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Organizing practices of university, industry and government that facilitate (or impede) the transition to a hybrid triple helix model of innovation

Abstract

Drawing on the contemporary turn to discursive practices we examine how the organizing practices of industry, university and government facilitate (or impede) developing countries transition to a hybrid triple helix model of innovation. Placing emphasis on the everyday situated practices of institutional agents, their interactions, and collaborative relationships, we identified three domains of practices (advanced research capabilities and external partnerships, the quantification of scientific knowledge and outputs, and collective entrepreneurship) that constitutively facilitate (or impede) partnership and in turn the successful transition to a hybrid triple helix model. Our study also highlights the contextual influence of differential schemata of interpretations on how to organize innovation by the three institutional actors in developing countries.

Keywords: Discursive practices, innovation, Malaysia, organizing practices, triple helix

Introduction

In parallel with the emergence of the knowledge based economy, research into national systems of innovation has flourished over the past 50 years (e.g. [1-5]). Indeed, national and regional innovation scholars have dedicated considerable effort and attention to understanding how and when linkages between governments, economic actors, universities, and other institutions may lead to the identification of opportunities for innovation that deliver value to all stakeholders (e.g. [6-9]). As institutional collaboration becomes increasingly wide-spread, the capacities for such partnerships to stimulate innovation and generate inclusive economies has attracted a lot of research interests [8,10]. At the centre of these developments is the evolutionary triple helix model which advocates strategic interactions and collaboration between universities, industry and government [10-12].

Recurrent themes in recent theory have therefore focussed on the evolution of the triple helix model of innovation in developing countries, particularly those in East Asia, regarded as having developed institutional infrastructure and appropriate technologies to support innovation and production hubs [13-15]. This interest has also been extended to the exploration of the potential of triple helix in contribution to technology commercialization, new venture creation, and its consequences for policy initiatives in transition economies [16-19]. As this research suggest, triple helix plays a crucial role in integrating relevant institutions to boost national innovative activities and technology development [20]. Promising flexible and desirable outcomes from close interactions and optimal collaborations' between universities, industry, and government, triple helix enable nations to anticipate how they could create wealth and build knowledge based society. Yet, as research indicates, there are no ready-made recipes to guide countries in transitioning to the triple helix model. In this regard, some researchers have criticized the triple helix model for paying scant attention to social context [21], and lacking 'socio-cognitive' micro-foundations to drive its empirical development [22]. Pioneering advances in triple helix scholarship, have also focussed predominantly on macro-level theorizing at the expense of micro-foundations required to institutionalise the concept. Perhaps owing to this focus, scholars have overlooked the relevance of the actions and situated practices of institutional agents and actors in institutionalizing triple helix. From a theoretical standpoint, these issues may have been sidestepped due to the methodological complexities involved in mapping the activities, connections and architectures underpinning triple helix in practice. Likewise, from an empirical standpoint, the top-down conceptualization raises a potentially critical question: What are the organising practices of institutional actors and agents that facilitate (or impede) the transition to a triple helix model of innovation. By organizing practices, we refer to the formal and informal canonical rules and structures that prescribe, coordinate, and govern situated practices and the 'acceptable way' work is done [23]. In our view, this question is important because it compels consideration of a reversed causation (a bottom-up), and has the potential to extend our understanding as to why some countries may be (un)successful in their efforts at transitioning to a

triple helix; likewise it provides insight into how taken-for-granted organizing practices of agents acting on behalf of their institutions may simultaneously enable or constrain them in enacting knowledge based action in their situated practices.

We address the research question posed above by drawing on the contemporary turn to discursive practice in social theory to examine how the triadic influence of individual (micro), organizational (meso), and contextual everyday practices may constitutively influence a country's transition quest to transition to a triple helix model of innovation. Specifically, we seek to account for how the organizing practices of institutional protagonists and agents may enable (or impede) the successful transition to a hybrid triple helix model of innovation. We argue that organizing practices and their temporal linkages to collaboration processes ordered across space and time [24-26], influences institutional agents' commitment to adopting emerging new ways of organizing. Thus, we submit that organizing practices, through the flow of agents 'sayings' and 'doings' may shape the degree to which a country (un)successfully transition to a triple helix model of innovation.

Our study makes two contributions to the literature on triple helix. First, its focus on organizing practices adds a complementary but previously underemphasized perspective to the ongoing debate on the successful transition to the triple helix model of innovation in developing countries. Second, by employing a qualitative case-study approach, our paper provides rich narrative accounts of the protagonists of national innovation systems enriches our understanding of the micro-processes of change at work and opens up new possibilities for rethinking the antecedents and challenges for successful university-industry-government collaborations. We develop our contribution in the context of Malaysia, a developing country that is pushing to implement the triple helix model of innovation to mobilize its technological capabilities to pursue its agenda of developing a knowledge base economy.

We begin with a brief review of the literature on the triple helix model of innovation. Next, we draw on the discursive practice as a meta-theoretical lens to delineate the complex linkages and connections between organizing practices and the trajectories of transitioning to a triple helix model

of innovation. Following this, we provide an overview of the Malaysian triple helix transition after which we present our research methodology. In the penultimate section we present our research findings and conclude with its implications for theory, practice and policy.

