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Establishing Appropriate Best Practices in Intellectual Property Management and Technology Transfer in the United Arab Emirates: Building Human Capital, Global Networks and Institutional Infrastructure to Drive Sustainable Knowledge-Based, Innovation-Driven Development

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ESTABLISHING APPROPRIATE BEST
PRACTICES IN INTELLECTUAL PROPERTY
MANAGEMENT AND TECHNOLOGY TRANSFER
IN THE UNITED ARAB EMIRATES: BUILDING
HUMAN CAPITAL, GLOBAL NETWORKS
AND INSTITUTIONAL INFRASTRUCTURE TO
DRIVE SUSTAINABLE KNOWLEDGE-BASED,
INNOVATION-DRIVEN DEVELOPMENT

*Stanley P. Kowalski**

ABSTRACT *For the United Arab Emirates (UAE), to sustainably build, foster, and sustain accelerated transformation towards globally networked knowledge-based, innovation-driven, economic development in the 21st century, a suite of internationally-standardized best practices (BP) in intellectual property (IP) management and technology transfer (tech-transfer) will be necessary. Appropriate BP are not only integral to national and international IP law, practice, and management, but, perhaps more fundamentally, are critical as the UAE seeks to forge strategic partnerships linking the private (e.g., small/medium enterprises: SMEs), government (e.g., funding sources), and public sectors (e.g., universities and research institutions), towards a dynamic nationally, regionally and globally interconnected innovation ecosystem. The importance of realizing the enormous, and indeed catalytic, potential which integration across these seemingly disparate sectors entails cannot be overstressed, and the urgency of addressing this challenge must not be delayed lest evanescent opportunities evaporate. However, the key initial questions should be: What are BP for the UAE to establish and follow in order to make this happen? Who should develop and then make use of such BP- UAE IP professionals or*

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expatriate consultants and advisors? If UAE personnel (which it indeed must be) were to do this, then who should do this and how? This article addresses these questions in the context of building the human capital and institutional infrastructure in the UAE which will form the foundation for sustainable knowledge-based, innovation-driven development. It presents a candid appraisal of the current challenges that the UAE faces, the necessity to not only leap-frog from a petroleum-based to a knowledge-based economy but to catch-up in an ever accelerating, competitive, and unforgiving global IP/innovation economy, the role of IP management and tech-transfer expertise and requisite BP in this process, and the need to coherently and strategically implement a cultural transition in its citizens and institutions commensurate with this new century while recognizing the attendant risk, uncertainty, challenge, and opportunity.

I. UAE BACKGROUND AND CONTEXT

The United Arab Emirates (UAE), along with the other states comprising the Cooperation Council for the Arab States of the Gulf (hereinafter “GCC”: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia), is caught in an increasingly serious and urgent dilemma, between the predictable stasis of the latter half of the past century and the dynamic and disruptive shocks that will in all likelihood come to epitomize the coming decades of the current century. If one drills down deep enough, the question to ask is this: What is the core issue that encapsulates this disturbing dilemma? The answer is quite straightforward: it is the double-edged scimitar ... the blessing and the curse of oil. The UAE increasingly and urgently needs to diversify from primarily being a commodity-based, petroleum (petrol) dominated, expatriate (expat) managed economy to a knowledge-based, innovation-oriented, UAE citizen driven economic system. In the GCC, the UAE is perhaps the leader in terms of, at least, recognizing the urgency for economic diversification and modernization, i.e., transition from hydrocarbons to knowledge and innovation as a foundation for national wealth and prosperity. (Light foot, 2014; Kane, 2015) However, can a transition from petrol to patents not only happen but occur at an unprecedented accelerated rate?

This challenge is common to all of the GCC countries, each of which similarly, albeit to a greater or lesser extent, recognizes (or at least appears to acknowledge) the looming urgency, and whose respective leaders thereby

pronounce broad, albeit vague, policy aspirations to “address”. However, in order to clearly conceptualize the true urgency of the problem and then formulate a strategy that catalyzes sustainable development, a pair of quotes are apropos for framing and further expounding this dilemma. King Faisal of Saudi Arabia has stated, ‘In one generation we went from riding camels to riding Cadillacs. The way we are wasting money, I fear the next generation will be riding camels again.’ (Gylfason, 2000, p. 1) And, prophetically presaged by the Economist over a decade ago, the urgent truth this presents can neither be ignored nor bartered away with petrol riches: ‘ “The Stone Age did not end for lack of stone, and the Oil Age will end long before the world runs out of oil.” This intriguing prediction is often heard in energy circles these days. If greens were the only people to be expressing such thoughts, the notion might be dismissed as Utopian. However, the quotation is from Sheikh Zaki Yamani, a Saudi Arabian who served as his country’s oil minister three decades ago.’ (Economist, 2003) In other words, predominant reliance on a hydrocarbon/commodity-based economy is increasingly risky and unsustainable. The only viable path forward in this century is knowledge, information and innovation, as this article will illustrate.

Likewise, as with its neighbour Saudi Arabia, the UAE is in a precarious situation in its historical development. Decisions, investments, and commitments made in this decade will determine its future, well into the current century and beyond. Whereas this cursory analysis is beguilingly simple, the crux of the issue is far more complex: How can the UAE rapidly, strategically, and sustainably transform from a commodity-based to a knowledge-based, innovation-driven, globally-networked economy? More specifically, what are the necessary steps to establish a system of best practices (BP) in intellectual property (IP) management and technology transfer (tech-transfer)? This article will address this issue, and offer a systematic series of recommendations for accelerating the building of indigenous capacity and capability to affect and accelerate this crucial transformation in the UAE. It will provide a strategic approach towards implementing a system of BP in IP management and tech-transfer that is both appropriate to the challenges facing the UAE and sustainably enables and propels a methodical diversification and transition affecting the principal economic foundation of the country.

Accelerated diversification of a petrol-saturated economy to an innovation-driven system will neither be easy nor necessarily straightforward; yet it will come to epitomize a general principle in economic development across the globe, that is, the wane of the post-colonial era. This era is characterized by the decline of an erstwhile commodity/industry-based neo-mercantilism and the coincidental exponential expansion of the globalized knowledge-based

economy. IP plays an indispensably central role in this new economic order as the property rights system (the international IP rights (IPR) regime) is requisite for efficient protection, valuation, and transactions in the global innovation market. The urgency and importance of rapid economic, societal and legal transition is underscored by the paradoxical simultaneous confluence of the end of the oil age by mid-century, precipitated by an unrelenting collapse of oil prices, the ensuing wave of shocks, (Economist, 2016b, 2016e) and the sweeping global innovation and economic revolution. In the case of the UAE, the end of the oil age will likely not be due to wells running dry. Rather, a suite of green, alternative, and as yet undiscovered (and possibly unimagined) energy resources and related technological advances will be the major innovation juggernaut that undercuts and then replaces the petrol-based energy economy as we have come to know, rely on, and verily live and die by over the past century.

The paradoxical dilemma that the UAE must deal with is how to quickly engage in a global innovation market economy and strategically engineer the dramatic paradigmatic shift needed to make such a rapid and urgent transition? As intimated hereinabove, the unforgiving paradox is that the UAE must transition its economic system over to that which will end the very economic foundation that has nourished it and brought it to such a level of prosperity, comfort, and prominence to this day, i.e., innovation supplanting the global petrol energy economy while simultaneously being embraced by the UAE as its best strategy for sustainable development, transition, and survival in this century. Such a rapid economic transition is not unprecedented as the rapid disappearance of horse transportation at the turn of the last century attests. (The Economist, 2016e)

A. The UAE: Historical Context

The UAE has become both wealthy and impoverished on petrol. Over the past five decades petrodollars have built an impressive physical infrastructure out of the sun baked sand, perhaps no better exemplified than by the magnificently bizarre Ski Dubai. However, this wealth has come at a very high price: the societal impact of a petrol-wealth-saturated state has engendered a societal system that is fundamentally rentier and welfare-based, dis-incentivizing the citizenry into indolent passivity via a distributive, allocation-driven system of state operations, perhaps the very antithesis of innovation-driven, knowledge-intensive, globally-networked entrepreneurialism.

The much ballyhooed jargon, ‘rentier economy’ is used, and perhaps misused, in many contexts. However, as alluded to in this article, the term defines a paradoxical predicament that confronts the UAE, in that a suite of

benefits and entitlements negatively affect the motivation of UAE nationals to pursue education, career development, and the attendant risk of entrepreneurship. Could it be that the rentier economy is very antithesis of innovation-driven, globally-networked, knowledge economy? Why is it the case? What is the cause/effect nexus?

A rentier economy is a special mindset that follows when there is a break in the causation between ‘work’ and ‘reward.’ If reward, say in the form of salary or status, is disconnected from the type or quality of the work being done or the effort that is put into it, and instead is related to luck (e.g. cash hand-outs or debt forgiveness, free housing) or proximity to people in power, then society provides the individual with very few incentives to work hard, pursue long and hard university degrees, or apply a long term perspective to climbing a career ladder. The disrupting effect of ‘unearned money’ on economies is frequently referred to as the ‘Resource Curse’ and ...‘the Arab Disease.’ (Hvidt, 2015, pp. 37-40)

A major paradigmatic shift is necessary to overcome the inertia that the rentier mentality has infused and percolated throughout UAE society.

Indeed, as cautiously and cogently noted by Askari, Iqbal and Mirakhor (2014) ‘The entrenchment of ... open-handed welfare policies has posed challenges to development and economic reform in the [GCC] region.’ Therefore, to prosper, diversify, and even survive in the coming century, the UAE needs to rapidly wean itself off the petrol udder, and dive into the world of innovation, with all the risk and opportunity that this entails. However, such a developmental process must not only be rapid but also qualitatively different from the precedential pattern as it occurred in the developed countries: ‘over a period of centuries agriculture as the economic foundation of societies was succeeded first by industrialization, then by the so called “information society”, and finally by the present “knowledge economy”. The Gulf states have not – so far – been forced to invent nor to innovate, but have been able to base their development on learning or imitation; that is, by using their favourable financial situation to import technologies, know-how and manpower already available elsewhere.’ (Hvidt, 2015, p. 24) The UAE cannot buy its way out of this dilemma; it must (verily in the truest sense of the term) develop its way out.

A brief summary of the past sixty years will provide a historical context that illustrates the complex challenge the UAE currently faces. Before the UAE existed, the region was inhabited by a deeply traditional tribal (e.g., Bedouin) society and later colonized by the British who in the mid-1950s

explored and then exploited the enormous oil and natural gas resources hidden beneath the scorched desert sands. Upon independence in 1971, the UAE, comprising seven ruling families (sheikhdoms) in the respective emirates, were founded. (Zemoui and Cervantes, 2009) This remarkable, and unique, federation of seven states (Abu Dhabi, Dubai, Ajman, Fujairah, Ras al Khaimah, Sharjah, and Umm al Qaiwain) has undergone astounding economic change in little over six decades. Originally, the UAE economy was dependent on the pearl industry, in addition to some agriculture, fishing, and artisans who hammered coffee pots or stitched sandals to wealthy pearl merchants and powerful Sheikhs; however, since the discovery of oil and the subsequent boom, the country's economy has transformed dramatically, from an unknown backward region to a globally envied jewel of prosperity. (Haouas and Soto, 2012; Al-Abd and Mezher, 2014; Birnhack and Khoury, 2016) That the UAE now seeks to accelerate, i.e., leapfrog, development towards a predominantly knowledge-based, innovation-driven, globally-networked economic system is an astonishingly (perhaps naively) ambitious and highly aspirational goal. In such an ultra-compressed historical time frame (six decades), the UAE is attempting (as are several of the other GCC countries) a paradigmatic feat historically unprecedented, i.e., to 'leapfrog directly from a pearling/fishing/trading economy into a knowledge economy.' (Hvidt, 2015) Put another way, in approximately sixty years the UAE would make the extraordinary economic transition from pearls to petrol to patents.

In light of this unusual historical context, it is quite, yet perhaps beguilingly, inspirational to read the laudatory, operative language of UAE Vision 2021. Albeit lacking in strategic formulation and tactical detail, Vision 2021, if taken seriously, suggests that developmental change is imperative and imminent:

Innovation, research, science and technology will form the pillars of a knowledge-based, highly productive and competitive economy, driven by entrepreneurs in a business-friendly environment where public and private sectors form effective partnerships.

We want the UAE to transform its economy into a model where growth is driven by knowledge and innovation. Productivity and competitiveness will come to rival the best in the world, as a result of investment in science, technology, research and development throughout the fabric of the UAE economy.

Outstanding information and communication infrastructure will network our businesses together and give them a leading edge as they

transact and interact with the world. Individual citizens will also reap the benefits of efficient connectedness in their digital lives as they search online for knowledge and the fulfilment of intellectual curiosity.

This shift to a knowledge economy can only be accomplished within an entrepreneurial environment that harnesses the talent and creativity of Emiratis. A new class of entrepreneurs will be nurtured and supported with the help of practical programmes such as start-up incubators. In a national effort, the UAE will cultivate a healthy risk-taking culture where hard work, boldness and innovation are rightfully rewarded.

Legal frameworks and government services will be designed to provide businesses with the efficient environment that they need in order to grow, thrive and commercialise innovative ideas. Regulations will promote efficient markets and protect intellectual property. Partnerships will flourish between the public and private sectors, spurring growth and maximising opportunities. The UAE will become one of the best places in the world to do business. (Federal Government of UAE, 2011).

However, upon reading this and then pausing for a second, one is left with several questions: How will this be accomplished? Who wrote this- a UAE national or perhaps a well-paid expat consultant? What is missing herein is the ultimate challenge, indeed a challenge far and above greater than even of constructing a Swiss-style ski resort in one of the world's hottest deserts, or even the tallest man made structure (Burj Khalifa). Manipulating vast amounts of reinforced concrete, glass panels, steel beams, plumbing, electrical conduits and extensive air conditioning and refrigeration infrastructure, albeit hard and demanding, involves *what is known and what is done*, and does not entail the excruciating fundamental transformation needed to sustainably effectuate UAE Vision 2021: accelerate a societal paradigmatic transformation from a highly localized, resource-based (perhaps cursed?), permeated-with-rentier-and-welfare activity system towards an entrepreneurial, innovative, information-driven, globally networked powerhouse. When viewed in this context, it is understandable that the focus had been on the (relatively easier) task of mega-construction projects. Not surprisingly, entrenched administrative inertia is likely also to be an obstacle: 'Physical infrastructures exist, funded by oil revenues, which can potentially enable this shift [towards innovation], but difficulties remain in terms of human resource development and highly bureaucratic nature of policy creation and enactment.' (Patrick, 2014, p. 243)

Notwithstanding that such an accelerated economic transformation would be hitherto virtually unprecedented in human history, i.e., from pearls to petrol to patents in less than six decades, the uncomfortable and inconvenient reality is that there is no viable alternative option for development. In the 21st century innovation will dominate global commerce, accelerating exponentially, where countries either catch up, engage, and win, or are left behind to become economic backwaters, or, even worse, failed states. (The Economist, 2017a) The GCC states have sadly done little substantively to 'prepare for a post-oil future. Now they must catch up.' (Economist, 2016b) Yet, in the case of the UAE, an intoxicating mix of petrol wealth and subsequent extravagance likely masks the reality that a resource-cursed, rent-seeking government management system might, actually, hamper sustainable development. (Zemoui and Cervantes, 2009, p. 8) Therefore, it is crucial that for such a dramatic shift to rapidly proceed and achieve sustainable success, it must be driven, led, and implemented by UAE nationals and not the cadres of highly paid expat professionals who have come to dominate the UAE private sectors ranks. These cadres, if relied on in this context, will be more a part of the enduring problem than a sustainable solution; in other words this is a distinct UAE challenge requiring directed and strategic UAE ownership and commitment, wherein the UAE builds the requisite human capital and institutional infrastructure to rapidly effectuate this urgent transition.

Furthermore, reliance on highly paid expat professionals extends to seemingly misguided partnerships with major western institutions, e.g., universities, which seek to somehow recreate in the UAE a level of innovation that is neither possible nor appropriate considering the UAE's current developmental circumstances. In sum, the process of paradigmatic transformation from the current rentier state (wherein a distributive/allocative system saturates and permeates) to a knowledge-based, innovation-driven economy must be in the hands of the UAE, its people, human capital, and institutional infrastructure, all of which is more daunting a task to rapidly build than might be an extravagant pseudo-city on Palm Jebel Ali. This indeed will entail attendant risks, obligations, focus and challenges (and shocks). However, courageously dedicated policy, clear strategy, and coherent, focused tactical implementation will catalyze success towards the transformation needed to move UAE Vision 2021 from aspiration to reality.

B. Ambitious Policy Aspirations of the UAE

The UAE's articulated aspirations regarding rapid transformation into a global knowledge-based, innovation-driven economic powerhouse are ambitious:

The public policy agenda of Abu Dhabi Government for 2030, which represents the vision of the wise leadership of UAE President, H.H. Sheikh Khalifa Bin Zayed Al Nahyan, may God guard him, has been based on exerting ongoing efforts towards building a safe and coherent society as well as an open, sustainable and international competitive economy. This can be achieved through establishing a modern state, qualifying its citizens to face future challenges and building a knowledge-based economy, the key elements of which include innovation. Our wise leadership's awareness of the paramount importance of innovation, technology, research, creativity and leadership has been the luminous beacon for the Abu Dhabi Government and the beating heart for its sublime goals to focus on building and developing human capabilities and skills and providing them with the opportunity to embody the model of efficiency, innovation and excellence, build a human being capable of effectively contributing to progress and promote our beloved country to reach internationally advanced levels. (IKED, 2010, p. 4)

Whereas transforming a country and its society requires clearly articulated aspirations, these alone represent only a vague starting point. Policy, strategy, and tactical implementation, via clear and coherent action plans, must necessarily follow. Otherwise, lofty pronouncements predominate and proliferate with little, if any, sustainable impact. What is required then? According to the World Bank, a knowledge economy framework transition will necessitate 'sustained investments in education, innovation, information and communication technologies along with creating a conducive economic institutional environment will lead to increases in the use and creation of knowledge in economic production, and subsequently result in the sustained economic growth.' (Ahmed and Abdalla Alfaki, 2013, p. 86) In other words, to move from lofty aspiration to mundane implementation the grueling work of building human capital and institutional infrastructure is essential.

Perhaps to its credit, the UAE, likely more so than any other of the GCC countries, not only recognizes but is active in investing in program development vis-à-vis sustainable diversification (ostensibly/hopefully) towards a knowledge economy, appearing to recognize that human resource development must be a major priority in this process. (Ahmed and Abdalla Alfaki, 2013; Lightfoot, 2014; El-Khasawneh and Pech, 2015) Still, ambitious aspirations appear to abound, possibly overshadowing such sustainable development programs and related agendas, e.g., 'According to the Abu Dhabi Technology Development Committee, Abu Dhabi will be an Emirate in which the benefits of Science and Technology pervade every aspect of life;

empowering the Nation, transforming the economy, and inspiring the people.’ (El-Khasawneh and Pech, pp. 507) This aspiration is variously reiterated, e.g., ‘With its 2030 economic strategy, the Abu Dhabi authorities have committed to diversifying the economy, strengthening the role of the private sector, and fostering innovation and a KBE.’ (IKED, 2010, p. 17) Abu Dhabi 2030 vision of his Highness Sheikh Khalifah Bin Zaid envisions that ‘64% of the total GDP will be from non-oil sectors and the oil effect on the GDP will just present 36%.’ (Al-Abd and Mezher, 2014, pp. 121).

However, notwithstanding the confident and ambitious, albeit possibly misguided, optimism of official policy statements, such unrealistic aspirations are likely to face a challenge, i.e., the conundrum that implementation might require structural changes in the very foundations of society: ‘While the UAE exhibits a strong innovation capacity base, particularly in accessing, anchoring and diffusing knowledge, its creation capabilities have significant potential for growth. In this regard, the UAE should continue to focus on input factors that will enhance its knowledge creation capabilities as well as its knowledge commercialisation and exploitation efforts.’ (Mahroum, Alsaleh and Kanhere, 2013, p. 54).

Such exhortations stated, restated, and reiterated ad nauseam, provide little in the way of tangible strategic planning with clearly delineated objectives: How can BP in IP management and tech-transfer become integral to the UAE? That is, how can they be adapted in order to rapidly build a sustainable innovation/IP ecosystem? This conundrum has not escaped esteemed commentators: ‘Assessing how Islamic communities respond to these challenges provides a unique case to examine how culture is affected by the adoption of Western educational ideologies and “best practices” in communities characterized by traditional socio-cultural norms and gender roles. And, it has significant consequences for the development of knowledge societies in Arabian Gulf countries given the inclination for knowledge economy and society development to be characterized by Western cultural and ideological assumptions.’ (Wiseman, Alromi and Alshumrani, 2014, p. 4) Wiseman et al., however, offer a path forward: ‘As a result, the challenges to creating an Arabian Gulf knowledge economy are twofold. One is a functional and structural challenge of developing a knowledge economy-oriented mass education system. The other is a cultural and contextual challenge of aligning Arabian Gulf expectations, traditions, and norms with those of knowledge economies.’ (Wiseman, Alromi and Alshumrani, 2014, p. 2) Therefore, as this article elucidates, strategically building a system of BP must balance the inner cultural with the global developmental dimensions. This can only be carried out by the citizenry of the UAE, i.e., all of the

people ... especially the young, (Hvidt, 2013) with women taking an active and dynamic leadership role.

II. CHALLENGES COMPLICATING THE UAE'S DEVELOPMENT

The urgency for rapidly transforming the UAE towards becoming a global innovation leader is counterbalanced by a series of serious and palpable challenges, which can be broadly categorized as cultural, societal, economic, and political. Although these categories are neither absolute nor all encompassing, and admittedly there might be a cross-over conceptually, they are presented thus herein to merely organize a very complex topic and illustrate that the road from pearls to petrol to patents is unpaved, unmarked, and unmapped: a largely an unknown risky passage, as was the New World voyages of the resolute Conquistadores in past centuries.

Furthermore, in the context of challenges towards becoming a knowledge economy, it is important to remember that IPR and IP law must always be viewed in the context of a country's stage of development. Therefore, this article seeks to present a context for BP applicable to the UAE, i.e., on the role of law in enabling the efficient operation of an innovation system: the effective use of IP law towards IP management and tech-transfer in order to accelerate innovation. As an analogy, in most developing countries, IP in the context of development might be compared to a series of traffic lights and laws, with neither a road network, cars, nor even people who know how to drive; only after the roads (infrastructure), cars (tools), and capable drivers (human capital) are in place will the laws and traffic lights have a context for useful operation, as law does not exist in a vacuum, but in a dynamic system. Likewise, IP law needs to be conceptualized in a larger systemic context, addressing challenges and building capacity, capability, and institutional infrastructure to operationalize IP law so that it facilitates efficient and sustainable IP management and tech-transfer, whether local, regional or global.

The challenges, in general, hindering the efficient establishment of an appropriate and efficient system of BP in IP management and tech-transfer in the UAE include (yet are not necessarily limited to) (Modarress, Ansari and Thies, 2014, p. 119):

- Lack of innovation capability;
- Low female participation in the workforce;
- Inadequate UAE nationals with the skills demanded by the private sector;

- Excessive national reliance on government support;
- Increasingly precarious economic overreliance on hydrocarbon exports;
- Weak convertor industries, i.e., lack of robust triple helix;
- Shallow cluster of R&D;
- Bureaucratic management and a lack of transparency in government; and
- Societal instability due to the disproportionately high ratio of foreign labor and income inequality.

A. Engaging the Global Knowledge Economy

For the UAE to rapidly undergo a transition from its current, largely petrol-based, economy to a knowledge-based economy is not only ambitious, but also somewhat vague. As has been oft pointed out, the term ‘knowledge economy’ has certain degree of tautology, i.e., can be jargonish, ambiguous, and/or abstract. (Patrick, 2014, p. 237). It might therefore be prudent to proffer an elucidation for what the term ‘knowledge-based economy’ means in the context of this article. Then only, an appropriate organization and discussion of IP management and tech-transfer BP can be presented in a framework that is logically coherent.

