply efficiently across many different innovation projects (Richter and Niewiem, 2009). Gassmann (2006) points out that new ICT and in particular the Internet provide the opportunity for new firm-consultant relationships since many consultants perform as “portfolio workers”, offering their specialised knowledge to different clients at the same time.

Thus the contribution of this study to the innovation management literature is twofold. First, it adds to the few, large-scale surveys that have investigated the impact of knowledge flows via social media from market-based actors on innovation and firm performance. Prior empirical work mainly draws on users in a single virtual community (Mahr et al., 2014) or customers of a single organisation (Marion et al., 2014). By utilising a large-scale survey of businesses in Tasmania, Australia we address this gap, providing quantitative evidence on the impact of knowledge flows via social media from market-based actors on innovation and firm performance.

Second, we extend extant research that examines the effect of new organisational practices in accessing customer-based knowledge (Foss et al., 2011) and demonstrate how firms can organise to benefit from external knowledge sourced through social media, utilising so-called modern HRM practices. The term “new” or “modern” HRM practices (also referred to as new organisational or new management practices and “High-Performance Work Practices”) (Foss et al., 2011; Laursen and Foss, 2013) typically includes practices such as high levels of delegation of decisions and extensive lateral and vertical communication channels (among others) that are separate and distinct from traditional HRM practices (e.g. recruitment, training, promotion etc.). As noted above, to date, little empirical research investigates the role of organisational design in providing a more comprehensive understanding of firms' performance in the open innovation context (Colombo et al., 2011; Flatten et al., 2011; Ihl et al., 2012; Lazzarotti et al., 2015; Mount and Martinez, 2014). In particular, there is scant understanding in the innovation management – or marketing – literature (Foss et al., 2011) of how enterprises organise for and implement social media for open innovation (Mount and Martinez, 2014) and the role of new organisational practices in explaining why some firms benefit more than others (Ihl et al., 2012). Research that does exist tends to be qualitative in nature (Mount and Martinez, 2014), or where quantitative evidence exists, the focus is on the role of new organisational practices in facilitating knowledge sourced from customers in general (Foss et al., 2011), rather than external knowledge sourced via social media. Thus there exists an incomplete picture about how knowledge sourced from customers is leveraged in the innovation context (Foss et al., 2011). This is surprising, given the recent proliferation of the use of Web 2.0 technologies or social media via numerous social networking communities, including YouTube, Facebook and Twitter (Papagiannidis and

Bourlakis, 2015), enabling external actors, and customers in particular, to interact and collaborate with firms (Aral et al., 2013; Mount and Martinez, 2014).

Thus by explicitly examining the relationship between knowledge sourced through social media, innovation and performance, and delineating the HRM conditions under which knowledge flows via social media from market-based actors contribute to innovation and firm performance (Roberts and Candi, 2014) we address this gap. In so doing, the study also responds to calls for more research on organisational mechanisms that underlie inter- and intra-organisational use of boundary-spanning tools, including social media (Ooms et al., 2015). Further, we provide a more fine-grained analysis by distinguishing between different levels of importance attached to HR practices. We find that while knowledge flows from market-based actors are positively related to innovativeness, the relationship between external knowledge flows via social media and innovativeness depends on the importance a firm places on modern HRM practices: a significant positive relationship exists between knowledge sourced via social media and innovativeness when firms attach high importance to modern HRM practices. In contrast, there is no significant relationship in firms in which modern HRM practices are of low importance.

The study also shows that social media serves as a mediator for the effect of external knowledge flows on firm innovativeness when firms attach high importance to modern HRM practices. Furthermore, while the results demonstrate that innovativeness and firm performance are positively related, innovativeness does not translate into improved firm performance in firms that attach low importance to modern HRM practices. Taken together, the findings underscore the importance of modern HRM practices to enable knowledge inflows via social media to influence innovativeness, and innovativeness to translate into productivity benefits.

The rest of the paper is organised as follows. Section 2 presents the conceptual model and hypotheses. Thereafter we outline the data collection and source, and variable measurement (section 3). Results of the statistical analyses are presented in section 4. Section 5 discusses the findings while section 5 outlines the conclusions and implications for research and practice.

2. Literature review

Fig. 1 presents the conceptual framework for the study that shows the hypothesised relationships between knowledge inflows from market-based actors, social media, innovativeness and firm performance. Our research is primarily interested in the role of external knowledge from market based actors sourced via social media, innovation and firm performance, and the HRM conditions under which knowledge flows via social media from market based actors contribute to firm performance. However, traditionally research posits a direct

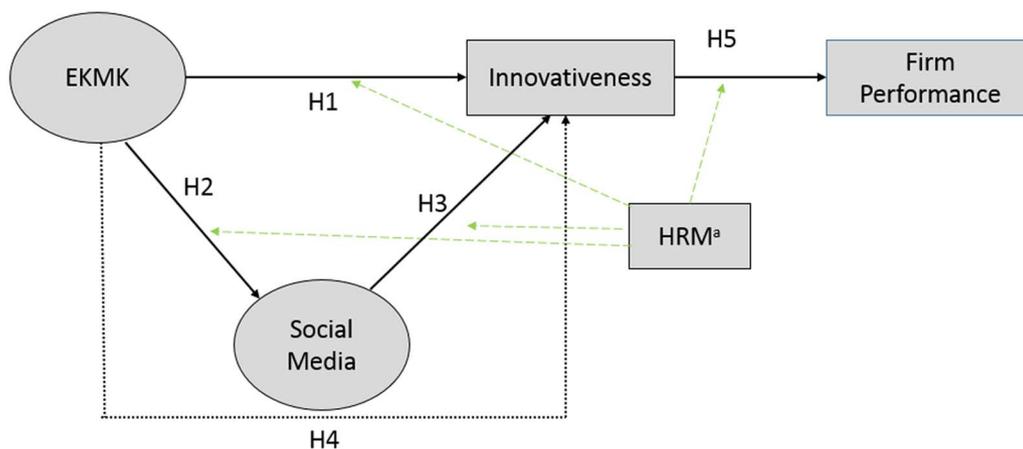


Fig. 1. Conceptual model.

^aDashed lines represent mediating (indirect) effects.

^bHypothesis will be measured comparing two groups' low/high HRM practices.

relationship between external knowledge inflows from market-based actors and innovation (Hypothesis H1). We include this relationship in the model as we are interested in understanding the mechanisms behind the effect of external knowledge on innovation performance, including the role of modern HR practices.

2.1. External knowledge flows from market-based actors and innovativeness

Enterprises can collaborate with a diverse range of different providers or sources of knowledge, including market-based actors comprising customers and suppliers who are typically conceptualised as providing market-based knowledge (Danneels, 2002; Du et al., 2012). While empirical studies indicate that market-based actors are important sources of knowledge for innovation outcomes (Faems et al., 2005; Hughes et al., 2009; Lasagni, 2012; West and Bogers, 2014), there is no clear consensus about which is more beneficial — knowledge sourced from customers or suppliers. Some research finds that customers are most important (Davenport, 2005; Enkel et al., 2009; Mina et al., 2014; Moilanen et al., 2014; Theyel, 2012), while other work suggests that suppliers are more important (Laursen and Salter, 2006). For example, Moilanen et al. (2014) find that external knowledge inflows from a range of actors improve firm innovation performance; however, the single most important relationship is with customers, who have a direct positive effect on innovation performance. Sourcing knowledge and ideas from customers and end users during new product development is logical as customers have close links to markets (Pittaway et al., 2004) and thus are able to provide first-hand information, including critical insights in respect of market needs and future demand (Von Hippel, 2005). Arguably, knowledge about market preferences and requirements that is timely and reliable is the single most important type of information needed for product development (Cooper and Edgett, 2008; Dyer, 1996; Henkel and Von Hippel, 2005; Ogawa and Piller, 2006; Woodruff, 1997). Customer input can help firms produce customized and commercially viable products thereby reducing risks with innovation, and economising on resources (Parida et al., 2012).

