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Innovation generation through formalisation and fairness in university – Industry collaboration

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ABSTRACT

Relationships between universities and industry are a source of entrepreneurial activity and innovation. Considering the complexity of university-industry (U–I) collaboration though, the underlying activities require formalisation mechanisms to help overcome ambiguity, mismatched objectives, demands and expectations to ensure joint innovation outcomes. Fairness perceptions have also been found to determine the success of inter-organisational relationships. However, to date fairness has not been explored in stakeholder contexts, such as those prevalent during U–I collaboration. This research extends knowledge on U–I collaboration processes by exploring if formalisation mechanisms increase fairness perceptions and joint innovation outcomes. We adopt a survey methodology to explore the experiences of German professors engaging in U–I collaboration. Our findings identify that formalising U–I collaborations, through mechanisms such as clear procedural guidelines and contracts which agree responsibilities and outcome expectations, leads to enhanced perceptions of fairness and trust. Furthermore, both procedural and distributive fairness were found to increase the positive effect of formalisation on joint innovation outcomes. These findings advance U–I collaboration and strategic alliances literature through identifying the importance of perceived fairness, which is often deemed to be as important as material outcomes and will impact upon join innovation outcomes being achieved. Furthermore, this research proves the positive relationship formalisation has on innovation outcomes.

1. Introduction

University-Industry (U–I) collaborations are amongst the cornerstones of national innovation systems (Cunningham and Link, 2015) and an important indicator of the impact of universities within a region (Guerrero et al., 2015). The power of this relationship lies in the reciprocal knowledge sharing and engagement in value co-creation that leads to joint innovation outcomes, stimulating and augmenting innovation (Alexander et al., 2020; D'Este and Patel, 2007). Besides mutual goals, however, academics and practitioners also display asymmetric goals and missions that bring challenges into the partnership (Meissner et al., 2022). Potential inter-organisational conflicts and misunderstandings emerging from divergencies are among the major issues to collaborations' success (He et al., 2021). Different perceptions and motivations of practitioners and academics in U–I collaborations may prevent mutual satisfaction and can ultimately lead to the partnership's end (Clauss et al., 2022; De Silva et al., 2021; Patnaik et al., 2022). Therefore, one of the major challenges for facilitating innovation generation in U–I collaborations is to manage these relationships in a way that mutual contributions are aligned despite varying motivations and perceptions.

Despite the substantial literature contributions on U–I collaboration, the complexity of this phenomenon means that much remains unknown though (Huang and Chen, 2017; Rossi et al., 2022; Scandura, 2016). The intricacies which ultimately determine the success of U–I collaborations are not fully understood (Bruneel et al., 2010; Rajalo and Vadi, 2017; Steinmo and Rasmussen, 2018). There is a lack of understanding regarding management mechanisms and regulations which govern U–I collaboration and ultimately determine their success (He et al., 2021; Huang and Chen, 2017; Rajalo and Vadi, 2017; Steinmo and Rasmussen, 2018). The issue becomes even more problematic when considering the role of subjective aspects, such as perceptions, which have been neglected (De Silva et al., 2021), especially in light of the persistence of a dominant institutional view in which the system determines the actors'

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behaviour.

Prior research predominantly focuses on micro and macro motivations and barriers, and modes of collaboration (O'Dwyer et al., 2023), while inter-organisational literature often focuses on relational mechanisms, such as trust and communication (Plewa et al., 2013). However, governance and formalisation issues, such as contracts and reporting mechanisms, have received considerably less attention – despite their importance in ensuring value co-creation for actors (Hoetker and Mellewigt, 2009; Poppo and Zenger, 2002). Gesing et al. (2015) found that a lack of formal management processes can lead to a misalignment of goals and expectations regarding innovation outputs. Mismatched objectives, demands and expectations of university and industry actors can lead to misunderstandings, tension and dissonance, which van Burg and van Oorschot (2013) suggest can be understood as fairness perceptions. Fairness perceptions are a key determinant of inter-organisational relationships, where actors evaluate decisions, outcomes or procedures being correct and balanced (Poppo and Zhou, 2014). van Burg et al. (2013) identified that in business-business and supplier-buyer research, perceived fairness governs the motivation of actors to engage in collaborative activities. Furthermore, Bstieler et al. (2015) found that perceived unfairness will lead to uncooperative behaviour and in many instances will result in a cessation of activity.

This is particularly relevant in the context of U–I collaboration, because outcomes for universities, such as scientific and practitioner publications and reputation gains, and outcomes for businesses, such as expanding market share and improving customer satisfaction to achieve a better market position, hold little value to the collaborating counterpart. Furthermore, the significant differences between the two parties regarding their goals, organisation and procedures characterises a situation where formalisation have previously been regarded to influence the success and longevity by the inter-organisational literature (e.g., Grandori, 2006). Therefore, putting a spotlight on joint innovation outcomes, defined as outcomes at the collaboration level that are produced together and benefits both collaborating parties. In the context of U–I collaboration it comprises filling out patents, discovering new knowledge, solving technical problems and developing new products (Clauss and Kesting, 2017; Petruzzelli, 2011).

With the ongoing changes in the university sector, which have led to an extending academic remit and increased pressure put on academic resources (Cunningham et al., 2018; Sjöö and Hellström, 2019), we suggest that fairness perceptions may be important in determining the success of academic engagement with industry. However, in a U–I context, little is known about how fairness is perceived by key actors and the consequent impact stricter governance and formalisation of U–I collaboration processes have on fairness perceptions. This is important to understand for universities, where an increased focus on the 'impact agenda' has led to them opening up their technology commercialisation processes to engage with industry at any stage of the innovation process (Miller et al., 2018).

However, how these relationships can be effectively managed still remains unknown (Bruneel et al., 2010; Rajalo and Vadi, 2017; Steinmo and Rasmussen, 2018), which is relevant once opportunism emerging from one-sided actions are one of the main causes to failure and partnership termination. There is a need for enhanced understanding of how U–I collaborations can be managed and governed to not only co-create value across all partners and facilitate joint innovation outcomes but to ensure the relationship can be reproduced and perpetuated (Huang and Chen, 2017; Sjöö and Hellström, 2019). Consequently, this research aims to explore the following research question: Does formalisation increase fairness perceptions and joint innovation outcomes during U–I collaborations?

To explore this, we draw upon the U–I collaboration, supplier-buyer and inter-organisational collaboration literature to criticise existing studies on fairness perceptions and formalisation, which leads to our hypothesis development. Through a survey of German professors, we then explore the influence that fairness perceptions and formalisation have on U–I collaboration. We present our findings and discuss the implications for theory and practice.

The findings of this research have three key contributions. First, we add to the U–I collaboration literature by theorizing and demonstrating the relevance of the nascent concepts of formalisation and perceived fairness as determinants of successful U–I R&D collaboration, which to date have only been explored in business to business and buyer-supplier relationships. Second, we extend research on the importance of social preferences, such as perceived fairness, which are often deemed to be as important as material outcomes during inter-organisational collaborations. Third, we prove the positive relationship formalisation has on performance which to date has been inconclusive. From a practical perspective, our findings provide guidance to collaboration actors on the importance of fairness management and formalisation of processes to improve clarity of roles, guidelines, and outcomes to increase collaboration performance and success.