Various definitions of knowledge-based economy have been proffered:

The World Bank had defined knowledge-based economy as: ‘[T]he knowledge economy ... meaning is broader than that of high technology or the new economy, which are closely linked to the Internet, and even broader than the often-used information society. Its foundations are in the creation, dissemination and use of knowledge. A knowledge economy is one in which knowledge assets are deliberately accorded more importance than capital and labor assets, and where the quantity and sophistication of the knowledge pervading economic and societal activities reaches very high levels.’ Note: the same source considers four pillars for a knowledge-based economy, which are the main framework that guides analysis in the current paper, i.e.:

1. information and communication technology
2. education
3. innovation

4. economy and regime (which includes IP system) (Parceró and Ryan, 2016, pp. 2-3)

As this century unfolds, knowledge, and related intangible assets, will increasingly become the 'key driver of productivity and economic growth, thereby departing from the traditional emphasis on the accumulation of physical capital [e.g., petrol]. In this regard, knowledge refers to the cumulative stock of information and skills involved in connecting new ideas with commercial values, developing new products and processes, and therefore doing business in a new way.' (Mahroum, Alsaleh and Kanhere, 2013, p. 11) This will entail a rapidly emerging global innovation marketplace where innovation drives an accelerated, seemingly exponential, technological evolution of 'innovation with new products and processes that develop from the research community (i.e., R&D factors, universities, labs, and educational institutes).' (Hvidt, 2015, p. 27) In order to engage with this challenging economic reality, emerging economies need to leapfrog ahead with both capable human capital and capacitated institutional infrastructure, lest they be left behind in the oil bin of history.

Therefore, fundamental to the concept of knowledge economy is the effective and efficient utilization of intangible assets, such as knowledge, skills, and innovative potential, applied and implemented towards competing in the rapidly emerging global economy. (Hvidt, 2015, p. 28) Critically noteworthy in this regard is the role of IPR, beyond the narrow paradigm of protection of IP, i.e., to the broader more dynamic vision of IPR as the legal property system which lowers transactions costs and thereby accelerates the movement of technology and innovation. In this regard, 'The output of a knowledge economy would consist of knowledge products, such as trademarked or copyright processes, and technologies ...[K]nowledge products and ideas need to be protected as a form of property if they are to operate within competitive capitalist societies.' (Weber, 2014, p. 61) And, to take this concept to the next step, i.e., from IP protection to use, requires fundamental changes in terms of paradigms, perceptions and practice: 'In general, changing the IP-related environment and phenomena ... suggests a need for IP systems to evolve further from an institution to protect IP to one that fosters more use of IP.' (Lee et al., 2013, pp. 39)

In the globalized knowledge economy of the 21st century, what are the essential components, i.e., the nuts and bolts? In other words, the industrial economy has been built on a tangible infrastructure of steel, glass, reinforced concrete and petrol, but what about the knowledge economy? Certainly data, information, and knowledge are fundamental, but, as Patrick has pointed out, the person as the knowledge worker is the key: 'It is not just knowledge

that becomes commodified in policy and practice, but the person in the form of the knowledge worker.’ (Patrick, 2014, p. 239) However, Patrick continues by questioning whether Arabic cultures can readily adopt the new ways of thinking, working, and networking, essential in a knowledge economy, such as teamwork, open communication, and autonomous learning. How can a balance be reached wherein the demands and suite of knowledge, skills and abilities of a globalized innovation culture are adapted yet in harmony with localized culture and custom? The UAE will likely need to carefully consider this issue as it invests in its own human capital resources. The new generation of knowledge workers must be capable, proactive, and enthusiastically committed to contribute to economic development, and not simply become a next generation of ‘largely passive individual[s] who will simply adopt new ways of thinking and working.’ (Patrick, 2014, p. 239)

Fostering this human capital requires an integrated/interconnected innovation system, the essential platform from which a knowledge-based economy can be built. Such a system includes a network of professionals, small/medium enterprises (SMEs), public and private institutions, as well as the laws, rules, and regulations that foster the dissemination and use of knowledge and technology towards sustainable economic transition and growth. IPR, as a legal foundation, and IP management and tech-transfer as a means to actualize IP BP, will accelerate and maximize efficiency in this innovation ecosystem. (Abdalla Alfaki and Ahmed, 2013, p. 9) ‘Knowledge-based development requires a holistic approach that brings together researchers, entrepreneurs, and policymakers. Connecting scientist and researchers with entrepreneurs in clusters, networks, and regions is an essential ingredient for an innovation ecosystem.’ (Tadros, 2015, p. 5) A proper system of education is the rock-solid foundation upon which to build an innovation ecosystem. Neither free nor easy (although a knowledge economy is primarily composed of diverse intangible assets, these do not magically materialize gratis), this will require investments in education, research and development (R&D), including capacity building and collaborative research, entrepreneurship, and commercialization of appropriate innovations and technologies with global marketing strategies. (Tadros, 2015, p. 4) A crucial initial question is what might constitute a hub, a catalytic center that focuses a critical mass of talent, expertise, and knowledge to rapidly and sustainably drive the transformation? And in the case of the UAE, how to establish, should it one day face the exigency of a departure (possibly sudden) of expat expertise?

The current situation in the UAE is characterized by a systemic inadequacy that, if not strategically addressed and managed, could spell failure in the longer term. The UAE cannot buy its way out of this challenge;

it must transform its way out and then accelerate forward. Currently the UAE is hobbled with an economic and social order that can, to a discernible degree, be described as distributive, rentier and welfare, due to the mixed oil-cursed blessing of opulent wealth. However, it must realize that building a robust, sustainable knowledge economy necessitates an entirely new dynamic paradigm, as contrasted with the petrol-soaked paradigm of a pervasive and perverse yet comfortable and beguiling world of disincentives, security, and somniferous complacency. The challenge, therefore, is to avoid being left behind, verily to leap-frog across the chasm of development. To build a knowledge-economy, education cannot be static, stale, or traditional (i.e., rote learning and memorization ... the late, esteemed philosopher and educator, Dr. Mortimer Adler going so far as to describe such education as producing cadres of 'educated ignoramuses'); in order for it to be part of the solution, and not part of the problem, education must promote entrepreneurial drive, innovative thinking, critical analysis, active learning, and most importantly risk taking. The acceptance that failure is not catastrophic but part and parcel of the dynamism of the innovation ecosystem is the key. Such an educational system is iterative and self-reinforcing, feeding back to advance development and competitiveness and stimulate interest and catalyze networks among students, educators, policymakers, entrepreneurs and employers. (Kirk, 2014; Hvidt, 2015).

B. Cultural Challenges

From a cultural perspective, it is primarily important to understand and appreciate the rapidity of the UAE's development. A sensitivity and respect for the cultural paradigm must, therefore, be balanced against the unfor-giving reality of the emerging global knowledge-based economy and the necessity to either engage in the global innovation market or risk being left behind. In this regard, three possible avenues have been suggested for an Arab approach to the inexorable juggernaut of globalization:

1. those who reject it as the highest form of cultural imperialism which serves to undermine their local traditions and cultures;
2. those, mainly secular individuals, who welcome globalisation as a force for modernisation, which brings the age of modern science, advanced telecommunication and freedom of choice to their conservative homelands; and
3. those who believe, pragmatically, that it is possible to find a form of globalisation which is compatible with local cultures and beliefs. (Light foot, 2014, p. 87)

The current educational system presents a somewhat daunting challenge. In the GCC region, ‘Islamic education traditions have little to do with theories of human capital formation, but much more to do with the establishment of social conformity in line with the Quranic teachings.’ (Light foot, 2014, p. 98) It might, therefore, be argued that the development of a national knowledge-based economy and globally networked innovation-system should be in congruence, and not in conflict with a ‘dynamic intersection between religious ideology, economic development, and educational infrastructure, which are defining characteristics of the “Gulf State Phenomenon”’. (Wiseman, Alromi and Alshumrani, 2014, p. 19).

As currently established, the educational system in the UAE (characterized with obsolescence) fosters an indigenous workforce which is ill-prepared to drive innovation based development. From preschool to university, ‘[T]eaching in the Arab world tends to emphasise rote learning rather than developing analytical skills.’ (Economist, 2016a) With a labor market that is significantly segmented by sectors, compensation, and skills, over 90 percent of the UAE nationals are employed in the public sector, i.e., governmental, with wage and benefit packages that rival those of expats similarly positioned. (IKED, 2010, p. 18-19) Whereas this employment demographic provides security and stability to many in the UAE, it might not be sustainable over the next several decades (e.g., with youth unemployment alarmingly increasing). Yet, the challenge of economic diversification, wherein UAE nationals assume leadership and risk, will necessarily involve ‘widespread cognitive and attitudinal shift ...through the process of indigenization’. But when ‘individuals [continue to] look to be ruled, told, guided, and provided for, this expectation militates against the changes in individual outlook needed for a shift towards a knowledge based society: autonomy, critical thinking, innovation, tolerance for ambiguity, and resilience to the unpredictable nature of knowledge creation and innovation.’ (Patrick, 2014, p. 247) Hence, there is a seemingly paradoxical, paradigmatic dilemma for the UAE government and national education system to address: to build appropriate human capital that can engage in the exponentially expanding global innovation market. (Wiseman, Alromi and Alshumrani, 2014, p. 7).

C. Societal Challenges

From a societal perspective, UAE nationals have become somewhat jaded from a monetary windfall that followed the hydrocarbon commodity boom of petrol in the middle of the last century; they live in a comfortable distributive society, with a governmental focus on consumption and sharing, congruent with the ‘elaborate welfare states in all Gulf states, encompassing free

healthcare, schooling, generous pensions, etc.’ (Hvidt, 2015, pp. 37-40) A subsequent flood of wealth fostered a sort of societal ‘evolution’ that is premised on a preponderance of cash in perpetuity, understandably an unsustainable proposition given the dynamics of the 21st century. This is exemplified by the fact that the ‘UAE is an extreme welfare state when it comes to the treatment of its own nationals. Emirate males receive over \$55K per year in total transfers. Not surprisingly then, the country faces a lack of incentives typical in welfare states.’ (Parcero and Ryan, 2016) However, an incipient crisis looms: ‘the distributive model has run out of steam, and it has left the economies in the region under significant stress.’ (Hvidt, 2015, p. 25)

Yet inertia persists; for example, employment and careers are largely incompatible with creation of a knowledge-based society, i.e., ‘the fact that ... Gulf national[s] prefer high status, high job security, and guaranteed payment like that offered through the public sector. Therefore, the most frequent employment for [GCC] nationals has been in the public rather than the private sector.’ (Wiseman, Alromi and Alshumrani, 2014, p. 15) Despite governmental efforts to the contrary (such as Emiratization programs for the private sector), this persists in the UAE. (Parcero and Ryan, 2016) Such a social system is, at best, disincentivizing, and at worst, crippling (inimical to knowledge-based development). ‘[T]he public sector has to stop acting as the main employer. That would be a big shift. Gulf citizens have got used to earning without doing much.’ (Economist, 2016b) In addition, this has also created a sort of perverted elitist expectation and stratified status within society, wherein ‘attitudes and expectations about which kinds of jobs are appropriate have formed among Gulf nationals.’ (Wiseman, Alromi and Alshumrani, 2014, p. 12) A combination of expectations and entitlement has therefore created an environment of inertia and morass, with a troubling societal paralysis. Official proclamations, albeit comforting in the short term, require commitment and strategic investment. “Diversification, long talked about, has to happen now.... Plans look good on paper ...but more uncertain in real life.” (Economist, 2016b)

The beguiling sense of security that permeates the current societal/cultural environment in the UAE is, at best, pleasantly illusory, and, at worst, ominously dangerous. For the young of the UAE this environment fosters weakness, lack of stamina, and diminished ambition, along with an entire spectrum of disincentives ranging from educational goals to career development ambitions; furthermore, this weakens the link between the education sector and the innovation market, fueling a downward spiral that feeds upon itself with a chronic institutionalized misallocation of human capital that ultimately stymies sustainable economic growth. A shift is necessary,

which might require a sort of shock therapy in order to rapidly overcome the ‘significant challenges related to motivating the national population to pursue knowledge through education, engage in innovative activities, and participate in, claim ownership of and actively involve themselves in the knowledge economy.’ (Hvidt, 2015, p. 37) Therefore, this endemic lack of motivation (particularly among the youth) must be overcome swiftly to overcome extraordinary challenges, that is, to implement and actualize, in little over a decade, the aspirational policy proclamations of the UAE government to transform UAE into a major innovation-driven economy.

D. Economic Challenges

From an economic perspective, intimately related to education, is the pervasively negative impact that the petrol/hydrocarbon natural resource economy afflicts on knowledge based development. This relationship, repeatedly articulated by numerous commentators, is perhaps best summarized by Gylfason:

1. Economic growth varies inversely with natural resource abundance.
2. Three different measures of education intended to reflect education inputs, outcomes and participation are all inversely related to natural resource abundance.
3. Economic growth varies directly with education.

Therefore, natural resource abundance seems likely to deter economic growth not only through the Dutch disease, rent seeking and overconfidence that tends to reduce the quality of economic policy and structure ...but also by weakening public and private incentives to accumulate human capital. (Gylfason, 2000, p. 7)

In addition, whereas this hydrocarbon economy fosters ‘traditional’ education, capacity-building educational initiatives, towards accelerating the development of a knowledge-based economy, are conversely disfavoured. In other words, the greasy slog of petrol creates a viscous inertia in the entire educational enterprise.

More eloquently elucidated by Hvidt, ‘natural resource abundance and educational levels are inversely related because abundance of resources – if not controlled properly – leads to high levels of non-wage incomes, and as such reduces the private and public incentive to accumulate human capital.’ (Hvidt, 2015, pp. 37-40) This perpetually unfolding and downward spiraling economic predicament is ironic in that the very capacity building initiatives

needed to launch out of the petrol/commodity based economy are, in fact, stymied by the viscous economic morass that permeates society. Whereas laws and business climate are important, they are insufficient; significant and strategic investment in education and know-how is critical and key. (Haouas and Soto, 2012, p. 33)

As the global innovation economy continues to expand, the urgency of change likewise increases. The challenge to connect to the global innovation economy will be key. To do so requires acceptance of international rules, standards, business practices, networks and acumen, which absolutely include capacity and capability in IP management and tech-transfer, with related expertise and BP. For the UAE, there is no turning back, no stasis, only forward into this century: 'International competition and interdependence create a common community in which all nations participate, willingly or not. Nation-states cannot compete with others that do not acknowledge their status within this community. The importance of inclusion in an international economy suggests the need for legitimization within a global community.' (Wiseman, Alromi and Alshumrani, 2014, p. 18)

Still, in the context of the GCC countries, the UAE might be in a better position to make the transition to a knowledge-based economy than most of the others. In its most egregious manifestations, the oil curse (also called the resource curse ...some even calling oil 'the Arab Disease.', Hvidt, 2015, pp. 37-40) is when hydrocarbon capital crowds out of capital resources crucial for subsequent knowledge-based development. However, the UAE's progressive governmental policies have promoted investment in 'the institutional fabric that deals with the working of the private sector (rule of law, corruption control, etc.)' In spite of this, the UAE government must continue to make concerted, strategic efforts to overcome the impact of oil rents. (Haouas and Soto, 2012, p. 34) Paramount among these efforts is building human capital that will effectively connect to, engage with, and compete in the global innovation/IP marketplace. This cannot be done by well-paid expatriates; ultimately, they are an obstacle, part of the problem and not the solution. 'Addiction to cheap foreign labor, including expatriate knowledge workers, are serious barriers to the creation of a knowledge society.' (Weber, 2014, p. 80)

In a sense, the UAE is exemplary of countries that, although investing significantly in various input factors supporting innovation, still do not generate high levels of innovation, e.g., patents, know-how (trade secrets), scientific publications. (Mahroum, Alsaleh and Kanhere, 2013, p. 51) Furthermore, a good indicator that a country has taken knowledge into the production sphere is when knowledge/innovation 'products' comprise an important

component of the country's exports; the UAE performs quite poorly as an exporter of high technology. (Parcero and Ryan, 2016, p. 13) The question to ask at this junction is - why, in spite of investments physical and infrastructure, the UAE still lags in terms of becoming a knowledge-based economic power? To a great extent this is because the UAE is still not building the requisite human and institutional capacity and capability to become the much aspired for innovative power that its leadership envisages.

E. Political Challenges

As has occurred repeatedly, and sadly, from a political perspective, the mixed blessing/curse of oil more often than not fosters misguided 'development' priorities, pervasive wealth inequality (also known as the wealth gap ... which refers to the unequal distribution of hydrocarbon-derived assets), and a consequential retardation of anything resembling a knowledge-based, innovation-driven economy. 'Rarely have developing countries used oil money to improve the lives of the majority of citizens or bring steady economic growth. More often, oil revenues have caused crippling economic distortions and been spent on showy projects, weapons and Paris shopping trips for government officials.' (Gylfason, 2000, p. 1) In the case of the UAE, 'evidence suggests that resource-rich countries show a tendency to implement large-scale projects without significant collaboration with private enterprise ...' (Mahroum, Alsaleh and Kanhere, 2013, p. 54) Ski Dubai is perhaps the most egregious manifestation of this sort of short-sighted 'strategic' trend in capital asset misallocation.

In general, therefore, the GCC countries are currently encountering a somewhat precarious predicament of promoting principles and values that foster knowledge-based economic development while maintaining political systems and order that have persisted since the pre-petrol economies emerged in the middle of the last century. Such a cautious approach might also be inimical to rapid transformation towards a sustainable innovation-driven economic engine. The dilemma is ubiquitous, essentially pitting past against future, with very high stakes: 'The rulers of the Arab Gulf states find themselves in a difficult position in this regard: they are keen to promote and develop their knowledge economies, as outlined earlier, but they find it hard to reconcile this new freedom of ideas and openness with a form of government which at best could be described as constitutional monarchies, but in many ways are conservative, traditional, tribal, patriarchal and often authoritarian.' (Light foot, 2014, p. 95)

The oil-induced 'Arab disease' has fostered a dangerously comfortable inertia, not unlike resting on a bed of roses as the petals slowly wilt and

one gradually descends into the treacherously spiny thorns. The misguided overconfidence in the sustainability of the petrol economy in the GCC resource rich states, e.g., the UAE, has caused these countries ‘to underrate or overlook the need for good economic policies as well as for good education. Indeed, resource-rich nations can live off their natural resources over extended periods, even with poor economic policies and a weak commitment to education. Awash in cash, they may find that education does not pay.’ (Gylfason, 2000, Ex. Guide) A spiral ensues, wherein wealth promotes overconfidence which generates inertia that stymies incentives and quashes education. This establishes a feed-back cycle that reinforces petrified political progress and increasingly obsolete economic policy and strategy, i.e., inimical to solid knowledge-based economic development: forever fossilized in the past century’s seemingly endless petrol-fueled prosperity.

F. The Problem with Petroleum: Economic Diversification

Despite policy pronouncement to the contrary, the UAE continues to be strongly dominated by hydrocarbon activities, which contribute to its continued economy wealth and prosperity. This is entirely understandable, e.g., ‘boasting 8-10 per cent of the world’s known oil resources, Abu Dhabi will retain the benefit of a solid economic bulwark, which can be relied upon to produce substantive revenues for many years to come.’ (IKED, 2010, p. 17) Yet, this is neither a sustainable nor a sensible economic policy.

The dominance of the natural resource, hydrocarbon commodity-based economy not only perpetuates but in fact contributes to and fuels under performance in innovation. ‘Analysis of factors crucially hindering innovation further identifies eight gaps that require policy action:

1. Low economic diversification;
2. The turnover of expatriates;
3. Weak ties among talented individuals belonging to different organizations;
4. Absence of an environmentally sound and sustainable economy and society;
5. Weaknesses in opportunity-based entrepreneurship;
6. Under performance in R&D and technical innovation;
7. Mobilization of human resources and investments to match opportunities for economic and business development, and;

8. Weaknesses in governance.’ (IKED, 2010, p. 9)

Although likely recognizing that the historical burden of this precedent weighs heavily against it, the UAE nevertheless aspires to be an exception to the prevailing reality that ... ‘oil economies have been largely unsuccessful in transitioning beyond natural resources and into more sustainable industries. This is, in part, because oil abundance is associated with low levels of human capital formation.’ (Ewers, 2013, p. 128)

The flow of petrol and wealth has been an intoxicating boom, and data unambiguously support the proposition that the hydrocarbon economy continues to prevail and dominate the UAE. Put into blunt perspective, the trend which creates such wealth continues to copiously flow forth and, to a certain degree, continues to smother incentives towards realizing serious investment in programs that will generate sustainable indigenous human capital and institutional infrastructure, so sorely needed for transition to a knowledge-based, globally-networked economy. With a per capita income of approximately \$24,000, it is informative to note that between 2003 and 2007, UAE oil revenues almost tripled, from \$23 to \$63 billion, i.e., 33 per cent of GDP in 2007. Yet, despite policy initiatives and calls for diversification, oil exports still dominate, accounting for approximately 35% of the UAE’s federal budget. This has been deeply entrenched in the economic structure of the country for decades, e.g., ‘between 2000 and 2005, oil and natural gas provided 66% of the UAE’s fiscal revenue.’ Blessed (cursed?) with one of the world’s largest reserves of oil and natural gas (214 trillion cubic feet of proven natural gas reserves), the UAE possesses the sixth largest proven oil reserves on planet earth, at 98 billion barrels, that is, 8% of the global total. (Lugar, 2008, pp. 75-77) This paints an oily picture: putting the economy of the UAE and calls for innovation-based development into ominously stark perspective, i.e., a ‘lack of innovative activities and inability of the UAE economy to assimilate and create new knowledge and technologies that cater for domestic needs.’ (Abdalla Alfaki and Ahmed, 2013, p. 9) Amelioration cannot be achieved via reinforced concrete, steel and shiny, indeed palatial, new buildings, which unfortunately appear to be commonplace throughout the GCC region:

Diversification is important to most Natural Resource Rich Economies (NRE). Such economies tend to develop an excessive dependency on their natural resource base while, at the same time, they possess significant financial resources to support new sectors. In the GCC countries, substantial oil revenues have been re-invested not only in large-scale infrastructure projects, but also in the creation of science and technology parks, innovation incubators and the development

of clusters. Despite the demonstrated zeal and tangible results seen in several such undertakings, hurdles and challenges remain when it comes to laying the foundation for innovation-led long-term sustainable economic growth. (IKED, 2010, pp. 18-19)

It is perhaps far easier to pour concrete, raise steel, assemble ironwork, and raise skyscrapers than to rapidly generate entirely new priorities and values in societies that thereby generate new systems; even easier to build glitzy techno parks than to forge a new paradigm in the national psyche. The magnificent, albeit astounding absurdity, of the indoor sky resort, Ski Dubai, both illustrates this and cautions us: Investing in physical infrastructure is much easier than building human capital and institutional infrastructure, and verily is a woefully sorry substitute therefor.

For the UAE, leapfrogging, that is, jumping over an entire stage of development is unprecedented, as the UAE did not undergo developmental phases that the industrialized countries have (from agrarian to industrial to innovation). Enormous oil revenues have accelerated wealth accumulation and shortcut to a path of 'economic development'. (Erogul and Horne, 2014, p. 186) Having bypassed an industrial phase may have had its advantages, yet as with massive wealth in general, this also entails enormous weaknesses and deficiencies. Closing the gap towards becoming a knowledge-based, globally-connected innovation economy might also be complicated if not severely compromised. (Hvidt, 2015, pp. 44-45)

Considering that the pace of global innovation's exponential acceleration is inextricably coupled with an ever-increasing need to engage in this complex global innovation marketplace in order to survive, delays towards strategic transformation in the UAE portend an ever widening gap, with a concomitant ever greater distance to leapfrog, i.e., conceptually from a cranny to crevasse to chasm as time passes and the pace of global innovation accelerates. This is even further exacerbated by the reality that innovation is now less about individual genius inventors laboring away, patenting, and thereby generating value and wealth, but is now driven by the identification and assembly of innovations, technologies, and appurtenant IPR, i.e., the open innovation paradigm. (Chesbrough, 2003; Granstrand and Holgersson, 2014) For a developing or emerging economy such as the UAE, an unflinching acceptance and understanding of this 21st century reality requires a new and brutally objective change in view, i.e., a paradigm that must be embraced in order to leapfrog, verily vault, over the industrialization phase.