Suppliers, on the other hand, can assist in outlining the possibilities for innovation on the basis of their direct knowledge of the materials, equipment and techniques that they supply (Kaufman et al., 2000). In particular, collaborating with suppliers facilitates the improvement and further development of existing production technologies and processes (Faems et al., 2005), since suppliers have expertise and knowledge on the most up to date technologies and components available on the market (Du et al., 2012). Sourcing knowledge from suppliers may also enable the identification of potential technical problems early in the innovation process (Kessler and Chakrabarti, 1996) thereby improving product reliability and performance (Dyer, 1996; Langerak and Hultink, 2005). In summary, the foregoing implies that knowledge sourced from market-based actors form the basis of innovation.

Hence we hypothesise:

H1. *External knowledge flows from market-based actors are positively associated with firm innovativeness.*

2.2. External knowledge flows from market-based actors and social media

While the foregoing states that a direct link exists between market-based actors and innovation, collaboration with market-based actors may also occur through social media, with research showing that social media is increasingly being adopted in organisations as a knowledge transfer mechanism (Jespersen, 2011; Murphy and Salomone, 2013; Piller et al., 2012).

The Internet is an ideal digital-based platform for collaboration and knowledge exchange between firms (Lucio-Nieto et al., 2012) as it is underpinned by the democratization of knowledge, and as a consequence facilitates collaboration and knowledge flows which, inter alia, may be used to facilitate creativity and innovation (Lucio-Nieto

et al., 2012; Pérez-López and Alegre, 2012; Soto-Acosta et al., 2011). The social web constitutes an Internet-based digital platform that enables the formation of social networks, facilitating information distribution and knowledge sharing (Joo and Normatov, 2013; Pan, 2012). Consequently, firms are deploying social web technologies including social networking, wikis, and internal blogging to facilitate collaboration and social web knowledge sharing within and external to their boundaries (Lim et al., 2010; Soto-Acosta et al., 2014a; Soto-Acosta et al., 2014b).

As noted above, social media refers to highly interactive platforms in which individuals and communities may share, co-create, discuss and/or modify user-generated content (Piller et al., 2012). Social media enhances collaboration by establishing online channels and communities that companies use for interaction with users, particularly in the idea-generation and product development stages, vastly increasing the breadth and depth of user input. For example, online channels such as internet websites, emails and social networks have enabled users to submit ideas or suggestions for new products or improvements to existing products, evaluate and select among designs (through online surveys, suggestion boxes and competitions), or to experiment via simulations and virtual product testing (Hoyer et al., 2010; Jespersen, 2011). Social technologies including online customer communities, social networking sites, instant messaging together with wikis also provide opportunities to involve market-based actors, particularly consumers, in the commercialisation and post launch stages of an NP. For example, firms can release information to their consumer community via social media tools creating awareness or “buzz” about a product or service, and provide online sites that encourage consumer-consumer interactions enabling potential consumers to share ideas, experiences and feedback with other potential consumers that the firm then monitors and utilises (Hoyer et al., 2010). Social media can also be used internally to support improved internal communication, faster access to information and knowledge management, and collaboration among employees (Meske and Stieglitz, 2013).

Because social media tools enable more flexibility and are more open to participation, they enable diverse and larger groups of people to connect vis-a-vis traditional communication channels, leading to more connections. This may enable individual consumers to more easily find and collaborate online with other consumers who may possess complementary information needed to solve an innovation problem. By connecting otherwise disconnected sources of knowledge and insight, social media increases the potential for serendipitous discovery of knowledge from previously unconnected sources (Jansen et al., 2005; Murphy and Salomone, 2013; Ooms et al., 2015). The multi-medium, multi-directional, viral nature of social media allows for the communication and sharing of knowledge far beyond the confines of traditional knowledge management mechanisms, enabling organisations to leverage previously unavailable information and expertise from market-based actors (Murphy and Salomone, 2013). The premise that underlies the use of these tools is that firms can enlarge their information base in respect of customer needs, applications and solutions that users, suppliers and experts (among others) have, and that the company can then use this knowledge to increase the effectiveness and efficiency of the innovation process, particularly in the concept generation phase (Piller et al., 2012). Thus we propose:

H2. *External knowledge flows from market-based actors are positively associated with social media use.¹*

¹ As indicated by an anonymous reviewer, there could be a two-way causal relationship between knowledge sourcing from market-based actors and the use of social media. Hypothesis H2 therefore allows for the possibility that some knowledge and information from market-based actors was provided to the firm only because social media is now available as a knowledge sourcing channel.

2.3. External knowledge flows from market-based actors via social media and innovativeness: The direct effect

Research shows that firms are utilising Web 2.0 technologies, and social media in particular, to access market-based knowledge for the NPD process in order to improve performance, including improving innovation outcomes (Marion et al., 2014; Roberts and Candi, 2014). Specifically, social media are used for market research, collaboration with their customers, users and suppliers, and, in particular, to engage and facilitate customers and users in the innovation process, particularly in NPD (Jespersen, 2011; Piller et al., 2012; Prahalad and Ramaswamy, 2013; Roberts and Candi, 2014; Sawhney et al., 2005). We delineate the theoretical arguments and empirical evidence for the use of social media for these purposes below.

The premise underlying the utilization of social media to guide NPD is that they provide a new dimension offering unparalleled reach and speed for the collection, analysis and dissemination of information about the customer and market (e.g., market research), and can improve the firm's understanding of consumers and help develop products that customers value and embrace. This is especially important in the early stage of NPD, when firms can utilise social network sites to test and iterate new ideas and product concepts in real time (Roberts and Candi, 2014). Despite these purported advantages, Roberts and Candi (2014) find no relationship between social network sites leveraged for market research and innovativeness, and conclude that the tools to achieve this are still evolving. Along similar lines, Marion et al. (2014) attribute the lack of a significant impact of social network tools on performance outcomes (i.e., NPD team collaboration or concepts/prototypes generated) to their limited use in the development phase.

In contrast, research indicates that the relationship between social network sites for collaboration with customers and innovativeness is positive, with firms tapping into virtual communities of customers who suggest new ideas, particularly in the idea generation process and concept development, leading to products that are highly valued by customers, and are characterised by a high level of novelty (Roberts and Candi, 2014). Leveraging social network sites for marketing and product launch is also positively related to innovativeness, with social network sites offering innovative, interactive platforms (e.g., community sites and blogs) to communicate with customers in an informal and personalised manner (Roberts and Candi, 2014), enabling businesses to get close to their customers vis-a-vis traditional communication methods. Positive word of mouth through 'online friends' is a particularly influential source of new product and brand information that can help to create interest in new product launch activities as well as increase early acceptance of products (Roberts and Candi, 2014).

