

MANAGING PARADOXICAL TENSIONS AND CREATIVITY IN UNIVERSITY TECHNOLOGY TRANSFER

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Key words: paradox, tensions management, university technology transfer

Abstract:After a systematic literature review, we outline an analytical framework where tensions and creativity are managed in university-industry relationships. UTTOs act as intermediaries between industry, universities and researchers to assess the potential economic value of research findings, so that they can be translated into commercial products. Design thinking is presented as an umbrella of the interplay of different actors that enables the synthesis of paradoxical tensions. Interactions enable actors to upgrade their technological capabilities. By managing organizational paradox, a dynamic equilibrium fosters learning and creativity.

1. INTRODUCTION.

The university-industry-government interdependence model, which promotes a triple-helix of networks of relationships is now a classical view. Knowledge transfer organizations have developed, according to this evolutionary interdependence, to intermediate their institution's relationships and projects. The recent focus on open innovation (Chesbrough, 2009), and various extensions of the triple helix to higher dimensions, quadruple, quintuple and N-tuple helices extends the partner reach and complexity of intermediation further (Alexander and Martin, 2013) Now the triple helix (industry-university-government) include new dimensions: media and environmental challenges.

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Whilst commercialization clearly represents an important way for academic research to contribute to economy and society, there are multiple other ways in which university research is transferred (Perkman et al. 2013). According to the position of the university-industry relationship within the wider spectrum of science-industry, the key university technology transfer commercialization mechanisms are (Perkman et al. 2007):

- Commercialization of licensing agreements;
- Collaborative research partnership, research services, and consultancy;
- University-based start-ups or academic entrepreneurship.

There is a large body of diverse research in this area. Markman et al. (2008) suggest organizing the multiplicity of “channels of transfer” by elaborating a taxonomy around the key modes of commercialization. Siegel et al. (2004,2003) focussed on the more practical necessity of defining a coherent and feasible technology transfer strategy, and suggest that this is a mechanism to enable the assessment of university technology transfer office’ performance. Alexander and Martin, 2013, develop a conceptual framework that identify keys indicators to assess UTTO (University and Technology Transfer Office) activities. These channels can be characterized in a number of ways, one of which is their dominant mode of governance –transactional or relational (Ferguson et al. 2005; Perkmann et al. 2008). Alexander and Martin, 2013, identify thirteen channels:

- 1- Student placements/graduate employment: transfer of a graduate into a company partner.
- 2- Joint conferences: audience of company employees and academics and speakers are taken from both groups.
- 3- Spin-outs: university personnel join together with commercial partners to create a company.
- 4- Professional journal publications: academics and professionals develop a paper together into professional journals.
- 5- Networks: groups of professionals and/or academics come together and meet face-to-face under a banner of common interest or subject discipline.
- 6- Joint supervision: academics and industrialists come together to supervise a piece of research.
- 7- Training and continuing professional development: commercial partners keep their professional knowledge up to date with new developments delivered by academics
- 8- Secondment: member of staff is present for a period of time in another organization.
- 9- Collaborative research: commercial and academic partners agree to work together to discover new knowledge or to propose solutions solving a problem.
- 10- Contract research and consultancy: a company has a problem and wishes for either:
 - a. A “known” solution to be applied to their problem (consultancy)
 - b. An unknown solution to be researched and then presented to the company,
- 11- Shared facilities: a university and a commercial partner join together to invest in the development and operation of a facility or piece of equipment.

- 12- Patents and licenses: a particular piece of knowledge or know-how is protected by either an academic or a commercial partner.
- 13- Joint Ventures: rely on a set of legal agreements that ties a company partner and academic with a common purpose without creating a new legal entity.

Technology transfer communities provide an opportunity to develop theories of human and social capital in a novel context (Martin Rubio and Andina, 2016). Leadership in such communities depends on trust and mobilization of stakeholders. Close collaboration may help to overcome barriers as different institutional norms between firms and universities (Gretner et al. 2011).

There are university technology offices more focusses toward intellectual property and entrepreneurial activity in direct comparison toward the less output drive and more outcome centric focus toward knowledge sharing and boundary spanning through human resource practices. These relates to an impetus of transfer office to engage in channels with a mix of relational and transactional governance and with a bias toward relational activities. Other university technology transfer office relies more on formal and transactional activities.