[T]he Gulf States are attempting to leapfrog over the industrial phase and proceed directly to the knowledge economy. The effect of that, it can be hypothesized, is that the Gulf States most likely lack the production-oriented experience, skills, and work-related discipline pertaining to the industrial age in establishing their knowledge economies. Stiglitz points out that the scientific orientation on which the industrial phase is founded also has an important bearing on the ability to proceed to a knowledge economy: ‘The scientific revolution of the past century has resulted in the systematization of change itself: the very process of producing new innovations has been altered, from isolated and independent inventors like Thomas Edison to huge research laboratories. Knowledge and information is being produced today like cars and steel were produced a hundred years ago.’ (Hvidt, 2015, p. 43 (quoting Stiglitz))

G. Urgency

The urgency of the UAE’s serious commitment to innovation-based development is glaringly apparent when one considers that the accelerating global innovation economy entails both beneficial and potentially catastrophically disruptive innovations. (Al-Filali and Gallarotti, 2012, p. 2) Innovations will bring significant changes to the market for energy, undercutting and further altering the already fragilized, oil price-shocked global petrol energy economies, e.g., unexpected, highly novel advances in energy production. This concept of ‘disruptive innovations’ is not historically unprecedented; it is the fabric of the story of humankind. To paraphrase what was articulated hereinabove, the stone-age did not end for want of stone. ‘[T]he development of new and feasible technologies for energy have the potential to drastically change conditions in the market for oil.’ (Al-Filali and Gallarotti, 2012, p. 2)

Hence, the central irony that petrol states must become innovation-driven because of the ever-looming specter of disruptive innovations becomes even more apparent; for example, disruptive innovations in the energy sector could rapidly and drastically undermine the petrol market, just as petrol had undercut the whale oil market in the late 19th century (Beaton, 1955), and automobiles undercut the centuries old horse-based transportation in the early 20th century. (The Economist, 2016e) And whence might such disruptive energy innovations arise? Perhaps from the greenery that surrounds us all - plants. That is, the invention of a revolutionary catalytic, bio-based, renewable water splitting technology that harnesses the very enzymatic and energetic processes of photosynthesis as a power supply for bio-hydrogen

production. One can only imagine the vast disruptive impact such would have on the global energy economy. (Esper, Badura and Rögner, 2006)

It is not a question of if the change is coming but rather when it will hit, not whether it might occur but rather that it will happen: it is coming and the UAE must prepare for proactive engagement in this global IP/innovation economic dynamo or risk being run over and left behind in the dust of history. In chronicles yet to be written, the UAE might be nostalgically remembered as that glittering, albeit evanescent, mirage in the vast sands of the Arabian Desert, which, in little more than a century, waxed triumphantly, and then waned tragically into failure ... windswept buildings, lost opportunity and possibly even greater tragedy and sorrow. (The Economist, 2017a)

Any current sense of security that is present in the UAE can only be objectively viewed as short-term: whereas there appears to be time, there really is not, and whereas it appears that its wealth will serve as an economic prophylactic, it might be to the contrary. For example, the UAE might arguably be better situated than other GCC countries, but that is not saying much, as it is a matter of being better positioned in an overall precarious geographic instability of the highly volatile Persian Gulf and global economic uncertainties of petrol. The UAE as the miracle in the desert could rapidly, in a matter of decades, become the nightmare in the sand, just as so many abandoned mining boom towns litter the deserts and parched prairies of the American West, populated by grass, geckos and ghosts. In other words, 'Despite innumerable warnings and innumerable failed attempts to diversify ... away from oil ... it is still only a matter of time before the crunch comes.' (Economist, 2015)

Accelerating establishment of a robust and dynamic knowledge-based economy involves 'enterprise development and entrepreneurship (including SMEs, start-up rates, risk-taking and venture capital functions)', not only connecting to international markets and integrating in global value chains (IKED, 2010, pp. 18-19), but also investing in the human capital and institutional infrastructure that will facilitate sustained momentum and growth in an increasingly globalized and competitive innovation marketplace. A systematic and strategic approach is warranted: 'The process for building a regional innovation system (RIS) in three stages: (1) realise a cluster of innovative firms in a specific area; (2) create and/or reinforce a set of knowledge institutions; and (3) implement social interaction mechanisms among firms and universities that allow the generation of the interactive learning process.' (Ewers and Malecki, 2010, p. 501) Whereas appearances of current initiatives might suggest otherwise, it is, at least, questionable whether these stages are in fact manifest in the UAE. For example, Masdar's Innovation and

tech-transfer office (TTO) are still nascent. What is missing? Perhaps making the global connections necessary for true integration into the IP-driven innovation market, coupled with a continuing lack of local expertise, i.e., an incomplete metamorphosis that is more cosmetic than substantive, the transition from petrol to patents is still spinning wheels in the oily sand.

III. THE IMPERATIVE: KNOWLEDGE-BASED, INNOVATION-DRIVEN DEVELOPMENT AND THE GLOBAL INNOVATION MARKET

The challenge that confronts the UAE is that of leapfrogging from oil to innovation. However, this is a much broader construct of the term ‘innovation’, as it is largely understood: ‘Innovation, whether it is undertaken internally or externally, is a complex process which often involves knowledge flows ... and hence requires knowledge absorption and learning. The innovation-value creation process is viewed as systemic, i.e. [organizations] do not innovate in isolation but do so through a complex set of interactions with external actors.’ (Mahroum, Alsaleh and Kanhere, 2013, p. 12) In the UAE, the complexity of leapfrogging is, at its heart not an IP question, but rather a broader economic development issue: albeit a key component of the overall innovation system, IP is not, per se, the innovation system; it establishes the rules, regulations, and tacit understanding that fosters trust, enables arms-length licensing, lowers transactions costs and in so doing accelerates the entire innovation process and related enterprises.

Therefore, within the context of the development of a robust and sustainable innovation ecosystem in the UAE, there must be a complementarity of open innovation as a process and IP as the facilitating body or rules and regulations which catalyze and facilitate an efficient system of global transactions. For this to rapidly transpire, a sophisticated interdisciplinary expertise needs to be established: the capability and capacity in identifying, accessing, absorbing, and assembling innovation, and importantly the attendant IPRs. All personnel involved, whether scientific, legal, business, managerial or governmental, including (but not necessarily limited to) innovators, researchers, developers, and marketers, verily ‘must ensure that all technologies and associated IPRs required to support [an innovation R&D enterprise] are collected from various owners; the problem of collecting all the required rights is the IP assembly problem. As innovations become increasingly dependent on multiple IPRs, likely with multiple IPR holders, the IP assembly problem becomes more complex, creating a pressing need

for well-functioning technology markets and technology management.’ (Granstrand and Holgersson 2014)

The dynamism of the open innovation system is thereby greatly enabled by sophisticated knowledge and IP management, tech-transfer, and related licensing acumen: ‘The whole discussion on open innovation is actually ... about building a business model utilizing inward and outward licensing, because it argues that innovation strategy should consider not only the product, but also the technology market. The rise of innovation models utilizing multi-field and outside knowledge and the associated rise of patent licensing is a call for new policies and strategies for business firms and governments, particularly those in latecomer countries [e.g., UAE], to handle a whole new group of issues.’ (Lee et al., 2013, pp. 34) In other words, by lowering attendant risk, i.e., reducing transaction costs, a sophisticated ability to manage and assemble IPR not only facilitates, but sustainably drives the open innovation process; parties to an innovation/technological transfer can thereby operate as co-equal partners in negotiations, licensing, and even determination of downstream ownership partition of that which might, and most likely will, pertain to subsequent innovations that arise from any given R&D program, whether in health, energy, agriculture, communication or other emerging important field.

In the world of global business transactions, this is becoming the norm, epitomizing the major trend of global economic development in this century: ‘IP management and the increased skill with which it is managed by companies has assisted them in developing open innovation strategies. The way in which open innovation operates in a commercial firm is the outgrowth of the need to access resources from a variety of partners. IP ownership enables firms to conduct the trade in technology that accompanies an open innovation strategy...’ (Hall, 2010)

Organizational capability and capacity, whether public or private sector entities, large companies or SMEs, or even nation States, must therefore be optimally configured and networked in order for open innovation, which necessarily entails strategic IP management, to sustainably develop and thrive, i.e., the ‘ability to mobilise knowledge and technological skills in order to create new economic value.’ (Mahroum, Alsaleh and Kanhere, 2013, p. 11) This, in turn, necessitates that developing and transitioning countries accept and adapt to a dramatic paradigm shift, ‘to identify and cultivate new ... models to appropriate the potentiality of technology implied by an open innovation paradigm ... to utilize and combine diverse sets of technology to enhance the value of output Therefore, the necessity of growing the

capability to ... [build] a proper ... model [system of BP] to design products in a timely manner has risen.’ (Lee et al., 2013, pp. 35)

The UAE still (fundamentally and chronically) lags in this respect. As with the impressive physical infrastructure of gleaming skyscrapers, a world class airline (replete with showers in first class) and staggeringly luxurious amenities (not to mention Ski Dubai), the current UAE institutional infrastructure, whereas also ostensibly impressive, is neither configured to incentivize innovations nor to integrate and coordinate societal resources and human talent to absorb, assimilate, assemble, and apply external knowledge via the open innovation paradigm. The requisite human capital and institutions are simply missing. Although ‘[t]he UAE institutional context is highly conducive to attracting and acquiring external knowledge, as well as for the transfer and circulation of knowledge among foreign firms and their workers,’ (Ewers, 2013, p. 135) this appearance of a seemingly sophisticated and progressive system is misleading: the institutional status quo is absolutely inadequate for innovation-driven development. There is ‘a lack of ability to absorb, adapt and create new technology and knowledge.’ (Abdalla Alfaki and Ahmed, 2013, p. 11)

IPR transaction costs (e.g., licensing) dramatically and proportionally decrease as capacity and capability increase with respect to human capital and institutional infrastructure. This principle is not inconsistent with the theory propounded by Nobel laureate economist Ronald Coase (1990), that is, if transaction costs are zero and property rights are well defined, the parties to a transaction can bargain to an efficient result regardless of which party holds said rights. The decrease in perceived risk to the transaction via capable, confident, consistent acumen in IP management and tech-transfer is a key facilitating ingredient, effecting success or failure of tech-transfer in the global open innovation marketplace. The same is also alluded to by Baldia (2013, p. 24): ‘If the licensor foregoes entering the transaction at all in light of high transaction costs, both parties and the market in which they were to collaborate suffer lost opportunity costs. In either scenario, the licensor has engaged in sub-optimal commercial activity because the outcome in each case is economically inefficient.’ In the context of the foregoing, it is arguably prudent that the UAE shall not ignore or delay serious strategic and sustainable capacity building lest it be left behind, whilst other countries leapfrog over it into the dynamic, innovation-driven economy of the new century.

A. The UAE and Knowledge-Based, Innovation-Driven Development: A Nation of Expatriates and Welfare

As with many the other hydrocarbon-based economies of the GCC, the easiest (and perhaps safest) path to “development” has been via leveraging the copious flow of wealth towards foreign, i.e., expat professionals, be they human or, as is the case with MIT and Masdar, institutional. However, whether seemingly altruistic or not, it is crucial to never forget that the ranks of expats are disproportionately populated by single-minded mercenaries, who seek partnerships for a pecuniary purpose, an unsustainable proposition. (The Economist, 2016e)

[M]uch of the knowledge-based expertise in the Gulf has been imported from abroad as a way to “leapfrog” the development cycle. This system of importing knowledge-based expertise does not contribute to the sustainable shift toward a knowledge economy in the Gulf, however. When a knowledge-based economy is built upon a foundation of foreign or transitional labour and expertise, sustainable change cannot occur. Broadly speaking, Gulf national capacity has not been simultaneously or equitably developed to sustain the knowledge base without reliance on foreign expertise. (Wiseman, Alromi and Alshumrani, 2014, pp. 4-5)

A move towards Emiratization of the UAE (Wiseman, Alromi and Alshumrani, 2014, p. 6), will necessitate far more than well-intentioned proclamations and ad-hoc programs dominated by mercenary expats. Thus, the UAE faces what can be perhaps best described as an expat dilemma.

The key and central issue the UAE faces is “whether a society can transfer to a knowledge economy when a large part of the highly skilled and motivated workers i.e. the knowledge workers, are in fact expats.” (Hvidt, 2015, pp. 44-45) For the UAE, the answer to this question must be in the affirmative. However, weaning off of the intoxicant of expat “help” will need to be systematic, strategic and sustainable.

The persistent presence of expats must therefore be systematically managed, incrementally matched and replaced by UAE talent, expertise, commitment and ultimately ownership. When the petrol runs out, the expat will as well: “[T]he higher the number of expat knowledge workers relative to national knowledge workers, the higher the risk to the national economies if all or a portion of the workers for some reason were inclined to leave the country. ... Thus the policy implication for the Gulf countries related to this issue must be ...[placing] an increased emphasis on educating their

own people to become knowledge workers.” (Hvidt, 2015, pp. 44-45) The UAE must begin to invest now in building the new, virtual, human capital and infrastructure, necessary for dynamic and rapid transition to a knowledge-based economy. All resources will necessarily need be utilized, particularly all available human talent, with an emphasis on the greatest underutilized resource in the UAE: women.

B. Empowering Women in the UAE: A New Model for a New Century

Underutilization (or even non-utilization) of valuable natural resource wealth is obviously not a good strategy for building economic power under any circumstances. Consider, for example, this hypothetical: a country which possesses vast oil fields, many of which, albeit clearly known, remain untapped due to ancient cultural restrictions imposed on the land under which they lie, e.g., association with superstitious legends and unauthenticated folklore. Outdated, obsolete concepts and paradigms obstruct realization of this vast resource, and the potential wealth that it embodies is thereby neglected and derelict. Likewise, if countries of the GCC truly aspire to accelerate development of innovation-drive economies managed by their citizenry, then they must fully utilize their most valuable human capital resource: women.

The bias that women should not assume dynamic leadership roles in the GCC countries must yield to the reality that knowledge-based economic systems, which are driven by IPRs, necessitate mobilization of all human resources. Furthermore, women in the GCC are increasingly demonstrating their extraordinary capability in intellectual prowess, albeit still chronically under represented as knowledge workers, much less leadership roles. “In one unexpected way, however, Arab institutions are making rapid progress. Women now outnumber men in half of the top 15 Arab universities. Even in Saudi Arabia, where women cannot drive and must have permission from a male guardian to travel, women’s faculties are being added to what were all-male institutions. King Abdulaziz’s student body has 57 female students for every 43 males. Sadly, female graduates are not going into the workforce in the same numbers as their male peers.” (Economist, 2016a)

Ironically, in the UAE, the vast underutilized resource of female human capital is juxtaposed against the prevailing presence of expat mercenaries, who have at best dubious devotion to the country’s future prosperity or even survival. The need to modernize the indigenous knowledge workforce is glaringly obvious: “[T]he share of women entering higher education and their further integration into the workforce has consistently increased over the past two decades and currently constitutes 65% of graduates in the UAE.

However, several challenges remain with regard to human capital. ... [D]espite an increasing trend, female participation in the workforce remains low, around 28%. The under-representation of women in the workforce is especially surprising when one considers that they are the majority in tertiary education. Moreover, girls perform better in school than boys. Reducing this gender gap is of concern, given that the integration of women in all fields is key to economic growth and to creating local capabilities for innovation.” (Aswad, Vidican and Samulewicz, 2011, p. 560)

This gross underutilization of human capital is juxtaposed against the role that women professionals have assumed in the fields of IP, innovation management and tech-transfer across the globe, throughout organizations and even other emerging and developing countries. In 2010, in the Philippines, “IPOP HL launched a project to establish Innovation and Technology Support Offices (ITSO) or ‘Patent Libraries’ within universities and higher education institutions. The objective was to strengthen local institutional capacity to access patent information for use in research, education, idea generation and general business development. At the same time, the ITSOs were envisioned to be the patent service providers in their local communities, conducting not only patent searches but also patent drafting, prosecution representation, advisory, training and over-all IP management.” (<http://info.ipophil.gov.ph/itso/>) Notably and exemplarily, it must be understood that over 40% of the ITSO managers are women. In the globally-networked organization AUTM (“the Association of University Technology Managers ... a non-profit organization dedicated to bringing research to life by supporting and enhancing the global academic technology transfer profession through education, professional development, partnering and advocacy”, <http://www.autm.net/>), the leadership role of women is impressive and commendable: Since the turn of the current century, the presence of women serving in leadership positions on the AUTM Board of Directors has averaged 37%. This further reinforces the fundamental proposition that women need be not only participants but leaders in advancing establishment of innovation ecosystems in developing and emerging economies across the globe, regardless of previous cultural traditions and societal bias; the stakes are too high, the need, too urgent to ignore this fundamental principle of development.

Yet, as with other related parameters, when compared to the other GCC countries, the UAE might hold greater promise for empowering women to assume leadership roles in building a globally networked, innovation-driven economy. For example, “[i]n the labour market females have also made impressive progress over the last 20 years, although participation remains low by global standards.” (EIU, 2014, p. 3) This is not necessarily a negative,

as women are a reserve knowledge labour force, ready, able and willing to assume a dynamic role in the nation's developmental diversification towards innovation and IP.

Notwithstanding the foregoing, in the UAE, full engagement of women in a knowledge-based economy workforce is still far from a fait accompli. Challenges persist: "Females face an array of obstacles in the workplace, including managing a work-life balance; cultural obstacles, such as society seeing women as family caretakers rather than engineers or scientists; a dearth of role models and mentors; and gender discrimination. More proactive measures from both the public and the private sector are needed to tackle these obstacles. ... [However] if the female labour participation rate reaches the same level as that for men, GDP could benefit by as much as 12%." (EIU, 2014, p. 4) This challenge is exacerbated by the negative impact of petrol wealth: "the vast oil incomes have dulled the aspirations and incentives for the younger generation of Gulf Arabs to actively pursue education at all levels: primary, secondary and tertiary. This seems to be especially true for boys, who are significantly under represented in the university system by a ratio of 3 to 1." (Hvidt, 2015, pp. 37-40)

Furthermore, as Ross made clear, "Oil not only hinders democracy; it also hinders more equitable gender relations." (Ross, 2008, pp. 15) To take this concept one step further, in addition to, and likely complicit with, long-standing and deeply rooted cultural norms and practices (e.g., "Bedouin biases" and not Islam per se, Al-Nasr, 2009), the resource curse has also negatively impacted effective economic participation of women in the GCC petrol-rentier economies. This development challenge must be overcome in order to transition to the full utilization of the most valuable, albeit heart-breakingly underutilized, capital asset of this century :women.

IV. THE UAE: INTELLECTUAL PROPERTY LAWS, PATENT DATA AND INNOVATION INFRASTRUCTURE GAPS

In a post-TRIPS world, the UAE, as with nearly all developing, emerging and transitioning economies, is, at least on paper, IP compliant and presumably a beneficiary of the global system. (Birnhack and Khoury, 2016) However, closer analysis suggests that much still needs to be done to fully realize the true value of IP and its role in accelerating innovation-driven, knowledge-based development. In other words, the tools are available, but few know how to appropriately, effectively and strategically make use of them.

A sampling of pertinent laws and treaties illustrates that the IP law toolbox is indeed well stocked in the UAE, (<http://www.wipo.int/wipolex/en/profile.jsp?code=AE>):

UAE IP Treaties:

- Berne Convention for the Protection of Literary and Artistic Works (July 14, 2004)
- WIPO Copyright Treaty (July 14, 2004)
- Patent Cooperation Treaty (March 10, 1999)
- Paris Convention for the Protection of Industrial Property (September 19, 1996)
- World Trade Organization (WTO) - Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) (April 10, 1996)
- Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity (December 11, 2014)

UAE IP Domestic Laws:

- Federal Law No. 37 of 1992 on Trademarks (as amended by Law No. 19 of 2000 and Law No. 8 of 2002) (1992)
- Federal Law No. 40 of 1992 on the Protection of Intellectual Works and Copyright (1992)
- Federal Law No. 31 for the Year 2006 Pertaining to the Industrial Regulation and Protection of Patents, Industrial Drawings, and Designs (2002)
- Federal Law No. 7 of the Year 2002 Concerning Copyrights and Neighboring Rights (2002)

Establishment of appropriate laws and regulation, albeit absolutely essential, only represents an initial step in the establishment of an innovation-driven economy. As previously noted: “As the UAE evolves in its innovation journey, it will need to build a robust and enforceable intellectual property rights system. Recently, the government has reviewed its laws on intellectual property and copyright and harmonized them with international standards (e.g., the US Patent Office and Patent Cooperation Treaty).” (Byat and Sultan, 2014, pp. 107-109) IP law as one, albeit essential, component of a high-functioning innovation ecosystem, does not exist in a vacuum; it

is part of a much larger, interconnected, dynamic and global innovation/business ecosystem.(Birnhack and Khoury, 2016)

A robust IP right system is like a complex machine with many moving parts, e.g., “gears”, which interconnect to drive development. The efficient and strategic use and management of IP fuels this system. Therefore, laws must be viewed and developed whilst remaining constantly cognizant of context:

[I]t is important for the drafters of IP laws in developing countries to increase their understanding as to how IP can affect their economies and how to connect it with the economic realities of their countries. While IP may bring Foreign Direct Investment (FDI), technology transfer, domestic innovation, and Research and Development (RD) to developing countries, economic development will not occur simply through the introduction of IP laws. Policy makers in developing countries need to consider broader development initiatives in the structuring of their IP system. To this end, every provision that is introduced into the IP law should be studied and examined as a part of the *broader development plan* for the country. (Olwan and Fitzgerald, 2012, p. 88, emphasis added)

This is, of course, assuming there even is a “plan”. One measure of how well the “IP system” is functioning, i.e., where the country might be in terms of knowledge-based development, is patent information-data analysis.

Whereas patent data should not be relied on, and indeed can even be beguilingly deceptive, as a primary metric for innovation (McGregor, 2007; Nagaoka, Motohashi and Goto, 2010; Steen, 2010), they are nevertheless at least indirectly indicative of where a country is in terms of its IP and development status, or lack thereof. They may, therefore, be informative on a case-by-case basis; cautious interpretation might thereby provide insight into the innovative situation in a country. In the case of the UAE, patent data qualifiedly appears to be useful, with judicious analysis, as one proxy measure for the level of innovation in the country and also indirectly to approximate whether the innovation in the UAE is indigenous or foreign. Tables 1 to 3 provide patenting statistics which support the proposition that neither is the UAE innovative nor is the IP regime in the country supportive of domestic innovation. Instead, it primarily benefits foreign owners of IPRs (i.e., patents).

Table 1 UAE Patent Applications

Year	Resident	Non-Resident	Abroad
2001	1		9
2002	3		28
2003	5		50
2004	2		51
2005	7		64
2006	4		99
2007	4		101
2008			77
2009	3		101
2010	3		136
2011	26	1,325	197
2012	26	1,331	246
2013	30	1,408	386
2014	49	1,443	343
2015	15	1,738	349

A resident filing refers to an application filed in the country by its own resident; whereas a non-resident filing refers to the one filed by a foreign applicant. An abroad filing refers to an application filed by this country's resident at a foreign office. Blank cells indicate absence of data (e.g., missing/incomplete/not-reported).

Source: http://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=AE

Patent application filings in the UAE has been dominated by foreign (non-resident) entities (Table 1). Albeit recently, since 2011, there has been a, somewhat tepid, increase in UAE national (resident) filings, it is still a mere dribble in comparison to the foreign entity filings, i.e., cumulatively at only 2 per cent. However, the number of patent applications filed abroad by UAE nationals has increased significantly since 2001, suggesting that UAE nationals are absolutely capable of creativity and inventiveness when working within actualized and functionally robust innovation ecosystems. This is a key point, that IP flourishes in dynamic innovation ecosystems and talent will move to such locales: the globalization of this phenomenon is ignored at one's peril, i.e., the global innovation juggernaut is increasing in intensity regardless of where countries aspire to be.