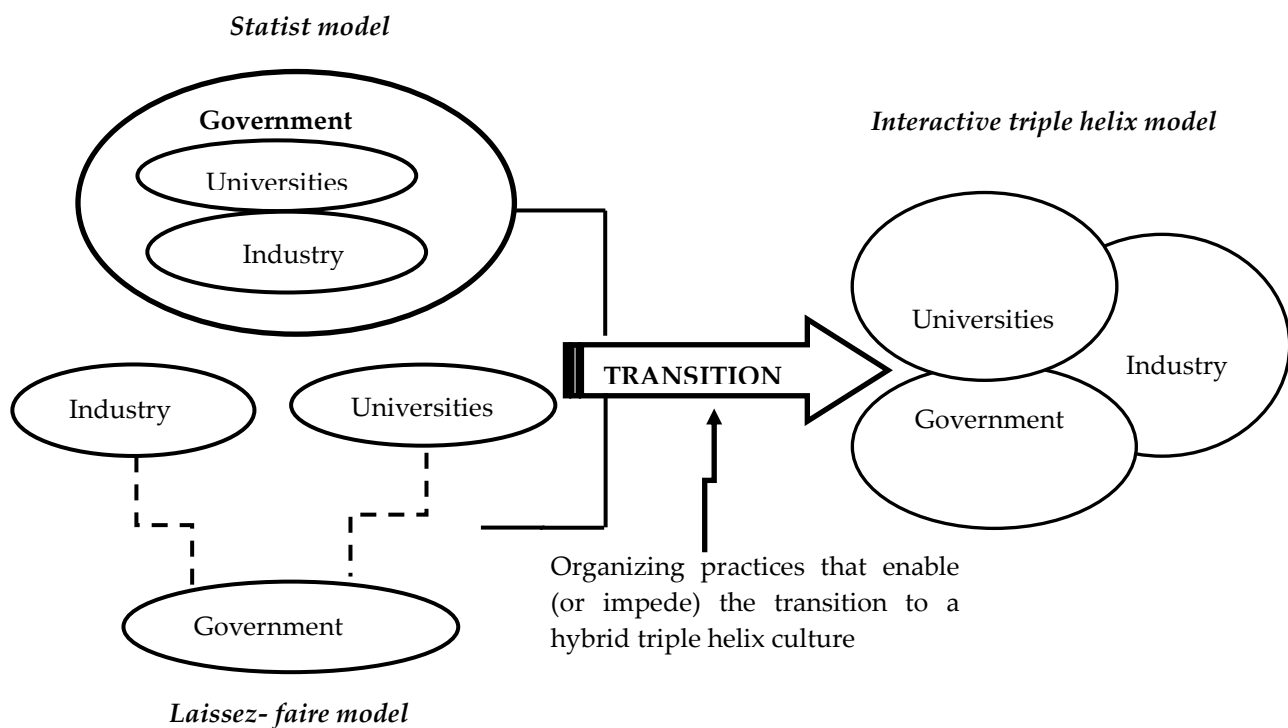
The triple helix model of innovation

The search for national competitiveness, economic development, and ways to shore up national innovation capacity has led to considerable research interest into National Innovation System (NIS) [5,27,28]. At the heart of this development in recent times is the triple helix concept which comprises an evolutionary model for collaborative relationships between the traditional three institutional spheres that comprise universities, industry and government in which innovation is an outcome of the interaction. The triple helix model incorporates three distinct typologies of innovation systems.

First is the statist model. Under this regime, the government plans, controls, and directs the relationship between industry and academia in search of innovation. Industry is regarded as the national champion of innovation, while the university's role is reduced mainly to teaching and academic research [11,12,29]. Under this model, the potential to exploit knowledge generated by universities is limited as university teaching and research tend to be far removed from industry needs and universities themselves have little or no incentive to engage in the commercialisation of their research [30-32]. Second is the laissez-faire model. Here, governments, universities and industry operate independently in separate institutional spheres [12,32]. The lack of a synergistic relationship between the institutional spheres means that government's role in harnessing innovation is limited to addressing market failures, while universities engage in basic research and manpower training [33]. Even firms embedded in the same industry operate independently from each other and are linked only through the market. Here too, industry is seen as the driving force of innovation with the other two institutional spheres acting as ancillary supporting structures [29]. Third is the hybrid triple helix model which represents a combination of the statist and laissez-faire models. This hybrid model places emphasis on building overlapping and relatively interdependent relationships between the three spheres. A radical departure from the statist and laissez-faire model, the hybrid model is a

network that encourages movement towards mutual collaborative relationships and linkages among the three major institutional spheres and other diverse organizations and disciplines in which innovation policy is an outcome of their interactions rather than a prescription from government. Under the hybrid configuration, each institutional sphere maintains its own distinctive characteristics while assuming the role of the others [11,12,29]. The transition from statist and laissez-faire positions towards a hybrid triple helix position allows the capitalization of knowledge in the sense that universities begin to take on a generative role in directing regional economic development through 'academic entrepreneurial' activities that share common characteristics with the traditional roles of industry and the state in economic regulation [34-36].

Figure 1 The triple helix model of innovation



Many countries, as part of their innovation strategy, continue to experiment on optimal mixes of functions and institutions in the hybrid model through diverse arrangements such as strategic alliances among firms, university spin-off firms, science parks and technology incubators to spur innovations [37]. The organizing logic of such experimentations are centred on the leveraging of each

actor's traditional core competences and the continuous strengthening of their (inter)national innovation networks. This logic is reinforced by the dynamic re-configuration of the relationship between the three institutional spheres, as well as the proactive transformation in the way they organize their innovation activities [29,36,38]. The hybrid triple helix configuration is now a global phenomenon. Its potential to support self-organization in the pursuit of innovation [39] means the model has become so ubiquitous and internationalized even though the institutional structures supporting it remain country-specific [40,41]. Nevertheless, while attempts to adopt the hybrid triple helix model are on the rise, there are no ready-made recipes to help guide countries to develop the capabilities of their institutions and global networks to support their endeavour. In particular, guidance on the successful transition from the statist or laissez-faire models to a hybrid triple helix configuration remains sparse [42-44]. Of relevance for this paper, developing countries have struggled to make the transition to a hybrid triple helix model by virtue of their lack of resources and weak institutions [37,45,46]. Recent work has increasingly focused on identifying antecedents and specific institutional factors that constrain the adoption of the triple helix model of innovation in developing countries [17-19,47,48]. This stream of studies identifies national innovation culture as a salient, but often, taken-for-granted factor that shapes the triple helix ambitions of developing countries. They conceptualise national innovation cultures as not just the 'mental programming' of the three institutional spheres that shapes and gives form to their interaction and collaborative relationships that result in innovation, but also a proxy to understanding collaboration governance, and the way innovation is organized. Saad [19] for example contends that a careful analysis of the situation points to a weakness in institutional design and working practices of most developing countries accounting for this widespread failure; in short their organizing practices seldom promote interaction, learning, and innovation between the three institutional spheres.

Surprisingly, there is as yet no explicit theory or empirical work delineating how the organizing practices of the three institutional spheres as an extension of national innovation culture influences the transition to a triple helix model of innovation. Thus, in our effort to extend this line of

research, we draw on the discursive practice turn in contemporary social theory [24, 49,50] as a meta-theoretical lens to examine how the organizing practices, routine behaviours, and situated activities of the three institutional spheres may contribute to our understanding of the (un)successful transition to a triple helix model of innovation. We argue that the transition to a hybrid triple helix may not only require the accentuation of interdependent relationships and interactions between the three institutional spheres. It also involves the reconfigurations of institutional actors' doings, routines, and their situated organizing practices in ways that could lead to productive innovation outcomes. In the following section, we attempt to chart our discursive practice approach to triple helix and specify its underlying logics in context.