In summary, empirical evidence on the impact of social media tools on NPD performance is limited (Mahr et al., 2014; Marion et al., 2014; Roberts and Candi, 2014). Research that does exist has been equivocal regarding its impact, with some research suggesting that the use of social network sites to collaborate with customers in the NPD process, or to launch new products, is positively related with innovativeness (Roberts and Candi, 2014) while other empirical evidence indicates that social media tools (e.g. weblogs and Twitter) have no impact on NPD performance (Marion et al., 2014). Similarly, empirical research shows no statistically significant relationship between the use of social networking sites for market research for the development of new products and innovation (Roberts and Candi, 2014). Despite mixed findings in respect of the effect of external knowledge sourced from customers via social media on innovation, and on the basis of theorised benefits, we posit a positive relationship as stated in the following hypothesis:

H3. Social media use is positively related to firm innovativeness.

2.4. External knowledge flows from market-based actors and innovativeness: The mediating role of social media

In the open innovation era, knowledge acquisition and exploitation from external actors have been a popular choice for improving firm-level innovation. While the extant literature suggests a complicated relationship between external knowledge acquisition and innovation it has not fully explicated the mechanism(s) behind this relationship (Qin et al., 2014). We suggest that social media mediates this relationship as explained below.

Cerne et al. (2013) find that knowledge exchange results in innovation through IT systems (computers, Internet, communications devices, etc.) that enable information and knowledge to flow within an organisation. In other words, IT system development and utilization was found to be a partial mediator in the knowledge exchange- (management) innovation relationship in non-Anglo-Saxon countries (Cerne et al., 2013).

However, research also highlights the role of Information and Communication Technologies (ICT) in vastly increasing the ability of firms to work across different organisational and geographic boundaries (Pavitt, 2003) with social media increasingly being adopted by organisations to enhance the effectiveness of knowledge acquisition and sharing practices (Amidi et al., 2015).

Thus we extend previous analyses by moving beyond the role of ICT in internal knowledge exchange (Cerne et al., 2013) and focus on ICT that enable the exchange of distributed sources of innovation knowledge; in other words, sources external to the focal organisation. We focus on one specific form of new Web 2.0 technology – social media – and its role in supporting the innovation process, by forging closer links with market-based actors, which are crucial for providing market-based knowledge needed for successful innovation (Laursen and Salter, 2006). Specifically, we examine the mediating role of social media, which we argue is critical in facilitating the interdependencies and knowledge flows that occur in the open innovation process, as it enables customers and suppliers to collaborate and exchange knowledge with the focal firm enhancing information and knowledge sharing, which, in turn, can generate the requisite knowledge to transform ideas into innovation outcomes (Lucio-Nieto et al., 2012; Pérez-López and Alegre, 2012; Soto-Acosta et al., 2011). Therefore, we suggest that:

H4. Social media mediates the relationship between market based actors and innovation.

2.5. Innovation and performance

Our fifth hypothesis concerns the relationship between innovation and firm performance. Much of the extant literature highlights the advantages of openness, and the potential positive impact of knowledge sourced from external actors on an enterprise's business success and financial performance (Laursen and Salter, 2006; Torkkeli et al., 2009; West and Bogers, 2014). For example, external knowledge linkages, particularly naturally occurring supply chain linkages (Vahter et al., 2014) can increase the likelihood of obtaining knowledge complementary with the enterprise's internal knowledge (Cassiman and Veugelers, 2006; Roper et al., 2008), which when recombined with the firm's existing knowledge base and applied to commercial ends may enhance the firm's revenue potential and, ultimately, business performance (e.g. Tsai, 2001). In addition, significant cost savings can accrue through the acquisition of consumer and/or supplier input, which may decrease the need for input from employees (Hoyer et al., 2010). Further, the acquisition of knowledge through external linkages with existing suppliers and customers involves relatively low entry costs, and is less likely to incur the same fixed costs as performing in-house research and development (Vahter et al., 2014). Resources and risks may be shared among collaboration partners, generating higher commercial returns (Chesbrough, 2003; Chesbrough and Crowther, 2006).

Despite these purported benefits, existing empirical research on the openness-performance relationship is mixed, with some studies finding a positive relationship (e.g. Laursen and Salter, 2006; Spithoven et al., 2013; Vahter et al., 2014), and others no (Rosenbusch et al., 2011), or negative relationships (e.g. Kostopoulos et al., 2011).

A possible reason for the mixed research findings on the open innovation-performance relationship is that, with few exceptions (Ahn et al., 2015; Vahter et al., 2014), studies have not distinguished between knowledge sourced from different types of actors, and whether external collaboration is beneficial to enterprises' performance may to some extent depend upon the types of external actors firms collaborate with (Belderbos et al., 2004; Rosenbusch et al., 2011). For example, Ahn et al. (2015) examined the relationship between external partners and firm performance and found that broad and intensive engagement with non-competing partners, such as customers, consultancy/intermediaries and public research institutes are positively associated with firm performance. Using panel data from Irish manufacturing, Vahter et al. (2014) find that small manufacturing plants gain significantly more than their larger counterparts from using supply chain linkages, underscoring the importance of accounting for different external actors.

Although the foregoing suggests a complex relationship between innovativeness and performance, we suggest that a firm's innovativeness due to OI will improve a firm's performance, on the basis that there is significant empirical evidence that innovativeness is an important correlate or determinant of firm performance (e.g., Crepon and Duguet, 1998; Klomp and van Leeuwen, 2001). Hence we state:

H5. Firm innovativeness is positively associated with firm performance.

2.6. The moderating role of modern HRM practices

As noted above, social media technologies increasingly provide a platform for users to collaborate, and share and exchange ideas, knowledge and suggestions. However, it is not just the introduction of social media technologies that drives success; instead, organisations need to take a holistic approach and take into account how these technological tools impact the way employees work on a day-to-day basis (Murphy and Salomone, 2013), and specifically, what organisational mechanisms facilitate the use of inter- and intra-organisational use of social media tools (Ooms et al., 2015). Appropriate structures, roles, procedures and systems are important to enable knowledge transfer to be effective (Jolink and Dankbaar, 2010; Petroni et al., 2012; Ritala et al., 2009).

Foss et al. (2011) find that firms that implement HR practices that delegate authority and enhance internal vertical and horizontal communication are better able to access, absorb and exploit customer knowledge for innovation. Specifically, delegating authority facilitates interaction by enabling employees within organisations to search for, and interact with, holders of relevant information, while improved internal communication facilitates the diffusion of externally sourced knowledge. We extend this perspective to how modern HRM practices facilitate leveraging of external knowledge sourced from market-based actors via social media, on the basis that the open, horizontal, transparent and multi-directional nature of social media technologies demands a change in organisations characterised by rigid, bureaucratic management (Dutta and Fraser, 2009). In particular, Murphy and Salomone (2013) conclude that organisations must give up some managerial control to enable these technologies to be adopted from a grass-roots level, and enable a more diverse and larger group of people to connect. This accords with the HR practice of delegation of decision-making authority. The degree of delegation or decentralisation represents the locus of decision-making authority and refers to whether decision-making rights are concentrated or dispersed within an organisation (Pfeffer, 1981). When decision-making authority is concentrated with senior management, the organisational structure is 'centralized'. In contrast, a "decentralized" structure delegates decision-

making authority, providing employees throughout the organisation with an opportunity for a high degree of participation in decisions (Aiken and Hage, 1971). This may increase the number of interfaces a firm has with its external environment (Cohen and Levinthal, 1990) because employees have the latitude to identify, access and assimilate knowledge held by customers that the focal firm needs as an input into the innovation process, and that it would not otherwise have access to. Because social media allow more flexibility and are more open to participation (Ooms et al., 2015), exposure to a wider range of external knowledge sources may be more likely to give rise to novel solutions (Boschma, 2005).