2. Theory and hypotheses

Numerous studies have explored U–I collaboration from a variety of perspectives, which has resulted in the identification of collaboration types, motivations and challenges. U–I collaboration comprises of a wide range of inter-organisational activities on a spectrum, ranging from informal communication and knowledge transfer to more formal mechanisms aimed at innovation outcomes such as shared facilities and collaborative R&D through patents/IP, joint ventures and spin-outs/start-ups (Clauss and Kesting, 2017; D'Este and Patel, 2007). Universities are increasingly reliant upon U–I collaboration as a sustainable source of income to replace government funding cuts in the education sector and to fulfil requirements by funders to demonstrate the impact of their research (Guerrero et al., 2015). This has resulted in new co-creational collaboration mechanisms and the design of platforms which facilitate the sharing of knowledge between regional stakeholder's (Miller et al., 2018). These mechanisms require more stringent forms of governance to capture the value of such interactions (Gesing et al., 2015). The 'management' aspect of U–I collaboration has received little attention so far. This is surprising, considering inter-organisational literature stressing the importance of structural and co-ordination mechanisms as determinants of collaboration success (Bruneel et al., 2010; Steinmo and Rasmussen, 2018). Huang and Chen (2017) identify that formal management mechanisms are important to influence academic innovation performance. Yet, much remains to be known on how to best organise and manage U–I collaboration to ensure joint innovation outcomes.

D'Este and Patel (2007) and Cunningham and Link (2015) identify that collaborations between universities and industry are predominantly motivated by financial reasons thus they are becoming more aligned with business - business and business - supplier collaboration arrangements. Other motivations include access new knowledge, tools and R&D (Perkmann et al., 2013a, 2013b; Scandura, 2016). Motivational factors may vary depending on the type of U–I collaboration though (Freitas and Verspagen, 2017). Prior research as well identifies a number of key challenges to U–I collaboration, which often relate to differences in the norms of public and private knowledge which govern how both academics and industry perceive research (Bertello et al., 2022; Bruneel et al., 2010).

Academic research has always been considered a public good. However, the Bayh Dole Act empowered universities to commercialise academic knowledge which led to greater collaborations between universities, government and industry (Miller et al., 2018). Despite this, university environments instil a climate or competitiveness amongst academics where academic reputation often is associated with publications, research awards and prizes (Atta-Owusu et al., 2021; Bruneel et al., 2010). This has been found to influence academics motivations regarding the time they allocate for engagement in formal collaboration activities with industry (Perkmann et al., 2013a, 2013b).

Tensions between academics often arise regarding fairness of workload allocation and promotional mechanisms (Miller et al., 2018; Rothaermel et al., 2007). In recent years, government funding mechanisms have focused on more applied research which has fuelled a demand for increased U–I collaboration and led to changes in academic key performance indicators (Cunningham et al., 2018). Callaert et al. (2015) identify the challenges of academic freedom. They find that whilst institutional frameworks do impact academics behaviours, academics are still free to dictate their research agendas which includes whom they collaborate with. They identify how many researchers continue to prefer working in 'pure science' fields due to perceived lack of rewards of industry engagement and personal preference. Bruneel et al. (2010) suggest that academics are motivated by intrinsic factors which are often prioritised over the social objectives of a university. However, academic work does lend itself to a combination of scientific and more applied research, with various studies identifying the positive relationship between patenting and an increased number of publications (Czarnitzki et al., 2007; Meyer, 2006). In contrast, private firms generally strive to appropriate economic value from knowledge to gain a competitive advantage (Bertello et al., 2022; D'Este and Patel, 2007; Perkmann and Salter, 2012).

Due to inherent differences and mechanisms involved in transferring public and private knowledge into innovation outcomes, many challenges and conflicts often arise. Callaert et al. (2015) identify that whilst U–I collaborations can lead to successful outcomes for both parties, there is still a lack of knowledge on how to overcome problems. Challenges that arise relate to conflicting objectives (McAdam et al., 2017; Miller et al., 2018), issues of coordination, power, legitimacy (Bies and Sitkin, 1993; McAdam et al., 2017), language (Kaghan and Lounsbury, 2015; Rothaermel et al., 2007), cognitive frames (Nooteboom, 1992), institutional barriers (Bruneel et al., 2010), culture (Bjerregaard, 2010), trust (Bstieler et al., 2015, 2017), academic trade-offs and research agenda alignment (Callaert et al., 2015). However, Steinmo and Rasmussen (2018) identify that there continues to be a lack of knowledge on how to effectively manage U–I collaborations and overcome barriers. Bruneel et al. (2010) stress the need to unravel factors which influence an actor's perception of barriers to collaboration. Their research identify trust as being a key factor to help lower the perceived barriers to collaboration. However, trust can take time to develop (Bstieler et al., 2017) with many U–I collaborations beginning as weak ties and are often time sensitive if external funding is involved. Consequently, there is a need to understand other factors which determine how U–I can be effectively managed (Callaert et al., 2015).

Pre-existing relationships can also aid collaboration success: Steinmo and Rasmussen (2018) identify the importance of cognitive and relational social capital, which can improve trust and shared meaning between partners, leading to more successful U–I collaboration. Drawing upon inter-organisational collaboration literature, social preferences, namely, fairness perceptions have been found to influence collaboration behaviours and success (Gachter et al., 2010; Yeoman and Santos, 2016). However, the role of fairness perceptions in a U–I collaboration context is unknown. The two issues of formalisation and fairness are now explored, which will form the basis of our model and hypothesis development.

2.1. Formalisation of U–I R&D collaboration

Formalisation is "*the process of codifying and enforcing output and/or behaviour, and its outcomes in the form of contracts, rules and procedures*" (Vlaar et al., 2007, p. 439). In U–I collaboration, this entails clearly defined roles and mutually agreed-upon responsibilities between universities and industry partners. Research on inter-organisational relationships highlights the role formalisation can play in helping actors make sense of and manage relationships (Vlaar et al., 2006). Formalisation usually takes a written form which provides structure "*within which on-going relationships can proceed sensibly over time*" (Kaghan and Lounsbury, 2015, p. 260). Boyle and Dwyer (1995) identify that formalisation can take the form of rules, procedures and fixed policies to help align goals, expectations and outcomes between diverse partners.

The process of formalisation can aid relationship building. Cosh et al. (2012) identify that partners exchange details on operating practices, objectives, routines, expectations and inherent culture thus helping overcome some of the problems of understanding during inter-organisation relationships. During risky and uncertain collaborations, where the end goal is innovation, the design and governance of relationships is fundamental to collaboration success (Bstieler et al., 2015, 2017). Burnside and Witkin (2008) identify the need for partners to jointly agree upon objectives, roles and take mutual responsibility for its success, which can be facilitated through a shared governance approach where formalisation reduces risk of opportunism. Furthermore, Bstieler et al. (2015) find that shared governance approaches help to develop trust during U–I collaboration, which positively influences knowledge transfer and innovation performance. Formalisation of collaboration has been found to improve relationship performance (Aulakh and Gençtürk, 2008), reduce the risks of knowledge misappropriation and increase the chances of joint innovation outcomes (Balogun and Johnson, 2004; Bstieler et al., 2015). Duplat and Lumineau (2016) identify that the formalisation of collaboration terms through contractual commitment can help govern partner's behaviours to avoid potential disputes.