On the way to a hybrid triple helix: a discursive practice approach

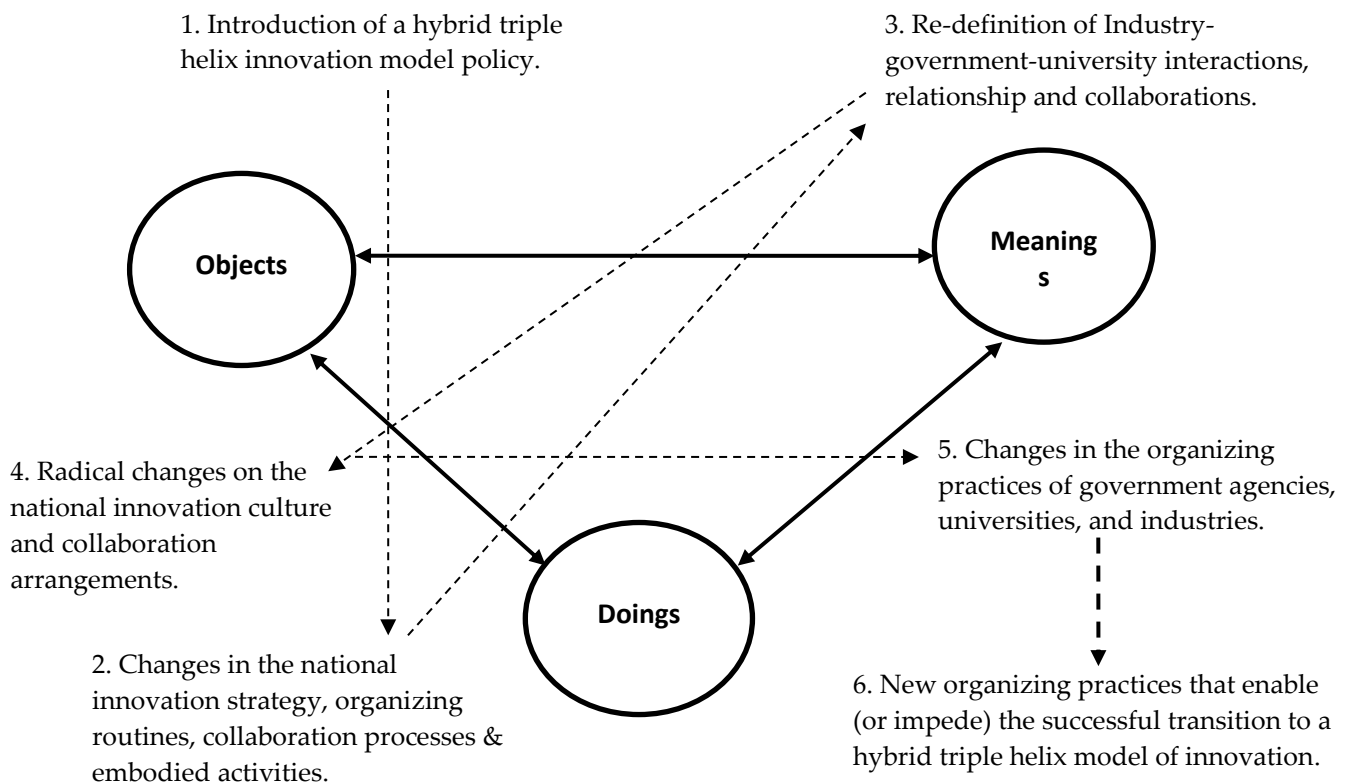
The notion that our social world is a construction of meaning has led to the contemporary turn to discursive practice in addressing the processes by which cultural meanings are produced and understood [51,52]. Drawing on the interpretive tradition [53,54], our discursive practice approach to understanding the transition to a hybrid triple helix is rooted in how individuals perceive and categorize their world and their rules and meanings that guide how they imagine and explain things. In this regard, we deploy the use of language, the discursive accounts of actions and text to 'unpack' the constellation of localised patterned activities and practices that give form to the introduction and transitioning from one national innovation systems to another.

Following Pickering [55], we argue that the development of science and technology is an activity rather than mere representations, and that the relation between people, practices, and institutions, could extend our understanding of human conduct in the evolution of complex technological systems. From this perspective, we argue that the organizing practices that shape and give form to the transition to a hybrid triple helix model are characterised by collective agreements, have a history, are flexible, and are in constant flux of transformation [56,57]. These organizing practices, we argue are neither processes nor something that the three institutional spheres have.

Rather, they are the 'things' they do, serving as the junction where 'doings' and 'sayings' meet and interconnect in actual situations to drive the transition process [49, 58].

Delineating the dynamic configuration of practices or what they referred to as the 'circuit of practice', Shove et al. [24] identified objects, meanings and doings as the three dimensions of practice which constitutively create, stabilize and transform human activities across space and time. Conceptualizing things such as mind and morality as matters reserved for agents, they argued that a 'practice' is the outcome of the performative linkages between objects, meanings, and doings. This linkages or 'held-togetherness' (Zusammenhang) in Schatzki's ([57], p. 14) terms, suggests a temporal interrelatedness, of the three elements whose (re)production 'depends on forms of practical knowledge, guided by structural features-rules and resources-of the social systems which shapes daily conduct of actors ([24], p.3). Their successive enactment is goal oriented, stabilized, sustained and based on the experience and intelligibility of actors. The role of intelligibility however, brings to the fore the role of mental organisation in practices. Schatzki ([49], p. 49), in accounting for this, refers to mental phenomena such as desires, hopes, fear and anxiety as fundamental 'states of affairs' that enable actors to cope with their involvement with the world. Drawing on the 'circuit of practice' notion as further developed by Magaudda ([59, p.30]), we attempt to account for the changes and transformation that may influence and reconfigure the organizing practices of institutional actors during the transition from statist and laissez-faire models to a hybrid triple helix.