Organizing raises multiple tensions, such as collaboration-control, individual-collective, flexibility-efficiency, exploration-exploitation, and profit-social responsibility. As environments become more global, fast paced, and competitive, and as internal organizational processes become more complex, such contradictory demands become increasingly salient and persistent (Lewis, 2000). Leader' responses to these tensions may be a fundamental determinant of an organization's fate.

Contingency theory offers one response to tensions. Assuming that organizational systems are most effective when they achieve alignment or fit among internal elements and with the external environment, this approach explores conditions for selecting among competing demands. Early contingency theory from the late 1960s inspired decades of research exploring how context influence the effectiveness of opposing alternatives.

Paradox studies adapt an alternative approach to tensions, exploring how organizations can attend to competing demands simultaneously. Although choosing among competing tensions might aid short-term performance, a paradox perspective argues that long-term sustainability requires continuous efforts to meet multiple, diverse demands. Discussions of paradox from the late 1980s motivated research in such domains as innovation, change, communication and rhetoric, identity, and leadership. As an alternative to contingency theory, the paradox literature has become increasingly crowded. Yet, even so, insights from a paradox perspective are limited by fundamental debates about the nature and management of paradoxical tensions.

The challenge is to develop a better understanding of the inter-dependencies within the knowledge transfer activities (perhaps when considered as an "ecosystem") and how these interrelationships relate to constructive organizational tensions management around UTTO offices. First, we study the conceptualization of tensions, and later we present different strategies to manage tensions. In figure 1, we present the framwork we are following in this work, after a systematic literature review.

Innovation steps		CHANNELS	STAKEHOLDERS apart from academic researchers	TENSIONS	SOLUTION
Research Projects	U T O M A N A G E M E N T	Students placement	1. National and International Government Agencies	Identity	Repression
		Joint-Conferences	2.Other Universities and Research Centers 3. Firms		Supresion
Invention & Patents		Prof. Publications	Intermediaries in Patent Offices	Stakeholders	Separation
Early Stage Development of Innovation: Innovation gap: Capital and Entrepreneurial gap		Networks	-Intermediaries in the Patent Market: suppliers and sellers of technology	Goals	Org.Tensions Sustainability
		Joint Supervision	-Business Angels & seed capital		Synthesis
		Training	-Dealmakers: accountants, executives	Structural	Paradox
Product Development	Secondment	-Large and small firms(suppliers and partners of complimentary assets)	Behavioral		Design Thinking
	Collaboration Research	-Venture Capital	Psychological		
	Consultancy	-Other investment funds			
Product and Marketing	Shared FACilitites	-Venture Capital -Other investment funds			
	Patents and Licencies	-Large and small firms(suppliers and partners of complementary assets)			
	Joint Ventures	-Intermediaries specialized in global business			

Figure 1: Stakeholders around KTO & innovation steps: tensions and solutions.

2. DARK SIDE OF RELATIONSHIPS: TYPE OF TENSIONS IN ORGANIZATIONS.

Tensions are often conceptualized as an underlying source of challenges, dilemmas and paradoxes that organizations experiences (Lewis, 2000). Lewis (2000) further suggests that paradoxical tensions are perceptual phenomena, that is, cognitively or socially constructed polarities that mask the simultaneity of conflicting truths.

Tensions may appear in several forms, including tensions between multiple demands, goals and stakeholders (Smith and Lewis, 2011).

- Tensions of identity arise between one's personalized identity and one's collective identities or group membership.
- Tensions of stakeholders arise between the differing and often conflicting demands of varied internal and external stakeholders
- Tensions of organizational goals can include those between collaboration and competition, empowerment/autonomy & direction/control, and exploitation /routine and exploration/change, as well as organic and mechanistic organizations

Several studies provide insights into how seemingly good relationships can deteriorate. Although a number of studies have investigated the causes of partnerships termination such a conflicts, switching behavior, opportunistic behavior, and network inertia, the explanations presented in these works are generally either weak or incomplete. Consequently, the relationship tensions perspective offers potential to fill this gap, and provides a clear accounting of the significance of dark side of relationships (Fang et al 2011).