Table 2 UAE Patent Grants

Year	Resident	Non-Resident	Abroad
2001			
2002			
2003			12
2004			5
2005			3
2006			16
2007			35
2008			35
2009			23
2010			28
2011	2	98	35
2012	1	39	50
2013	1	62	68
2014	3	110	121
2015		177	94

A resident filing refers to an application filed in the country by its own resident; whereas a non-resident filing refers to the one filed by a foreign applicant. An abroad filing refers to an application filed by this country's resident at a foreign office. Blank cells indicate absence of data (e.g., missing/incomplete/not-reported).

Source: http://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=AE

Although less, possibly due to prosecution status, patent grants fundamentally parallel patent application filings in the UAE (Table 2). Similarly, and not surprisingly, foreign (non-resident) entities dominate, with significant UAE expat (UAE residents abroad) displaying substantial evidence of inventive behaviour that apparently is not fully realized and actualized in their home country.

Table 3 UAE Patent Documents Top Applicants

Applicant Name	Applicant Country and Product/Service	Number of Patent Documents
Qualcomm Incorporated	USA, Semiconductor and telecommunications	55
Halliburton Energy Services, Inc.	USA, Products and services to the energy industry	44
Welltec A/S	Denmark, Well intervention solutions and completion products for the oil and gas industry	38
Borealis AG	Austria, Producer of polyethylene and polypropylene	30
Raytheon Company	USA, Weapons and military and commercial electronics	25
Novartis AG	Switzerland, Multinational pharmaceutical	24
Gojo Industries, Inc.	USA, Health and hygiene products	19
Sicpa Holding SA	Switzerland, Identification, traceability and authentication solutions and services	16
BASF SE	Germany, Chemicals	16
Schlumberger Canada Limited	Canada, Oil and natural gas	15

Source WIPO Patent scope UAE National Collection
<https://patentscope.wipo.int/> (2,947 Records)

That foreign entities dominate patent activity in the UAE is clearly illustrated (Table 3), with the predominant patentees' nationalities being American, Canadian, Austrian, Dutch, German and Swiss; not surprisingly, technology sectors include petrol and chemical industries and military industrial sectors. To further corroborate this data (Tables 1, 2, 3), analysis of patent information culled from Thomson Innovation® (the leading IP, intelligence and collaboration platform for patent data and informatics) estimates that, since 2001, total (priority) patent family filings in the UAE jurisdiction are only 120 (analyzing 111 INPADOC and 130 DWPI families, from a total of 292 patent document records identified). This provides additional support for the proposition that the majority of patents in the UAE is

flowing into the country, and not generated therein. Interestingly consistent with said trends in patenting in the UAE, trademark registration appears to follow the foreign ownership pattern: “[T]he volume of mark registrations in the UAE by non-residents far exceeds the number of marks registered by UAE residents in their country. For example, according to WIPO, in 2013, 18,747 marks have been registered. Of these only 5,293 are owned by UAE residents (28.2%), while the majority of these marks (13,454 marks, which are 71.7%) are owned by non-residents.” (Birnhack and Khoury, 2016, pp. 32)

Furthermore, this data is consistent with observations of previous commentators: utility patents obtained by the UAE between 2009 and 2013 are only 120 (Hvidt, 2015, p. 32); several years ago, the number of patents originating from the UAE (including Dubai) registered with the USPTO were only 136, with 186 pending patent applications originating in the UAE (Khoury, 2009, pp. 105-107). On a per capita basis, relative to countries with roughly comparable GDP per capita, utility patents (2011-2012) per million populations, (at 1.5) compared to Korea (at 241) and Singapore, (at 126) seems alarmingly low. (Ahmed and Abdalla Alfaki, 2013, p. 98) Notwithstanding this, it is somewhat encouraging to note that over a period of five years the number of registered UAE patents nearly doubled, with the UAE now generating the highest number of patents per capita in the GCC region. (Mahroum, Alsaleh and Kanhere, 2013, p. 24)

Nevertheless, the patent data strongly suggest a more deeply rooted, systemic problem: “The fact that currently over 225,000 patents are granted yearly across the world provides proof that knowledge and information is being mass-produced today. The weak performance of the [GCC] in both research and in the actual number of patents granted is a testimony to the low levels of funding for research over the years and to the resulting weakly developed research infrastructure in the region.” (Hvidt, 2015, pp. 44-45) Patent data are an imperfect metric for innovation, yet when considered in the larger context of the UAE’s current lamentable status as an aspiring knowledge-based economy one reasonable conclusion is that “it is imperative to invest more in the human factor that will, in time, also contribute to the creation of patentable inventions in various areas.” (Khoury, 2009, pp. 105-107) In other words, an innovation ecosystem in the UAE will be the fertile ground from which patents sprout.

Analysis of these patent data indicate that IPRs, e.g., patents, in the UAE primarily benefit non-UAE external interests and are not indicative of any significant development of the UAE towards becoming an innovation-driven economy. This further reinforces the argument that an ad-hoc,

expat/consultancy approach is neither strategically sound nor sustainable: “The insignificant relationship between IPRs and economic growth in the case of GCC countries might be related to the fact that GCC countries are ‘rentier states’ in which IPRs per se are not sufficient to ensure technological progress and innovations. The results suggest that for IPRs to promote innovations and economic growth, a coherent set of complementary policies are required, and that the governments of the GCC countries need to play a positive role in inducing technology acquisition and creation [i.e., the open/symbiotic innovation system].” (Al-Mawali, 2015, p. 245) Pessimistically, commentators have even suggested that it will take 20 years for the UAE to realize its aspirational goals towards becoming a knowledge economy. Aspirations appear to be inversely related to current reality, and patent data supports this proposition. “It is clear that the UAE had not achieved a stage of being a leader, particularly in the most critical indicators for knowledge based development: journal articles per capita, patents per capita, and high technology % of manufactured exports. For instance, in terms of both journal articles and patents per capita, the UAE is quite far from achieving this level at least in the following 15-20 years [that is, an estimated 2 decades required for catch-up].” (Parcero and Ryan, 2016, p. 17)

The innovation shortfall appears to be endemic to the region, e.g. the GCC and its neighbours. This is somewhat perplexing in that “Arab countries produce 5.9% of the world’s GDP, but the region’s governments account for less than 1% of total global R&D spending, according to UNESCO. Bahrain spends just 0.04% of GDP; Egypt spends 0.7% (see chart). By contrast India spends about 0.8% and Britain 1.6%. ... [UAE only 0.5%].” (Economist, 2016c) In addition, “[t]he bigger deficit ... is that private companies barely spend on R&D ... in much of the Arab world the private sector’s contribution is less than 5%.” (Economist, 2016c) This strongly suggests that in the Arab world, and the GCC countries in particular, contribution to the generation of new knowledge has been insignificant: “The UNESCO World Science Report of 1998 reported on four indicative performance areas as follows: Expenditure on Research and Development, Scientific Publications, European Patents and US Patents. At that time, in all of the key indicative areas, the Arab world, with a combined population of approaching 300 million, was making a contribution less than that of sub-Saharan Africa.” (Light foot, 2014, p. 90)

Therefore, “[W]ays should be worked out to ensure better use of networks for international sourcing of knowledge broadly in the economy. Competencies attracted from abroad should be encouraged to ‘take root’ locally. Improved conditions for seed and venture capital funding, enhanced

interconnecting roles of universities, science parks and incubators, and improved conditions for technology based entrepreneurship, are needed. Measures should also be deployed to spur the rise of a community of professional private service providers, that can help underpin and boost the capability of both larger firms and Small and Medium-Sized Enterprises (SMEs) ...” (IKED, 2010, p.10) However, what are the “ways” to move forward? This article will strive to address that key question with a 10-point strategic action plan.

A. Policies, Initiatives and Investments for IP/ Innovation Development in the UAE: Towards a Triple Helix System

Current policies, initiatives and investments seem to be made in the UAE to catalyze accelerated development of an innovation-driven economy ... to move beyond petrol to patents. However, these largely appear to be ad-hoc, poorly strategized, expat/consultant dominated approaches. What is missing is a systematic indigenous capacity building effort towards establishment of a functional and sustainable triple helix. But what is this “triple helix”? As elucidated (Ranga and Etzkowitz, 2013):

Triple Helix systems [is] an analytical construct that synthesizes the key features of university–industry–government (Triple Helix) interactions into an ‘innovation system’ format, defined according to systems theory as a set of components, relationships and functions. ... The relationships between components are synthesized into five main types: technology transfer; collaboration and conflict moderation; collaborative leadership; substitution; and networking. The overall function of Triple Helix systems – knowledge and innovation generation, diffusion and use – is realized through a set of activities in the knowledge, innovation and consensus spaces.

In other words, the triple helix concept is the triadic combination of university-industry-government which becomes the source of innovation and economic development in a knowledge society. (El-Khasawneh and Pech, p. 499)

The ultimate goal of establishing the triple helix in the UAE is to drive sustainable and dynamic network synergy. “This includes entrepreneurs, government entities, educational institutions, funds, the media, entrepreneurial organizations, and others. Unlocking innovation requires getting these disparate parties with distinct agendas to work together to drive the same objective.” (Byat and Sultan, 2014, pp. 107-109) An essential step towards

change is increasing collaboration between academia and industry, which requires a broad approach to develop networks and linkages. Such academic-industry collaborations will positively impact the level of innovation in the UAE. (Pervan, Al-Ansaari and Xu, 2015, p. 3) Academic-industry collaborations further benefit the private sector by establishing “close ties with academic institutions, both physically and intellectually, to maintain ongoing relationships, gaining benefits of talent recruitment, technology-transfer, research and development capability and innovation stimulation.” (Pervan, Al-Ansaari and Xu, 2015, p. 3)

For the UAE, an innovation ecosystem will need to be composed of a dynamic system of organizations that can assimilate, adapt and create knowledge, with an educated population that can both create knowledge and use it effectively. Within the context of the triple helix concept, “a good innovation system consists of an interconnected array of universities, research centers, firms, consultants, and other organizations that create, assimilate, and adapt knowledge,” (Parcero and Ryan, 2016, p. 11) wherein the government must provide incentives for the creation, dissemination and use of existing knowledge, (i.e., the open innovation paradigm as more thoroughly discussed below). (Parcero and Ryan, 2016, p. 5) Sadly, as articulated by Parcero and Ryan, “the indicator S&E journal articles per capita shows a very low performance for the UAE This is a result of the fact that until recently the universities focused on teaching and were behind in terms of research.” (Parcero and Ryan, 2016, p. 11) Furthermore, “for ... [university-company research collaboration, i.e., public private partnerships] ... the UAE fall[s] short of what one would expect.” (Parcero and Ryan, 2016, p. 12) This further corroborates that the UAE has very poor performance in innovation. Indeed, the triple helix is still in early development phase. IP protection is not the same as IP creation which is not the same as IP management/transactions.

The dynamic, interconnected and mutual complementarity of the university–industry–government interactions is what drives the ongoing development of the innovation ecosystem; it is a synergistic symbiosis of investment, knowledge, IP and innovation. However, it must be conceptualized, built and implemented according to the specific situation, needs and challenges facing the UAE, and not as an attempt to re-create Silicon Valley, Research Triangle (North Carolina) or Route 128 (Massachusetts).

In order to accomplish such a monumental task, to rapidly forge a strong triple helix, a set of fundamental components must be committed, including:

- strong supportive infrastructure that is capable of accessing the physical and financial capital to effectively create, transfer and commercialize knowledge,
- networks within an economy, linking the public and private sectors with government as well as other, national and supranational organizations,
- innovation policies both private sector-oriented (e.g. business support and advice, risk capital, loans and subsidies, etc.) and innovation system-oriented (e.g. network building and brokering through cluster development and other system-enhancing interventions),
- policies facilitating innovation-based development recognizing country specific conditions that influence the interactions between the various stakeholders in knowledge creation/value-creation activities, (Mahroum, Alsaleh and Kanhere, 2013, p. 5)

Currently, there are several initiatives in the UAE to foster development of an innovation ecosystem. These include the National Research Foundation (NRF), “founded in 2008 to help build a competitive knowledge economy in the UAE and be a key element in the UAE national innovation system.” As a “key element”, three components are central to the national innovation system: knowledge production, knowledge application, and knowledge diffusion. Launched in 2007, the Khalifa Fund “seeks to help develop local enterprises in Abu Dhabi, with a total capital investment of AED 2 billion,” to “create a new generation of Emirati entrepreneurs by instilling and enriching the culture of investment amongst young people, as well as supporting and developing small to medium-sized investment in the Emirate.” (El-Khasawneh and Pech, pp. 507-508) Furthermore, “Dubai has established the Emirates Institute for Advanced Science and Technology (EIAST). This institute aims to “enhance prosperity and support sustainable development by inspiring scientific innovation and fostering technological advancement.” (Khoury, 2009, pp. 105-107) As another example, “Takamul is an initiative launched by the Technology Development Committee (TDC), in the emirate of Abu Dhabi, to provide support for companies and individuals seeking to file patents. Through the Takamul Initiative, the government of Abu Dhabi aims to create awareness of IP rights and to provide legal and financial support for international patent filings.” (Mahroum, Alsaleh and Kanhere, 2013, p. 23) “In addition ... [t]he total number of patent applications underwritten by Takamul has now risen to 66, of which 33 were underwritten in 2013 alone.” (Byat and Sultan, 2014, pp. 107-109)

The business newspeak used to describe these various and sundry initiatives is mind-numbingly beguiling, possibly to inspire confidence that “progress” is occurring notwithstanding the thick fog of bureaucratic jargon? Yet, the list of “innovation initiatives” in the UAE only continues:

Khalifa University and Mubadala Aerospace are planning to establish an aerospace research and innovation centre Beyond driving R&D in universities, the UAE government is keen on establishing scientific hubs to address socioeconomic issues relevant to the region. For example, Techno Park was established as a science and technology park whose scientific activities are managed by the Dubai Institute of Technology (DIT). DIT is focused on enhancing research in five sectors: water, health, energy, engineering, and logistics and mobility. The International Center for Biosaline Agriculture is another example of an R&D centre focused on innovation specific to regional issues, ... [aspiring] to deliver agricultural and water scarcity solutions in marginal environments. (Byat and Sultan, 2014, p. 107)

Ambitious plans, aspirational proclamations and leapfrogging “logic” aside, all of this appears to ignore the grueling reality of pragmatic indigenous capacity building. Respected commentators have (indirectly and politely) intimated the makeshift nature of such initiatives, e.g.: “[W]here the UAE still has room for improvement is in its ability to create new knowledge and, to a lesser extent, in its ability to commercially exploit innovations. Aware of the need for further improvement along these two dimensions, the government has launched several initiatives to support entrepreneurs and build the environment required to encourage start-ups ... R&D and innovation.” (Mahroum, Alsaleh and Kanhere, 2013, p. 4) Where is the coherent, coordinated, clearly articulated national plan to accelerate development of an innovation ecosystem in the UAE? Perhaps, if enough mud is flung at a wall, some will eventually stick? All of this is, albeit highly aspirational, replete with current operational jargon and optimistically “visionary”, lacking in strategy and tactical steps towards implementation. Revealingly, “Although at the present time there are no direct policies that address innovation, there are certain initiatives that foster the development of entrepreneurial innovation and activity. For instance, the Masdar Institute Science and Technology, announced that the Institute plans to launch the Center for Innovation Systems and Entrepreneurship (CISE). The CISE is a new initiative to further develop and spread entrepreneurial *spirit among youth* in the UAE.” (Erogul and Horne, 2014, p. 203, emphasis added) Whereas important in terms of attitude, “spirit” alone is not enough. Highly aspirational, yet sorely lacking strategically, how might this apply to the development of a

tech-transfer system? Does CISE imply a nascent innovation ecosystem? For example, how does it contribute to the development of a triple helix system in the UAE? Who will make use of BP in IP management and tech-transfer? And just what should BP entail for the UAE? Initiatives ostensibly poised to address these questions include: “Dubai Internet City, Dubai Technology Park and Dubai Silicon Oasis, Khalifa University for Science, Technology and Research and Masdar Institute in collaboration with MIT in the United Arab Emirates”. (Tadros, 2015, p. 5) Perhaps the Masdar Institute program can provide greater guidance in this regard?

As reported in 2013, Masdar Institute (a private academic research institute) had entered into a collaboration with MIT, sharing R&D interests focusing on alternative energy and sustainability, in advanced technologies, and innovation and entrepreneurship, all of which represent increasingly critical global innovation sectors and skills. Masdar had been envisioned as a bridge between industrial and academic interests in the UAE, i.e., as a sort of proto triple helix platform. In order to accelerate establishment of a robust innovation ecosystem in the UAE, the Institute Center for Innovation and Entrepreneurship (iInnovation) was created. This “center forms the final piece of the Middle East’s first large-scale industry-academia research collaboration, and is the fifth Masdar Institute center (iCenter). It is charged with channeling the University’s research into innovative commercial products and services by facilitating the formation of new startups.”(MIT, 2013)

The MIT – Masdar Institute collaboration focuses on several key research project areas, in the broad categories of clean and renewable energy, water purification, and next-generation crucial infrastructure “smart” technologies, including:

- low-cost water-monitoring device for sensing blooms of potentially toxic algae,
- waste-water filtration and treatment system,
- high-efficiency membrane-based approach to desalination,
- energy-efficient transmitter for wireless communication,
- water desalinating technology, and
- solar energy. (Stuart, 2015)

From the Masdar Institute website (<https://www.masdar.ac.ae/research/research-centers/icenters-research/cise>) one can learn more about the ambitious agenda that has been set: iInnovation facilitates innovation and

entrepreneurship activity at Masdar Institute and throughout the UAE, to accelerate technology-based innovation and entrepreneurship by:

- Adapting BP from world-class innovation hubs to meet requirements in Masdar Institute and the UAE;
- Supporting the translation of technology research into innovative commercial products, services and processes; and
- Working with stakeholders to improve the innovation ecosystem in the UAE.

Research theme areas are:

- Translation of university research into commercially viable products, services and processes that provide the foundation for startup companies
- Technology-based entrepreneurship in the UAE and abroad
- Innovation policy.

Additionally, from the Masdar Institute website (<https://www.masdar.ac.ae/research/office-of-vice-president-for-research/technology-transfer-office>):

Tech-transfer Office (TTO)

The TTO is responsible for managing the Institute's IP and promoting the effective commercialization of Masdar Institute's research. To achieve this, the TTO manages the patenting and licensing of faculty and student inventions, provides training on IP and advises on IP terms of sponsored research and other agreements with external parties. The office assists with developing and managing the Institute's IP policy and works with the Masdar Institute Intellectual Property Committee to engage the Institute community in building a strong IP infrastructure. TTO contact: James Petell (Director of TTO)

One might envision iInnovation (replete with the Masdar Institute TTO) as a tech-transfer office/center/hub. Based on this, what might go wrong? Five possibilities immediately present themselves:

- 1) There is most likely an over-reliance on expat experts, whether MIT consultants or MIT itself as an entity. It is crucial for the UAE to remember that petrol dollars attract "help" of this kind. The UAE must wean itself off the expat addiction (and consequential learned helplessness) and become strongly self-reliant.

- 2) Basic R&D should not be the emphasis; rather, accessing, absorbing and adapting existing innovation via an open innovation strategy, e.g., driven by BP in IP management and tech-transfer including collaborative R&D, in-licensing, cross-licensing and other IP assembly mechanisms.
- 3) Following from number 2, the linear, MIT model of R&D, i.e., disclose, invent, patent, license, revenue (and then repeat, repeat, repeat) is not appropriate for the UAE. Open innovation is the UAE's best strategic option for development. The UAE is currently innovation impoverished, and must build a solid foundation in order to rapidly develop a sustainable innovation ecosystem.
- 4) There is a general lack of indigenous UAE capacity building in terms of IP management and tech-transfer capabilities (over reliance on expats). UAE men, and importantly women, must become the leaders ... indeed trailblazers, of the UAE knowledge-based economy.
- 5) The UAE must not fall into the MIT or Silicon Valley want-to-be delusional trap. It cannot be or have a Silicon Valley or MIT. It needs an appropriate and realistic capacity building strategy.

Whereas the MIT – Masdar Institute collaboration has ostensibly admirable intentions, solid financial backing and prudently chosen technological sectors, it is also plagued with ongoing limitations which also, ironically, account for its initial successes. The policy which forms the foundation of the collaboration is not inconsistent with the formation of a proto-triple helix in the UAE, and as such is commendable and strongly indicates that this initial, and “initial” must be stressed, step has been worthwhile; that is, “advancing the interconnecting roles of universities, science parks and incubators, while taking steps to spur a community of professional private service providers that can help underpin and boost the capability of both larger firms and SMEs in a spectrum of areas, including with regard to funding, marketing, handling IPRs, using ICT innovatively, etc. Important new initiatives such as those associated with Masdar and renewable energy, are important in this context but need to be paralleled by more such efforts.”(IKED, 2010, pp. 144-145)

Still, numerous limitations and developmental gaps prevail. For example, as late as 2011, the UAE did not “have a technology transfer office, a science park or a spin-off incubator.”(Al-Saleh and Vidican, 2011, p. 26) And as further noted by Al-Saleh and Vidican, “there is still the potential to do more in terms of fostering networks of collaboration between the relevant government agencies, industry and academia.” Therefore, what appears to be

happening in the UAE, i.e., the appearance of rapidly becoming an innovative GCC country, must be viewed with extreme caution, as appearance can be, as stated above, beguilingly deceptive. Aspiration does not equal innovation: “... [T]he UAE is in the top tier of 23 innovation-driven economies. This high ranking in innovation is due to the Government’s heavy investment in the development of infrastructure. Currently, the UAE Government is seeking increased collaboration between the private and public sector as well as industry and academic partnerships in research and development, recognition of top quality innovative and entrepreneurial talent, and the leveraging of technology and education, as the UAE aspires to become a more innovative economy.” (Erogul and Horne, 2014, p. 203) However, the UAE government does not appear to prioritize building its own institutional infrastructure with its own human capital, i.e., a UAE-driven research, innovation, IP enterprise and appears to instead focus on reinforced concrete, glass, money and expat expertise.

B. Appropriate Development Paradigms and Strategies: Open Innovation as Applied to UAE

In order for the UAE to rapidly progress towards becoming a sustainable knowledge-based, innovation driven economy, a paradigmatic shift is necessary: a sophisticated strategy that acknowledges the necessity of serious investment in indigenous human capital and institutional infrastructure. In addition, such a strategy necessarily must recognize the inherent limitations and preliminary tentativeness of current initiatives, such as the Masdar/MIT collaboration, over-reliance on expat expertise and attempts to transplant successful innovation ecosystem models into the nascent UAE innovation environment. In this regard, a future sustainable system of BP will be appropriate in order to relentlessly accelerate development of a UAE-centered innovation, IP, tech-transfer system. To be blunt, if the petrol money disappears, in all likelihood so will the helpful expats, whether they are humanoid or institutional in nature. Therefore, appreciation of the rapidly evolving global innovation system and the dynamics of effectively and efficiently navigating, mastering and succeeding in this increasing complex market are essential.

A realistic appraisal of establishing an innovation system with an appropriate system of BP in IP management and tech-transfer must start with fundamental assumptions:

“[F]ive pillars of innovation capability are ... key capabilities that make innovation systems function effectively: accessing, anchoring, diffusing,

creating and exploiting knowledge. The capacity to execute these five functions is the key factor that varies across countries.

1. **Accessing:** The ability to connect and link to international networks of knowledge and innovation.
2. **Anchoring:** The ability to identify and domesticate external knowledge sources e.g. people, institutions and firms.
3. **Diffusion:** The collective ability of a place to adapt and assimilate new innovations, practices and technologies and spread them in the economy.
4. **Creation:** The ability to generate new knowledge. There is a general perception of a strong and direct link between knowledge creation and value creation.
5. **Exploitation:** The ability to mobilise and exploit new knowledge for social and commercial purposes. Without this, economies cannot benefit from new knowledge and innovation produced locally/internationally.”(Mahroum, Alsaleh and Kanhere, 2013, p. 15).

Innovation must therefore be viewed and conceptualized as a system, a global ecosystem that is integrated and networked to achieve optimal efficiency. As a key driver of this system, IPRs and BP are the indispensable facilitators that enable strategic planning and tactical implementation for R&D, tech-transfer, and commercialization. The UAE is at an early embryonic stage of being truly innovative, and can be even thought of, not disparagingly, as innovation impoverished. A system of BP in IP management and tech-transfer will therefore need to be devised which maximizes the five pillars of innovation capability within the context of the open innovation paradigm.