Figure 2 Triple helix transition visualised through the 'circuit of practice'



Based on Magaudda (2011)

As shown in Figure 2, the solid lines represent the triadic relationships between the elements constituting the practices characterizing a hybrid triple helix innovation as an entity. The dotted lines show the actual relationships and influences these elements establish in the institutional actors' experiences and activities. We argue that the transition to a hybrid triple helix involves (1) the introduction of objects, technologies and material culture in general which may come in the form of a new national science and technology policy. The new sanctioned 'social order' binds the three institutional agents to adopt common practices to enhance their interactions. For example, universities interfacing the public-private partnerships as envisaged by triple helix will the development of trilateral relationships, forming alliances, and the proactive commercialization of their technologies. The stabilization of these new 'ways of doings' may then leads to; (2) Changes in the national innovation strategy represented by embodied competences and activities, processes and

routines of the innovation institutional spheres. Here Universities again in playing its entrepreneurial role in consultation with government and the private sector begins to set new research agendas, shore-up their intellectual property management capabilities, and set up commercial units to manage their new technology development and transfers. These changes may then lead to; (3) what we call the creation of new meaning on the (re)definition of industry-university-government interactions, cooperative relationships, and collaborations. Thus, the universities will begin to corporatize their activities, broaden their engagement with industries, and put a premium on mutually agreed collaboration with external partners in developing and probing emerging technologies. The redefinition of the collaborative relationships could then lead to; (4) radical changes on the national innovation culture and collaboration arrangements protocols in ways that strengthen the interdependence of institutions as they seek to achieve transformative synergies. This may involve the performative integration of cultural values, experiences and activities of partners in ways that support enterprise and the new spirit of collaboration in the pursuit of innovation. Such a cultural shift may then lead to; (5) changes in the organizing practices of the three institutional spheres into effective configurations that work. For example, the three institutional spheres may consider making changes on their funding arrangements in ways that encourage collaboration and accountability. Their new ways of 'doing' and accomplishing innovation activities may then lead to; (6) new organizing practices at the micro-level that has the potential to support (or impede) the successful transition to the new national innovation system - a hybrid triple helix, where optimal collaboration between different institutional sphere drives national innovation activities. In the next section we chart Malaysia's triple helix journey.

The Malaysian triple helix journey

Malaysia serves as an interesting setting for understanding the evolution of the triple helix model of innovation (as shown in Table 1). From the late 1950s up to the early 1970s its innovation strategy was akin to the statist model. During this period, collaborative research between universities and private firms was reportedly almost non-existent and Malaysian firms carried out little research themselves

even though they were seen as the champions of innovation [60,61]. The government drove both industry and universities, State Owned Enterprises (SOE's) dominated the economy, the universities' role was restricted to teaching and learning, while government R&D institutes provided technical assistance to farmers [60]. For instance, while universities received funding they required to grow and function from the government, university academics were considered civil servants, subjected to strict public service regulations imposed by the Public Services Department which restricted their working hours and engagement in activities such as consultancy [62].

Table 1 Malaysia triple helix transition journey

Statist triple helix	laissez-faire triple helix	Hybrid triple-helix
<ul style="list-style-type: none"> ▪ Government played the major role in 'driving' academia and industry ▪ Universities role is reduced mainly to teaching and academic research ▪ R&D Institutes provided technical assistance for agricultural activities ▪ industry regarded as the national champion in driving economic development 	<ul style="list-style-type: none"> ▪ Government, universities and industry operated independently as separate institutional spheres ▪ Publication of the first Malaysian science and technology policy in 1986 ▪ Intensification of Research in Priority Areas (IRPA) programme in 1987 ▪ Limited economic and industrial policy to promote university-industry-government collaborations 	<ul style="list-style-type: none"> ▪ Corporatization of Malaysian public universities allowing them to engage in commercializing their technologies ▪ Emphasis on science and technology development and an aggressive investment to develop local technological capabilities (MIGHT, 2004; 2000). ▪ Increased tripartite technology and innovation partnerships
Period 1: Late 1950s and 1970s	Period 2: Late 1970s–1990s	Period 3 2000s–Present

The late 1970s up to the late 1990s saw a shift in Malaysia's national innovation initiatives which did not only guarantee extensive autonomy to universities, but also encouraged them to engage in some research into appropriate technologies to solve local problems[60-62]. The desire to develop indigenous technologies and national innovation capabilities prompted the government to create the National Council for Scientific Research and Development (NCSRD) and the Ministry of

Science and Technology which published the country's first science and technology policy in 1986 [63]. The policies in principle sought to encourage partnerships between public funded organisations and industry as well as between local and foreign companies for the co-development of generic technologies. Initial success in the agricultural sector led to the launch of the Research in Priority Areas (RIPA) programme in 1987 which had rubber and palm oil production at its heart [61, 64].

Despite its intentions, the 1986 Science and Technology policy promoted limited economic and industrial collaboration between the government, universities, and industry, because they continued to operate independently as separate institutional spheres. Furthermore, no incentives were given for firms to engage in research or technological innovation activities [60]. While industry, seen as the champion of national innovation, grew strong it was by virtue of exploiting national location specific advantages. Industry during this period continued to be inefficient in developing novel technologies, and lacked the strategic knowledge in understanding and capturing sustainable value to remain globally competitive.

The changing global competitive landscape, wherein national economies are linked by a competitive world market and technical changes outside a country can exert massive pressure for technical change inside it [65], forced the Malaysian government to rethink its science and technology policies [61]. In the 2000s, the country made a conscious effort to transition to the hybrid triple helix model of national innovation according to the Malaysian Industry-Government Group in High Technology (MIGHT) [66]. In this regard, the country introduced the concept of the 'Research University' under the 9th Malaysian Plan [67]. Under this plan, research intensive universities were to receive additional support and funding to develop advanced technologies and all public universities were expected to achieve a self-financing target of around 65-70% by the year 2020 [68,69].

Some universities have set up Technology Transfer Offices (TTOs) to commercialise academic work, create external income and shape internal research agendas with a view to exploiting the external sources of funding [70]. A typical example is the establishment of USains Holdings, which is the commercial arm of University Sains Malay. In addition, most of them have shored up their

Intellectual Property (IP) management capabilities, and drawn up guidelines for the use staff time and income distribution for industrial link activities. Others have gone further to set up incubator facilities or expanded units within their institutions to operate as industry-liaison offices charged to promote their links with industry and the commercialisation of academic research outputs [47, 62]. Despite the current science and technology policy and the rapid movement of resources to strengthen each of the triple helix institutional spheres, transformation and development of Malaysia's innovation prowess has been limited to incremental innovations. The promise of local research to develop new, radical and advanced technologies has not been fulfilled. Collaborative arrangements, especially among local partners, are still limited, while existing and emerging industries continue to depend massively on technologies developed in advanced countries.