The dark side of relationships frequently emerges during the stage in which organizations have developed close relationships. Scholars of strategic management believe that partners initially exhibit mutual adaptation, but that the relationship gradually destabilizes as each party learns what the other knows. Although the maintenance of a close relationship is rooted in the premise of mutual benefit, excessive-closeness may increase the possibility of inter-organizational conflict (Anderson & Jap, 2005). Over the longer term, the dark side of relationships is not always bad. Over the longer term, it might serve as a trigger for forming new partnerships.

Tensions denotes two co-existing contradictory forces with conflicting goals. These force have potential to break up partnerships, and are often the primary causes of aggravation with in partnerships. Fang et al. (2011) show this type of tensions:

- 1- Behavioral tensions:Whenboth parties display excessive cooperation or competition, the result is imbalanced behavioral tension, producing the dark side of relationships. Competition aims to protect self-interest, stimulating firms to compete with one another in mutual learning, while cooperation seems to realize mutual learning and internalize partner know-how to enhance value creation.

Luo et al. 2006 argued that in competitive situations, each party seeks to control its own resources and thus increase its bargaining power, conversely, in

cooperative situations, firms attempt to identify complementary resources to gain stronger reciprocal support from their counterparts. Cooperation fosters the smooth working relationship needed to accomplish mutual goals, while competition prevents firms from losing their specific advantages through inattention. If firms are too cooperative or competitive, the dark side may be increasingly generated between firms, ultimately leading to partnership dissolution. Excessive competition leads partners to focus on self-interest, ultimately undermining relationship functions. Similarly, when organizations are too cooperative, and mutual expectations are unreasonably high, the likelihood of complaints and dissatisfactions grows. In these circumstances arguments rapidly evolve into dysfunctional conflicts which can spoil the fulfillment of relationship functions.

- 2- Structural Tensions: When inter-organizational structure is too flexible, firms lack specific asset investments, clearly property rights, and definite authority structure, conversely, when inter-organizational structure is too rigid, firms may be constrained by their binding mechanisms. High flexibility can protect the rights of an organization to adapt to changing environments, but offers no guarantees for partners. When both parties are reluctant to commit to a relationship, the advantages of a flexible structure are reversed.

Although structural flexibility possesses certain advantages, excessive flexibility may cause partnerships to spin out of control, decreasing connectivity among parties, stimulating opportunistic behavior, and thus weakening the effect of relationship quality on relationship function. In contrast, structural rigidity can tighten a loose partnership by providing a formal structure, and also reduce uncertainty. However, excessive structural rigidity stipulates that interaction between organizations must follow established formal procedures, and neglects the importance of trust, thus lessening the influence of relationship quality.

- 3- Psychological Tension: Two opposing tendencies: short-term and long-term orientation, constitute a pair of contradictory forces in the proposed framework. Long-term and short-term orientation are different attitudes representing opposing psychological perspectives. Extreme short-term orientation is largely governed by transactional characteristics, focuses on prompt and tangible results, and exploits partnerships. Partnership characterized by such an orientation thus tend to be fragile. However, if a long-term orientation dominates the mindset of both parties, they will be inclined to ignore tangible performance, tolerate partner mistakes, fail to actively learn from failures, and lose opportunities to improve their competitive advantage.

Fang et al. (2011) explores the factors that lead to the generation of the dark side of relationships, using a tension-based view in which imbalanced tensions drive partnership failure. This approach was adopted to offer an alternative explanation for the inconclusive empirical results presented in the literature on the dissolution of inter-organizational relationships (Andersen & Jap, 2005). Multiple tensions exist between organizations (Das & Teng, 2000). Manager thus should pursue any pair of relationship tensions in a balanced condition to prevent the dark side of relationships. Meanwhile, the analytical results presented here also demonstrate that imbalanced tensions cannot weaken the relationship between relationship quality and direct function, and these results may help managers identify disadvantages of well-connected partnerships, such as inertia problems.