The inherent uncertain nature of U–I collaboration lends itself to a high degree of formalisation. Hence, IP issues, ownership and exploitation of knowledge generated in the course of collaborations need to be predefined in advance (Abramo et al., 2009; Link et al., 2007). Universities have IP policies and other regulations which govern knowledge ownership and exploitation (Rybnicek and Königsgruber, 2019; Siegel et al., 2003). For example, nondisclosure agreements are used to ensure confidence regarding trade-sensitive information (Lee, 2000). Extensive contracts and reporting mechanisms (Hoetker and Mellewigt, 2009; Poppo and Zenger, 2002) help reducing uncertainty and the risk of opportunism (Hoetker and Mellewigt, 2009; Williamson, 1985), whilst ensuring joint innovation outcomes for both university and industry. However, Gesing et al. (2015) identify that in collaborations where there is ambiguity and uncertainty in the outcome, for example in contexts involving science and market-based collaborations, informal self-reinforcing governance can be more beneficial.

Prior inter-organisational research identifies the value of relational governance which can substitute formalisation (Ring and Vandeven, 1994; Steinmo and Rasmussen, 2018). However, relational and other forms of informal governance are contingent upon organizations operating within the same sector where norms, values and processes are aligned which can lead to socially enforceable contracts (Grandori, 2006). U–I collaboration usually involves stakeholders with very different operating practices and norms, intensifying the chances of organisational differences and goal misalignment (Bertello et al., 2022; Bruneel et al., 2010; Perkmann et al., 2013a, 2013b). Furthermore, differing language and norms between universities and industry often turn out to be a key barrier regarding U–I collaboration (Miller et al., 2018; Rothaermel et al., 2007).

Bruneel et al. (2010) note that transactional related barriers often exist during U–I collaboration where concerns regarding the distribution and capturing of benefits and outcomes, can result in a wide range of stakeholders. This refers to both internal (e.g., technology commercialisation staff, heads of schools, administrators, IP managers) and external (e.g. government, policy makers and wider society) stakeholders being involved. This is particularly relevant with the need for universities who nowadays need to report on their external engagement and impact which forms a large part of their funding and global ranking. Therefore, many universities have implemented additional reporting mechanisms, which has included setting up centres of research and impact to replace traditional technology transfer offices (TTOs), with the aim of more fully capturing the impact of academic activities (McAdam

et al., 2017). Whilst the move away from TTOs to research and impact centres is in an attempt to aid the creation and capture of value across a wider range of knowledge transfer activities; adding additional stakeholders to U–I collaboration can increase the complexity and time required to complete reporting and administration processes (Miller et al., 2014). Furthermore, research and impact staff within universities often do not have an academic background. Whilst this can be beneficial as research and impact staff can act as boundary spanners between the academic and industry; formal governance processes can help ensure there is not a mismatch between expected and actual innovation outcomes due to miscommunication and misunderstanding as a result of cultural and language problems (Bstieler et al., 2015, 2017).

Vlaar et al. (2006) and Huang and Chen (2017) research shows that formalisation enhances the ability to co-create and capture value from collaborations due to clearly defined processes, expectations and goals. Formalisation has also been found to help prescribe the range of acceptable behaviours and helps define concrete collaboration outcomes (Hoetker and Mellewigt, 2009; Masten, 1996). However, formalisation is not without challenges. Perkmann and Salter (2012) identify that formalisation can lead to rigidity which may not be suitable for uncertain environments such as innovation where innovation outcomes cannot be guaranteed. However, Cosh et al. (2012) identify that formalisation enhances innovation in most circumstances and is superior to other structures. Furthermore, Gesing et al. (2015) identify that formalisation can be more effective in ensuring returns from both market-focused and science focused collaborations than informal governance mechanisms. Consequently, we put forth that formalisation will enhance the chances of not only overall U–I collaboration success but will lead to both partners having joint innovation outcomes.

Hypothesis 1. U–I R&D collaboration formalisation positively influences joint innovation outcomes.

Fairness perceptions during U–I collaborations ultimately reply upon agreement of roles, behaviours and expected outcomes. Consequently, we argue that formalisation may have a moderating relationship (Bstieler, 2006; van Burg et al., 2013). This forms the basis of our second hypothesis which will now be discussed.

2.2. Fairness in U–I R&D collaboration

Fairness refers to the perception that decisions, outcomes or procedures are correct and balanced and is a determinant of collaboration behaviour (Poppo and Zhou, 2014). Prior research identifies 'fairness' to be a critical factor with respect to successful, mutually beneficial long-term relationships between universities and businesses (Bstieler, 2006; van Burg et al., 2013). In social psychology, perceived fairness is widely recognised to influence individuals outcome evaluations (De Cremer et al., 2005); where perceived fairness can differ depending on culture, the situation, personal values or preferences (Blader, 2007). In any type of inter-organisational relationship, actors take part with the assumption of mutual benefit. Mutual benefit can take various forms varying from equitable returns, fair compensation for effort or social good in situations where the aim is to enhance social value (De Cremer et al., 2005). The achievement of mutual benefit is reliant upon trust and commitment which without prior relationships can take time to develop (van Burg et al., 2013). During negotiations, if an actor perceives terms to be unjust or unfair then this will cause strain on the collaboration and could cause opportunistic behaviour or even termination (van Burg and van Oorschot, 2013).

Prior research identifies that an increase in perceived fairness can lead to greater collaboration success (Amaral and Tsay, 2009; Sommer and Loch, 2009). Indeed, Appley and Winder (1977) and Fjeldstad et al. (2012) put forward the need for collaborative partners to have similar values which include a concern for the welfare of each other which should result in the equitable distribution of rewards. However, van Burg and van Oorschot (2013) identify that perceived fairness can mediate unequal power relationships where weaker partners who perceive processes and outcomes to be fair will accept adverse outcomes in the form of fairness compensation for effort. This has relevance for U–I collaboration where depending on the relationship and stakeholders involved, the academic or industry player may have misaligned levels of power which could prevent collaboration if inequitable outcomes were perceived (McAdam et al., 2016). Tootell et al. (2021) find opportunistic behaviour in U–I collaboration to be adverse with respect to knowledge creation.

Prior research identified that many unsuccessful inter-organisation collaborations are often the result of perceived unfairness of terms which can then lead to disharmony, resentment and in some cases uncooperative behaviours or sabotage (Duffy et al., 2003; Sommer and Loch, 2009). Poppo and Zenger (2002) stress that clear rules and procedures which clarify responsibilities, collaboration conditions and outcomes will enhance perceptions of fairness. van Burg et al. (2013) identify that fairness perceptions of entrepreneurs influence their collaboration behaviours with universities. Their research found that the entrepreneurs experience and relational capital helped to develop fairness rules which consequently govern the entrepreneur's collaboration with a university. From an academic's perspective, fairness perceptions are particularly important since these types of activities are often undertaken by academics on a discretionary basis (Tartari and Breschi, 2012). In many institutions, academics can choose to not engage in these types of activities and instead focus on other remits such as teaching, research or other related activities. However, a lack of willingness of academics to be involved in U–I collaboration will have consequential implications for universities demonstrating their impact in society (Guerrero et al., 2015). Research carried out by D'Este and Patel (2007) and Bruneel et al. (2010) identifies that a core barrier of academic engagement in commercialisation activities is perceived disharmony over university rules and processes. Thus, overcoming these issues may lead to greater levels of academics engaging in collaboration activities.