In a recent national innovation survey, only a fraction of firms reported having co-operation in innovation activities with either universities or government research institutions [46,80]. Like many other developing countries, our review of policy documents, innovation reports and the existing scholarly literature shows that Malaysia, is presently attempting to attain some form of the hybrid triple helix variant, but has not transitioned fully to the hybrid triple helix model of innovation [18,19,47,81]. The objective of Malaysia as suggested by AbdRazak and Saad [47] was to become the innovation hub of East Asia that could boast of university spin-off firms, R&D centres, and incubators all linked together through external global collaboration, research networks, and linkages where the knowledge produced could be applied to advanced science and technology problems facing both industrialized and developing countries.

Behind this lofty ideal, we see Malaysia that while the national effort to embrace the hybrid triple helix model of innovation has been welcomed by all the major players, the cultivation of the relevant organizing practices to attract the necessary support, relationships, and investment, has been mostly left with policy developer, MIGHT. In this light, our study seeks to examine how the organizing practices of the various institutional spheres facilitate (or impede) Malaysia's transition to

the hybrid triple helix innovation model. In the next section, we present the research methodology underpinning our empirical inquiry.

Research methodology

Given the paucity of empirical research emphasizing 'practice' as the site for the emergence of a hybrid triple helix model of innovation, an exploratory qualitative research approach was found to be meaningful and appropriate to advance insight into the organizing practices of the three institutional spheres of triple helix. In this regard, qualitative methods of data collection were adopted to help us capture the triple helix protagonists lived experiences as well as their inherited knowledge which were of prime importance in generating relevant insights into their everyday organizing practices. We utilized semi-structured interviews as the main data collection method and data for the study were collected over a twelve-month period. In all, we interviewed 27 strategic actors, 12 from Malaysian research intensive universities, 9 shakers and movers of industry, and 6 senior government officials and appointees. The research participants had spent an average of 10 years working in their institution of affiliation. The profile of the research participants are presented in Table2.

Table 2 Profile of research participants

Institutional sphere	Interviewee position	Institutional affiliation
<i>University</i>	Faculty Dean	Research Intensive university
	Deputy Vice Chancellor	Research Intensive university
	Research Fellow	Institute of Natural Resources
	Assistant Registrar (Research)	Research Intensive university
	Senior Manager	University Group
	Director	Univ. Innovation and Commercialisation Unit
	Deputy Director	Research Institute
	Director	Institute Research Management and consultancy
	Dean (Research)	Management Centre
	Dead of Department	University Industrial Liaison Office
	Researcher	Institute of Noise Vibration
General Head	Research commercialisation Institute	
<i>Industry</i>	General Manager	Industrial Instrument Company
	Director of Human Resources	Global Computing Firm
	Vice President (Education)	Shipping Corporation
	Vice President	Global Retail Bank
	General Manager	Regional Plastic company
	Senior Executive	Global Oil Company
	General Manager	National Automobile company
	Vice President	Fleet Management Services company
Vice President (Education)	Global Conglomerate	
<i>Government</i>	Chief Executive Officer	State Investment Agency
	Director	Technology Development Board
	Special Officer for Science	Technology and Innovation Ministry
	Director	National Biotechnology Directorate
	Deputy Director	Agricultural Research & Development Institute
Assistant Manager	Technology Park	

The interviews were open-ended starting with broad questions on individual's discussion of their everyday work and the role of their organization as set out in the Malaysian national innovation policy. We drilled further down to their perceptions of the current Malaysian innovation initiatives, the country's transition to a triple helix model of innovation and, how the recent emphasis on collaborations have impacted on their situated practice. Each interview lasted approximately two hours. They were digitally recorded and transcribed within 24 hours. In total, we generated over 300 pages of interview transcripts.

The full data analysis followed four stages. First, we meticulously sifted through the interview data collated and cross-checked what we thought were salient narratives with other vital information we gleaned from documentary sources to overcome possible biases in what we heard in the field. Second, following our theoretical perspective, the initial textual analysis focused on mapping the ‘doings’ and ‘sayings’ onto the ‘circuit of practice’ (See figure 2) by ‘analytically converting’ (Strauss [82, p. 30]) recurrent phrases to fit into the triadic logics. Next, our analysis focused on the elucidation of those practices that had the potential to enable (or impede) the evolution of a hybrid triple helix, producing a broad range of segments that were further categorized based on their similarities and analytical connexions. Drawing on theoretical insight from the extant triple helix literature, we analysed and interactively interpreted these segments until common themes emerged and our process became saturated [83,84]. These themes were then reconstituted and indexed to generate the analytical categories of facilitators and inhibitors of the triple helix. Probing further the connections and conceptual properties of the respective analytical categories [85], we developed three thematic frameworks of (i) advanced research capabilities and external partnerships, (ii) quantification of scientific knowledge and outputs, and (iii) collective entrepreneurship. We summarise these in Table 3.

Table 3: Emerging themes and their conceptual properties

Emerging themes	Facilitating triple helix culture	Constraining triple helix culture
Research capabilities and external partnerships	Formal and informal collaborative networks and partnerships.	Inflexible organizing architectures of collaborative networks and control systems.
Quantification of scientific knowledge and outputs	Formulation of readily countable ‘scientific knowledge’ in the form of impact and relevant metrics.	Galloping demands for auditable research assessment and critical scrutiny of impact.
Collective entrepreneurship	Creative framing of new innovations, markets and emerging technological opportunities.	The cultural legitimacy framing R&D as a cost rather than an investment.

We then applied the thematic frameworks to the entire dataset by annotating them with numerical codes supported with short descriptors that elaborate the headings. Typologies were generated and causal associations between the various themes were made. Emerging patterns were then used to develop greater insight and form descriptive explanations of the organizing practices that enable (or impede) Malaysia's transition to a hybrid triple helix.

Research Findings

Analysis of our data revealed insightful findings regarding the current triple helix culture in Malaysia. First, our evidence is consistent with the observation of earlier studies on Malaysian national innovation system [18,47,62] and suggests that Malaysia is still in a transition process to achieving a full triple helix status. Second, our data suggest that while the three institutional spheres are committed to achieving a hybrid triple helix model, they frequently engaged in practices that impede their ability to organize their distributed capabilities and scarce resources to support their innovation initiatives. Furthermore, their organizing practices demonstrate differential schemata of interpretations on how to strengthen their collaborations and alliances. We present a summary of the empirically validated practices that enable (or impede) Malaysia's transition to a hybrid triple helix model of innovation in Table 4. Note that the set of practices presented here are meant to help us develop some conceptual clarity rather than to be an exhaustive list.