Decentralisation increases the willingness of employees to share knowledge (Gupta and Govindarajan, 2000) and improves knowledge sharing between subunits within an organisation (Sheremata, 2000; Van Wijk et al., 2008). In addition, decentralisation broadens internal communication. This is important in the context of knowledge sourced externally since, often, customer knowledge transferred into the firm needs to be distributed to individuals in other areas of the firm. Indeed, in the absence of internal communication and cooperation, firms may not be able to implement knowledge acquired externally throughout the organisation (Hillebrand and Biemans, 2004). Organisations find it easier to disseminate and communicate such knowledge across the organisation, particularly via social media, if they implement HR practices that create an organisational context or climate which favours knowledge sharing and integration and inter alia, innovative performance (Cabrera and Cabrera, 2005; Lazzarotti et al., 2015; Ooms et al., 2015; Yang and Lin, 2009). Relevant HR practices include rotating employees between different functions, and implementing cross-functional work teams.

Such work design interventions establish interdependencies, frequent interactions and information flows among employees. Integration and cooperation of personnel from different functions (and inter alia, different knowledge disciplines) and hierarchies, and job rotation across functions and cross-functional work groups all lead to better integration and coordination of diverse streams of existing and externally acquired knowledge (Aoki, 1986) gained via social media. This arrangement allows anyone to exchange knowledge with any other member of the social network community, regardless of function or hierarchy (Ooms et al., 2015). Thus, social media exposes more and a wider range of people to a larger variety of knowledge, potentially leading to enhanced front-end innovation (e.g., ideation, development and refinement).

Firms that have practices (for example, delegation of decision authority) that facilitate more interaction with external sources are also likely to implement complementary practices such as job rotation and cross-functional teams that enhance internal communication (and vice versa), on the basis that a firm that allows employees to search for, and interact with, external holders of knowledge will then be able to disseminate the externally sourced knowledge within the organisation. Thus we expect that knowledge flows from market based actors sourced via social media will enhance innovativeness and firm performance when modern HRM practices are implemented and considered important.

3. Research methodology

3.1. Survey and data collection

The analysis uses the Tasmanian Innovation Census (TIC) conducted in 2013 by the Australian Innovation Research Centre (AIRC) which is a firm survey that collects information on business innovation activities in Tasmania. Tasmania is an island state of Australia, with a dispersed population base of over 500,000 (ABS, 2015). The majority of the businesses are in services, primary industries and low-tech-manufacturing and belong to the group of small and medium sized companies (O'Brien et al., 2014). Businesses in Tasmania face a geographically

dispersed customer and supplier base. Social media offers these firms an opportunity to communicate with distant customers and suppliers and collect knowledge and information they would not get otherwise. Thus, while our data set is not representative for multinational companies in Australia's large metropolitan centres (Sydney, Melbourne, Brisbane, Perth and Adelaide), it represents SMEs in more rural and remote areas of Australia. Indeed, for these firms knowledge sourcing via social media might be particularly important since they have fewer possibilities to meet face-to-face with their (international) customers. Therefore, our study using a firm-level data set of Tasmanian firms can serve as an example for other rather remote regions that are dominated by SMEs.

The target population encompassed all Tasmanian firms with five or more full time equivalent employees in all industry sectors. Non-profit companies (e.g., government agencies, educational institutions, charities) were excluded. Information on the target population was compiled by an AIRC research team, using various data sources including the Australian Business Register, Dun & Bradstreet, Australian Securities and Investment Commission, White and Yellow Pages. The data compilation resulted in a target population of 1965 firms. Data were collected via Computer Assisted Telephone Interviews (CATI). 1204 firms completed a full interview, which corresponds to a response rate of 61.3%. The data collected correspond to the three financial years prior to June 2013. There is no selection bias due to industry sector or firm size. Thus, the responding population appropriately represents the target population (O'Brien et al., 2014). Due to unit non-response, the sample we use for our analyses includes 1024 firms.

The response rate of the survey was 61.3%. The data show similar distribution based on industry analysis of the original population. Moreover, by using a sample survey of non-responding businesses the bias in the non-responding population was tested. The non-response survey included 149 randomly selected non-respondent firms and received a response from 96 giving a 64.4% response rate (and 13% of all non-responding firms). The questionnaire asked non-respondents if they had introduced any new or significantly improved goods, services, processes for producing or supplying goods and services, or processes for back office systems such as operations for purchasing, accounting, computing, or maintenance (repeating some questions from the original questionnaire). The tests showed no statistically significant differences between respondents and non-respondents with respect to the two core indicators product and process innovation (O'Brien et al., 2014).

3.2. Constructs

Table 2 presents the variables used in the analysis. The dependent variables include firm performance and innovativeness (which is also an independent variable — we discuss this issue further below). Independent variables include external knowledge flows from market-based actors and social media, and modern HRM practice is used as a moderator in the model. The majority of the statements are measured using a dichotomous scale and a few are measured using four-point scales. The questionnaire's measurement scales were designed with items connected with innovation, collaboration, social media used and firm performance. The constructs used in the analysis are presented in Table 2.

Knowledge flows from market-based actors are captured by three dummy variables indicating customers (39% of firms use this source of external knowledge) and suppliers (48%).

The questionnaire distinguishes between four different usages of social media. Firms most frequently use social media for marketing purposes, i.e. to develop their business's image or to market their products. The use of social media for marketing purposes does not necessarily involve external partners in the firm's innovation processes but it can support the commercialisation of a newly developed product and, thus, indirectly improve firm performance.

Business innovation activities are measured following the guidelines

of the OECD Oslo Manual (OECD, 2005). Firms in our sample introduced new or significantly improved goods or services onto the market over the three years to June 2013. For our econometric analysis we use a more sophisticated categorisation of business innovation activities. Arundel and Hollanders (2005) and Arundel et al. (2007) developed a taxonomy of innovation modes based on two main criteria: the level of novelty of the firm's innovations, and the creative effort that the firm expends on in-house innovative activities (Arundel et al., 2007, p. 1190f). O'Brien et al. (2014) drew on this taxonomy in order to classify innovative firms in Tasmania. Three mutual exclusive innovation modes are distinguished: innovation leaders, modifiers, and adopters. Innovation leaders are firms that conduct in-house R & D activities, develop products new to the market or processes new to the firm and sell these products or processes on the international market. Modifiers primarily innovate by modifying and improving technologies that were developed by other firms. The modification process might be performed by in-house R & D activities but the products or processes are new to the Tasmanian or Australian market only. Adopters do not conduct in-house R & D activities. They innovate by introducing products and processes new to the firm that were not developed or modified in-house.