Prior research distinguishes varying dimensions of fairness namely (i) distributive fairness, (ii) procedural fairness, (iii) interpersonal fairness and (iv) information fairness (Colquitt, 2001; van Burg et al., 2013). Franke et al. (2013) identify that collaborators no longer just want a good deal but want fair collaboration terms and outcomes. In the context of U–I collaboration activities, distributive fairness (fairness in outcomes) and procedural (fairness of the process) are considered to be most relevant since these types of fairness have been found to help overcome the challenges of dealing with diverse stakeholders who often have varying objectives and expectations (Li et al., 2007; Luo, 2008).

Distributive fairness for U–I collaborations refers to the perception that the allocation of outcomes relative to the effort, resources, and procedures involved is fair (Poppo and Zhou, 2014). It encompasses the evaluation of whether outcomes are equitable given the contributions of each party and the presence of potential asymmetries where one partner benefits more than the other. In a U–I collaboration context, distributive fairness relates to the proportional sharing of both benefits (i.e. joint innovation outcomes) and burdens as well as jointly working towards further stakeholder-specific investments and compensations (Bstieler, 2006; Poppo and Zhou, 2014). van Burg et al. (2013) identifies that perceiving distributive fairness is believed to reduce the risk of opportunism. Distributive fairness has been found to mediate the impact of negative outcomes, where the perception of unfair treatment has been suggested to impact an individual more than an adverse outcome of a collaboration (Tabibnia and Lieberman, 2007). Distributive fairness has also been found to increase the willingness of actors to not only engage in collaboration activities, but to helps to embed processes for value co-creation during the collaboration which will lead to joint innovation outcomes (Yeoman and Santos, 2016). This has led to the development of hypothesis 2a.

Hypothesis 2a. Perceiving distributive fairness positively influences the impact of U–I R&D collaboration formalisation on joint innovation

outcomes.

Procedural Fairness refers to the perception that decision-making processes are consistent, accurate, and transparent. It involves open communication (Colquitt, 2001; Leventhal, 1980) to address detailed questions, unspecified process issues, and behavioural concerns that may arise during collaboration (van Burg et al., 2013). It captures both consistency and flexibility of procedural decision-making that considers partners' views and opinions. Procedural fairness has been found to have a complementary relationship with distributive fairness and formalisation (Franke et al., 2013). van Burg et al. (2013) identify that it can support decision-making in situations where processes have not been formalised in advance or in sufficient detail. Busenitz et al. (2004) research on cooperative relationships between entrepreneurs and investors found that procedural fairness positively impacts venture performance and outcomes. Similarly, Sapienza and Korsgaard (1996) identified that perceived procedural fairness impacts cooperation behaviour of entrepreneurs and investors. Furthermore, Brown et al. (2006) identifies that both distributive and procedural fairness can limit conflict and encourage compliant behaviours during collaborations. This has led to the hypothesis 2b.

Hypothesis 2b. Perceiving procedural fairness positively influences the impact of U–I R&D collaboration formalisation on joint innovation outcomes.

Joint innovation outcomes are a key objective of university-industry R&D collaboration. From the previous discussion, we have suggested that both formalisation and fairness can impact joint innovation outcomes. However, Duffy et al. (2003) and Kashyap and Sivadas (2012) identify that perceived fairness can encourage partners to strengthen partnerships and engage in behaviours which lead to outcomes beyond what was formally expected from the collaboration. Indeed Hislop (2003) and Flood et al. (2001) identify that fairness can lead to a knowledge sharing culture which can provide benefits beyond specified goals. Ideally, the benefits of university-industry collaborations should continue beyond the formal collaboration has ended, where such relations should become self-sustaining (OECD, 2012). The heterogeneity of university and industry stakeholders can mean that preferred outcomes beyond project outcomes can differ, comprising outcomes for universities and for businesses. The first refers to outcomes that are relevant for, and conducted by, academics and university staff which map onto their institutional reward and promotional mechanisms such as research funding, access to data and resources for research publications and impact case studies (Miller et al., 2016). Industry representatives will wish to continue knowledge exchanges with the university in order to acquire further market-related advantages which should hopefully lead to greater profitability and market shares, which comprises the outcomes for businesses (Perkmann and Schildt, 2015; Perkmann et al., 2013a, 2013b). Whereas university knowledge transfer staff are interested in similar outcomes as academics but with the addition of graduate employment and civic engagement (Chapple et al., 2005). Consequently, success in university-industry R&D collaborations which lead to joint innovation outcomes should lead to the development of external knowledge capabilities which can be leveraged for future benefits and outcomes at the university and the business level. Thus, we suggest that university-industry R&D collaboration can lead to further idiosyncratic outcomes for all involved beyond specified joint innovation outcomes. This leads to our third hypotheses.

Hypothesis 3a. Joint innovation outcomes have a positive influence on the outcomes for businesses.

Hypothesis 3b. Joint innovation outcomes have a positive influence on the outcomes for universities.

A research model is presented in Fig. 1 to illustrate the constructs and corresponding hypotheses developed from literature. Each hypothesis which will now be tested to glean a more nuanced understanding of the role of formalisation and perceived fairness during U–I R&D collaboration.

3. Methods

3.1. Data and sample

To address our aim and test our research model, we carried out a large-scale survey study of German professors. The geographical focus of our study was North Rhine-Westphalia (NRW), which can be considered as a representative sub-population of academics engaging in research-based U–I collaboration. With approximately 18 million inhabitants, it has the largest population of all German federal states, NRW in total has 63 universities (including traditional universities, universities of applied sciences, art academies and conservatoires), which is the highest number of higher education institutions (HEI) of all German states. Furthermore, NRW holds the highest density of HEI in Europe, offering a remarkably varied academic landscape that virtually comprises all research disciplines (Ministerium für Innovation Wissenschaft und Forschung des Landes Nordrhein-Westfalen, 2014; Nordrhein-Westfalen, 2019).

Due to the prevalence of disciplines lending themselves to more naturally collaborate with industry, we utilized the "selected

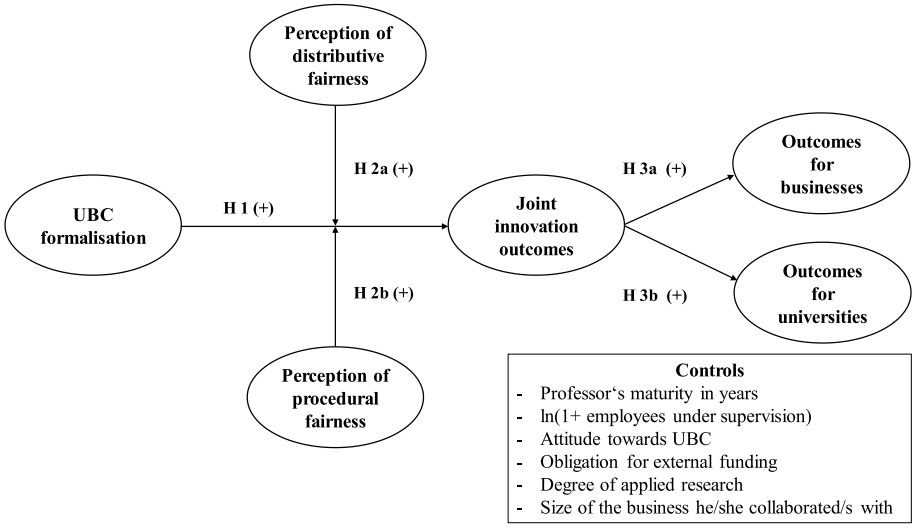

Fig. 1. Theoretical model.