Table 4 Organizing practices facilitating (or impeding) transition to hybrid triple helix

Organizing practices	Facilitating hybrid triple helix	Impeding triple helix
<i>Advance research capabilities and external partnerships</i>	<ul style="list-style-type: none"> ▪ Proactive engagement and utilization of formal and (in)formal alliances and collaboration partnerships ▪ Emphasis on applied science and technology research 	<ul style="list-style-type: none"> ▪ Poor incentive systems for dissemination of research output ▪ Mutual mistrust and competing interests of collaborative partners ▪ Incongruent organizing timeframes of partners
<i>Quantification of knowledge</i>	<ul style="list-style-type: none"> ▪ Effective resource (re) allocation and accountability ▪ Identification of Star scientist and increasing scholarly productivity, and ‘good research’ ▪ Active monitoring and feedback on project milestones 	<ul style="list-style-type: none"> ▪ Restriction of academic freedom and under-development of theoretical knowledge ▪ Crude conversion of research and collaboration outcomes into calculable units of economic resource
<i>Collective entrepreneurship</i>	<ul style="list-style-type: none"> ▪ Focussing of research attention on its application to potential users ▪ Shared understanding of commercialization process ▪ Defining roles and responsibilities of innovation partners 	<ul style="list-style-type: none"> ▪ Unwillingness to take moderate and calculated risks ▪ Competition between university, industry and government ▪ Over-emphasis on control over technologies

We delineate the organizing practices of the three institutional protagonists and how they constitutively enable (or impede) the cultivation of a triple helix culture in Malaysia around three specific lines of attention: (i) advance research capabilities and external partnerships, including formal and informal technology transfer arrangements between universities and industry which are often partially funded by government; (ii) the creeping audit culture driving the quantification of scientific knowledge and outputs; (iii) and collective entrepreneurship in the commercialization of innovation. We present the fine details of our findings in the next section.

Organising Practice 1: Advance research capabilities and external partnerships

The ability to draw on internal capabilities and partnerships to pioneer new scientific discoveries and advanced technological breakthrough underpins the triple helix concept. We therefore chose to examine the existing innovation organizing practices among Malaysia’s institutional actors through

the reflective gaze of Knowledge Transfer Partnerships (KTPs), an interactive mechanism frequently employed by the Malaysian technology fund in facilitating knowledge interchange, dissemination and sharing between producers and users of research [86]. As argued by Etzkowitz and Leydendroff [12], KTPs serve as the collaborative 'glue' that preserve the links between the three institutional spheres in the triple helix model. Our data suggest that the launch of the triple helix initiative in Malaysia has encouraged the three institutional spheres to work together in developing some important technologies, especially in the area of biotechnology. Nevertheless, we found that KTPs in Malaysia seldom yield innovation. At worst the three institutional spheres displayed what can be described as 'overt resistance' to engaging and interacting with one another as a result of misaligned objectives, interests, and mutual mistrust of each partner's competency, skills and commitments. Malaysian industries widely believe that local universities are only good in developing incremental innovations and manpower, and do not possess the capability to deliver the kind of advanced applied technologies they require to compete on a global scale. The account of one industry protagonist is indicative of this phenomenon:

Knowledge-wise they [universities] are good, but in terms of experience of what they are going to deliver to industry, I don't think they have the capability (Senior Executive).

In a related development, another industry grandee observed that:

The fact is that the university and its staff are simply not ready or do not fully comprehend the work culture of industry (Vice President).

After many years of depending on foreign technologies, the views of the industry captains we interviewed show Malaysian industries are yet to wean themselves from 'made in the west' technologies. Their mistrust in the competence of Malaysian universities [87] to pioneer advanced applied technologies has limited investment by Malaysian industries in KTPs involving local universities. The context and implication of this deep mistrust was summarised by a head of department and a deputy vice-chancellor as follows:

It should be collaboration and partnerships but the situation is far from that. Everybody is pulling in a different direction. We don't talk very much to each other. All the people are afraid to ask about each other (Head of department).

Industry look at us as the Ivory Tower but now universities must open the door to anybody who wants to co-operate, open the door wider, now it is not wide enough; however, we are moving in the right direction, although I must admit we still have some serious limitations (Deputy Vice-Chancellor of Research and Innovation).

While the universities have managed to enhance their capabilities in developing some advanced technologies, industry tends to view the cost of coordinating KTPs with local universities as very high and risky. As argued by Feldman [88] organizational actors in practice frequently use their understanding of how their organizations operate as a benchmark to guide their performances within their internal routines and against other organization's performance. That was the concern of a CEO when she explains why she doesn't see any collaborative advantage in working with local universities:

I think it is timeliness, timeliness is more than anything. The university needs to be timelier. They can't afford to take their own sweet time on every single thing. For example, if we give them money for some research, we want to see the timetables, the schedules, who are involved, and sometimes the universities just don't understand this (CEO state government investment agency).

Acutely aware, of the reluctance of industry to engage local universities, most KTP funding is frequently borne by the government which has been keen to see industry collaborate with universities. The government ends up being the driver and navigator of which technologies are appropriate and worth developing. The universities end up not being committed to some of the areas or projects that are not related to their prior and emerging research capability. This in turn has led to some strategic misalignment between the government and universities in delivering some projects:

They (the universities) are not very committed to research that matters. They are just focusing more on educating people. Lately they have started the commercial arm of the universities but it turns out that they are just selling their degrees and programmes, and not really working on some JV projects with the private sector to develop products (Special Officer for Science).

Nevertheless, the government still encourages universities to develop Technology Transfer Offices (TTOs) to commercialize some of their novel findings from the few their KTPs. In the background loom the inflexible organizing practices of industrial partners and government which leads to strategic drifts from the national innovation policy and initiatives. For example, the

universities argued that funding for some critical projects they see as important in enhancing their own capabilities to develop advanced technologies are difficult to access and sometimes not forthcoming. At worse, researchers seldom see real benefits from their labour because incentives for industrial partnerships and commercialization of research outputs, is always skewed to benefit industry and government. One researcher described how this happens (in veiled terms):

The government should come up with something like an SME bank that could readily fund innovative projects. The government has VC funds but the conditions are stringent, over demanding and bias, so our people [researchers] sometimes feel 'Why should I give up half of my inventions to somebody just because of money?'

Prevalent, although not universal, actors embedded in the three institutional spheres share incongruent frames on their differential capabilities and how innovation partnership between them should be structured and managed. Above all, the ever-creeping mistrust between them tends to undermine their commitment to develop complementary capabilities and learning required to unleash their full potential in developing advanced technologies.