Raischet al. (2008) call for more research on tensions between individuals in multiple levels. It is likely that organizational tensions, challenges and paradoxes may appear, when multitudes of stakeholders are involved, each having different roles and role patterns, like around UTTO offices projects. Further, studies on managing tensions are scarce and methodologically limited.

3. DESIGN THINKING FOR MANAGING PARADOXICAL TENSIONS AND CREATIVITY.

Several authors have documented different ways of approaching competing demands and dealing with resulting tensions in different ways (Smith and Lewis, 2014, Gaim and Wählin, 2016):

1°) Repression, including denial and blocking awareness that tension does not exist, more like the ostrich effect.

2°) Suppression, which involves a one-sided response to the tension in that one element is favored at the expense of the other. Suppression also explains compromise and reconciliation, with which attending to one demand is done but only at the expense of the other.

3°) Separation or splitting and it takes two forms –that is, spatial separation and temporal separation (Poole & Van de Ven, 1989)- .Spatial separation, also called structural ambidexterity, occurs when organizations designate different units to deal with issues such as exploration and exploitation (O'Reilly & Tushman, 2008,2013). Similarly, temporal separation, also called temporal ambidexterity, occurs when firms attend to one demand at a time, that is, they first focus on, for example, exploration or exploitation.

4°) Organizational tensions sustainability.

Dealing with organizational tensions sustainability in the long-term requires responses that lead to virtuous cycles. One grand response is transcendence where a response involves rethinking the relationship between competing demands and exploits the complementary and interdependence.

4.1) One way of transcending the tension is synthesis. In synthesis, there is a break from the first-order logic based on either-or thinking and a move towards both-and thinking. The move towards both-and thinking, according to Lewis (2000) means to “recognize, become comfortable with, and even profit from tensions, that the paradoxes incite.

4.2) Gaim and Wählin (2016) examined paradoxes in organizations and the organization's ability to deal with the resulting paradoxical tensions. Paradoxes constitute contradictory and interrelated demands that exist simultaneously, with the resulting tensions persisting over time. Such competing demands require simultaneous attention and are often viewed in contrasting terms. They include, for example, the needs for certainty and flexibility, (Thompson, 1967) for stability and change (Mintzberg, 1991), for exploration and exploitation (March, 1991), and for efficiency

and flexibility (Adler et al. 1999). However, this list is by no means absolute. For a deeper conceptual depiction, some authors turn to metaphors, mythologies, and ancient philosophy, for instance:

- the Roman god Janus emphasize the capacity needed to deal with competing forces at work,
- the Taoist philosophy from ancient China represented by the symbol of Yin and Yang as a way to describe flows of complementary yet opposite energies,
- Scylla and Charybdis from Odyssey to symbolize the navigation between polarities such as rigidity and chaos.

Given today's global and dynamic environment, competing demands in organizations are intensifying (Lewis & Smith, 2014). Managing the tensions resulting from competing demands is becoming necessary for effective innovation to occur. However, when organizations are faced with these competing demands, they often tend to choose one or the other, compromise between them, or attempt to reconcile them. This happens for many reasons –for example, organizational member's need to produce consistent and reliable outcomes (Martin, 2007) or being compelled by their cognitive limits to seek certainty, or attempting to simplify a complex reality. It is related to human beings' general tendency to see the world in black and white terms (binary terms), which is a false dichotomy. Thus, this formal logi lacks the ability to integrate contradictions and engage competing demands.

4.3) Design Thinking: Gaim and Wähling, (2016) start with the notion that the way competing demands are conceptualized affects the way they are approached and dealt with (Smith & Lewis, 2011). That is to say, how competing demands are framed (that is, dilemmas or paradoxes) prescribes the response that would lead to either vicious (choosing the one over the other, compromising) or virtuous (engaging both, synthesizing) cycles. Although they are not claiming that competing demands should be framed as paradoxes at all times, they stress that framing competing demands as paradoxes prevents organizations from picking one demand over the other or inclining towards one. Rather, framing competing demands as paradoxes helps organizations recognize that these demands can and should coexist, leading to creative alternatives that engage both. They construe competing demands as paradoxes defined as contradictory yet interrelated organizational elements that exist simultaneously, the resulting tension of which persist over time. In this regard, several studies have shown that organizations that pursue competing demands simultaneously (i.e. as paradoxes) are more successful in a dynamic environment.