disciplines" sampling technique, which helped to prevent biases towards a single university (Perkmann et al., 2013a, 2013b). We therefore consolidated our target population of professors from disciplines that are most likely to engage U–I collaboration. To ensure discipline bias was not an issue, we carefully excluded HEIs which do not usually collaborate with businesses such as HEI types which are not relevant for U–I collaboration activities (these are particularly conservatoires and art academies). This resulted in 44 HEIs remaining. We then excluded research areas which often do not have high levels of engagement in U–I collaboration (e.g. linguistics and theology). Thus, the target sample comprised of disciplines such as architecture, informatics, engineering, natural sciences, social sciences and business sciences. To develop our sampling frame, we targeted both full and assistant professors, since in a German context, academics in these positions are typically responsible for their research and teaching areas, and thus can freely decide for or against U–I collaboration. We then manually searched the websites of each of the remaining 44 HEIs to identify the email addresses of all professors' working in the selected disciplines. This led to a comprehensive list of 5351 professors who met the criteria of our target population.

Each of these professors was invited to participate in our survey via a personalized email. We followed up on this with reminders, one and two weeks after the initial invitation. We received 740 responses in total. As the response rates of web surveys targeting professionals are on average 23% lower than response rates of traditional mail surveys (Tourangeau et al., 2013), therefore our rate of 13.8% can be regarded as acceptable. We excluded surveys with a high amount of missing data from further consideration. We also disregarded all incomplete questionnaires and those with more than 20% of missing data, which reduced the number of useable responses to 415.

To check for non-response bias, the response behaviour of early and late respondents was compared (Armstrong and Overton, 1977). Three independent t-tests were conducted for comparing all model variables of initial respondents, respondents after the first reminder and respondents after the second reminder. These tests did not reveal any significant differences (at $p < 0.05$), thus non-response bias was not present. Representativeness was further tested by comparing our sample to observable variables of our target population. According to public statistics, 95.5 % of the professors in NRW are full professors, 74.4% are male (Information und Technik Nordrhein-Westfalen, 2014). Our respondents comprised of 96.1% of full professors and 81.5% males therefore our sample is generally representative of the target population.

Our respondents represented a diversified range of research disciplines, namely 32.4% engineering sciences, 18.6% business sciences, 15.0% natural sciences, 10.9% social sciences, 9.0% informatics, 5.1% medicine, 2.2% architecture/planning and 1.2% humanities. The surveys revealed that their collaboration partners are 73.7% companies, 13.0% organizations of public administration, 8.4% non-profit organizations, and 4.8% other types of organizations.

3.2. Checking for common method bias

Independent and dependent measures for the model were collected from the same respondents which can lead to common method bias (CMB). To address this issue, we utilized certain ex ante and ex post approaches in preventing and detecting CMB (Podsakoff et al., 2003). First, we ensured respondents absolute anonymity to help prevent perceived social pressure to provide responses which align with their specific university policies. Second, the survey was self-administered and filled out in privacy online, therefore the salience of social cues was reduced (Nederhof, 1985). Third, we specifically mixed measurement items in the survey so that they were not adjacent to each other. Fourth, our endogenous model constructs were measured by asking about particular manifest outcomes (e.g. number of filed patents) that are less influenced by individual perceptions. Fifth, our model includes latent interaction effects, which are more complex as compared to simple linear effects and where shown to be robust against CMB (Siemsen et al., 2010). Thus, we are confident that a respondent would not have been able to anticipate our hypothesized model.

We further carried out ex post remedies to assess whether or not CMB might significantly influence our results. We applied the correlational marker technique by testing the influence of a theoretically unrelated marker variable on the relations in our hypothesized model structure (Lindell and Whitney, 2001). As social desirability could potentially influence the answering behaviour of professors because of external pressures to increase the amount of third-party funding in academic research (Tartari and Breschi, 2012), we used an item related to the professors opinion about university-business interaction as marker variable (i.e. I believe that academia and industry should be distinct) as a correlational marker variable (Clauss and Kesting, 2016). After adding this variable as a control variable into a partial-correlation analysis of the latent variable scores in our model, all zero-order correlations remained stable regarding sign and significance. Finally, we added an unmeasured latent method factor to our model (Liang et al., 2007; Podsakoff et al., 2003). The average variance explained by the method factor loadings is only 0.8%. In contrast, the average variance explained by the theoretical constructs was 64.4% (ratio 80:1). Collectively, our analysis indicates that CMB is not a serious concern in our study.

3.3. Operationalization of constructs

We asked respondents to report about one specific U–I collaboration project they recently had had or currently have. Constructs were operationalized using validated scales from literature. If not explicitly stated, all items were measured with 5-point Likert scales ranging from 1 = fully disagree to 5 = fully agree. We adapted a scale to measure formalisation from Boyle and Dwyer (1995). Measures to capture procedural and distributive fairness were taken from Yilmaz et al. (2004). To overcome potential issues of CMB, we operationalized joint innovation outcomes via self-developed formative measures. We therefore collected potential outcome measures which are relevant and clearly articulated by the partners and asked how much each of these objectives could be achieved in the university-business R&D collaboration. We used a five-point measurement scale ranging from 1 = not at all to 5 = to a very high degree. As not all U–I R&D collaborations follow the same objectives, the items could not be interchanged and therefore had to be formative.

To control for factors other than formalisation and fairness that might influence our endogenous constructs, we included five constructs assessing the requirements, motivation and capability of professors regarding U–I collaboration. The obligation to get external research funding was controlled as suggested by Lee (1998), since it can influence the degree to which academics engage in U–I collaboration. In line with this, we further controlled two dimensions which are attributed to a professor's motivation to collaborate with practitioners: Attitude towards business collaboration, which was measured using items proposed by Lam (2010); and items for the differentiation between basic and applied research were adapted from the Frascati Manual (OECD, 2002). As these items differentiate between two antithetic research foci, they were measured as six-point semantic differentials ranging from −2 to 2. We controlled for two metric single-item indicators influencing the general capability of a professor: logarithm of the number of academic employees under his/her supervision and maturity of the professor, measured as the years in the current position.

3.4. Method

We tested our model using partial least squares structural equation modelling (PLS-SEM) with SmartPLS 3.0 (Ringle et al., 2015). PLS-SEM is particularly suited here, as it enables the use of formative and reflective indicators (Lowry and Gaskin, 2014). For the estimation of the outer and inner model parameters, nonparametric bootstrapping with 1000 replications, individual-level changes and mean replacement of

missing values was conducted to assess the significance of factor loadings and path coefficients.