Organising Practice 2: (Un) purposeful quantification of scientific knowledge and outputs

The hybrid triple helix model of innovation derives its legitimacy from its claims to enhance accountability to society and transparency in accounting for innovation outputs, collaborative partnerships and accessibility of knowledge [89-91]. Practices that fully incorporate these imperatives have led to comparison, evaluation and quantification of scientific knowledge outputs. Following Shore [92], we define the quantification of scientific knowledge outputs as calculative practices including 'performance indicators' and 'benchmarking' that are increasingly being used to measure and evaluate the quality of research and innovation outcomes. Our data suggest the practice which has been widely embraced by universities, government, and industries, has a profound influence on Malaysia's quest to transition to a hybrid triple helix model of innovation. On the bright side, the new audit culture accompanying the launch of the national innovation agenda has enhanced the universities' role in innovation by increasing external demand for transparency in research funding

and accountability [93]. In describing the new accountability regime, a government agency representative had this to say:

We are very tough on evaluation; we expect updates when we give grants for research projects. We expect responsiveness more than anything else.

This emerging audit culture has led to targeted funding for research in emerging technologies with high potential for novel applications, e.g. in bio- and nano-technologies. Consequently, some advanced technology researchers viewed the emerging audit culture as an opportunity to strategically garner influence within their institutions and shore up legitimacy for their work:

We don't expect government to just dump money for research. They should look at our outputs and assess the quality of the research we produce. Government policy should not be wasting money on research with little impact (Researcher, top local public university).

The (un)conscious escalation of commitment of this researcher to the new accountability order, we could surmise, was not only driven by a desire to produce cutting-edge research but a reactive response to managerial tendency of viewing research output as readily countable widgets [90]. Our evidence suggests that while the discourse on research transparency and accountability employs powerful notions of legitimacy, quality, and accessibility, the practices employed to sustain these ideals has placed emphasis on exploitation at the expense of exploratory research. There is a surge in the crude conversion of research and collaboration outcomes into calculable units of economic resource which in turn, has led to (un)purposeful stifling of the construction of academic subjectivities with theoretical knowledge been perceived as misguided.

Our scientists are committed to doing good research but never really think about their social and economic impacts, and commercialisation opportunities. They have a one-track mind (Industrial General Manager).

This constrained conception of knowledge and innovation production has led to decision makers applying commercial thinking even to sacrosanct disciplines such as philosophy and the arts. All the Researchers we interviewed agreed that, disciplines like medicine, law, and resource management whose value decisions find immediate application tend to receive more attention while the arts based disciplines unduly get relegated to the background. In this regard, Biotechnology research in

particular, attracts a lion share of national research funding. 70% of the country's research is in biotechnology because that is what the government is now concentrating on.

We are ignoring other areas of research and the researchers do feel neglected. They (Active Researchers) are selling their patents to big MNCs, and that is exactly what I did a year ago (MNC Research fellow).

This targeted research 'strategy' has the potential to enhance Malaysia's position in the global biotechnology research competition [94], it has a potential detrimental influence on developing other equally important emerging technologies. Rather than challenging extant power, researchers whose area of interest has been side-lined by the government's implicit innovation policy and the quasi restriction of academic freedom see no need to engage with the existing structural arrangements. The potential negative effect on behaviour from the creation of this audit culture and system is the defiant resistance to the much needed transition to a triple helix model of innovation.

Organising Practice 3: Collective entrepreneurship

Entrepreneurship has been identified as the overarching phenomenon that drives national innovation systems [95], nevertheless, under the triple helix model entrepreneurship focuses almost exclusively on the university sector. From this perspective, the 'entrepreneurial university' is frequently 'pre-packaged' as the single most important institution in coordinating and driving innovation [96]. Our interviews suggest that transition to a hybrid triple helix requires a broader notion of entrepreneurship that takes into consideration the interdependencies of university, industry and government in the identification of innovation opportunities and the capture of value from yet-to-be realized innovations. In this regard we adopted the term collective entrepreneurship [97,98] as an all-encompassing term to organize our findings. By collective entrepreneurship, we refer to the mobilization of different visions of the three institutional spheres working collectively to learn and (re)direct science and technology research attention to productive and predefined outcomes. Emphasising the combination of talents to create and advance enterprise, our evidence suggests that collective entrepreneurship leads to clearly defined roles and responsibilities of partners in the

exploration and exploitation of innovation opportunities. The director of the national technology board metaphorically observed that:

It is like TV set: the company will see the solid flat screen, the university will look at the process inside the TV and the government will look at the messy wires and cables.

The role assumed by collective institutional spheres means actors may apply their collective knowledge and the resources at their disposal, including those capabilities gained from their conscious individual experiences and collective psychic life, in a dynamic, generative way to probe opportunities for innovation. Most importantly, we found that the practice of collective entrepreneurship tends to enhance communication between partners and direct the focus of science and technology research attention on its application to potential users:

We want the companies to be more proactive, to pick up the phone and find out how to work with universities...the universities don't know what the companies are looking for. The companies know what they looking for, so the companies can easily call up and find out what the universities can offer. This way they can work together to achieve greater feats (CEO state government agency).

As observed by Sarpong and Maclean [99] successfully organizing in concert with others to pursue innovation requires not just the mobilization of differential visions of actors towards an idealized vision, but also the interpretation of partners' interests, hopes, fears and anxieties. This way, collective entrepreneurship, we found, helps in the cultivation of a shared understanding of the commercialization process and the navigation of intellectual property minefields:

...Sometimes because of the lack of experience, they have not negotiated the IP position properly. They end up quarrelling about the IPR, not because of greed, but people have less experience, they don't have the experience of conducting collaborative projects, they do not know, they don't have the expertise (Director Government agency).

In passing, collective entrepreneurship as observed by the director of government agency, on numerous occasions has helped in co-producing the future, and moving partners towards an idealized vision and collective action frames on intellectual property challenges. At the other end of the continuum, we found some entrenched organizing practices under the rubric of collective entrepreneurship that is impeding the transition to a hybrid triple helix model. The first is reticent attitude to investment in general entrepreneurial capacity building. While investment in research has

seen a steady increase in the past years, resource allocation for managing collaborations has been dwindling. This was summed up by the general manager of one university's commercial arm when he rhetorically asked:

What is the size of the industrial liaison office at Harvard University? Ours is like one person and one secretary borrowed from the school of communication. It used to be a large one which was called corporate division, but over the years they have been moulded with other things and changed its name to international office (General Manager University's commercial arm).