C. Open Innovation, IP and Development

Open innovation has become a highly refined concept in innovation theory and practice, from the early definition towards a greater holistic paradigm that embraces development and IP. “The open innovation concept is defined as ‘the use of purposive inflows [inside] and outflows [outside] of knowledge to accelerate internal innovation and to expand the markets for external use of innovation’”. (Pervan, Al-Ansaari and Xu, 2015, p. 2, quoting Chesbrough, 2003). “As knowledge becomes widely dispersed and multi-disciplinary, innovation becomes increasingly open, competitive, co-operative, globalized Indeed, innovation in the 21st century is a highly interactive, multi-disciplinary process that involves cooperation among a growing and

diverse network of organizations and individuals across national borders. Such a partnering model is referred to as ‘networked’ or ‘open’ innovation.” (Baldia, 2013, pp. 14-15)

The dynamic interaction between open innovation and IP has been elucidated by Baldia: “Intellectual property is a key strategic driver of competitive advantage in today’s global marketplace. Intellectual property is also the linchpin of the evolving open innovation paradigm. Both globalization and open innovation are profoundly advancing the strategic role and value of intellectual property ...” (Baldia, 2013, p. 3) As Baldia further states, this is a global trend that will continue, unabated in the current century: “The evolving innovation landscape ... is increasingly open, collaborative, and global in nature.” (Baldia, 2013, pp. 5-6) According to Baldia, the current international system of IP transactions is inadequate to realize the full potential of the open innovation paradigm towards accelerating establishment of robust innovation ecosystems in the developing countries: The challenge is “lowering transaction costs and increasing transactional efficiency in cross-border IP exchange transactions.” (Baldia, 2013, pp. 5) Appropriate capacity building in human capital and institutional infrastructure replete with a correct application of BP is therefore urgently required in the UAE in order to foster sustainable and efficient IP/innovation transactions which reach deep into the global market. Ergo, the linear model of tech-transfer espoused by mature developed country organizations, e.g., MIT, is not applicable to the developmental realities of the UAE; instead a dynamic open innovation paradigm is apposite. To illustrate plainly: maple trees from Boston cannot be transplanted into the sands of the Al Khatim.

A refinement of the concept is symbiotic innovation. Open innovation is a fluid system. Symbiotic innovation, however, strategically applies open innovation. Such an approach is specifically and urgently necessary for emerging economies, e.g., the UAE, to leapfrog from commodity-based economies to truly knowledge-based, innovation-driven development. Whereas open innovation is serendipitous, symbiotic innovation is strategic:

Open Innovation focuses on... the inflow of external ideas and the outflow of innovations to market via new channels ... Symbiotic innovation recognizes that organizations should look at factors related to spin-in and spin-out at the same time ... [beyond merely] ‘open,’ [i.e., to] evaluate and leverage [their] innovations as something that may help identify and bring value to an external player that also has a technology or capability [needed or required]. Many times this leads to joint development of a new innovation. Technology push and pull are interdependent, collaborative activities that inform each other and

make each other more successful in the symbiotic approach. (Fuentek, 2015)

The role of the UAE government must be to clearly articulate and establish policy and strategy that then can be implemented via tactics which are sensible in the context of the global open (symbiotic) innovation market. Otherwise, ill-conceived, albeit high level, policy articulations remain divorced from the unforgiving reality of this century, essentially existing in a fictional world of make-believe and bureaucratic fantasy (Let's become just like MIT!). "The role of government is necessary to establish policies and incentives to improve its capacity to promote national advantage and technology development that enables firms to develop innovations and competitive advantages. ... That is to say, a policy alone to promote innovation, when there is a lack of synergy between industry players, may be inappropriate and likely to fail." (Pervan, Al-Ansaari and Xu, 2015, p. 2) An illustrative example of how this might be applied pragmatically is water.

Solving the country's water concerns through research is a prime example of how a knowledge economy should work: initial assessment and policy research carried out by Rand Qatar Policy Institute (RQPI) and the General Secretariat for Development and Planning identified the specific water challenges and suggested solutions. Money through QNRF [Qatar National Research Fund] was then made available for researching solutions. Partnerships were then formed with international companies: for example, Qatar Electricity and Water Company (QEWCo) has partnered with Japan's Water Reuse Promotion Center to develop reverse osmosis desalination methods that would greatly reduce energy consumption. (Weber, 2014, p. 65)

As one can construe from this, at the very least, the Qataris understand how to effectively and efficiently mobilize human capital, organize institutional resources and enter into international partnerships to strategically move critically essential technology, i.e., methodically pursue a symbiotic innovation strategy to accelerate access, absorption and adaptation of extant innovation with broad social and economic value. In other words, they appear to be already applying fundamental principles which the UAE should begin to seriously consider.

Perhaps it would be wise for the UAE to look to Qatar for guidance in this respect, i.e., to emulate the approach that Qatar has taken in its knowledge-based, innovation-driven development and concomitant capacity building efforts; in other words, "to increase the level of knowledge and entrepreneurship among their national populations, so that they can

successfully tap into foreign knowledge and adapt and create new knowledge for their countries' own specific needs.” (Hvidt, 2015, p. 25) As the IKED Report suggests, the UAE, e.g., Abu Dhabi, has lagged in this respect when compared with other Natural Resource Rich Economies around the world; although it performed well in knowledge anchoring, it was considerably weaker in knowledge access, diffusion, exploitation, and absorption. (IKED, 2010, p. 9)

Open/symbiotic innovation is the wave of the present and the tsunami of the future. The UAE's lack of appreciation of this, and apparent low level of understanding of the role of BP in IP management and tech-transfer for its development is hazardous. Strategic capacity building will be increasingly essential for sustainable development, for every country on earth, including and most importantly developing countries: “Previous research has focused on developed countries and their applications of open innovation to assist the flow of technology and information among key stakeholders and this concept is beginning to be explored in developing countries.”(Pervan, Al-Ansaari and Xu, 2015, p. 1)

D. SMEs and the Triple Helix: Central Role in Actualization in the UAE

For the open/symbiotic innovation model to be fully actualized and effectuated in the UAE, a full appreciation and involvement of small/medium enterprises (SMEs) must occur from the very start. Why is this so important, particularly in the case of the UAE? Astute commentators have observed that SMEs comprise a significant portion of the economic dynamism in the UAE, accounting “for 95% of the total enterprise population in Dubai and employ[ing] approximately 42% of Dubai's workforce.” (Hajjiri, Benallal, Ahmad, Ali and Paufique, 2014, p. 16) SMEs will indeed be integral, indispensable components of an enterprising entrepreneurial triple helix system in the UAE, as they represent the nuclear core of innovative energy in the UAE itself:

The capacity to continually innovate is central to the strategy of Dubai ... to position itself as a world hub in commerce and product and service development and it is particularly important as it looks to transition from economic growth based on hard (oil infrastructure) to soft (knowledge infrastructure) products and services. With more than 90% of firms in the Dubai manufacturing and service sectors are ... SMEs, it faces the challenge of encouraging innovation in firms that have traditionally been inward focused, competing fiercely but

locally, with limited innovation outcomes and contributions to the local economy. (Pervan, Al-Ansaari and Xu, 2015, p. 1)

The fundamental importance of SMEs to the triple helix system and the challenges inherent in maximizing their participation are obvious: “SMEs are crucial generators of employment and income, and champions of innovation and growth not only in the UAE but also globally. Despite their impact on and importance for the economy, SMEs are frequently confronted with market imperfections ...” (Hajjiri, Benallal, Ahmad, Ali and Paufigue, 2014, p. 9) In the context of this article, a “market imperfection” would be loss of opportunity via, e.g., tech-transfer transaction failure due to a general lack of an interconnected innovation ecosystem and a specific dearth of expertise in IP management and tech-transfer capability and capacity; in other words, innovation ecosystem failure. Hence, as Hajjiri et al. further state, “it is important to ensure that the UAE adopts supportive policies and legislative reforms in order to further develop the local economy ... providing employment, creating innovation and fostering competitiveness.” (Hajjiri, Benallal, Ahmad, Ali and Paufigue, 2014, p. 14) Once again we might ask ... yes, but how?

Although these commentators primarily address SMEs more broadly in the context of business, employment and finance, the same holds true for SMEs in IP and tech-transfer. This is particularly the case with SMEs in emerging and developing countries in the context of IP management and the open innovation paradigm. In this context, IP is both a tool and asset, used as a form of intangible collateral for finance and transactions. Therefore, among other IP management BP, IP valuation, protection and licensing will be critical for SMEs in emerging economies such as the UAE. This will, in turn, further foster the development of a knowledge-based economy by attracting investment, e.g., venture capital, building public-private partnerships, accessing advanced innovation for assessment, adaptation and development, protecting inventions that flow there from and building a globally recognized intangible asset base. The UAE, at the very cusp of this supremely important endeavour, must therefore make a strong commitment toward strategic and sustainable capacity building and global networking. (Kowalski, 2009)

To realize such a triple helix dynamo in the UAE, with SMEs as key participants (indeed the drivers), more needs to be accomplished. That SMEs are such critical components of the nascent knowledge-based, innovation ecosystem in the UAE is yet to be fully appreciated, particularly in the context of the open/symbiotic innovation paradigm:

[A]cademic-industry collaborations seem non-significant to SMEs and their innovation processes. ... SMEs through the open innovation model can look beyond their internal environment and limited resources for ideas, opportunities and partners. This weak effect suggests that SMEs in Dubai acknowledge the difficulties in accessing qualified manpower to act entrepreneurially and give impetus to the innovation processes. The difficulties arise because of the gaps between graduate capabilities (for example skilled and knowledge workers) at the local academic institutions and the competency requirements of various firms and industries in the market. To this may be added the mismatches between academic institutions outcomes and industrial needs and challenges, a lack of access to academic and research institutions, low participation in collaborative-research and technology transfer activities between academia and industry and the absence of entrepreneurial attitudes and skill development at the local academic institutions to encourage individuals with new ideas to start firms. (Pervan, Al-Ansaari and Xu, 2015, p. 65)

Pervan et al. state that there appears to be a dearth of “attitudes” and “skill” in the UAE. Basic education, although essential, alone will not suffice. “For instance, even though there are high levels of school enrollment and internet use in the GCC, there is also an overall lack in innovation indicators. This suggests that there are particular factors that are unique to the GCC that may be inhibiting the development of knowledge and innovative research and development.” (Wiseman, Alromi and Alshumrani, 2014, p. 20) Although the UAE appears to possess a solid education system and corresponding educated population, the cadre of educated ignoramuses it graduates are neither incentivized, properly capable nor possess the capacity to work in the fast-paced, competitive, information-driven, IP-infused global innovation market. The burden of petrol wealth weighs heavily, and must be lifted:

The notion of resource curse posits a negative relationship between productivity growth and resource richness, the routes through which the capital generated is reinvested, and an apparent lack of focus on innovation and entrepreneurship. This suggests a need for close collaboration with existing educational institutions to design programmes to encourage a proportion of students to start business ventures rather than seeking employment within often saturated public sectors ... promoting home-grown business. ... The challenge ... is to spread these capabilities wider especially to SMEs and the private sector. (Mahroum, Alsaleh and Kanhere, 2013, p. 54)

In the UAE, the realization of SMEs as dynamic components of a robust triple helix can and must be actualized. There are already a few examples, which guide the way and also highlight system deficiencies, suggesting remedies, i.e., strategic and sustainable capacity building, global networking and investments to accelerate the establishment of an appropriate system of BP in the UAE: “A rare example of an innovative SME, incorporating the results of several ‘made in the UAE’ patents is the floating villa based in Abu Dhabi. However, the lack of government research centres and universities with strong technology transfer systems impedes the growth of the firm and expansion into new markets ... and minimal linkages and partnerships that exist between universities in the UAE and private and public sector industries. This is understandable when the oldest university in the UAE is less than 40 years old. This clearly differentiates the UAE from the other innovation-driven economies and is a significant barrier to increasing the number of new and young businesses that are involved in the high/medium tech sector.” (Erogul and Horne, 2014, p. 195) The solution to this problem: rapidly establish a world-class triple helix system in the UAE that reaches beyond its borders and region, to every corner of the global innovation market.

V. STRATEGIC DEVELOPMENT OF A SYSTEM OF BEST PRACTICES IN IP MANAGEMENT AND TECH-TRANSFER FOR THE UAE

For the UAE to build a solid, sustainable and appropriate system of BP in IP management and tech-transfer, the key concept that must be stressed on is that this is fundamentally an issue of development. Ergo, establishing such BP is a task of significant magnitude. Furthermore, the UAE itself must own this initiative. It cannot be effectuated via ad-hoc, expat consultant-driven programs which invest primarily in expensive, impressive real estate in lieu of intangible, yet very real, paradigmatic and transformative societal capacity building. Establishing a true innovation ecosystem, an aspired to and lofty ambition, requires such mundane investment in people and institutions. Ignoring this subtle yet ubiquitous reality will not only lead to loss of wealth but more importantly, loss of opportunity: leapfrogging can go in either of two directions, forward into the new century, or (due to ongoing, e.g., bureaucratic discussions and attendant delays) backwards towards unpredictable scenarios. In addition, each year of delay is magnified by an ever widening gap between developed and developing economies, conservatively measured in the decades (several years of delay equivalent to being several decades further behind). (Economist, 2014)

Sadly, the prevailing trend that exemplifies “development” has become a trap that results in an opposite outcome, a serious problem as the GCC countries grapple with new realities: “The Kingdom of Bahrain is one example of a wider regional trend toward policy borrowing and the importation of foreign systems and practices in education.” (Kirk, 2014, p. 129) Aspiration and determination need to be reined in by realistic assessments and strategies: “[A] rapid rate of development and ambition must be tempered with caution, however, as Gulf leaders need to be careful not to go ‘too fast and too foreign’ in their quest for national development. Locally driven and contextualized models will be a better fit, and *drawing on international best practice and then making it work for the national and local setting will yield, over time, a more effective and sustainable education system.*” (Kirk, 2014, p. 143, emphasis added) Therefore, the Masdar/MIT “partnership” must be viewed with at least a small amount of healthy skepticism. The earnest drivers of knowledge-based development must be the key stakeholders in the process, i.e., the nationals of the country involved, in this case, the people of the UAE.

A. Best Practices in Intellectual Property and Intellectual Property Rights (IP/IPR) Management and Tech-transfer for the UAE

Albeit widely used, the term “best practices” is interpreted in many ways, based on where used, by whom and in what context. For the purpose of this article, we refer to Black’s Law Dictionary to initially understand “best practices” as operative legal language:

“best practice 1. An optimally efficient and effective mode of proceeding or performing a particular activity, esp. in business. 2. A description of such a mode of proceeding or performing prepared so that other people or companies may learn and follow it as a set of guidelines or rules.”(Garner and Black, 2014)

With this definition as a point of departure, an outline of BP in IP/IPR management and practice and tech-transfer is summarized herein below. However, their efficacious application to the current circumstances of the UAE tends to be problematic, in that a compendium of BP is only useful when the requisite human capital, institutional infrastructure, policies and legal system are operational. The system of BP for any given country must also be carefully conceptualized in the context of the specific development stage, e.g., whether least developed, developing or in transition. Hence, operationalizing such a dynamic, interconnected, globally-reaching system is the central challenge facing the UAE. As per Garner and Black, “an

optimally efficient and effective mode” of BP must be carefully and thoughtfully nuanced to serve as an applicable guide for the UAE to implement in order to foster a dynamic and sustainable innovation ecosystem.

Pragmatically, the key concept of BP must begin somewhere, i.e., a system of BP cannot exist solely as an abstract concept. It requires a tangible platform which then becomes a base of operations for subsequent capacity building and development initiatives. In the case of the UAE, this should ideally be the public sector, e.g., universities. Therefore, a programmatic strategy is crucial to assist universities in developing their IP/IPR and tech-transfer management capacity. This is necessary for universities to fulfil their vital role in the economic, technological and cultural progress of society and as the bridging link in a globally networked triple helix innovation system. Implementation of the programmatic strategy must prioritize building capacity and capability, i.e., human capital and institutional infrastructure. Technology managers from universities therefore require training in IP and tech-transfer management towards the establishment of TTOs and IP units. This necessarily requires the formalized memorialization of institutional IP policies developed as a baseline for effectuating efficient and appropriate BP. (Kowalski, 2007)

That universities, as central public-sector institutions, should be central to this process of accelerated, transformative development is well established: “The innovative capacity of a country is an important indicator of its overall economic potential. In today’s highly globalized and knowledge-based economy, governments and industries are investing heavily in research and development (R&D) activities in order to increase their national competitiveness. As one of the primary sources of generation of new technologies (inventions), universities and R&D institutions increasingly play a crucial role in the process of technological innovation, technology transfer and commercialization of intellectual property (IP) arising from their research activities. Consequently, the effective management of IP and technology throughout the research and commercialization phases has become extremely important for universities.” (www.wipo.int/uipc/en)

Operationally, as a starting point to build an appropriate system of BP, a given university should designate a university IP coordinator (UIPC) who will be the key resource for advancing the subsequent implementation of human resource development and related institutional capacity building. In the earliest stages of this process, a comprehensive needs assessment must be conducted. This will determine and prioritize subsequent steps in capacity building. In conducting the needs assessment, information might be gathered via a form (questionnaire), interviews with the UIPC, or by other

independent research approaches. Establishing such a platform to garner useful information will not happen overnight, and implementation might necessitate a coordinated and methodical action plan, possibly over a period of several years to a decade. Building such requisite capacity and capability, via technical training and dissemination of useful information and advice along with strategic network building, must be focused, ongoing and relentless, bringing together diverse communities of interest in order to catalyze the sort of transformation to which the UAE now aspires.

A crucially important early step in building an IP ecosystem that supports and fosters BP is communication. For example, a lead university, possibly via the designated UIPC, must have active and consistent engagement with the various national government institutions (e.g. National IP Office, Ministry of Science etc.). The UIPC can thereby connect university management to the ongoing capacity building initiatives vital for advancing both the human capital and institutional infrastructure which will sustainably embed an appropriate system of BP.

Objectives of a strategically focused capacity building program will thereby accelerate the establishment of IP and tech-transfer management infrastructure via:

1. establishment of TTOs,
2. development of institutional IP policies that foster effective (and appropriate) tech-transfer mechanisms, and
3. promotion and advocacy to increase institutional awareness, viz. the urgency and importance of IP and innovation in national development.

Coordinated and networked training in IP and tech-transfer related topics might include appropriate R&D planning, promotion of the efficient and strategic use of patent information, research collaboration contracts and agreements, identification of IP assets and liabilities (via IP audits), the invention disclosure process, patent drafting, the patent application process, administration of IP legal matters, technology marketing, technology valuation, licensing, commercialization, incubation of start-ups/spin-offs and strategic management and balancing of patents and trade secrets (an oft-overlooked and misunderstood, albeit supremely crucial, aspect of IP management, e.g., hybrid licenses covering both patents and trade secrets) (Jorda, 2007); all of the aforementioned should be in the context of fostering the dynamic facilitation of national and international collaboration, i.e., the open innovation (symbiotic) paradigm.

An important national aspect of such programmatic development will be the creation of an IP and tech-transfer forum for reaching out to other universities in the UAE, e.g., to foster the sharing of information, experiences, and BP and establish a mentoring system. Capacity building efforts must also include global networking for access to advanced expertise, e.g., leading international organizations such as AUTM, WIPO and LESI.

To summarize, successful IP management and tech-transfer towards eventual product/process development and commercialization requires human resources with appropriate expertise, i.e., human capital and institutional infrastructure strategically assembled, organized and trained. Furthermore, in developing countries, the majority of new technology development is carried out in public universities and R&D institutions. Therefore, university-industry collaboration is essential, especially with regard to SMEs. In addition, the active, ongoing and unambiguous involvement of government is essential, which forms the triple-helix system that has proven so successful in many developed countries, synergizing interactions, facilitating transactions and accelerating the development of a sustainable innovation ecosystem. IP and tech-transfer management capacity thus applied and embedded, enables full benefit from IP/IPR assets. As the following sections elucidate, when methodically implemented via application of an appropriate suite of BP, for example licensing, start-ups/spin-offs (particularly as in the case of SMEs), IP/IPR management and tech-transfer can catalyze the transformation of a nation's economic system.

B. Intellectual Property and Intellectual Property Rights

Intellectual property (IP) and intellectual property rights (IPR) are key concepts that form the foundation for any system of best practices (BP). However, although IP and IPR, as complementary intellectual assets, are frequently used interchangeably in articles, legal literature, and even published court cases, it is critical in the context of BP to distinguish the two from each other. A starting point is to articulate that an IPR confers one, and only one, right to its owner: the right to exclude (a “negative right”) - and the duty for the others is to forbear, i.e., not use the protected IP in accordance with the law. Therefore, whereas the term IP refers broadly to the creations and inventions of the human mind, IPRs protect the interests of inventors/creators of said IP by providing them with a limited property right. Whereas this might all sound esoteric to the general community, it is a crucial distinction when considered in the context of a sound system of BP.

As defined by Black's Law Dictionary (Garner and Black, 2014), intellectual property is

A commercially valuable product of the human intellect, in a concrete or abstract form, such as a copyrightable work, a protectable trademark, a patentable invention, or a trade secret. ‘While there is a close relationship between intangible property and the tangible objects in which they are embodied, intellectual property rights are distinct and separate from property rights in tangible goods. For example, when a person posts a letter to someone, the personal property in the ink and parchment is transferred to the recipient ... [T]he sender (as author) retains intellectual property rights in the letter.’ [Black’s quoting] Lionel Bently & Brad Sherman, *Intellectual Property Law* 1–2 (2001).

Therefore, from the very beginning, one must understand and differentiate the concepts of IP and IPR. Although the distinctions might be viewed as subtle, to do so will facilitate management of IP via IPR in a way that ultimately fosters a system of BP that is appropriate, efficient and sustainable.

Table 4: Differentiating Intellectual Property (IP) and Intellectual Property Rights (IPR)

IP	IPR
Inventions	Patents
Proprietary Business Information	Trade Secret
Brands and Logos	Trademarks
Shapes of Items	Industrial Designs
Fixed Works (writing, films, phonographs)	Copyrights
Kowalski, 2009	

To take this concept one step further, we can think of IPR, as bundles of rights capable of being selectively or individually parsed and conveyed: e.g., patent owners can divide their bundle of rights not only into separate exclusive licenses to make, sell, and use the patented item, but also divide each of those into fields of use and/or geographic locality. For example, in an open innovation system, “IPR sticks” forming the “IPR bundle” can be strategically parsed and conveyed via licensing, sublicensing or assignment in order to maximize value, foster and ultimately accelerate the sustainable establishment of an ecosystem for research, development and innovation in a variety of public and private sector business enterprises, which, in the case of the UAE, would necessarily include SMEs. (Kowalski, 2009; Hajjiri et al., 2014)

IPRs are conferred by the state via a number of legal (predominantly statutory) mechanisms. These include:

- Patents
- Industrial designs
- Utility models (sometimes, perhaps derogatorily, referred to as “petty patents” or “innovation patents”)
- Copyright
- Trademarks
- Trade secrets
- Plant variety protection

With all of these legal mechanisms of IPR, the key concept to understand is that of ownership rights. For example, an inventor might have been the sole source of conception and reduction to practice for an invention (IP), yet not be the owner (the patentee) of the IPR which protects said invention; the rights could have been assigned to another party or entity (i.e., “successors in title”, 35 U.S. Code § 100 - Definitions).

Therefore, a starting point for a system of BP requires an understanding of the fundamentals of this statutory IPR toolbox, how to effectively use these tools and what the range of options might be available in order to maximize value and impact for any given IP asset. From the earliest stages of the R&D process, an informed and strategic management of IP is crucial. Ignorance is not a viable option: verily, capacity building in both human capital and institutional infrastructure is not only fundamental but also requisite for survival in the highly competitive global innovation market economy of the 21st century.