Accordingly, to understand, describe, and manage the resulting paradoxical tension, theoreticians and practitioners are shifting from a tunnel-vision, non synthesized "either-or" thinking that emphasizes only one element of the tension towards a more synthesized approach based on both-and, best-of-both, neither-nor, thinking that engages both demands (Smith and Lewis, 2014). In line with this, organizations are increasingly adopting paradoxical frames.

In response to a wider perspective and a readiness to engage competing demands, in addition to dissecting what constitutes paradoxes, this paper aims to elaborate how design thinking as a management concept (Johansson-SKöldberg,

Woodilla & Cetinkaya, 2013), can help organizations and their members deal with paradoxical tensions. The term Design Thinking has been part of the collective consciousness of design research since Peter Rowe used it in late 1980s (Dorst, 2011). However, Herbert Simon (1966, 1969), laid the basis in his book “The Sciences of the Artificial” and claimed the relevance of everyone who devises courses of action aimed at changing existing situations into preferred ones. Although design thinking is relatively new to fields outside the design, it has been slowly evolving and coalescing over the past decade in organization and management studies (Martin, 2009). It has been used to address open-ended challenges faced by today’s organizations (Dorst, 2011).

Design Thinking, in general, though, has been criticized for being loose, elusive and confusing in its conceptualization, leading to various interpretations (Johansson-Sköldberg et al. 2013). Moreover, as practitioner-led, a comprehensive theoretical framework is missing. There is also a lack of scholarly works to balance the overstated praise bestowed upon it by the practitioners (Carlgren, 2013). Nevertheless, we consider that design thinking’s integrative approach and the mindset it instills makes it relevant to organization studies, particularly to the challenge of engaging paradoxes. Accordingly, Gaim and Wähling’s paper operationalizes design thinking as the interplay between perspective, process, structure and mindset rooted in the fallibilists’ epistemology of pragmatism, and central features in pragmatic philosophy such as pluralism, abduction, and unaesthetic vice. By doing so, the paper conceptually maps a way to achieve a synthesis of paradoxical tensions informed by design thinking.

Similar to Simon, 1966, Neumeier, 2009 claimed that anyone who tries to improve a situation is a designer. Design Thinking is presented as an umbrella description of the interplay between perspective, structure, process and mindset that enables the synthesis of paradoxical tensions. The key point is that a synthesis is based on “creating” rather than “choosing”, which supports the pragmatist notions that there is always something undiscovered. Through using synthesis as a way of dealing with tension from competing demands, organizational members look at the resulting tension from a paradoxical angle to develop a creative alternative based on the integrative perspective.

4. RESULTS: MANAGING PARADOXICAL TENSIONS IN UTTOs.

After a systematic literature review, we outline an analytical framework where tensions and creativity are managed in university-industry relationships. UTTOs act as intermediaries between industry, universities and researchers to assess the potential economic value of research findings, so that they can be translated into commercial products. While research findings may prove to have a potential economic value, they are often unproven at the industrial level (Ghislaine, 2012). Al-Tabbaa et al. (2016) emphasizes the existence of various difficulties that complicate the planning and execution of University-Industry relationships. They report different impediments: lack of commonality in background, fear of priority of conflict and recruiting suitable partners, ownership dispute over intellectual property, government legislation, and opportunism.

The UTTO may assist researchers in obtaining R&D funding support (e.g., from venture capital), negotiating research contracts and licences with funding agencies and

industry, filing for patent protection, and seeking industrial financial support for further development. Administrative staff from the UTTO must be technically trained, have good communication and negotiation skills, and act as “neutral” intermediaries between researchers and industry to protect the university’s and researcher’s intellectual property rights. It is common knowledge to people active in the UTTO sector that they should pay attention to their institutional conflict of interest (COI) policy. Some US universities – such as Harvard University, the University of Minnesota and the University of North Carolina – have even implemented specific guidelines addressing the management of COI in technology transfer Ghislaine (2012).