The lack of resources and its accompanying structural uncertainties are so pervasive that universities sometimes find it difficult to attract the right industrial partners to pursue and commercialize some of the promising and pioneering technologies they develop. Instead of facilitating technology transfers and facilitating R&D finance, some Malaysian university TTOs have progressively turned into financial transaction centres, managing their executive education departments. As observed by a deputy vice-chancellor, even government as a partner, has become a bit too competitive and myopic with regards to its expectations:

Our government doesn't consider research as an investment. I keep telling government agencies that if they give us research funds, they shouldn't always expect commercial outputs. They should sometimes consider that as development fund as it brings larger benefits to the people.

Within the contingency of these challenges, the government which remains a dominant influence, persistently views Malaysian universities as Ivory Tower institutions who are not achieving the necessary balance between their research and teaching, but yet are also tasked with developing an entrepreneurial mind set. Their emphasis on autonomy and control over their technologies, argued a director of a government agency, means they are far removed from reality and are not good in building the necessary networks to commercialize their technologies:

...commercialisation of research is dependent upon the existence of entrepreneurs who want to commercialise in the first place. Our universities don't have entrepreneurs.

As observed by AbdRazak and Saad [47], Malaysian universities are yet to evolve to assume the role of industry in commercializing their innovations. Therefore, the need to support their

entrepreneurial capacity building cannot be overemphasised if Malaysia is to transition to a hybrid triple helix model of innovation.

Discussion and conclusion

In this article, we develop a granular understanding of how everyday organizing practices influence the transition of a country's system of innovation to a hybrid triple helix model of innovation. We empirically studied how the organizing practices of the three institutional spheres of university, industry and government in Malaysia is shaping the country's quest to transition to the dynamic hybrid triple helix model of national innovation. Extending previous studies on the transition to the hybrid triple helix model of national innovation in developing countries [13,32,37,46], our study draws on discursive practices as a meta-theoretical lens to unpack the institutional dynamic that shape the evolutionary transition from one system of innovation to another. In doing this, we placed emphasis on the everyday situated activities, routines and collaborative relationships, between the three innovation protagonists to examine how these constitute a 'triple helix culture' for innovation. At the meso level, we found that the three protagonists are keen on reforming and reconfiguring their organizing practices to enable Malaysia to transition to a fully-fledged hybrid triple helix model. Nevertheless, the country's transition journey has been tortuous as a result of the differential frames on collaboration, the incongruent visions on what counts as relevant innovation, and the contextual challenges they face in the commercialization of their technologies. Highlighting the contextual influence of these differential schemata of interpretation, we found deep-seated mistrust among the three institutional spheres which tends to undermine their own capabilities and efforts at developing advanced research capabilities and innovations.

Within these contingencies of evolutionary innovation system transition, we identified three quintessential organizing practices that operate in combination or serially, and which may lead in turn to facilitate (or impede) the successful transition to a hybrid triple helix model of innovation. The first set of practices we identified are those that contribute to the proactive development of advanced research capabilities that could lead to the production of advanced technologies the country requires

to compete in the knowledge economy. Second, the practice of (un)purposeful quantification of scientific knowledge and outputs, we found has a positive influence in developing innovations only if it can transmit its ideals of accountability without ambiguity to others. At worst they end up expanding the conceptual wedge between different bodies of knowledge, which in turn gets occupied by audits and performance benchmarks which constrains the conception of knowledge production. Finally, we move beyond the concept of 'entrepreneurial university' to propose collective entrepreneurship as a broader notion to capture the mobilization of differential visions of the three institutional spheres working in collectives to learn and (re)direct science and technology research attention to productive and predefined outcomes.

Our theoretical contribution extends the burgeoning research on triple helix model of innovation by elucidating the realities of the three institutional spheres. At a basic level, our research has explicated the relevance and influence of organizing practices on the transition to a hybrid triple helix: a crucial lens that remains under-researched. More importantly, our emphasis on everyday organizing practices signifies a paradigmatic shift away from the bulk of empirical research on the triple-helix concept and policy talk that has tended to focus on particular sets of influences that reside at the macro level of analysis. Instead our work suggests greater emphasis should be placed on building those micro-level practices that tend to shape the actions and doings of institutional actors. In this regard, we have responded and contribute to calls for new approaches to the study and theorizing the evolution of triple helix model of innovation [20, 22,100]. By pointing to a complex web of organizing practices that may constitutively enable (or impede) the successful transition to a more dynamic model of national innovation, our findings bring to fore the challenges faced by Malaysia and other developing countries in implementing their science and technology policies effectively. We are of the view that our sociological level of analysis, in particular, suggests novel theoretical opportunities for Science-technology scholars, as it opens up new possibilities for developing strategic foresight and rethinking barriers to adopting the triple helix model of innovation.

Our research holds implications for transitioning to a hybrid triple helix model. Our general argument is that organizing practices of the three institutional spheres of triple helix should be the starting point in designing and developing policies aimed at transforming national innovation systems. This is because organizing practices by virtue of their embodied knowledge, competences, and flexibility, serve as a prime unit in evaluating the actions of the national innovation 'foot-soldiers'. Highlighting the salience of domains of embeddedness as a link between cause and effect, countries striving to transition to a hybrid triple helix of innovation must invest time and effort in understanding the organizing context, the formal and informal emergent structures that embody and govern the situated practices, and the organizing relationships of the three institutional spheres. A lesson from this study is that leaders of the three institutional spheres, particularly, universities need to take micro-level activities and practices seriously as they strive to build and maintain the relevant motivational value systems that have the potential to drive collective entrepreneurial thinking among employees who are involved in the day to day management of their external collaboration and partnerships. They can do this by tightly managing their institutions' often diverging and conflicting values in order to mobilize differential visions of their collaborating partners towards their yet-to-be realized innovations. This does not necessarily call for the 'micromanagement' of mundane institutional practices. Rather, it is more about striving to integrate flexible organizing routines and procedures into their organizational processes and collaboration architectures as they seek to engage in productive innovation partnerships.

Our study is a starting point for further discussion into the strategic re-organization of the underlying relationships between university, industry and government and their evolutionary trajectory towards a hybrid triple helix model of innovation in middle income countries. In this regard, our adoption of discursive practices as a theoretical lens, we hope, will contribute to steering the current debate in the direction of a more sensitive and accurate understanding of the relevance of the everyday routines and mundane organizing practices of the three institutional spheres constitutively shape the strategic relationship and collaborative processes of universities, industry

and government. We therefore see our study as an invitation to continued focussed discussion among researchers, policy analysts, and practitioners on the contingency role of organizing practices, and how they may contribute to the smooth and rapid transition to an idealized innovation system.

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