Examples of proactive IP management could include:

- Data protection and exclusivity in pharmaceuticals and agrochemicals
- Patents balancing protection with the public domain (e.g., defensive publication or the erstwhile statutory invention registration)
- Provisional patent applications (remaining cognizant of their advantages and limitations)
- Designing patent applications (e.g., for possible field-of-use licensing)
- Patenting strategies (cost consideration, international patent filing via the PCT)
- Filing international patent applications (risk/benefit and cost considerations in foreign markets and jurisdictions)

- Pyramiding of IPR considerations (e.g., a plant simultaneously covered by trade secret, patent, plant variety protection and trademark IPR)

C. Intellectual Property Management

IP management, as defined in the IP Handbook (Krattiger et al., 2007) is the means by which an institutionally owned IP portfolio is managed with regard to marketing, patenting, licensing, and administration. However, this somewhat terse definition leaves room for further articulation and expansion of key concepts. In a broader context, IP management entails a system of BP for management of an entire suite of intellectual assets, including IP and IPR. This can range from the earliest stage of an invention disclosure to patenting with subsequent licensing of IPR and concomitant royalty-revenue flow. However, such a linear conceptualization of IP management implies a closed innovation system. For the UAE a far more complex, web-like system of open/symbiotic innovation will be optimal for accelerating the establishment of a robust, globally networked knowledge-based economy.

In the context of a system of BP in IP management, contracts and agreements are fundamental for IPR transactions, and this is increasingly the case with the globalized innovation economy as transactions in intangible assets occupy a greater proportion of international commerce. (Baldia, 2013) Such contracts are applicable to a number of possible situations; a system of BP must not only anticipate the basic types of agreements but also how they might be negotiated, drafted and strategically used in tandem. Examples of agreements/contracts include: collaborative research, service, material transfer, confidentiality (confidential disclosure agreement), consultancy, commercialization and, of course of the highest importance, licenses (more precisely IPR license contracts, e.g., granting field-of-use and/or geographic licensing provisions or defining restrictions such as research use license agreements or evaluation licenses allowing a trial period to “test-drive” technologies). Contracts and agreements must clearly articulate provisions with a level of diligence that coherently conforms with internationally recognized and accepted BP, including (but not limited to) obligations, definitions, milestone and benchmarking requirements, ownership of IP, publication restrictions/requirements (including theses and dissertations), tangible and intangible property considerations, conflicts of interest and/or commitment, ownership of equipment, proprietary reach-through rights, issues relating to liability, monitoring, enforcement, and resolving disputes and royalty/revenue management.

All steps in the process and practice of invention disclosure need to be conducted in the context of a carefully crafted, memorialized and implemented system of BP. Among the many aspects of IP management which require a coherent and appropriate system of BP, inventions (as IP) and patents (as the attendant IPR) certainly deserve special mention. This involves, in the early stages, the timely and diligent disclosure of inventions, which is of critical importance as a primary tool of IP management. IP professionals need to understand how to handle a disclosure, particularly as premature disclosure (e.g., to the world) can create possible issues with the subsequent acquisition of patent rights. The obligations of an inventor during and after invention disclosure are also part of the system of BP in IP and IPR management. Additional aspects of invention disclosure and management include managing a confidential disclosure agreement, documentation of inventions (e.g., docket filing system), parsing patentable inventions and trade secrets, early evaluation and valuation of technologies potentially embodied in inventions, clarification of inventorship and ownership of inventions and ultimately the role of the inventor in the tech-transfer process.

BP in IP and IPR management entail many other facets, including IP and information management (libraries, databases, geographic information systems and software), institutional policies and strategies, making the most of IP via the development of institutional IP policies, conducting IP audits, IP portfolio management in the context of open innovation paradigm, freedom to operate (FTO) and risk management, identification and management of genetic resources and biodiversity as intellectual assets, monitoring and guarding IP and IPR assets, selecting and working with external patent counsel and finally, and among the most critical, laboratory notebook policies and guidelines. A common theme running through the BP concepts discussed herein is the importance of information systems and management. In this respect, a concise IP mantra to memorize and repeat is: access to information drives innovation.

D. Technology Transfer

In the overall suite of BP discussed herein, from IP to IP/IPR management and then to tech-transfer, it is the latter which completes the cycle and thereby energizes the innovation ecosystem towards sustainability, analogous to the energy necessary to propel a jet aircraft from runway to cruising altitude and then maintain its velocity and trajectory. Tech-transfer moves beyond the realm of IP and IPR management, securement and protection to the actual use of IPR as a mechanism for facilitating transactions, i.e., to move

and assemble innovation components for a pragmatic purpose. Therefore, as defined by Black's:

“technology transfer 1. The sale or licensing of intellectual property.
2. The field involving the sale and licensing of intellectual property.
Many major universities have an office of technology transfer to control the university's intellectual property and generate income from it.”

To presume that the scope of this article could possibly include the plethora of BP in tech-transfer would be presumptuous. Therefore, the reader is referred to the cited materials (IP Handbook, Tech-transfer Tactics, and WIPO) as a second step to appreciate that BP in tech-transfer is a very large, dynamic and intensive field of study and practice.

BP in tech-transfer can be characterized in the context of a hierarchy, that is, from the institutional to the operational levels, with a series of policies, protocols, and procedures which serve as guiding principles. First and foremost, there must be an institutional IP policy in place that includes provisions regarding ownership of IPR, conflict of interest and of commitment in the management of technology transfer, factors to be considered when discussing, negotiating and drafting a licensing agreement, revenue distribution, patenting, confidentiality, and disclosure. A detailed set of guidelines can then build on the IP policy, which necessarily “should be a succinct statement, as opposed to a detailed list of procedures. The latter can be accessed elsewhere, while the IP policy should be the basis of regularly updated IP strategies and serve as a guiding principle for the management of intellectual property.” (Kowalski, 2007)

The next level of the tech-transfer hierarchy is the physical, institutional, base of operations: the TTO. In developing countries, establishing and operating a TTO is necessary for the sustained, strategic success of the tech-transfer enterprise (in a narrow context) and the fostering of innovation-driven, knowledge-based development (in the broader context). Therefore, training a critical mass of TTO staff in IP and IPR and related management needs to be a priority. With an established TTO and staff, a subsequent step would be building networks, particularly via the Association of University Technology Managers (AUTM), which supports and enhances the global academic tech-transfer profession via education, professional development, partnering, and advocacy. (<http://www.autm.net/>)

The TTO's responsibilities and activities lead to the next level in the tech-transfer operational hierarchy: policy, advocacy and fostering the

innovation ecosystem. TTOs in developing countries might be similar in some respects to those in developed countries, yet developing country TTOs' purpose and roles need to be significantly different, to address their special strategic role in transforming the economy, e.g., from commodity to knowledge-based. In addition, although similar in principle to the articulated mission of developed country TTOs not to be primarily revenue generating machines, this is all the more the case in developing countries wherein their primary role must be in the context of development.

Therefore, the TTO takes on the role of an intermediary, and ideally even a catalytic driver, moving IP and IPR to commercial products with societal benefit, e.g., advanced innovations in health, energy, communications and agriculture. The suite of activities is both dynamic and catholic. These can involve:

- administering IPR license agreements
- specific strategies and mechanisms for facilitating access to innovation
- appraisal and valuation of IPR, market evaluation and licensing of IPR
- fostering public-private partnerships (e.g., university-SME collaborations)
- forging commercialization alliances (e.g., once again with SMEs)
- tech-transfer data management
- monitoring, evaluating, and assessing impact
- in-licensing strategies to build an innovation base
- negotiating skills and tactics
- fostering entrepreneurship
- identifying and attracting venture capital (university-VC partnerships can open up opportunities for start-ups)
- faculty outreach and education (crucial for accelerating the establishment of an innovation-IP centered paradigm shift)
- advocating for IP, IPR, tech-transfer legislation (in emerging and developing economies) similar to the Bayh-Dole Act
- elucidating on the proper role of clusters in driving innovation
- exploring public policy options for supporting regional innovation

- cultivating new companies to commercialize IPR, i.e., creating and developing spinouts and startups and formation of business incubators.

BP in patent license negotiations includes preparing to negotiate (assembling a team), exchanging of term sheets, drafting contracts, meeting deadlines. BP also entails valuation approaches, proprietary position, the developmental stage of invention/innovation, exclusivity and field of use licensing, benchmarks, payment terms/royalties, rights to improvements and related reach-through provisions. All of these, and more BP, need to be judiciously established ideally as key operational protocols for nascent TTOs. (Giordano-Coltart and Calkins, 2009)

For the UAE, BP in IP management and tech-transfer must be implemented strategically, with a mix of both caution and boldness, yet tailored to the unique situation and attendant challenges the UAE faces.

Nations can no longer rely on national resources for economic success. Today the most powerful competitive advantage is brain power. ... [Developing countries, therefore, need to turn their] attention to wider educational research and understanding, drawing upon what is perceived to be global best practice and economically rigorous investments in education. However, it must be remembered that borrowing and importation often come at a cost to the receiving nation, not least of all due to clashing issues of suitability and replicability, which often do not happen the way it is hoped. Such a grafting of models and practices can often create the educational equivalent of 'tissue rejection' with local conditions not fully accepting foreign systems. (Kirk, 2014, p. 134)

Note: the overall contents of this section are derived, condensed and then amalgamated from several key cited sources. (Jorda, 2007; Krattiger et al., 2007; Kowalski, 2007; Ku et al., 2008; Tech Transfer Central, 2014)

VI. TEN PRESCRIPTIVE RECOMMENDATIONS FOR THE UAE

For the UAE to truly undergo a knowledge economy transition, much needs to both happen and also be avoided. In this section, a list of broad and also focused guidelines, divided into fundamentally two sections, i.e., the not-to-do list and then the to-do list, is presented: (1) A broad critique of current paradigms, approaches, and considerations, based on the wisdom of previous commentators and authorities. (2) This is then followed by ten

prescriptive recommendations which are intended to form the foundation for a paradigmatic shift towards strategic implementation of an appropriate and sustainable development action plan for the UAE. A suitable system of BP in IP management and tech-transfer can thereby be conceptualized and then successfully established.

The common concern among the GCC countries is the rapid transition from a petrol, hydrocarbon commodity to an innovation-based economy. However, this is more easily articulated than implemented. Saudi Arabia exemplifies this:

Overall approaches from the Saudi government to developing human resource skills and enabling economic diversification and growth depend on a series of top-down strategies. These strategies rely on the use of oil wealth to enable major job creation initiatives or the creation of employment and technology zones (such as the King Abdul Aziz City for Science and Technology). These approaches tend to be based on exorbitant levels of spending to create infrastructures and bureaucracies in the hope of promoting economic diversification and human capital development rather than on sustainable approaches that balance government input with localized developmental initiatives. (Patrick, 2014, p. 235)

An appealing concoction of petrol dollars, expensive buildings, useless bureaucrats and overpaid expat consultants is not a sustainably sensible strategy. This presents a policy epitomized by a paradox which promotes negative cash flow, with little to show in terms of sustainable outcomes.

As Patrick further elucidates, the challenges facing Saudi Arabia are many and complex. Perhaps the greatest among these is that a collective paradigmatic shift cannot be accomplished via copious flows of petrol money, extravagant techno-parks, innovation hubs, and highly paid ministers. The change must be fundamental.

Even if economic expansion and diversification can be accomplished, Saudi Arabia may need to be prepared for any advantages gained to be transitory. The attempt to attain knowledge economy status is indicative of a global tendency for convergence of approaches to education policy and practice. To what extent the government of Saudi Arabia can navigate this tendency while retaining distinctive knowledge traditions remains to be seen if the aim of moving from a rentier state to a globally competitive economy is to be realized. It may well be that, without a concomitant shift towards the cultivation of the individual

and collective mindsets and cultural habitus on which knowledge creation rests, knowledge economy status will remain elusive. (Patrick, 2014, p. 248)

This situation is ubiquitous among the GCC countries. For example, Bahrain, while having several nascent accomplishments in terms of tech-transfer, follows the petrol-wealth pattern of “development”:

As an example in Bahrain, the seemingly limitless expenditures allocated to building a glittering regional center of corporate finance in Manama, and the drive for extraordinary rates of modernization on the island in general, make this country a key case in point regarding the role of education in the national development agenda of a given country, especially when one considers the fundamental role an expatriate workforce plays in the development of the state. (Kirk, 2014, p. 136)

Transplanting the innovation ecosystem culture of the developed countries into the GCC region is also unworkable. The Masdar/MIT partnership raises this concern, as it appears to engender the tendency of emulation instead of the difficult and complex task of diversification and transformation. When formulating a coherent national knowledge-based development policy and attendant strategy action plan, there are several aspects of this for the UAE to carefully consider. This includes, but is not necessarily limited to, cultural considerations, avoidance of an inappropriate innovation ecosystem model (need for a developmentally appropriate approach suited to the UAE) and also a recognition of the scale and complexity of the challenge the UAE faces in order to rapidly accelerate establishment of a suitable system of BP in IP management and tech-transfer.

Local cultural factors might not be readily considered when initial “capacity building” programs are conceptualized, leading to (at best) transitory/evanescent outcomes or (at worst) animosity towards (culturally insensitive) foreign modes of conducting IP management and tech-transfer. In other words, one cannot expect that everyone and anyone can become another MIT or magically raise a Silicon Valley out of the baking sands of the Rub’ al Khali. Such expectations are highly unrealistic, ridiculously impracticable and doomed to disappointment with tragically concomitant lost opportunity. Still and all, such assumptions are often made which might partially explain the poor success outcomes of so many international capacity building initiatives.

When considering capacity building programs in the GCC region,

[t]he strategy for developing a knowledge society in the Arabian Gulf, therefore, includes building a knowledge economy and transitioning to an Arabian Gulf knowledge society by creating a Gulf-wide knowledge culture that is characterized in several key ways. First, it is responsive to and incorporates Arab and Muslim identity, culture, social mores, and shared expectations. Second, a Gulf-wide knowledge culture is most likely to develop while using science and technology infrastructures to building the capacity for a sustainable transition and eventual change to a Gulf knowledge society. (Wiseman, 2014, p. 279)

In the context of capacity building initiatives which involve multiple international participants, the paradigm must therefore be that capacity building is not unidirectional, e.g., MIT teaches Masdar, but instead reciprocal wherein all parties learn from each other and build appropriate and sustainable innovation ecosystems accordingly. In this respect,

[i]ndeed, transition to a knowledge society is more likely to occur when the cultural and social conditions that enhance epistemic knowledge cultures and support the development of knowledge communities are encouraged. [A] knowledge society is not simply a society of more knowledge and more technology and of the economic and social consequences of these factors. It is also a society permeated with knowledge settings, whole sets of arrangements, processes and principles that serve knowledge and unfold with its articulation. (Patrick, 2014, p. 240)

This is crucially important in all international development scenarios, and perhaps paramount when considering the GCC countries.

When considering capacity building in IP management and tech-transfer, it is critical to recognize that emulation of an ultra-mature institution's operating model might not be applicable to the developmental status of the country wherein the program is contemplated, e.g., the MIT/Masdar partnership endeavor. Paradoxically, there is no such quick fix. Still, action must be taken expeditiously and strategically, as the pace of change in this century will continue to be unrelenting and unforgiving. Bess best frames this in the broader historical context that emphasizes the overall contextual challenges rooted in history and culture, which the UAE (as well as the other GCC countries) currently faces:

Until recently in human history, the major technological watersheds all came about incrementally, spread out over centuries or longer.

Think, for example, of the shift from stone to metal tools, the transition from nomadic hunter-gathering to settled agriculture, or the substitution of mechanical power for human and animal sources of energy. In all these cases, people and social systems had time to adapt: they gradually developed new values, new norms and habits, to accommodate the transformed material conditions. But this is not the case with the current epochal shift. This time around, the radical innovations are coming upon us with relative suddenness – in a time frame that encompasses four or five decades, a century at most. (Bess, 2016, p. 35)

The MIT/Masdar partnership endeavor aspires to leapfrog across this unprecedented “current epochal shift”, i.e., for Masdar to become MIT-like, a noteworthy goal. When examined in the context of longer-term, sustainable development, the MIT/Masdar partnership approach should be viewed with extreme caution. The programme, albeit appealing, with early “successes”, is likely to only be a short-term mirage, much like the vision of an oasis in the sun-parched expanse of the Ad-Dahna desert. Whereas an imitator program such as the MIT/Masdar partnership might, in the short term, appear successful, in the longer term it will likely incur subtle yet very profound and serious opportunity costs. That is, in lieu of dedicated and focused capacity building, mirage-like appearances of progress obscure, obviate and obfuscate dedicated investment towards establishing a robust triple helix system that connects to the global open innovation market.

Therefore, domestic investments in people and institutions are crucial, wherein they take ownership, accept risk, take the lead, and show the way forward:

[A]s long as the capacity of other NIS [(National Innovation System)] actors in the UAE is not sufficiently leveraged, the role of research universities is likely to be curtailed. To that end, one cannot overemphasize the importance of embracing NIS thinking in national S&T planning and public policy in order to both understand the innovation dynamics of the UAE’s local context and guide its transition to a knowledge-based economy ... It is unlikely that these long-term goals will be achieved if the government chooses to continue its over reliance on short-term consultants for policy work. Rather than believing in the principle of ‘getting the incentives right and everything will follow’, attaining a thorough NIS-based understanding of the status quo should be a policy priority. (Al-Saleh and Vidican, 2011, pp. 28-29)

An ongoing challenge is that senior policymakers appear to largely, and erroneously (perhaps due to ignorance), believe that because the assets of a knowledge-based, innovation-driven economy are intangible, they are therefore not “real” in the same sense as tangible assets (e.g., reinforced concrete, machinery, factories, etc.). This is a serious misunderstanding. There must be a significant and sustained investment in human capital and institutional infrastructure along with relentless network building. The capital assets in a knowledge economy, albeit intangible, are not free. “Intellectual property is people-driven. It is based on the human wealth of a nation which, in turn, is contingent on developing human resources to a degree whereby it is possible to shift into the creation of patents and original works.” (Houry, 2009, pp. 105-107) Such confusion among policymakers creates a chronic fecklessness in setting strategic agendas and a corresponding treadmill of expat expertise and domestic dysfunctionality. “Without operationalizing incentives for interactive, collective learning opportunities as a condition of entry for foreign firms and their workforces, the result is a dual economy: first, a dynamic, market-based economy driven by expatriate labor and knowledge, with little local content; and, second, a distorted, oil-driven public sector which provides employment to the local population.” (Ewers, 2013, p. 135) For the UAE, building capacity and capability in both human capital and institutional infrastructure in IP management and tech-transfer, albeit intangible investments, is nevertheless quite real; delays, official inertia and reluctance to prioritize such efforts raises the all too real possibility of catastrophic consequences: state failure. (The Economist, 2017a)

For UAE there are no quick fixes; the country is currently innovation impoverished. A realistic system of BP should focus on the open/symbiotic innovation model. This has been reiterated by commentators: “[G]iven the country’s limited technological capabilities and industrialization history, a more realistic target could have been an attempt to adapt foreign technologies to the local context instead of the announced intention of focusing on basic research for technological development.” (Al-Saleh and Vidican, 2011, p. 25) In other words, it is critically important to be realistic and not to overstate the potential roles to be played by UAE universities as they are currently configured (e.g., Masdar Institute). Thus, “an emphasis should be placed on the exploration, adaptation, and commercialization of technologies as opposed to generating new scientific knowledge from scratch.” (Al-Saleh and Vidican, 2011, pp. 28-29) The open/symbiotic/networked innovation model as a realistic and sustainable development strategy must be taken seriously in lieu of the current UAE “strategy” dominated by gleaming techno-park complexes and (highly compensated) expat consultancies.

A. Ten Prescriptive Recommendations

The UAE has lofty aspirations and for economic diversification, away from a hydrocarbon-based commodity economy, towards sustainable knowledge-based, innovation-driving development. Sadly, progress has been replete with obstacles, misplaced priorities and a generalized ignorance that is likely, at least partially, due to the disproportionate influence of expat consultants “benevolently supervising” the UAE’s development. Commentators have noted that many pieces of the innovation ecosystem are lacking; these are critical components akin to gears in an engine, i.e., without which the system simply will not function: “Evidence reveals a positive progression of the UAE in transitioning towards the innovation-driven stage.... However, several issues remain a concern and challenges remain to be addressed. In recent years, the country’s economy experienced negative trade trends in foreign technology transfer, exhibited low investments in education and R&D activities and a lack of ability to absorb, adapt and create new technology and knowledge.” (Ahmed and Abdalla Alfaki, 2013, p. 98)

Current attempts to build an innovation ecosystem in the UAE are therefore at best ad-hoc, and at worst counterproductive in that they will fail and thereby entail opportunity costs that had not been anticipated. “[I]nnovation can in some ways be boosted over a short period of time, but building the capacity for more radical, sustainable and all-embracing improvement in societies that have achieved high incomes and high costs through other means, requires investment for the long-term and a continuous consistent effort involving all major stakeholders.” (IKED, 2010, pp. 144-145). Expansion of innovation requires sustained investment, with a discrete institutional base of operations that serves as the catalytic center for driving the sustainable transformation of the UAE. Nothing less will suffice. Leapfrogging is necessary, i.e., a platform from which to leap, with a carefully conceptualized and strategically formulated action plan.

In this respect, Ahmed and Abdalla Alfaki, in a very broad fashion, note not only the deficiencies and gaps in the nascent UAE innovation ecosystem, but also proffer clear suggestions for moving the country forward. This entails the essential retooling of the workforce via a paradigm-shift in education, training, and overall capacity building, recognizing the pragmatic realities the UAE faces in terms of where it currently is, and where it aspires to go: “The UAE needs to ... concentrate on strengthening technical and vocational training and revamping curricula, particularly, a[t] the higher educational level, where learning outcomes should emphasize the promotion of critical thinking skills together with creativity and problem-solving capacities. This is instrumental in providing a highly skilled professional

workforce to counteract the current mismatch in supply and demand in the country's human resources. It is also instrumental in providing R&D manpower required to improve the country's ability to adapt and assimilate new technologies and to develop an innovation base. UAE's investment in knowledge inputs would benefit the country's competitiveness standing and would increase its chances of achieving sustained productivity growth as a result of increasing the indigenous innovation" (Ahmed and Abdalla Alfaki, 2013, p. 98)

Therefore, tersely put, what is the message for the UAE? What steps should be taken to move from policy to strategy to actual tactical implementation? This is the crucial issue which policy-makers, consultants and commentators fail to address. Yes to Ahmed and Abdalla Alfaki's wisdom, but how to proceed is the question? What are the strategic steps to implement? How to move from objective identification of a challenge to pragmatic and strategic capacity building? What follows hereinbelow are discrete, concrete and implementable prescriptive recommendations designed to specifically and methodically outline an action plan to move the UAE forward. These ten recommendations include the establishment of a center of excellence, i.e., an innovation IP hub that the UAE owns, manages and leads. This could thereby become a focal point for coherently strategic capacity building, both of human capital and institutional infrastructure. In this regard, Emiratization is fundamental for sustainable economic diversification in order to survive, compete and prosper in this century.

i. Establishment of a Center of Excellence for IP capacity building

Developing countries urgently need personnel trained in tech-transfer, IP management, information systems and related business, technical and legal disciplines. This will require corresponding institutional infrastructure, both for immediate and then subsequent ongoing capacity and capability building. Therefore, in a nascent innovation ecosystem such as the UAE, personnel resources and talent need to be focused on institutional entities. Whether they are called Centers of Excellence (COEs), Innovation and Technology Entrepreneurship Centers (ITECs), TTOs, IP Hubs (IPHs) or Technology and Innovation Support Centers (TISCs), the fundamental principle is the same, that is, to accelerate knowledge-based, innovation-driven development via the establishment of requisite human capital (a critical mass of knowledge, talent and skills), and institutional infrastructure (a base of operations for a sustainable and long-term strategic development plan). For the purposes of this discussion, the term ITEC will be used as a generic representation of the concept.