Firm performance is captured by the (logarithmic) labour productivity, measured as sales per full time employee during the financial year July 2012 to June 2013. Since our data set does not provide any information on capital stock or value added, more appropriate measures like value added per employee (or per hour worked) or total factor productivity cannot be computed. Due to this lack of information, our measure of firm performance depends on the capital intensity of an individual firm's production process. However, differences in capital intensity are closely related to industry sectors. We therefore measure firm performance as the difference of individual firm labour productivity from the mean labour productivity within the industry sector the individual firm is affiliated to. Sector is defined as a division of the ANZSIC classification. With this relative measure, we expect to absorb much of the potential differences in capital intensity. The average (absolute) labour productivity of the firms measured as sales per full time employees amounts to AU\$ 303,285. Relative labour productivity is computed as the difference of individual firm labour productivity from the mean labour productivity within the industry sector the individual firm is affiliated to. We used the third column of Table 3 to report the mean labour productivity per industry sector. A high value of relative labour productivity means that the individual firm's absolute labour productivity exceeds the average absolute labour productivity within its industry. A small (i.e., negative) value of relative labour productivity means that a firm's absolute labour productivity is smaller than the average in its industry.

By analysing a kernel density estimation of the (logarithmic) relative labour productivity, a visual comparison shows that the distribution of relative labour productivity is close to the normal distribution.

Questions on modern HRM practices were adopted from a module of the 2010 European Community Innovation Survey (CIS). The questions aim to capture organisational practices that enhance decision-making processes or team work capabilities (Nielsen et al., 2009), or promote learning and competence building (e.g., related to the development of technical skills). The TIC questionnaire asked firms to indicate how important three different HRM practices were to managers and staff (planned job rotation of staff across different functional areas, regular brainstorming sessions for staff to think about improvements that could be made within the business, and cross-functional work groups or teams). Importance was measured on a Likert scale ranging from 1 = "not applicable" to 4 = "high".

For our econometric analysis we divide the sample into two sub-samples. The first sub-sample encompasses firms where the three HRM practices are of low importance, and in the second sub-sample the HRM practices are of high importance. The division of the sample is

Table 2
Constructs.

<i>External knowledge</i>	
Suppliers	Binary dummy variable measuring the use of a firm's suppliers for seeking information and assistance in the three financial years to June 2013 0 = no, 1 = yes
Customers	Binary dummy variable measuring the use of a firm's customers for seeking information and assistance in the three financial years to June 2013 0 = no, 1 = yes
Consultants	Binary dummy variable measuring the use of business consultants for seeking information and assistance in the three financial years to June 2013 0 = no, 1 = yes
<i>Social media</i>	
Internal use	Binary dummy variable measuring the use of social media for exchanging views, opinions or knowledge within the business during the three financial years to June 2013 0 = no, 1 = yes
Marketing	Binary dummy variable measuring the use of social media for developing the business's image or market product during the three financial years to June 2013 0 = no, 1 = yes
Customer opinions/questions	Binary dummy variable measuring the use of social media for obtaining or responding to customer opinions, reviews or questions during the three financial years to June 2013 0 = no, 1 = yes
NPD	Binary dummy variable measuring the use of social media for involving customers in the development of new goods or services during the three financial years to June 2013 0 = no, 1 = yes
<i>Innovativeness</i>	Ordinary variable that takes values from 0 to 3 with 0 = non-innovator, 1 = innovation adopter, 2 = innovation modifier and 3 = innovation leader; for the precise definition of the different innovation modes Innovation leaders are businesses who developed highly novel product or process innovations new to market or new to world. Innovation modifiers are businesses that introduced products or processes new to industry, and were adapted or modified from those originally developed. Innovation adopters are businesses that introduced products or processes only new to their business normally developed by other firms.
<i>Relative labour productivity</i>	Difference of individual firm labour productivity (sales per full time employee) from the mean labour productivity within the industry sector (ANZSIC division) the individual firm is affiliated to, measured for the financial year July 2012 to June 2013; variable excludes extreme values below the 1st or above the 99th percentiles of the distribution of relative labour productivity
<i>Modern HRM practices</i>	Binary dummy variable distinguishing firms according to the importance they attach to modern HRM practices 1 = low importance, 2 = high importance.

Table 3
Sectoral distribution and labour productivity of firms.
Source: TIC 2013.

	Industry sector	%	Labour productivity (sales/employees)
A	Agriculture, forestry and fishing	5.27	305,425
B	Mining	0.88	620,254
C	Manufacturing	21.68	268,756
D	Electricity, gas, water and waste services	1.07	451,865
E	Construction	10.35	283,834
F	Wholesale trade	8.89	493,781
G	Retail trade	10.45	378,574
H	Accommodation and food services	4.20	276,560
I	Transport, postal and warehousing	4.59	323,821
J	Information media and telecommunications	1.07	238,644
K	Financial and insurance services	3.32	643,293
L	Rental, hiring and real estate services	2.83	219,419
M	Professional, scientific and technical services	12.21	173,503
N	Administrative and support services	1.95	306,433
O/P	Public administration and safety, education and training	0.98	121,782
Q	Health care and social assistance	3.71	227,081
R	Arts and recreation services	1.66	149,928
S	Other services	4.88	208,003
	Total	100	303,285

Industry classification based on Australian and New Zealand Standard Industrial Classification (ANZSIC) 2006, revision 2.0.

conducted by summing the individual values of the three Likert scales. If a firm indicates “not applicable” to all three HRM practices, it will get the score value 3. Accordingly, if all three practices are of “high” importance the score reaches the value 12. Firms with a score of 7 and below are assigned to the sub-sample for which modern HRM practices are of low importance, firms with a score of 8 and above constitute the sub-sample of high importance. For 28% of the firms in our sample, modern HRM practices are of low importance; 72% belong to the sub-sample where these practices are highly important.

4. Statistical analysis

The data analysis was subdivided into two parts. First, we undertook a descriptive analysis using Stata, version 14. Second, we used structural equation modelling (SEM) to analyse the measurement and structural models. AMOS version 20 was used to run the SEM. We selected SEM as the statistical technique because of three characteristics. First, other methods have limitations – multiple regression, factor analysis, multivariate analysis of variance, and other techniques help researchers to address research questions, however they share a common limitation as they can examine only a single relationship at a time (even in multiple regression analysis there is a single relationship between the dependent and independent variables) (Hair et al., 2005). In contrast, SEM allows the analysis of multiple relationships at the same time. Variables can be independent and dependent variables at the same time, which enables a more holistic approach to studying the phenomena under investigation. Second, some of the variables are latent variables with multiple indicators. By using multiple variables under one latent variable, it is possible to measure the combined effect of these variables. Third, the research design implies multiple simultaneous dependencies among the model's variables. SEM appears to be an appropriate technique, as it allows for simultaneously testing an integrated set of dependent links, distinguishing between direct and indirect effects.

4.1. Descriptive analysis

Ninety-six percent of firms in the sample are SMEs comprising < 200 employees (ABS, 2015). Thirty-five percent of firms are medium-sized businesses (20–199 employees), and 61% are small businesses (< 20 employees). Only 4% of firms (or 42 firms) have 200 or more employees. The average number of employees in firms is 39, and the median is 15 employees.

Firms primarily operate in service sectors (including trade), with 22% in manufacturing, 10% in construction and 5% in primary industries. Table 4 presents the distribution of the variables in the analysis.

Sixty-four percent of firms introduced new or significantly improved goods or services (OECD, 2005) onto the market from June 2010 to

Table 4
Model variables by level of importance of modern HRM practices.
Source: TIC 2013; authors' calculations.