4. Findings

4.1. Measurement model assessment

We assessed all reflective and formative multi-item measures relying on long established procedures and cut-off values for PLS-SEM (Hair et al., 2011). For all reflective measures, we tested indicator reliability, construct reliability, convergent validity and discriminant validity (Hair Jr. et al., 2021). Indicator reliability can be assumed as most indicator loadings reached or were slightly below 0.7 (Chin, 2010). Three indicators that only achieved very low loadings (>0.6) were excluded from the analysis. Construct reliability (CR) was found for all constructs, as composite reliability values were all above the threshold of 0.7 (Bagozzi and Yi, 1999; Dijkstra and Henseler, 2015). Consistently high average variance extracted (AVE) values substantiated high convergent validity of all reflective constructs (Hair Jr. et al., 2021). Discriminant validity (DV) is given as the differences of the AVE of each first-order and second-order reflective construct and its highest squared zero-order correlation with all other constructs at the same level is positive (Fornell and Larcker, 1981). We further assessed DV for all reflective constructs with the heterotrait-monotrait (HTMT) ratio criterion as well as the HTMT inference criterion (Henseler et al., 2014b). None of the HTMT values were above the conservative threshold of 0.85 (Kline, 2011; Ringle et al., 2023). The HTMT inference criterion indicates that all HTMT values are significantly different from one. Hence, we conclude that DV for our reflective constructs is given. Table 1 shows the results for the measurement assessment of all first and second-order reflective constructs.

To assess the formative construct, traditional tests for indicator reliability and convergence are meaningless, as there are no ex ante assumptions about the strength of the relationship of individual indicators and the construct (Hair Jr. et al., 2022). As a formative measurement is based on multiple regressions, multicollinearity could have been an issue. Hence, we calculated the variance inflation factors (VIF), which should be below 5 (Hair Jr. et al., 2021). As all indicators show values which are significantly lower, multicollinearity was not a concern. The relative importance of each formative indicator was assessed based on the second order weights (Becker et al., 2012). As insignificant formative indicators are still conceptually related to its constructs, they should be kept in the model (Henseler et al., 2009). Table 2 summarizes the results of the formative measurement model.

4.2. Structural model assessment

Our model shows overall good fit criteria. We achieve a standardized root means square residual (SRMR) value for the composite model of 0.049, which is significantly below the recommended threshold of 0.08 (Henseler et al., 2014). We also checked for collinearity at the structural model level, as predictor collinearity may lead to error bias (Sarstedt and Mooi, 2019). The VIF values (Table 3) are all below the conservative values between 3 and 5, indicating that collinearity is not an issue in our model (Hair Jr. et al., 2021). Our model explains a relevant share of 26% of the variance of joint innovation generation, 23% of the variance of the outcomes for businesses and 24% of the outcomes for universities. As cross validated redundancies (Q^2) for the endogenous construct are positive, predictive relevance of our model is given.

To test our hypotheses, we first calculated models in which only controls were included (M1). After including all main and interaction effects (M2) significant improvements of the model were made and the predictive relevance could be seen. Our findings show that formalisation has a positive effect on joint innovation outcomes, with path coefficient 0.14 at $p < 0.010$, supporting our H1. We also found supporting evidence that Procedural fairness, with path coefficient of interaction effect

Table 1
Assessment of the reflective measurement models.

Construct	Item	Factor loading	t-value
Formali-zation CR = 0.88, AVE = 0.71	Our collaboration with this partner is subject to a lot of rules and procedures'		
	There are standard procedures to be followed in collaborating with this supplier.	0.70	9.33
	The responsibilities of both partners are clearly specified.	0.90	29.19
	There are precisely defined procedures for collaborating with this partner.	0.92	40.20
Procedural Fairness CR = 0.88, AVE = 0.52	This partner.		
	… treats us without any predispositions.	0.73	19.78
	… applies consistent policies and decision-making procedures during the collaboration.	0.68	13.00
	… follows the principles of justice in this collaboration.	0.77	19.23
	… sometimes alters his procedures and behaviours in response to our objections.	0.67	17.43
	… seriously considers our objections to his procedures and behaviours.	0.79	26.29
	… never responds to ideas or objections coming from us. (reverse)[a]		
	… is knowledgeable about our situation and interests at the university.	0.72	19.23
	… takes pains to learn the local conditions at a higher education institute.[a]		
	… tries to understand the conditions and requirements we face at the university	0.68	16.57
Distributive Fairness CR = 0.93, AVE = 0.77	How fair are your outcomes and earnings from collaboration compared to …		
	… the effort and investment that you have made to support the collaboration.	0.91	65.93
	… the responsibilities you have to take.	0.91	70.77
	… what you would have earned in comparable projects.	0.91	86.68
	… what the project partner earns through the project.	0.77	21.35
Controls			
Obligation for External Funding CR = 0.85, AVE = 0.59	External research funding is important for my university in order to acquire additional resources for the realization of own research projects.	0.83	5.70
	At our university, we give priority to acquiring external research funding to obtain additional resources for department funding.	0.90	5.81
	My university regards external research funding as an academic achievement considered in annual performance evaluations and salary increase.	0.62	3.12
	Seeking external research funding is perceived as an integral part of academic advancement in terms of recognition and prestige.	0.71	3.96
Attitude towards UBC CR = 0.89, AVE = 0.58	I believe in the fundamental importance of academic-industry collaboration for scientific advancement.	0.76	23.28
	I believe that the benefits of collaboration with industry usually outweigh the inconveniences and costs of such work.	0.76	23.11

(continued on next page)

Table 1 (*continued*)

Construct	Item	Factor loading	t-value
	Because of my collaboration with industry, I have an increased understanding of what my own research brings to others.	0.77	32.08
	I am confident that collaborating with industry will yield valuable scientific outcomes.	0.79	32.35
	I try to combine industrial ways of working with my research methods to improve the outcome of my research.	0.73	21.96
	I believe in the fundamental importance of academic-industry collaboration for application and commercial exploitation.	0.77	27.72
Degree of Applied Research CR = 0.91, AVE = 0.72	My research activities primarily aim at … the investigation of general principles and theories. vs… the exploration of well-founded guides for practical actions.	0.85	17.11
	The goal of my research activities is … to acquire new knowledge about phenomena and observable facts. vs… to determine the possible use of new knowledge for achieving specific objectives.	0.85	15.03
	My research is conducted … for the advancement of knowledge without seeking economic or social benefits. vs… with the expectation of solving particular problems.	0.87	21.34
	My research efforts are focused on … studying phenomena in order to obtain information. vs… optimizing predetermined processes and methods.	0.82	16.10

[a] Items were excluded due to factor loadings below 0.6.

Table 2
Assessment of the formative measurement models.