To further conceptually illustrate with the gears/machine analogy, the ITEC would be the drive gear in the overall innovation ecosystem, central for interconnecting the component gears and thereby efficiently and effectively engaging and energizing the entire system. For example, IP laws and regulations could be optimally utilized and organized because the human capital and institutional infrastructure would facilitate and catalyze the overall process: “A supportive legal environment is necessary but not sufficient for ... effective technology transfer ... must be supplemented by the establishment of an [ITEC] to handle ... spinning-in, adapting for local use, and spinning-out technology. This organization can either be a newly established entity or an existing unit within an established organization (Inclusive Innovation Center or university technology transfer centers), retrofitted to carry out new functions.” (Watkins and Mandell 2010, pp. 20-23)

Similarly, nearly 20 years ago, Maredia et al., proposed an expanded and developmentally conceptualized TTO. As with Watkins and Mandell’s ITEC, their approach is consistent with a paradigmatically appropriate role for a developing country wishing to sustainably accelerate the establishment of an innovation ecosystem (e.g., via the open/symbiotic/networked global innovation system): “A framework to allow technology transfer to the public institutes of developing countries must be stimulated and developed. This has been addressed in some countries by the establishment of ... TTOs. TTOs are often located in a governmental unit... These offices work with researchers ... and with government officials to develop appropriate laws and policies for intellectual property protection. They develop means for providing ... invention protection and intellectual property management. TTOs can play multiple roles in research and development (R&D) institutes, [including] protection of intellectual property ... revenues through licensing of intellectual property ... education and awareness, networking ... creation of new start-up companies ... institutional policies related to technology transfer [and] service to society.” (Maredia et al. 2000, pp. 16-17)

Within the context of the WIPO Development Agenda’s pragmatic implementation, this fundamental concept of an institutionalized hub as a focus for IP and tech-transfer capacity building, has also been elucidated:

[TISCs] act as service-oriented providers to: allow local users to benefit effectively from the increased accessibility of intellectual property information offered by internet searches through direct personal assistance; assist local users in creating, protecting, owning and managing their intellectual property rights; strengthen the local technological base by building up or reinforcing local know-how; and to increase technology transfer, e.g. by investigating the possibilities of

licensing, joint ventures, etc. In short, TISCs are established so as to act as local drivers of innovation. The training of TISC so as to be able to assist local users and deliver these services is one of the most important elements ... and while initial training may be focused on searching patent and non-patent technology databases ... further training in other areas of intellectual property rights is considered particularly useful, as it not only continues to develop staff knowledge and their personal development, but also offers a one-stop-shop as regards other elements of intellectual property rights and of innovation support. (Takagi and Czajkowski 2012, pp. 32-33)

As these conceptual models for appropriate institutions illustrate (e.g., ITEC, TTO and TISC), a global innovation marketplace, where “pieces” of a potentially vital technology are scattered, and the technology may be, and verily usually is, under multiple ownership. For complex high technology to be produced (whether in health, agriculture, energy or information technology) numerous inputs might necessarily need to be identified, assembled, accessed and ultimately IP cleared (FTO) for commercial development. For developing countries, when considering such critical innovations and their application, the closed linear approach (as practiced by many developed country research universities and institutes) of R&D-invent-disclose-patent-license-royalty/revenue-repeat is inappropriate and likely disadvantageous (if not dangerous) to emulate, as many components and processes appurtenant to the development of innovations of interest are already in the global innovation marketplace. Hence a broader skill-set in tech-transfer, along with an IP toolbox (Intellectual Property Handbook of Best Practices, 2007) will facilitate transactions in this marketplace, one that will increasingly be driven by an open innovation paradigm. (Chesbrough 2003). Hence, distinct from the methodology of developed country technology-transfer practices, an appropriate institutional framework needs to be established which recognizes that an emerging country, such as the UAE, is in a very different stage of development, thus requiring a very different strategic approach of accelerated establishment of a robust, sustainable, independent and dynamic nationally-led and globally interconnected innovation ecosystem.

The unsuitability of developed country tech-transfer practices to the UAE has been noted, along with the need for more coherent, developmentally appropriate approaches. Albeit lacking strategic specifics, this has nevertheless been alluded to (aspirationally, yet at least attempting to define a path forward):

[P]revailing research has largely been undertaken in developed markets and thus may not be directly applicable to the emerging Dubai

market. This ... has implications for policymakers and managers. At the policy maker level, there is a need to take further actions to strengthen policy interventions for innovation that are designed to provide supportive institutional arrangements, establish tailored financial programs for SMEs and bring together a network of academics and firms conducting similar projects; for example, the government needs to focus on *catalyzing system-level thinking* through academic and industry forums and to set up mechanisms to encourage research collaboration. If innovation is to succeed in the future, a process of continuous policy and support development, implementation and monitoring needs to be introduced by establishing a national innovation council. It should provide incubator infrastructures, funds, training, consultancy services, networks and technical, legal and market supports for SMEs to stimulate innovations and interactions with both local and regional authorities. Further, policies and infrastructures to stimulate innovations should be encouraged, such as innovation and technology centers, where research outcomes and ideas can be tested. Building a strong local innovation base can position Dubai to rely upon the performance of its innovation outcome in future economic development. (Pervan, Al-Ansaari and Xu, 2015, p. 65, emphasis added)

This would necessarily include focusing on a critical mass of talent, expertise, and capability, wherein an ITEC could be the base of operations to assemble such talent: “[I]n conservative, low risk-taking cultures, such as those typified by countries in the Middle East, a critical mass of entrepreneurs that would change the economic topography does not yet exist. Therefore, education systems should have priority in the transformation process that could gradually modify the traditional mentality into a more business-oriented one, in which greater risk-taking capacity must become an everyday characteristic ... that higher education systems could adapt to enhance the entrepreneurial abilities of students and faculty.” (El-Khasawneh and Pech, 2015, p. 499, emphasis added) Note the use of the phrase “critical mass”; hence, a further role of the ITEC is to focus on talent, strategy, and resources. Also note Pervan et al.’s term “catalyzing system-level thinking”, which means (plainly) that it must happen rapidly, i.e., now ... not five years hence!

The ITEC as a base of operations could also function as a platform for the critical, yet often cautiously avoided, need for cultural paradigmatic transformation. “Excellence centers are of immense importance for developing the right skills, motivation, and sense of direction for both students and

faculty. It is an exchange and learning platform between the three most important players within a country; namely, government, industry, and academia. The excellence centers reduce the risks with maximum benefit to all involved. Business incubators and techno-parks drive knowledge economies and create business and technical dreams for participants and aspirants. This process is – incubation and it is a mechanism that acts as a social and technological haven within a conservative culture in which risk-taking is highly feared and discouraged. Within this mechanism, cultural constraints and bounds are relaxed and people think in a completely different paradigm.” (El-Khasawneh and Pech, 2015, pp. 501-502). In addition, the ITEC could serve as an inclusive safe zone, wherein all participants would be able to work as colleagues and build the requisite knowledge, skills, and abilities to develop and then implement an appropriate suite of BP in IP management and tech-transfer. Thus, the changes required to transform the UAE into a truly knowledge-based, innovation-driven economy are significant, far beyond the appearances of the MIT/Masdar joint initiative.

As bona fide innovation development will entail significant shocks to the UAE, the ITEC can also be viewed as a shock absorber that facilitates dramatic economic diversification as it systematically enables societal transformation. The concept of shock has been noted by highly respected commentators: “Attitudes need to change [(paradigms need to expand)], and awareness be raised, to inspire a more appreciative mindset in regard to research, creativity, innovation, and entrepreneurship. ... [D]ay-to-day practices in the vast number [of] ... educational institutions should be subjected to constructive ‘shock therapy’, to allow reliance on old-style authoritarian practices to be replaced by greater appreciation for the new tools available for the young to seek out and find knowledge in innovative ways, and to inspire more interest in sciences, discovery, development of new technical solutions” (IKED, 2010, p. 10, emphasis added).

Indeed, shock therapy to accelerate development is needed, to open the paradigm for the broadest view possible of the complexity and challenges of building a comprehensive innovation ecosystem, and not only focus on components (e.g., the narrow linear concept of tech-transfer of R&D, invent, patent, license, royalty and possibly protection of IPR via litigation). This is entirely analogous to the well-known fable of the blind men and the elephant, wherein the blind men mistakenly assume that a specific anatomical feature of the elephant is the entirety and not only a single component of a much larger and more dynamic creature ... for example, the tusk as a spear, the leg as a tree trunk, the ear as a carpet or the trunk as a hose, etc., i.e., a range of perceptions, misperceptions and alternate paradigms which can

spawn limitations in experience and understanding. It essentially teaches that the reductionist approach to knowledge can severely limit a holistic view of the entirety and thereby cripple progress.

Similarly, IP and tech-transfer are all too often apprehended within a narrow, reductionist paradigmatic context, with the holistic concept of the innovation ecosystem lost in the granular details. Analogizing the blind men elephant fable with narrow perceptions of the global IP/innovation ecosystem, particularly in many developing countries, there is a prevailing preoccupation with facets, e.g., IP valuation, patent thickets, blocking patents, compulsory licensing, patent trolls, patent monopolies (an oxymoronic phrase); or an unrealistic expectation of immediate wealth from IP and tech-transfer such as valuable patents, large licensing revenues or unanticipated financial windfalls. There is a corresponding fundamental lack of appreciation for the greater global IP system and innovation market with its many intricate interconnections, dynamic networks, and limitless opportunities. The IP/innovation global ecosystem is a complex array of interacting players, pieces and possibilities, with IPR and IP treaties/law principally functioning within the system to facilitate arms-length tech-transfer (e.g., licensing deals and fair determination of royalty rates) via the lowering of attendant transaction costs. Therefore, in the context of a development action plan for the UAE, the system needs to be viewed holistically, understood and then tactically navigated consistent with a realistic and appropriate strategy for the country.

That the global innovation economy is complex and multifaceted and must be viewed as a complete system with many interrelated components, needs to be comprehended quickly. Therefore, the role of the ITEC as a base of operations for a critical mass of “shock troops” to build the IP, innovation ecosystem is recommended. A dramatic paradigmatic shift is necessary. Knowledge and innovation in this century are unforgiving and moving forward with exponential speed. One can either catch up or be left behind. Ideally, the UAE should approach this challenge in a methodically strategic and informed manner, such that attendant “shocks” are minimized and the transformation occurs smoothly, successfully and sustainably. “Hopefully someday there will be an epiphany between the media, policymakers, and educational researchers that will eliminate the ‘shock’ factor and elevate the importance of evidence-based decision-making and reform.” (Wiseman, 2014, p. 301)

ii. Female professionals as full participants

If the UAE truly aspires to transform its economy from a hydrocarbon commodity to a knowledge-based, innovation-driven system, significant

paradigmatic shifts are necessary. Principal amongst these attitude shifts is the role of women in the nascent and emerging new UAE innovation ecosystem and its development. Throughout the GCC region, this important, and oft deftly avoided issue presses with greater urgency: “If the encouragement and utilization of skills development in women are not addressed, there is a negative impact on any country’s capacity ‘to draw on its best talents’ and this ‘ultimately undermine(s) economic growth and productivity’. However, a sense of artificiality remains with respect to the creation of employment opportunities for women in Saudi Arabia, suggesting that the shift from rentier economy to a global knowledge economy remains elusive for them.” (Patrick, 2014, p. 246)

Therefore, for the UAE to accelerate the establishment of an innovation ecosystem, replete with an appropriate, dynamic and fully implementable system of BP in IP management and tech-transfer, there is a crucial need to build human capital. This means mobilizing all human capital in order to provide the UAE with a unique regional strategic competitive advantage as a knowledge-based, globally networked economy. Not including and utilizing the talent, expertise and intellectual power of women in the UAE for knowledge and innovation development would be like, for some bizarre reason, not extracting petrol from fields with reserves known to contain over 50% of the UAE total. This is tantamount to non-utilization of the majority of the natural resources of a country for no apparent reason; in other words, a truly absurd waste of (human) capital. The palpable economic folly that this entails has been analyzed by leading economists and proposed as a fundamental factor hindering the progress of many developing and emerging countries. (The Economist, 2017b)

Noted commentators have advanced this argument, possibly in a more subtle and diplomatic fashion; still and all, the fundamental message is the same, absolutely true and bears to be repeated, repeatedly: “[It] will not be possible to build a knowledge-based economy and a knowledge society without first developing talented citizens [which includes women] in the UAE and ensuring that their knowledge and skills are utilized. In addition, there is a great potential for the government, universities, and industry to collaborate on addressing these issues.” (Samulewicz, Vidican, and Aswad, 2010, p. 14) As hinted at by Eroglu and Horne, “demographics” must be taken seriously, meaning that there must be female participation and leadership in the nascent innovation ecosystem of the UAE: “The goal of the UAE to become an innovative economy is to maintain competitiveness and sustain innovation rates among Emirati entrepreneurs. To enable this development, the strength and ease of technology transfers, advanced entrepreneurship education, and

networking opportunities ... are crucial. Significant changes in demographics should also be seriously addressed.” (Erogul and Horne, 2014, p. 204)

The need to move beyond absolutely economically wasteful gender bias paradigms has been articulated thus:

Given this growing gender gap, it is vitally important for the UAE’s future economy that Emirati females make their way into relevant positions in the labour market. But despite being open to the world, the UAE remains a relatively traditional society, where some citizens still view the primary role of the woman as the family care giver. According to the World Economic Forum’s Global Gender Gap Index (which is based on equality in economic participation and opportunity, educational attainment, political empowerment and health), the UAE does the best among Arab countries. But in 109th position out of 136 nations, there is still a long way to go. That said, policymakers are serious about empowering women. Gender equality is enshrined in the nation’s constitution, and the UAE is the first country in the Arab world to enforce quotas for women on company boards. It is also on the executive board of the United Nations Entity for Gender Equality and the Empowerment of Women (UN Women). (EIU, 2014, p. 7)

Thus, although the role of women as professionals in the UAE has been somewhat encouraging, particularly in the larger context of the greater GCC region, it is nevertheless still significantly inadequate with regard to advancing the establishment of an innovation-based economic transformation of the UAE. Whereas to some, traditionalism has its presumed benefits, yet also, in this emerging century, it also embodies obvious and onerous costs. In the UAE, this is of particular concern since females academically outperform males, are under represented in the workforce (indicating a large surplus of underutilized intellectual and creative human capital), and have not been coddled and thereby professionally attenuated by public-sector careers as has a large segment of the male population. (Ross, 2008; Parcerro and Ryan, 2016; Economist, 2016a)

Therefore, within the greater context of advancing the establishment of an innovation ecosystem in the UAE, and the narrow context of the multiple capacity building and program operations which would be integral to an ITEC, the leadership and professional roles of women will be critically important. As Aswad et al. note, this needs to be done systematically to be sustainable, respecting local culture, yet recognizing that the 21st century will necessitate the full mobilization and utilization of all human capital and related institutional infrastructure for UAE to successfully function in the

increasingly dynamic global innovation market: “[W]omen’s engagement in STE fields in the UAE ... is based on the assumption that qualifications in these domains are critical for sustaining the transition to a knowledge-based economy. In order for policy guidelines to successfully instigate a broader involvement of women in these fields, it is imperative that strategies reflect the local context. This is critical since a knowledge-based economy can only thrive when the indigenous context is addressed in programmes aimed to build local capacity. Finally, although it is expected that no single intervention can alter women’s STE involvement, it is hoped that a gradual implementation of policy changes at different levels may contribute to a greater realisation of the unfulfilled potential of women in these fields.” (Aswad, Vidican and Samulewicz, 2011, p. 567)

iii. Global networks

The importance of connecting to the global tech-transfer and IP community cannot be overstated. It must proceed methodically and systematically, such that UAE professionals simultaneously hone skills, build confidence and expand durable and sustainable international networks. This is a self-reinforcing feedback process which forges core competencies and thereby fosters sophistication, credibility, and trust when working in the global innovation market, whether this involves licensing, material transfers, collaborative R&D or patenting.

The ITEC can, therefore, become the operational center for focusing technical and educational programming with organizations whose charge is specifically in the area of IP and tech-transfer capacity building. For example, the ITEC can serve as host for international conferences, symposia, and summits aimed at fostering global IP and tech-transfer professional networks, whilst simultaneously building an ever-strengthening knowledge base to advance the system of BP. Networks established and professional relationships thereby forged will be the foundation for ongoing educational programs, strategic planning, collaborations, and capacity building. These organizations include:

- AUTM, Association of University Technology Managers: AUTM supports and advances academic technology transfer globally. <http://www.autm.net>
- EPO, European Patent Office: The European Patent Office (EPO) supports innovation, competitiveness and economic growth. <https://www.epo.org/index.html>

- WIPO, the World Intellectual Property Organization: WIPO leads the development of a balanced and effective international intellectual property (IP) system that enables innovation and creativity across the globe. <http://www.wipo.int/portal/en/index.html>
- USPTO, United States Patent and Trademark Office: “The USPTO’s mission is to foster innovation and competitiveness by: ... Guiding domestic and international intellectual property policy [and] Delivering intellectual property information and education worldwide.” <https://www.uspto.gov>
- LESI, The Licensing Executives Society International: encourages high standards and ethics related to intellectual property, including domestic and international licensing of intellectual property rights and transfer of technology. <https://www.lesi.org>
- CLDP, Commercial Law Development Program, U.S. Department of Commerce: “Working closely with the U.S. Embassies, CLDP has helped develop the legal infrastructure to support domestic and international businesses alike through programs in more than 50 countries.”

Dynamic programs which foster linkage to such organizations will catalyze and accelerate the formation of global networks. In the current century, viz. over the next several decades, the pace at which international knowledge-based, innovation-driven interactions and transactions occur will increase exponentially. The complexity of this should not deter bold, yet appropriate and methodical, strategy implementation, as its urgency and importance likewise exponentially increase. “The development of knowledge capacity and national innovation systems is a multileveled process and highly dependent on national context and international relationships. Knowledge enabling, as an extension of knowledge management, is the creation of knowledge through the development of social and institutional relationships and networks.” (Wiseman, Alromi and Alshumrani, 2014, p. 24) This is critically important, as linkage to the global innovation market will be integral towards accelerating the establishment of sustainable knowledge-based development in the UAE.

iv. Open Innovation system

To be entirely blunt, the UAE must adopt an open-innovation paradigm in order to rapidly establish a sustainable and dynamic domestic innovation ecosystem that is run by national talent and not “managed” by seemingly well-intentioned expat consultants who seek to transplant mature

tech-transfer systems from, e.g., the USA, into the UAE. Open innovation is the wave of the present and tsunami of the future in terms of how the global innovation ecosystem will operate. Therefore, an appropriate and carefully established set of BP in IP management and tech-transfer must be congruent with the open innovation paradigm.

Open/networked/symbiotic innovation differs from, and is inconsistent with, the time-honored closed innovation system paradigm. Closed innovation is the historically rusting, and increasingly obsolete, paradigm, perhaps best epitomized by the old corporate giants such as Kodak, consisting of an in-house, contained a straight and sequential line from basic and applied research to product development, manufacturing and sales. Open innovation, on the other hand, consists of vigorous networking with other (i.e., external) entities, R&D facilities, interacting with start-up ventures, public research institutes, universities, external suppliers and sharing and accessing outside information and technology. It is far more fluid, adaptable and organic. Dynamism and flexibility are therefore key aspects of open innovation. Hence, open innovation is the appropriate paradigm for innovation deficient (impoverished) developing/emerging countries, e.g., the GCC, to accelerate the establishment of a sustainable and dynamic globally networked innovation ecosystem.

Essential components of open innovation include:

- Networking, building contacts, meeting colleagues, creating opportunities
- Collaboration, working synergistically with partners;
- Entrepreneurship, thinking creatively to find solutions;
- IP management, maximizing value;
- Global Vision, recognizing that the 21st century marketplace is planet earth;
- Knowledge, the key asset in the global knowledge-based economy;
- Access to finance, learning how to be a magnet for investment;
- Access to information, which is the key driver of innovation.

In the emerging global knowledge economy, knowledge itself has become the key resource. Open innovation needs to be embedded in an overall national innovation and IP strategy that emphasizes the interchange of ideas, knowledge, and technology in value creation. In the 21st Century, developing countries cannot expect to do it alone, as contained units. They must

connect to the global network of information, technology, innovation and product development, wherein sophisticated acumen in IP and tech-transfer negotiations and transactions will be crucial. What is needed, therefore, is for the UAE to foster and connect to an integrated global innovation network system, with a suite of knowledge, skills, abilities, and BP which are designed to effectively and efficiently maximize success precisely in this global innovation market. (Kowalski, 2009) This will require fundamental investment in human capital and importantly, infrastructure in order to adjust to this rapidly evolving innovation paradigm: “[C]hanging modes of innovation relying more on sources from outside suggest a need for governments to build socially accessible knowledge infrastructure [human capital and appropriate institutions, e.g., TTOs] as a basis for establishing and promoting markets for technology and licensing.” (Lee et al., 2013, pp. 40)

v. Prioritization of innovations of strategic and economic importance

For both the UAE in particular and the GCC region in general, specific technological sectors should be considered and prioritized for investment and development, e.g., solar applications as a targeted strategy. The ITEC would serve as a base of operations for strategic organization and related management of IP and tech-transfer as related to these technology sectors, once again within the context of the open innovation paradigm in order to accelerate identification, access, absorption, adaptation and assembly of necessary innovation components and appurtenant IPRs or IP issues related to tangible property transfers (e.g., material transfer agreements: MTAs).

Tadros has made this point abundantly clear, articulating that “[t]he GCC states should focus the commercialization of research outcomes on areas of strategic importance to them and on providing products, services, and processes, not only to the GCC domestic markets but also to the larger markets of the region and beyond. GCC states should coordinate their STI activities and establish Regional Centers of Excellence for issues of strategic importance such as water desalination, environmental issues, and renewable energy. This will avoid duplication of efforts and enhance regional integration. GCC states should encourage the private sector to invest more in training and capacity building as well as R&D and innovation. There should additionally be more collaboration between universities and research centers and the private sector.” (Tadros, 2015, p. 2)

The Regional Center of Excellence referred to by Tadros might be analogized to the ITEC concept proposed herein; furthermore, it might be reasonably inferred that the author supports the proposition that the UAE (along with the other GCC states) should coordinate, manage and drive the process

for its own development, with its own people in charge and not by a cadre of expat consultants and ostensibly well-intentioned “partners”, e.g., the Masdar/MIT “collaboration”.

Furthermore, Tadros wisely points out that technologies and innovations of strategic importance must necessarily move beyond the narrow suite of sectors that currently predominate in the UAE, that is, those linked to an economic model dominated by hydrocarbon revenue and 20th century convention. For this to occur, sustained and committed capacity building and investment is crucial: “It is of underlying importance to ensure that innovation activities are expanded beyond the presently dominant sectors, i.e. mining, manufacturing, and business services. ... [S]ound governance of innovation policy has now been placed high on the list of overriding policy objectives for Abu Dhabi. It needs to remain there for some time.” (IKED, 2010, p. 144-145) The ITEC would be the base for operationalization of said innovation policy for development, beyond high-level aspirations and certainly far beyond prevalent show-case projects, e.g., the Masdar/MIT program (which in many ways is not unlike the astoundingly absurd Ski Dubai) to the hard and mundane work of pragmatic implementation.