	Modern HRM practices				Pearson χ^2 (1)	p-Value
	Low importance		High importance			
	N	%	N	%		
External knowledge						
Suppliers	89	30.90	399	54.21	45.086	0.000
Customers	73	25.35	328	44.57	32.089	0.000
Consultants	54	18.75	263	35.73	27.936	0.000
Social media					Pearson χ^2 (2)	p-Value
Internal use	39	13.54	218	29.62	28.464	0.000
Marketing	75	26.04	311	42.26	23.170	0.000
Customer opinions/ questions	58	20.14	242	32.88	16.224	0.000
New product development	25	8.68	127	17.26	12.041	0.001
Innovation modes					Pearson χ^2 (3)	p-Value
Leader	13	4.51	83	11.28	71.579	0.000
Modifier	137	47.57	476	64.67		
Adopter	39	13.54	82	11.14		
Non-innovator	99	34.38	95	12.91		
	288	100	736	100		
Labour productivity	N	Ø	N	Ø	t-Test	p-Value
Absolute labour productivity	288	271,870	736	323,427	2.493	0.013
Log relative labour productivity	288	-0.061	736	0.035	2.068	0.039

June 2013. During the same period, a similar share of businesses (63%) introduced new or significantly improved processes. Only 19% of firms did not introduce any new products or processes either new to the firm, market or industry. Thirty-nine percent of firms use knowledge flows from customers, and 48% from suppliers.

Almost half (44%) of firms in our sample used social media for business purposes in the three years to June 2013. Firms most frequently use social media for marketing purposes, i.e., to develop their business's image or to market their products (see Table 4). For 28% of the firms in our sample, modern HRM practices are of low importance, while 72% belong to the group where these practices are highly important. Furthermore, Cronbach's alpha for the three indicator variables for external knowledge sourcing amounts to 0.603 and the four indicator variables for social media usage takes the value 0.842, which is at a satisfactory level (Aron and Aron, 1999; Hair et al., 2005; Nunnally et al., 1967).

A *t*-test on the equality of means reveals that labour productivity (both absolute and relative labour productivity) is significantly higher in firms with high emphasis on modern HRM practices (absolute labour productivity: difference = A\$42,594 with *p*-value = 0.024; (logarithmic) relative labour productivity: difference = 0.095 with *p*-value = 0.039). It is unlikely that these differences purely result from a different sectoral distribution. In all sectors, the majority of firms regard modern HRM practices as highly important. Nevertheless, in all sectors there are firms that place low importance on these practices. Financial and insurance services show the lowest share of firms that regard modern HRM practices as less important (9%); agriculture and construction industries have the highest shares of firms that fall into this category (37% and 36% respectively).

As shown in Table 5, the correlations are at acceptable levels (below 0.80), and there are no multicollinearity issues.

In order to get some initial insight into how firms that use

“traditional” channels of knowledge sourcing only and those who source both via “traditional” channels and via social media differ from each other, we calculated descriptive statistics on innovation modes and labour productivity for these two groups of firms. As Table 6 (below) shows at the end of the document, firms that source knowledge via traditional channels and social media are significantly more innovative than firms that use traditional channels only. However, the higher level of innovativeness is not reflected by significant differences in labour productivity — at least not yet.

4.2. Structural model

4.2.1. Model fit and measurement model

The analyses of the model were undertaken using the maximum likelihood estimation method. The full structural model – incorporating external knowledge inflows from market-based actors, social media, innovativeness and firm performance – was evaluated. The model fit statistics suggest that the data fit the full structural model (see Table 5). The χ^2 was 76.419 and *df* 50, χ^2 /*df* index also shows an acceptable result (between 1 and 2) 1.52 (Bollen, 1989; Bollen, 1990; Goffin, 1993). The Bollen-Stine *P* was 0.182 also showing an acceptable value > 0.05 (Bollen, 1989; Goffin, 1993) which indicate factor validity (Vandenberg and Lance, 2000). Additional measures of model fit are used in our analysis such as RMSEA (root mean square error of approximation) = 0.023, TLI (Tucker Lewis index) = 0.984 and CFI (comparative fit index) = 0.989. A RMSEA value < 0.05 shows an acceptable fit (Bollen, 1990; Goffin, 1993; Kline, 2005; Schreiber et al., 2006). TLI and CFI are > 0.95 (Byrne, 2001; Hu and Bentler, 1999; Schreiber et al., 2006), indicating a reasonable fit of the model. Based on the fit indices we conclude that the model fits the data satisfactorily, and thus is useful for explaining the relationships between the proposed latent variables.

The full structural model relationships were examined. Table 7 presents the full structural model results for both groups as the model has been moderated by low and high use of modern HRM practices, presenting two alternative models. This table shows the extent to which the latent variables (external knowledge inflows from market-based actors and social media) influence innovativeness and firm performance. The hypotheses were tested and confirmed or rejected based on the significance of the relationships identified in the results in Table 8.

As shown in Table 8, the results indicate the following: H1 is supported for both groups (i.e. the subsample that attaches high importance and the subsample that attaches low importance to modern HRM practices) as external knowledge inflows from market-based actors were positively related to innovativeness ($\gamma_{1a} = 0.534$, *p* < 0.001 and $\gamma_{1b} = 0.543$, *p* < 0.001 respectively). H2 is also accepted as external knowledge inflows from market-based actors have a positive and significant influence on social media for both sub-samples ($\gamma_{2a} = 0.434$, *p* < 0.001 and $\gamma_{2b} = 0.329$, *p* < 0.05 respectively). H3 is rejected for the sub-sample of firms which attach low importance to modern HRM practices as social media had no significant influence on innovativeness ($\gamma_{3a} = 0.117$, *p* < 0.094); however, it is supported for the sub-sample of firms which attach high importance to modern HRM practices ($\gamma_{3b} = 0.095$, *p* < 0.020). H5 is rejected for the sub-sample of firms which attach low importance to modern HRM practices as innovativeness had no significant influence on firm performance ($\gamma_{5a} = 0.081$, *p* > 0.168), but it is supported for the high sub-sample as innovativeness was positively related to firm performance ($\gamma_{5b} = 0.108$, *p* < 0.003).

4.2.2. Mediation effect

Hypothesis H4 states that social media mediates the relationship between external knowledge flows from market-based actors and firm innovativeness. In order to test for mediation effects (Hair et al., 2005), we examine the direct and indirect effects in the path analysis following the related procedures in AMOS. As shown in Table 8 the indirect effect

Table 5
Correlations.

	1	2	3	4	5	6	7	8	9
1) Suppliers	1								
2) Customers	0.432**	1							
3) Consultants	0.262**	0.315**	1						
4) SM: internal exchange of knowledge	0.165**	0.219**	0.178**	1					
5) SM: marketing	0.170**	0.226**	0.168**	0.628**	1				
6) SM: exchange knowledge with customers	0.176**	0.240**	0.140**	0.597**	0.752**	1			
7) SM: development of new goods	0.146**	0.245**	0.166**	0.455**	0.491**	0.498**	1		
8) Innovativeness	0.374**	0.414**	0.298**	0.227**	0.284**	0.267**	0.236**	1	
9) Lab. Prod. der. (ln): difference from division mean (trim)	0.059	0.067*	0.075*	0.028	0.002	0.037	0.048	0.115**	1

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Table 6
Innovation modes, labour productivity and knowledge sourcing.
Source: TIC 2013; authors' calculations.

	Traditional channels of knowledge sourcing and ...				Pearson χ^2	p-Value
	... no use of social media		... use of social media			
	N	%	N	%		
Innovation modes						
Leader	35	10.97	43	13.15	16.875	0.001
Modifier	225	70.53	259	79.20		
Adopter	45	14.11	19	5.81		
Non-innovator	14	4.39	6	1.83		
	319	100	327	100		
Labour productivity					t-Test	p-Value
Absolute labour productivity	319	319,058	327	313,266	0.254	0.800
Log relative labour productivity	319	0.051	327	0.039	0.219	0.827

Table 7
Model fit statistics.