Construct	Item	Path weight	t-value	VIF
Joint innovation outcomes *self-developed*	Filing of patents	0.12	1.56	1.34
	Solving technical problems	0.21	2.12	1.51
	Development of new products	0.35	3.84	1.51
	Discovery of new knowledge and new findings	0.71	8.87	1.07
Outcomes for businesses *self-developed*	Enlarging market share	0.32	1.21	3.07
	Enhancing revenues	0.35	1.99	3.69
	Improving profitability	0.11	0.96	2.02
	Improving customer satisfaction	0.43	2.46	1.34
Outcomes for universities *self-developed*	Publication of practitioner-oriented papers	0.16	1.43	1.57
	Publication of scientific journal papers	0.49	2.99	3.11
	Presentation at scientific conferences	0.16	1.10	3.52
	Reputation gains in the scientific community	0.34	2.14	2.14

0.15 at $p < 0.001$, and Distributive fairness, with path coefficient of interaction effect of 0.07 at $p < 0.050$, positively moderates the effects of formalisation on joint innovation outcomes. Hence, providing support to hypotheses 2b and 2a. Finally, our findings also show that joint innovation outcomes have strong and positive effects on outcomes for businesses with path coefficient of 0.46 at $p < 0.001$, and on outcomes for universities, with path coefficient of 0.45 at $p < 0.001$. Thus, accepting the hypothesis H3a and H3b. Considering our sample size (N = 415), minimum path coefficient ($|p_{min}|$) of 0.07 and total number of 4 predictors (formalisation, distributive fairness, procedural fairness and joint innovation outcomes) in the multiple regression SEM-PLS we achieved statistical power of 0.998 (using G.Power Software, error probability $\alpha = 0.01$), which is well above the threshold of 0.8 with $\alpha = 0.05$, thus rejecting the null hypothesis when its true (false positive) is ruled out (Hair Jr. et al., 2021). The final models (Table 4) show that all five hypotheses are significantly supported by our data. Fig. 2 depicts the final validated model.

Table 3
Assessment of collinearity in the structural model.

Construct	Predictor	VIF
Joint Innovation Outcomes	Ln(1+Employees)	1.012
	Professors' Maturity	1.046
	Attitude towards UBC	1.551
	Obligation for External Funding	1.144
	Degree of Applied Research	1.47
	Formalisation (F)	1.07
	Procedural Fairness (PF)	1.476
	Distributive Fairness (DF)	1.401
	Interaction Effect: PF x F	1.064
	Interaction Effect: DF x F	1.058
Outcomes for Businesses	Ln(1+Employees)	1.007
	Professors' Maturity	1.025
	Attitude towards UBC	1.539
	Obligation for External Funding	1.111
	Degree of Applied Research	1.436
	Joint Innovation Generation	1.174
Outcomes for Universities	Ln(1+Employees)	1.007
	Professors' Maturity	1.025
	Attitude towards UBC	1.539
	Obligation for External Funding	1.111
	Degree of Applied Research	1.436
	Joint Innovation Generation	1.174

5. Discussion

The increased rise of universities attempting to demonstrate their impact upon society coupled with the increased need for universities to generated sustainable income has led to an increased surge of research published on U–I collaboration (Cunningham et al., 2018; de Wit-de Vries et al., 2019). However, the state of knowledge remains relatively fragmented and tentative, particularly in respect to how to best organise and manage U–I collaboration to ensure it is beneficial for both parties (Mindruta, 2013). Our findings contribute to this endeavour through exploring if formalisation increases fairness perceptions and joint innovation outcomes during U–I collaborations.

The results found that formalising R&D and innovation-based U–I collaboration activities, through specifying procedures, responsibilities and outcome expectations, led to less opportunism and enhanced perceptions of fairness and trust. This concurs with prior research on inter-organisational collaboration through identifying the positive effect formalisation has on collaboration effectiveness (Amaral and Tsay, 2009; Sommer and Loch, 2009). However, it is noted that formalisation processes should be efficient to reduce the chances of too much bureaucracy which leads to rigidity (Perkmann and Salter, 2012).

Magen (2013) identifies the risk of unconscious bias towards self-interest when making fairness judgements. However, our research suggests that formalisation can alleviate this through ensuring clarity of processes and expected outcomes from the outset which is agreed between partners which will clarify expectations and reduce the chances of opportunism. These findings align with (Hoetker and Mellewigt, 2009; Williamson, 1985) and Burnside and Witkin (2008), who identify how formalisation helps develop trust and limit opportunism between partners.

Table 4
Hypothesis test and model fit.

Dependent Variable:	Joint Innovation Outcomes		Outcomes for Businesses		Outcomes for Universities	
	M1 (only controls)	M2 (M1 + main effects + interaction effects)	M1 (only controls)	M2 (main effects)	M1 (only controls)	M2 (main effects)
Controls						
Ln(1+Employees)	0.03	0.02	−0.03	0.01	0.02	0.01
Professors' Maturity (years)	0.09*	0.04	−0.11	−0.06	0.08	0.06
Attitude towards UBC	0.37***	0.24***	0.14	−0.02	0.25***	0.09
Obligation for External Funding	0.04	0.03	0.02	−0.03	0.08	0.02
Degree of Applied Research	0.02	0.03	0.16**	0.09	−0.04	−0.06
Main effects						
Formalisation (F)		**0.14** (H1)**				
Joint innovation outcomes				**0.46*** (H3a)**		**0.45*** (H3b)**
Procedural Fairness (PF)		0.11**				
Distributive Fairness (DF)		0.17***				
Interaction effects						
FxPF		**0.15*** (H2b)**				
FxDF		**0.07* (H2a)**				
R^2	0.16	0.26	0.07	0.23	0.08	0.24
ΔR^2		0.10		0.16		0.16
Q^2	0.04	0.06	0.01	0.13	0.03	0.16
ΔQ^2		0.02		0.12		0.13

*p < 0.050, **p < 0.010, ***p < 0.001.

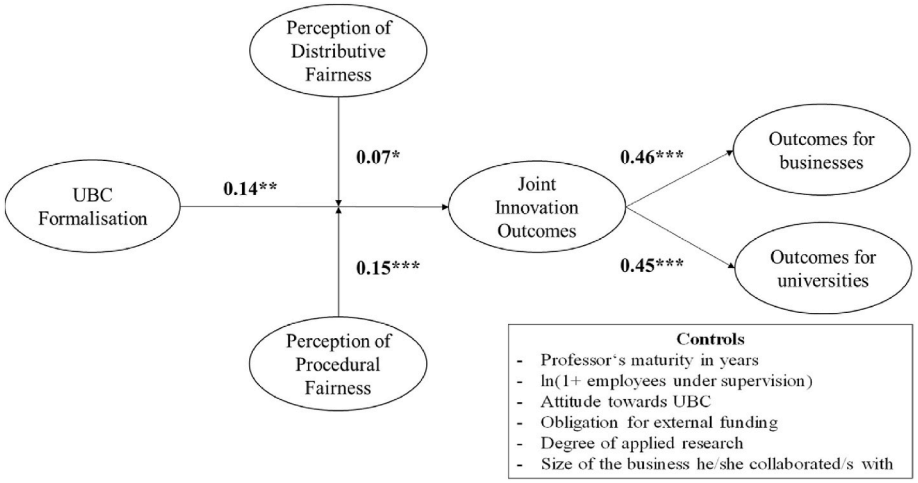

Fig. 2. Empirical model.

This clarity of processes and outcomes was found to help overcome challenges associated with differing exante and expost fairness perceptions which are often cited as being a key challenge in inter-organisational collaborations (Trautmann and van de Kuilen, 2016). Indeed, Huang and Chen (2017) suggest the need to co-create processes, milestones and goals to ensure all partners are clear of roles and expected outcomes. Furthermore, our findings identify that clarity of processes, roles and expected outcomes alleviated concerns of power asymmetries amongst stakeholders, which have been found in prior literature to be a key barrier during are U–I collaboration (Miller et al., 2014; van Burg et al., 2013). Consequently, our research shed light on the importance of formalising U–I processes in order to increase the chances of both collaboration satisfaction and performance.