Tadros cites several key technology sectors which might be of particular strategic interest for a UAE innovation ecosystem to prioritize, including renewable energy. Interesting, and perhaps ironic given the UAE’s relationship with petrol, is this emphasis on energy. Yet, this might not only be creative but also provide a globally recognized advantage for the UAE to establish precisely such expertise. Therefore, the potential of renewable energy sources for the UAE as future prospects for focus might include:

- Photovoltaic energy
- Concentrated solar power (CSP)
- Wind energy
- Hydrogen energy/fuel cells technology energy
- Bio-Fuels
- Biomass energy
- Geothermal energy
- Hydro power
- Wave energy
- Tidal energy

- Ocean thermal energy conversion system (OTEC)
- Solar thermal project
- Solar power for water heating
- Hydrogen power plant (Jamil, Ahmad and Jeon, 2016)

Although handicapped by the resource curse (that is, the so-called “Arab Disease” discussed hereinabove) and all that entails, the UAE is perhaps in a better position than other developing/emerging countries in several important ways, particularly in physical infrastructure and nascent programs which have significant potential if, and only if, the UAE strategically focuses domestic human resources to build human capital and talent in order to sustainably forge a truly UAE driven innovation ecosystem. As articulated by Mahroum, et al, the UAE has indeed “witnessed the mushrooming of institutes of higher education over the last decade, some of which have a strong research component. Growing from only nine universities in 2000, the UAE is now home to more than seventy-five universities and institutions of higher education. As is the case with all countries, however, the UAE cannot afford to specialise across all scientific fields. Most [of] its research and scientific activities have concentrated on key and strategic pockets of science and technology (S&T), such as renewable energy and health sciences.” (Mahroum, Alsaleh and Kanhere, 2013, p. 25)

These research programs could represent a launch pad for subsequent intensive, UAE-centric capacity building, which should gradually supplement, and then ultimately replace, what is currently an over-reliance on foreign expat “assistance”. Such an over-reliance is strategically unsound and sustainably untenable given the likely permanent drop in global oil prices in what has been termed the “oil price shocks”. (Berument et al., 2010) Therefore, the current initiatives can, with guidance from and the involvement of the proposed ITEC, form the basis for rapid expansion of the UAE innovation ecosystem via a more dynamic capacity building program and engagement with the global innovation market through a strategic open innovation paradigm of transactions; a list of current technology/innovation initiatives and projects includes:

- Masdar Institute in the UAE, as already discussed, was launched in 2006 by the Abu Dhabi Government; “an ambitious undertaking to transform the emirate’s oil wealth into renewable energy innovation and clean energy leadership ... was established through close collaboration with MIT.” (Mahroum, Alsaleh and Kanhere, 2013, p. 25) The question which remains is who is actually running this

initiative? Assuming that this is the flagship initiative of the UAE, and that MIT is actually in charge, as might be the case, does this suggest that real capacity building towards a UAE driven innovation ecosystem is occurring; or, as previously noted, is this only a larger, more showy and sophisticated continuation of the expat-driven model of “development”?

- Recent medical innovations in the UAE might be exemplified by the work of the U.S. expat Dr. Samih Tarabichi, who moved his practice from Tampa, Florida to the American Hospital in Dubai, with more than 700 surgeries a year: joint replacements for treatment of the phenomenon known as “Arab knee” or “Middle Eastern knee” by the global community of medical specialists. Whereas most artificial knees have a flexion at a maximum 120 degrees, Dr. Tarabichi (in collaboration with Zimmer, an American manufacturer of orthopaedic products) has developed a knee implant that can bend as much as 150 degrees. (Mahroum, Alsaleh, and Kanhere, 2013, p. 26) This is a praiseworthy and notable accomplishment, by an expat in collaboration with a foreign company. But is it really an example of UAE-driven innovation?
- DUBAL (The state-owned Dubai Aluminium Company Limited, the industrial flagship of the UAE) serves more than 300 customers from 50 countries. Capacity at the plant has expanded more than sevenfold over the past 30 years. Notably as an example of innovation-driven development, DUBAL has a dedicated technology development and transfer department that strives to improve technology and production processes, licenses technology (presumably patent rights as DUBAL appears to have filed, at least six, patent applications over the past two decades) and also provides start-up support and operations, training and skills development. (Mahroum, Alsaleh and Kanhere, 2013, p. 28) As such, DUBAL might represent one of the best examples of a truly UAE managed and led research and innovation enterprise, complete with IP management and tech-transfer expertise and practices along with nascent capacity building efforts.
- A UAE-based enterprise, RAK Ceramics produces a remarkable product: the world’s first ceramic tile to reduce microbial contamination and contribute to a healthy environment. To its credit as an exemplary enterprise in terms of global collaboration, RAK has agreements with designers and laboratories in Italy and Spain to support the development of its highly innovative products. RAK Ceramics is therefore somewhat of a model for other organizations in the UAE to

emulate, i.e., a UAE led enterprise which had established solid global networks, consistent with the open/networked/symbiotic innovation concept. (Mahroum, Alsaleh and Kanhere, 2013, p. 28)

It is therefore crucial, entirely sensible and quite logical for both the benefit of the UAE and the GCC region, that said specific technological sectors should be considered, continue to be cultivated and fostered by the UAE, and those additional sectors should also be considered and prioritized for future investment and development. There is no lack of possibilities, and the candidate list might be organized with respect to several considerations, including, as discussed hereinabove, what is already in place as well as what is of importance to the UAE as well as the GCC region and its environs. Indeed, as Weber has wisely elucidated (albeit for Doha, yet still entirely applicable to the UAE): “The city of Doha is struggling with severe liquid and solid waste management problems due to the tripling of the population and the rapid expansion of the city in the last decade. Prioritized areas that highly impact the nation [and therefore deserve careful consideration include]: water desalination, alternative energy (photovoltaic and concentrated solar power), biofuels, gas to liquids technology, energy and water efficiency, environmental management, genetic diseases, and diseases of affluence (obesity, cardiovascular disease, and diabetes).” (Weber, 2014, p. 66) For the UAE, the ITEC can be the institutional base of operations to facilitate and catalyze similar, critical and appropriate innovative R&D endeavors.

vi. Engage SMEs in the emerging Innovation Ecosystem

SMEs are global drivers of technological innovation and economic development. Perhaps their importance has been somewhat eclipsed by the mega-multinational corporate entities. However, SMEs represent the grass-roots dynamism of economic growth, innovation development, and entrepreneurial dynamism. Therefore, as key drivers of technological creativity, SMEs propel long-term growth by facilitating innovation and its diffusion across local, national, regional and international networks and markets. However, innovation immediately implies and involves IP and the concomitant need to address IPRs management and tech-transfer. Hence, to realize the maximum value of innovation, SMEs need to recognize, understand and manage IP in order to accelerate their innovations towards commercialization. This will, in turn, not only improve their business revenue flow, but ultimately raise the standard of living in their respective countries. An understanding of, respect for and capability in BP thus forge an essential link in the economic/technological development chain, between creativity/

invention, on the one hand, and innovation/commercialization, on the other. (Kowalski, 2009)

Therefore, in the context of open innovation, SMEs need to learn about IP BP, to connect to global markets and thereby advance innovation, and tech-transfer. IPRs are thereby not only protected, but are, just as if not more importantly, transferred, licensed, bought and sold and leveraged as a means to maximize value and build a sustainable intangible asset base to foster invention, drive innovation and promote commercialization, i.e., as both tools and assets for lowering transactions costs in tech-transfer and innovation management. The ITEC proposed herein can serve as the educator which builds such capability and capacity into UAE SMEs.

vii. Foster Public-Private Partnerships (PPPs)

Throughout the vast body of prevailing literature relating to IP, its management, tech-transfer, and international development, there is repeated mention of public-private partnerships (PPPs). However, what are PPPs? Comprised of partners from the public (e.g., universities) and private (SMEs) sectors, they typically are shared, collaborative ventures directed towards a common objective (e.g., tech-transfer of drought, insect or heat resistant crops to the Middle East region). Whereas, motivations and expectations of the individual partners likely vary, the shared purpose drives PPP formation and ultimately success. Partners participate in coordinated and cooperative decision making, expertise, resources, contributions and (yes, even) risk (Widdus, 2005). PPPs, therefore, can have a significant impact by facilitating and accelerating access, absorption, adaptation, assembly, and deployment of advanced innovation in developing countries. In addition, as the movement of innovation is global, the need for capacity in IP management and tech-transfer crucial, and the engagement of SMEs integral, recognition of the importance of PPPs in development is correspondingly paramount.

Participants in a PPP might include organizations at all points (logistical, temporal and locational) along the value chain, including developing country institutions, multinational corporations, government laboratories and agencies, universities, suppliers, purchasers, national or international research centers and philanthropic foundations (Gregory et al., 2008). Familiarity with the many parameters that influence IP management tactics and strategy (e.g., information access, assembly and analysis, assessment of markets, evaluation of candidate technologies, knowledge of regulatory landscapes, complexities of tech-transfer and expertise in the practicalities of delivery) enables PPPs to provide dynamic and flexible business models that pool skills, focus funding, and formulate strategy to identify challenges

and overcome bottlenecks. This reduces transaction and opportunity costs that might otherwise obstruct, delay or even prohibit the timely movement of key innovation pieces, i.e., once again within the paradigmatic context of open innovation.

With regard to IP and PPPs, e.g., IPRs and their management should neither be regarded as barriers nor obstructions but rather viewed as a tool to facilitate/accelerate access to and assembly of innovations critical for development. (Wheeler and Berkley, 2001) Hence, a PPP's objective is not (necessarily or solely) to manage IP in the standard context as legal, proprietary means to exclude (and file infringement suits and related legal actions), but rather IP as a means for establishing control, coordinating partners, mitigating risk, lowering transaction costs, defining objectives, sharing outcomes, and accelerating access to the most advanced and appropriate technologies for any given purpose. PPPs, therefore, reconcile the possible divergent IP practices and paradigms of partners, while being compliant with a recognized, fundamental and harmonized system of BP, with benefits to both the private and public sector organizations: for the private sector partner, reducing risks associated with emerging markets as well as creating longer-term access to said markets, and for the public sector partner, advancing food security, energy resources, public health and stabilizing sustainable economic development.

viii. Use information strategically

Access to information drives innovation; albeit a somewhat trite aphorism, it summarizes a critically foundational aspect of a key operation of an ITEC. The term access, as used here, means the ability to rapidly identify, sort, analyze and use complex sets of both patent and technical information (non-patent literature), in order to formulate knowledgeable strategic options towards accelerating innovation development and deployment.

In terms of managing information strategically, patent information and data are essential for accelerating establishment and sustained success of an innovation ecosystem in the UAE. The potential application and use of patent information are quite deep and broad. For example, it can serve as a great resource to identify and target research that is being conducted in the private sector (which is often not published in public resources), stimulate new ideas and importantly prevent the reinvention of the wheel (a painful, and even humiliating, waste of human and financial capital). In general, a patent search identifies relevant categories of patents, pending patent applications, and can be extended into a search of foreign (national or PCT) patent documents and also non-patent literature to effectively complement

patent information. In the context of open innovation, access to information will enable efficient formulation of strategic options, e.g., identifying potential collaborators, optimizing research efforts, categorizing tools/protocols that may hasten or improve product development and launch of a new product to market, determining FTO, where to file a patent application or enforce patent rights.

Furthermore, patent data can be culled and organized from open, web-based patent databases such as the USPTO (<http://patft.uspto.gov/>), Espacenet (<https://worldwide.espacenet.com/>), WIPO Patentscope (<https://patentscope.wipo.int/search/en/search.jsf>), or a variety of proprietary patent database platforms (e.g., Thomson Innovation, <http://info.thomsoninnovation.com/>). These databases are an invaluable resource, a veritable gold mine of informatics which can be utilized simultaneously for four distinct, albeit in reality overlapping, strategic purposes:

- 1) From a business perspective, patent information can help develop commercial strategies by monitoring patent portfolios of competing and/or complementary organizations, patent activity in particular geographic markets, and/or estimate the value of patents as well as develop new R&D strategies by identifying new application areas of existing patents, developing new products or improving existing products.
- 2) From a legal perspective, patent information can help to formulate options as to where to file patent applications (i.e., in which national jurisdictions), enforce or defend rights, ascertain patent ability within the context of patent statutes and/or to facilitate assembly of patent pools. In addition, patent information can also help businesses and lawyers develop an informed licensing strategy and formulate FTO analyses, options and possibly opinions.
- 3) From a scientific perspective, patent information provides detailed technical explanations of often complex innovations and is complementary to scientific and technical publications (non-patent literature).
- 4) From a policy agenda perspective, patent information can help determine the level of innovation, degree of foreign investment, and the tech-transfer capacity of a country, e.g., the UAE. For example, the proportion of patent filings in a country from foreign or domestic sources can be determined, thereby inferring the level of innovation in the country's R&D system. This can then guide in institutional and even national science, technology, and innovation policy,

and even help to conceptualize, formulate, and draft applicable and appropriate legislation (e.g., Bayh-Dole-type legislation to facilitate tech-transfer).

Patent searches which are tailored to answer specific questions are generally categorized accordingly:

- Patentability/novelty search
- Validity search
- FTO (“product clearance”) search
- File wrapper search
- Assignment/inventor search
- Landscape search

For the UAE, patent landscape searches are fundamentally critical to build its innovation ecosystem, providing data that can serve as a basis for subsequent use and strategic application. As such, patent landscapes represent a key BP to be institutionalized within an ITEC. Operationally, patent landscape searches entail the broadest overview of a given field of technology, and thus create an informational platform that can subsequently be analyzed for other sundry purposes. That patent landscape generation relies on such an eclectic assembly of information sources underscores this. For example, patent landscapes can include search and analysis of relevant patents (active and expired) along with non-patent (technology reports, scientific journals, conference proceedings, dissertations) literature. Therefore, patent landscape searches can be especially useful for technology development or tech-transfer purposes, since they corral a very specific, albeit broad, body of information. Furthermore, patent landscapes can also identify “patent family” information (the global reach of patents), and can thus be extraordinarily useful to formulate commercial, technical as well as strategic options.

Why are patent landscape searches an essential BP for the UAE to adopt? The reason is related to the actual developmental circumstances in the UAE, and the role that patent landscape searches play in building the critical informational component of the nascent innovation ecosystem. Patent landscapes can provide a broad overview of a technology or industry over time and location. Therefore, their application to the circumstances of a developing country needs to be in the context of the open/symbiotic innovation paradigm. A summary of such applications includes:

- Identifying gaps and clusters in technology,

- Developing R&D strategies,
- Identifying new application areas of existing patents,
- Developing a licensing strategy,
- Monitoring patent activity in particular geographic markets,
- Identifying potential competitors,
- And most importantly, identifying possible collaborators or in-licensing, cross-licensing opportunities.

The importance of patent information (and critically cardinal appurtenant non-patent literature) is underscored by the Development Agenda for WIPO. But, one might ask, just what is the Development Agenda for WIPO?

The WIPO Development Agenda ensures that development considerations form an integral part of WIPO's work. The effective implementation of the Development Agenda, including the main streaming of its recommendations into our substantive programs, is a key priority. The adoption of the Development Agenda was an important milestone for WIPO. The Agenda was formally established by WIPO's member states in 2007, in a decision which included the adoption of 45 Development Agenda recommendations, grouped into six clusters, and the establishment of a Committee on Development and Intellectual Property (CDIP). At the 2007 General Assembly, WIPO Member States adopted 45 recommendations (of the 111 original proposals) made by the Provisional Committee on Proposals Related to a WIPO Development Agenda (PCDA). (WIPO, 2007)

In the 45 Adopted Recommendations under the WIPO Development Agenda, seven either refer directly to, or imply from their language, the critical role of patent information in a dynamic innovation ecosystem (Recommendations 8, 9, 19, 24, 27, 30, 31). To best illustrate: "Recommendation 31. To undertake initiatives agreed by Member States, which contribute to the transfer of technology to developing countries, such as requesting WIPO to facilitate better access to publicly available patent information."

Whereas it might be argued that patent databases and patent informatics are ancillary to policy development, the truth is that poorly informed strategy, particularly in the context of IP, tech-transfer and innovation management, is worse than useless; it is hazardous. Therefore, a key function of an ITEC in the UAE must be the establishment of advanced expertise in patent databases and their judicious use and appropriate application to foster the

development of an innovation-driven, knowledge-based economy and globally networked open/symbiotic innovation ecosystem.

ix. Build the Triple Helix

As the esteemed former President of AUTM, Dr. Ashley Stevens, has so eloquently articulated, “The term ‘triple helix’ [is] the intertwining of academia, industry, and government to create research driven high technology clusters, a theory of economic development, the cooperation between government, academia and industry in action, dynamic and generating widespread, sustainable and beneficial outcomes and opportunities.” (Stevens, 2007) Dr. Stevens’ clear and wise exegesis illuminates the catalytic dynamism which a truly operational triple helix encompasses and indeed embodies.

In the UAE, a triple helix system is (at best) nascent. Essential components, along with the vital connections, are simply missing: “an immature innovation system can be depicted, where the UAE lacks a number of crucial pillars such as flows of networks between science and industry, in addition [to questionable] education system quality and postgraduates [with a corresponding] lack of technical people and engineers” (Al-Abd and Mezher, 2014, pp. 121)

The establishment of a vibrant triple helix system in the UAE is critically essential because it represents a sustainable systematic strategy for economic transformation:

“It is no easy task for a state to transform into a knowledge economy, because a successful knowledge economy rests on an intricate relationship between, entrepreneurship, motivation, enabling economic and institutional regimes, and so forth [e.g., the triple helix system]. Establishing a knowledge economy entails much more than just having a well-educated population; it is about a special mindset dominating such societies – a mindset that focuses on building and winning opportunities, on visions, and on creating a vibrant home base for globally competitive business [e.g., a dramatic paradigm shift]. [S]uccessfully establishing a knowledge economy requires a broader change in culture which focuses on citizens’ participation (in economic activities), *ownership of processes and active learning* so that motivation, aspirations and entrepreneurship will become an intrinsic ethos of the individual.” (Hvidt, 2015, p. 26, emphasis added)

Therefore, the triple helix will verily be the vehicle, driven by UAE IP/tech-transfer professionals (note Hvidt's use of "ownership"), whereby the UAE traverses to this entirely new economic and societal paradigm.

x. Invest in Human Capital development

For the UAE to execute a smooth implementation and sustainable establishment of its IP-related development strategy, education and training of personnel needs to be addressed in a methodical, coherent and practical manner. The ITEC can be the center of excellence which makes this happen. The UAE needs to view building human capital as an indispensable long-term investment, yet highly cost-effective in that it will yield benefits and value far in excess of any initial investment. This, in turn, will foster enhanced ability in licensing and partnership development and thereby catalyze indigenous R&D, tech-transfer and innovation commercialization. Therefore, strategic and practical training programs in BP will significantly stimulate and enhance proactive and efficient management of IP and tech-transfer.

As articulated by Pefile and Krattiger (2007), to ascertain specific needs of personnel, and thereby design educational programs that build appropriate levels of knowledge, skill, ability, confidence and related human capital, the following five questions should be asked and then addressed:

1. What knowledge and skills are required for optimal operation of a technology transfer/IP office and therefore required among the management and administrative staff?
2. What IP related knowledge and skills are required for the research staff?
3. What are the communication gaps with respect to IP both within the institution and with third parties?
4. What are the particular elements of IP policy that seem least well understood and implemented?
5. What resources are required to bring knowledge and skills to the required levels?

In addition, the institutional infrastructure of TTOs, i.e., their personnel organization and operations, will need to be developed such that they are operationally appropriate to the requirement and priorities of the UAE. Organizational charts of TTOs in the developed countries, possibly provided by AUTM, might serve as an approximate guide, a starting point from which to modify and build. This underscores the importance of the

institutional foundation as an anchor for human capital in the UAE, for accelerated sustainable, efficient, appropriate and successful developmental diversification and transition.

Within the context of ITEC operations, education and training programs can also be designed and targeted towards specific constituencies in the UAE, as a means for focused, comprehensive and ongoing development of an innovation conscious, IP aware, entrepreneurially driven UAE workforce, comprised of the best, brightest and most committed women and men. Said constituencies might include researchers, the legal community (lawyers and judges), tech-transfer personnel and managers, government officials and policy makers, business people (e.g., SME personnel) and professors and teachers at all levels. Perhaps most importantly, this must include primary and secondary level school teachers, as the new paradigm of an innovation-driven, knowledge-based UAE must begin with the next generation of the UAE's citizenry, the boys and girls who will become the future leaders of the country and region.

VII. CONCLUSION

Although the UAE appears to be a country with high potential in science, technology and innovation, potential is still just that- potential. Much more needs to be done to realize such potential, i.e., to make it tangible reality. This has been clearly elucidated by many expert commentators, with the gaps inherent in the system sorely in need of attention highlighted (albeit without any articulation of an action plan to remedy):

The UAE government should establish a national innovation plan, policy, council, and support program with more attention given to those factors that enhance the technological capabilities. It should provide specific reforms to improve its national competitiveness through innovation in different areas related to technological capabilities. Also to build a strong domestic innovation base, tackling new technological changes and competitive challenges. This will enable the UAE economy to depend on the performance of its national innovation system and its innovation diffusion. ... [A]lthough literacy percentage is remarkable, ... efforts must be made by policy makers to elevate the status of research, by spending higher share of the state budget on R&D, and by encouraging scientists for filing more number of patent applications. (Khayyat and Lee, 2015, pp. 216)

How might the UAE, in a truly pragmatic and strategic manner, realize said potential? In other words, how can “should be” become “will do”? The transition towards becoming a knowledge-based, innovation-driven economy can be made, not simply via lofty, inspired and (ostensibly) visionary proclamations, but only by mundane, methodical, and meticulous capacity building. The rapidly increasing systemic complexity of the global innovation marketplace is the unforgiving reality that defines the new century. (Antonelli, 2011; Baldia, 2013) However, the UAE, with its current cadre of professional ignoramuses, albeit “educated”, has neither the capability nor capacity to effectively implement a high-level vision for rapid diversification from oil to innovation, in any way approaching a sustainable manner.

As astutely pointed out by Patrick, it is not knowledge per se that builds the knowledge-economy, rather innovative thinking is based on how knowledge is strategically used: “Transformation towards a knowledge economy is not predicated merely on the development of scientific and technical knowledge, but on how groups understand and enact knowledge as process and practice. Shared aims between those who form an epistemic community are also crucial to knowledge generation, as is an individual agency.” (Patrick, 2014, p. 241)

Furthermore, advancing knowledge-based development entails a balance, with cultural components recognized, yet not impeding progress, and moving beyond traditional educational systems towards an entrepreneurial and innovative paradigm shift: “Yet, for innovation to occur at a scale where individuals, as well as whole nations, benefit, knowledge development is necessary beyond that which is passively or traditionally transmitted.” (Wiseman, Alromi and Alshumrani, 2014, p. 22) This is a step-wise process, leading to new viewpoints and attitudes suited to and appropriate for a dynamic globally innovative century: “As a result, there is a dual approach to knowledge economy development in the Gulf that may address the problem: (1) improve education to deliver knowledge and skills necessary for building human capital (functional) and (2) shift culture of Gulf nationals to embrace capacity building (cultural).” (Wiseman, Alromi and Alshumrani, 2014, p. 18)

Fundamentally, this describes building human capital and institutional infrastructure, i.e. strategic, focused and appropriately applied capacity and capability in IP management and tech-transfer. Such a comprehensive and broad transformation will entail shocks, since it must not only transpire rapidly but also coherently. Establishing a sustainable triple helix system in the UAE will absolutely require the appropriate application of BP in tech-transfer and IP management. The UAE must, therefore, be fully aware

of the challenge and its implications. “[The] UAE government should focus on developing a highly innovative entrepreneurial sector and on supporting high value-added new companies that have the potential to grow and to develop internationally. For this to take place and to create effective support programs that add value, policymakers and business developers need to collaborate with universities and research establishments to develop support systems that work towards supply-oriented policies by focusing on innovation, infrastructure, and ecological sustainability, rather than on the traditional tools of local demand.” (Erogul and Horne, 2014, p. 185) Underscoring the fact that a UAE innovation ecosystem can neither exist nor subsist in a vacuum, it is crucial to note that it can only function effectively in a suitable/compatible intellectual/cultural milieu, that is, congruent societal and cultural ecosystems which then foster and provide positive feedback for sustainable transformation. In this regard, the ITEC is the vehicle to move UAE society to that stage of development where informed coordination among all stakeholders (university, government, and private business sector, e.g., SME community) accelerates sustainable progress.

Therefore, the hard work of building an innovation ecosystem, involving disciplined and tactical efforts and investment, is sorely necessary. As with any other large endeavor, it requires commitment and a realistic acceptance of risk. Over-reliance on well-paid expat consultants, and even organizations (such as MIT), which dominate current IP and tech-transfer capacity building initiatives in the UAE, is not a sustainable approach. Their seemingly benign presence only delays the inevitable day of reckoning when the UAE must assume leadership and ownership of its own development, chart the course (verily through uncertain and risky territory) and become the captain of its own destiny. Therefore, the time is nigh for the UAE to build, foster and sustain its own system of BP in IP management and tech-transfer. The global innovation market beckons. The future of the UAE, and quite possibly the entire GCC region, hangs in the balance.

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