Name	Acceptable levels	Model fits indices
$\times 2$ (df)		76.419 (50)
$\times 2/df$	< 2	1.52
Bollen-Stine P	> 0.05	0.182
RMSEA	< 0.05	0.023
CFI	> 0.95	0.989
TLI	> 0.95	0.984

Table 8
Standardised regression weights for full structural model.

Hypothesis	Group 1 — low		Group 2 — high	
	Standardised regression weights	Hypotheses test	Standardised regression weights	Hypotheses test
H1	0.534***	Accepted	0.543***	Accepted
H2	0.434***	Accepted	0.329**	Accepted
H3	0.117	Rejected	0.095**	Accepted
H4	0.051	Rejected	0.031**	Accepted
H5	0.081	Rejected	0.108**	Accepted

*** $p < 0.01$.
** $p < 0.05$.

of external knowledge inflows from market-based actors on innovation is non-significant ($\gamma = 0.051$, $p > 0.099$) when we analyse the sub-sample that uses low importance HRM practices. However, it is significant when the firms use high importance HRM practices ($\gamma = 0.031$, $p > 0.018$), indicating that social media mediates the relationship between external knowledge flows from market-based actors and innovativeness.

4.2.3. Robustness tests

We explored the robustness of our results by re-estimating our model for a sub-sample that excludes non-innovative firms. It is evident that for firms that did not conduct any innovation projects there was no need to use customers, suppliers or business consultants as a knowledge source for innovation. Consequently, most firms² that are classified as non-innovators are also classified as firms that did not use any market-based source of knowledge. This could lead to a positive association between the latent variable EKMK and innovativeness. For the group of firms that attach high importance to modern HRM practices the results of the robustness test confirm the results we obtained for the full sample. For firms that place low importance on modern HRM practices H3 and H4 are still rejected, but H2 cannot be rejected. However, we also do not find evidence for H1, i.e., the association between knowledge from market-based actors and innovativeness.

As a final robustness test, we varied the rule according to which firms were allocated to the two groups that attach low and high importance to modern HRM practices respectively. The threshold value that distinguishes firms with low and high importance of modern HRM practices is decreased.³ For firms that attach high importance to modern HRM practices, H1 through to H4 cannot be rejected, although the coefficient estimating the relationship between social media and innovativeness is significant at the 10% level of significance only. For firms that fall into the extended group of low importance attached to modern HRM practices, H1 and H2 cannot be rejected in accordance with previous results. However, in this variation, H3 and H4 can also no longer be rejected.

Following a further variation in which the threshold value that distinguishes firms with low and high importance of modern HRM practices is increased, we repeated the analysis. Again, for firms in the category where modern HRM practices are highly important our previous results remained unchanged. In the reduced group of firms where modern HRM practices are less important we still reject H4. However, we do find that the use of social media is positively associated with innovativeness, but the estimated effect is significant at the 10% level of significance only. We conclude that, to some degree, our results depend on how we classify firms that attach different levels of importance to

² Please note that firms with ongoing and abandoned innovation projects did use market-based actors as a knowledge source for their innovation projects although they are classified as non-innovators. These firms were not excluded from the sub-sample of innovation active firms used for the robustness check.

³ Further information on the variation rules is available from the authors.

Table 9
Standardised regression weights for full structural model — alternative specifications.^a

Innovation active firms only				
H1	0.161	0.292***	× 2 (df)	75.210
H2	0.294**	0.238***	× 2/df	1.504
H3	0.047	0.085*	Bollen-Stine P	0.071
H4	0.103	0.084**	RMSEA	0.024
H5	0.014	0.020**	CFI	0.984
			TLI	0.978
Threshold value that distinguishes firms with low and high importance of modern HRM practices decreased				
H1	0.574***	0.516***	× 2 (df)	82.207
H2	0.425***	0.351***	× 2/df	1.644
H3	0.129**	0.086*	Bollen-Stine P	0.051
H4	0.139***	0.084**	RMSEA	0.025
H5	0.055**	0.030*	CFI	0.987
			TLI	0.981
Threshold value that distinguishes firms with low and high importance of modern HRM practices increased				
H1	0.528***	0.542***	× 2 (df)	76.898
H2	0.431***	0.355***	× 2/df	1.538
H3	0.144*	0.094**	Bollen-Stine P	0.223
H4	0.114	0.098***	RMSEA	0.023
H5	0.062*	0.033***	CFI	0.989
			TLI	0.984

*** $p < 0.01$.

** $p < 0.05$.

* $p < 0.1$.

^a The robustness test was also measure in terms of SMEs, the results show no difference between the groups which is logic based on the low number of large firms.

modern HRM practices. Better measurements are required in order to identify how intensively firms have to use modern HRM practices in order to benefit from knowledge flows through social media and how to locate potential threshold values or even turning points in the relationship between the use of social media on the one hand and modern HRM practises on the other hand.

For all robustness tests, the different model of fit statistics ($\times 2/df$, Bollen-Stine P, RMSEA, CFI and TLI) are in an acceptable range, indicating that the data fit the structural model and the estimates are valid. The results of the robustness tests are presented in Table 9.

5. Discussion

Our results show that, overall, knowledge flows from market-based actors are positively related with innovativeness, in line with most prior research (Faems et al., 2005; Hughes et al., 2009; Lasagni, 2012; West and Bogers, 2014). The results also reveal that knowledge from market-based actors and the use of social media are positively associated. The more market-based actors a firm draws on for knowledge for innovation activities, the more likely it is that some of these actors use social media as a communication channel with the firm. Moreover, a higher inflow of knowledge increases the necessity for a firm to use social media internally for exchanging and processing information obtained from market-based actors (Roberts and Candi, 2014).

The analysis indicates that firms most frequently use social media for marketing purposes. Using social media as an advertising tool may not necessarily lead to the collection of new (technological) ideas that can be used in a firm's innovation process. However, many social media platforms, even those that are primarily designed for marketing purposes, include functions for providing feedback, starting a discussion in a blog or similar. A firm that advertises on a social media platform may nevertheless get unexpected and unintended feedback that can shape and contribute to the firm's innovation projects. Moreover, innovativeness as it is measured in our conceptual model does not only describe the technological characteristics of the newly developed product but also considers on which market the new product is sold. Thus, to advertise and to market the new product is an important element to be

characterised as an innovation leader that sells its new product not only on the Australian market but overseas.

The results also show that knowledge collected via social media does not always have a positive impact on innovativeness. Consistent with our expectations, the relationship between knowledge inflows via social media and innovativeness depends on the importance firms place on modern HRM practices: a significant positive relationship exists between knowledge sourced via social media and innovativeness in firms that attach high importance to modern HR practices (Jolink and Dankbaar, 2010; Petroni et al., 2012; Ritala et al., 2009). In contrast, there is no significant relationship in firms in which modern HRM practices are of low importance, underscoring the importance of implementing these practices in order to enable knowledge inflows via social media to influence innovativeness.