Various asymmetries related to information, financial risk, culture (behaviours and expectations) and time scaling can be identified between the actors involved in technology transfer processes. These asymmetries provide a potential source for value creation in a collaborative work environment but could also become barriers, if ignored, in technology transfer process inducing important consequences on the innovation paths.

Strategic alliances (structural tension) have been described as a race to learn, with the partner that learns fastest dominating the relationship (Fang et al. 2011). The balance of the entire relationship may shift when one party obtains sufficient knowledge and skills to eliminate partner dependency. The race to learn yields winners and losers, and ultimately can dissolve partnerships.

Design thinking is a platform that encourages focusing on both sides of the tension. Design thinking is presented as an umbrella of the interplay between perspective, structure and mindset that enables the synthesis of paradoxical tensions.

Interactions enable actors to upgrade their technological capabilities.

Classical governance mechanisms can be defined along a continuum from market (coordination by price) to hierarchy. Within this continuum, and set in the context of academic knowledge transfer, are partnering (relational) and contracting (or transactional). Alexander and Martin, 2013, use five components to assess each channel: interaction, geographic proximity, degree of explicitness of knowledge transferred, mode of conflict and relational embeddedness.

The mode of conflict resolution, refers to attempts to control (or mitigate) risk through contractual approach. However within the boundaries of rationality it is impossible to define ex ante all the pertinent contractual clauses. To reduce this potential risk, either a complex contractual approach could be employed or alternative a third party appointed to resolve disputes. The resolution of disputes internally reflects relational governance, whereas resolution by third parties is a common place within transactional modes of governance.

There are university technology offices more focussed toward intellectual property and entrepreneurial activity in direct comparison toward the less output drive and more outcome centric focus toward knowledge sharing and boundary spanning through human resource practices (Alexander and Martin, 2013). These relates to an impetus of transfer office to engage in channels with a mix of relational and transactional governance and with a bias toward relational activities. Other universities offices relies more on formal and transactional activities. Wang et al. (2008) propose that governance mechanisms (norms, contracts and power) can provide safeguards that encourage the parties to share knowledge and think creatively. Without the safeguards provided by governance mechanisms, the parties in relationships may be reluctant to invest in

resources that produce creative ideas or approaches. They may be concerned that one stakeholder will either not receive the rents generated by the innovation development from a creative idea, or that other stakeholders will either expropriate the idea and develop the innovation assets internally or work with other competitive suppliers to develop them.

Furthermore, on one hand UTTO officers can enhance collaboration and encourage relational practices and trust, and yet on the other they can also assist in identifying competitive information which can provide advantage to one organization over another. Clear differences existed between transactional exchanges and relationship development (Quinton and Wilson, 2016)

4- CONCLUSIONS

This article has important implications for several stakeholders within university technology transfer ecosystems in order to understand and manage tensions. This study contributes to the literature by demonstrating how different levels of relationship tensions interactively shape the relationships. Imbalances in contradictory forces may spoil partnerships and hidden factors may undermine good relationships.

Paradox and Design Thinking Theory can challenge us to rethink our message to UTTO managers and stakeholders. It means helping practitioners experience and learn to accept tensions and apply paradoxical management. By managing organizational paradox, a dynamic equilibrium fosters learning and creativity. Managing paradoxical tensions also helps individuals, groups, and firms to be flexible and resilient, fostering more dynamic decisions making. Attending to competing demands simultaneously involves a consistent and mindful shifting of cognition, restructuring of resources, altering of structures, and rethinking of goals. Such constant movement fosters adaptability. Attending to Paradox and Design Thinking enable organizations to become a fluid, reflective and sustainable process.

The limitations of this study should be acknowledged. Whilst criticism could be given of the broad nature of this research and the breadth of the literature drawn upon, as an early paper in this subject domain, the inclusivity is necessary in order to delineate the tensions management approach around UTTO officers and leaders. A further avenue for research may be a more detailed examination of the specific value of weak ties within UTTO tensions and paradoxes. Our findings emphasized the value placed on the consideration of different UTTO mechanisms and its transactional and relational tensions management.

In summary, this research has contributed valuable, practical and methodological insights into an emerging but underresearched field of UTTO management.

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