The data identified that formalisation increases the speed of negotiations between actors and provided a clear pathway to ensure value creation and capture was achieved for all partners involved in the collaboration. Consequently, the findings suggest that formalisation not only helps to reduce risk, uncertainty and disharmony of differing objectives, which are often cited to be challenges of U–I collaboration (Bruneel et al., 2010; Lin, 2017), but formalisation can lead to enhanced joint value creation and capture (Aulakh and Gençtürk, 2008; Balogun and Johnson, 2004) confirming hypothesis 1. This provides new insights into how formalisation can enhance value creation and value capture within a U–I context which is important with the increasing emphasis on universities to report the impact they are having on wider society.

However, it was found that formalisation on its own often does not ensure complete clarity or trust between collaborative partners. Formalisation does not automatically lead to fairness perceptions, particularly if partners have not collaborated before. Furthermore, it is identified in prior literature that academics view formalised processes as an additional level of bureaucracy which limits their willingness and motivation to engage in U–I (Perkmann et al., 2013a, 2013b). Our findings identify that both procedural and distributive fairness increases the positive effect of formalisation on joint innovation outcomes thus confirming hypothesis 2b and 2a. This concurs with prior buyer-supplier and business-business research (Li et al., 2007; Luo, 2008; Sapienza and Korsgaard, 1996; van Burg and van Oorschot, 2013; Yeoman and Santos, 2016) suggesting that U–I collaborations are functionally similar to buyer-supplier relationships therefore universities should adopt collaboration practices from private sector organizations to enhance collaboration effectiveness and success.

Colquitt and Zipay (2015) identify that procedural fairness enhances

overall fairness perceptions since it precedes knowledge and awareness of the outcome. Procedural fairness is particularly important when dealing with uncertain or turbulent environments, which is characteristic of innovation processes. Our findings providing new insights in a U–I context by identifying that greater effort is needed by the knowledge transfer offices and academics to enhance both procedural and distributive fairness. This will alleviate the risks associated with uncertain innovation outcomes and align expectations between partners which will help improve overall perceived fairness of U–I collaborations (Abramo et al., 2009).

Furthermore, our findings identified that fairness is complementary to formalisation. We found that a combination of formalisation, procedural and distributive fairness perceptions can help achieve mutual value creation and capture during U–I collaborations (Mindruta, 2013). Indeed, increased perceived fairness led to greater trust and commitment where actors would then work harder at the relationship to overcome challenges associated with formal governance to make the project a success (Bruneel et al., 2010; Bstieler et al., 2015). This is important since prior research on U–I collaborations often cite bureaucratic administration and unclear procedures leading to long negotiations of appropriation rights as being a key inhibiting factor deterring industry from collaborating with universities (Miller et al., 2018; Rothaermel et al., 2007). Consequently, formalisation and increasing fairness perceptions will establish expectations and roles, leading to more efficient and effective processes.

From the discussion of our findings, it is clear that formalisation does play a key role in the perceived fairness and performance (i.e. enhancement of joint innovation outcomes) of U–I collaborations. Consequently, our research has a number of contributions. First, we extend U–I collaboration literature by demonstrating the relevance of the nascent concepts of formalisation and perceived fairness as determinants of successful U–I R&D collaboration. To date these concepts have been explored in business to business and supplier-buyer relationships with a dearth of research in a U–I collaboration context (Bercovitz and Tyler, 2014). Indeed, we respond to calls by Bstieler et al. (2015) who identify the need to explore how governance mechanisms such as formalisation can enhance satisfaction in collaborations. Our study shows how fairness and formalisation impact upon partner relationships, improving the effectiveness and innovation outcomes of U–I collaboration. Second, prior research on formalisation of alliances has resulted in inconclusive results (Barringer and Harrison, 2000). We extend alliance research in general by proving the relationship between formalisation and performance and in particular, we shed light on the how to enhance collaboration performance between universities and industry. We found that distributive and procedural fairness perceptions positively moderated the relationship between formalisation and joint innovation outcomes. Thus, this research sheds light on the importance of moving beyond material outcomes as determinants of collaboration behaviour and the importance social preferences, such as fairness have on collaboration behaviours (Gachter et al., 2010; Yeoman and Santos, 2016). Furthermore, by proving the inherent role formalisation has as a mediator to fairness perceptions, this research responds to calls for future research by van Burg et al. (2013) who identify the need to understand how actors form fairness perceptions.

We also have a number of practical implications. Through unravelling the importance of fairness perceptions in determining academic's industry engagement behaviours, universities can increase the motivation of academics through the development of clearer processes, rules and procedures for industry collaboration activities. Our research has implications for knowledge transfer managers by stressing the importance of perceived fairness management through formalisation (i.e. planning, implementation and control) to increase performance of U–I R&D collaboration. This would require greater communication of formal rules and contractual terms to academics and university partners and additional support staff, improving clarity of processes and removing power asymmetries in order to ensure that formalisation is not perceived as bureaucratic or limiting creative freedom but is there to ensure mutual benefits for all stakeholders (Poppo and Zhou, 2014). Lastly, building on research by Long et al. (2011) this research identifies the need for knowledge transfer offices to implement fairness monitoring to help develop more effective and long-term U–I collaborations.

Although our findings provide valuable scientific and practical implications, they bear certain limitations. First, our study geographically focuses on the most populous German state. Formalisation and fairness perceptions are sensitive to cultural contexts though, which dictates expectations and norms. Thus, future research should explore varying cultural contexts to help increase validity and generalisability. Second, our research exclusively explores the viewpoint of university professors and does not provide an insight into their reciprocal industry partners. Future research could undertake a dyadic study to facilitate a U–I actor comparison to enhance insights into formalisation and perceived fairness during collaborative relationships. Furthermore, fairness perceptions can vary over the lifecycle of an innovation. Therefore, future research should explore the dynamic nature of fairness and the antecedents which impact upon fairness perceptions at different stages of the U–I collaboration process.

6. Conclusion

We embarked on an investigation to determine whether formalisation increases fairness perceptions and joint innovation outcomes during U–I collaborations, given the intricacies and complexities arising from differences between the two parties. Our findings indicate that formalisation mechanisms, coupled with subjective perception, enhance joint innovation outcomes, thereby improving individual results for each side. Thus, we emphasize the importance of exploring the managerial aspects of U–I collaborations. As our study suggests, U–I collaborations may bear more resemblance to commercial relationships than previously assumed. Despite the significant influence of institutional settings and other external forces, the potential mutual and individual benefits underscore the need for further understanding of the mechanisms and drivers behind stimulating and securing innovation and long-term practices. Our study marks the initial steps toward this endeavour.

CRediT authorship contribution statement

Thomas Clauss: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Supervision, Validation, Writing – original draft, Writing – review & editing. **Tobias Kesting:** Conceptualization, Data curation, Investigation, Writing – original draft. **Matheus Franco:** Formal analysis, Methodology, Validation, Visualization, Writing – review & editing.

Declarations competing of interest

None.

Data availability

Data will be made available on request.

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