Furthermore, an indirect significant positive effect was found in external knowledge flows through social media to innovativeness (only) when firms use modern HRM practices. For this group of firms, social media serves as a mediator of the effect external knowledge flows have on firm innovativeness. However, this does not necessarily mean that “traditional” channels of knowledge transfer are less important. We expect traditional communication channels with customers or suppliers to continue to play a significant role, since the direct effect of knowledge flows from market-based actors on innovativeness remains positive in our model. However, for firms that regard modern HRM practices as highly important, this direct effect is complemented by an indirect effect of knowledge flows via social media. Unfortunately, we are unable to identify whether traditional channels of knowledge transfer are partly substituted by knowledge transfer via social media or whether the amount of knowledge that firms collect is actually increased by new knowledge inflows via social media. For firms that attach low importance to modern HRM practices, only external knowledge that is acquired via traditional channels of knowledge transfer helps firms improve their innovativeness.

Finally, the results demonstrate that innovativeness and firm performance are positively related (Crepon and Duguet, 1998; Klomp and van Leeuwen, 2001). Since we measure firm performance as labour productivity (i.e., sales per employee) the positive relationship can have two sources. Process innovations could lead to labour saving technological progress which, ceteris paribus, would increase labour productivity. Alternatively, product innovations could improve the firm's competitiveness on the product market, implying a higher volume of sales and, ceteris paribus, higher labour productivity. The size of the effect depends on the firm's innovation mode. For instance, a firm which has introduced a new product to the world on the global market might be able to earn a temporary monopolistic rent. This may lead to a higher increase in the firm's volume of sales compared to innovation modifiers or innovation adopters. Importantly, innovativeness does not translate into improved firm performance for those firms that place low importance on modern HRM practices, underscoring the importance of these practices in order for innovativeness to translate into firms' performance outcomes.

We highlight that the relationship between innovativeness and firm performance that we estimated is only a partial effect, as firm performance is influenced by a range of factors internal and external to the firm. Due to the cross-sectional nature of our data set we are unable to detect any long term impact of the innovation activities we observe. However, our measure of innovativeness covers innovation activity over a three year period, and labour productivity is measured for the final year of this three year period. Thus, it is reasonable to conclude that differences in labour productivity are related to firms' innovation activities conducted over the preceding three years.

6. Conclusion, limitations and future research

A recurrent theme in the strategic management and innovation literatures is that firms increasingly utilise external sources of knowledge

to gain and sustain competitive advantage (Chesbrough, 2003; Dyer and Singh, 1998; Foss et al., 2011; Teece, 2000), with social media tools increasingly being used to transfer knowledge. A key finding from the present study is that when firms use social media to source knowledge from market-based actors they will only realise the full potential from these interactions in the form of innovation outcomes when modern HRM practices are implemented. Social media does not replace traditional methods of knowledge sourcing, in particular personal contacts to customers or suppliers. But social media can complement these traditional channels not least in the case where it is difficult to meet customers or suppliers in person or to maintain regular personal contacts.⁴ Thus the study contributes to recent research that addresses the issue of under what circumstances do social media contribute to firm innovation and business performance.

Against this background, our study has important managerial implications. The results showed that social media mediates the relationship between external knowledge from market-based actors and innovativeness, and that social media influences firm innovativeness, but only in firms that use modern HRM practices. These results suggest that in order to benefit from open innovation, and in particular, fully exploit knowledge inflows from market-based actors via social media, and realise innovativeness and productivity benefits, managers are advised to implement modern HRM practices designed to facilitate inter- and intra-organisational use of social media tools, and create an organisational context that favours knowledge acquisition and sharing. This is imperative in light of the results showing, that in the absence of such practices, organisations do not derive innovation and productivity benefits. This finding also underscores the strategic importance of HR practices in the context of open innovation, by demonstrating how HR practices need to be implemented in order to generate firms' outcomes, and conversely, in their absence, firms do not derive performance benefits. This is not always straightforward however, since smaller firms – that comprise the overwhelming majority of firms in the sample – are more constrained by limited resources vis-a-vis larger firms making it more difficult for the former to invest in human resources/practices (Rauch, 2011). Moreover, the simple, informal structure characteristic of smaller organisations, may be at odds with the greater formality and relatively more time-consuming nature of implementing modern HR practices (Jack et al., 2006). However Kroon et al. (2013, p. 86) cogently observed that such practices “are expensive to implement, and their costs can outweigh the performance benefits (Sels et al., 2006)...when smaller bundles of practices, aimed at more specific performance goals, are implemented, the associated costs are more modest and the results more closely aligned with the contingent needs of the firm.”

Our study faces some limitations. First, our study is based on cross-sectional data only. As noted above, the relationship between innovativeness and firm performance that we estimated is only a partial effect, with firm performance impacted by a range of factors internal and external to the firm that we are unable to cover comprehensively. Second, although we are able to determine which firms use modern HRM practices such as job rotation and brainstorming sessions, we do not know which information is processed and how information is distributed within the firm. Third, modern HRM practices are not only implemented in order to process information collected from external, market-based actors, they also aim to unveil employees' ideas and creativity and there might be an interdependent relationship between external and internal knowledge sourcing. This is another topic for future, qualitative research.

Fourth, we focused on examining the use of social media and knowledge flows from the supply chain perspective only. This limitation opens up future research opportunities, for example investigating

the role of mainstream social media tools within knowledge flows. There is also the need for further research that distinguishes between knowledge from customers sourced via the classic channels and knowledge obtained from social media channels, and their effects on innovation and firm performance. It would also be interesting to explore the influence of knowledge inflows from other actors (e.g. science-based and government). In addition, research that distinguishes between how firms source knowledge from B2B vs. B2C customers is needed. Unfortunately, data limitations mean we are unable to undertake this level of analysis. But in general, firms can sell their products or services to both business customers and private customers. In this case, firms can source knowledge from both groups of customers via the same channel, either via traditional channels or via social media. In order to get an idea whether or not there are some differences between firms that typically sell their products or services to business customers and those that typically have private customers, we compared the use of social media by different sectors. Descriptive statistics show that firms with private customers (ANZIC divisions G “retail” and S “other (personal) services”) tend to use social media more often for collecting external knowledge and product development than firms in sectors that typically sell to business customers (ANZIC divisions F “wholesale” and M “Professional, scientific and technical services”). This result may indicate that social media is more important the more dispersed a firm's customer base is. The customers of retailers and personal service providers are often anonymous and firms take the opportunity to collect feedback and ideas via social media that otherwise they would not be able to collect at all. Other future research opportunities include the analysis of other factors that may influence social media use, such as firm size, market concentration, product life cycle and firm age. Data collection from a project level, matching the knowledge obtained from a social media platform and how this transforms into an actual product idea, can also provide further insight into the benefits of using social media for innovation purpose. Further research needs to investigate the extent to which experience with social media influences innovation.

Finally, the relationship between social media and innovativeness may be moderated by the quality of the feedback and knowledge sourced from market-based actors. It could also be argued that the quality of information is likewise important for the direct relationship between market-based actors and innovativeness (Hypothesis H1). The quality of the information is important independent on whether the information is collected via social media or in a more “traditional”, direct way. However, in order to fully explore the relationship between the quality of knowledge sourced and innovativeness additional data on the level of the individual information or at least data on the level of the individual innovation project is needed. Firms may have introduced more than one project or process innovation. For different innovation projects firms require different information that may be provided to them from market-based actors with different quality. Unless we are able to characterise the individual innovation project we are unable to relate the quality of the provided knowledge and feedback to the success of this individual innovation project. This is also a topic for future research.

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⁴ Most firms (78%) that use social media use traditional channels of knowledge sourcing.

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