Teaching Entrepreneurial Business Strategies in Global Markets: Comparison of CleanTech Venture Assessment in the US and China

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Abstract: The recent focus on the development of a 'circular economy' in China, commitments of global industries to green their supply chains in China, the availability of government underwritten 'venture funds' to provide a 40% match on foreign venture investment, and the on-going overhaul of China's patent system, are driving a new CleanTech innovation pipeline in China and prompting emphasis on global entrepreneurship in courses at US and Chinese Institutions. At the University of Michigan, we have integrated a focus on technological and social enabling features in our entrepreneurship courses taught to scientists, engineers, and MBAs. The objective of this course element is to allow the students to: (i) distinguish between entrepreneurial economic value creation in the US, China and other emerging economies, (ii) discuss approaches for countries to move up the value chain, and (iii) apply this approach using living case studies in the CleanTech space, both using US and Chinese companies located at the Suzhou Industry park (SIP). At the Suzhou Institute of Sichuan University, similar course elements are taught in seminar format to evening MBA students from the Shanghai Region. The objectives here are to introduce the students to entrepreneurial business fundamentals and venture assessment tools focused on company and product positioning strategies, entrepreneurial finance, and business model evaluation. The cross-cultural entrepreneurial education experience, enabled with real time video feeds, has allowed both the instructors and the students to gain insight in the global differences in entrepreneurial business development strategies and opportunities in response to macroeconomic strategy shifts.

Introduction

Two major economic forces are shaping China's economic growth. The first one is characterized by ever-increasing demands for energy, water and raw materials, escalating carbon and waste emissions, and mounting consumption needs of industry and a rapidly growing urban population. In order to achieve sustainable economic development and to help achieve the central government's impressive energy efficiency, emission reduction and resource consumption targets, the successful introduction and adoption of leading, scalable cleantech solutions across industrial and consumer sectors are essential.

The second is that China's long-term growth strategy plan is framed by innovations up the value chain, rather than by outsourced manufacturing alone. In fact, outsourcing is only responsible for 10% of all jobs in China, and 28% of value add (Economist, April 16 2009). These innovations are increasingly focused in the CleanTech opportunity space, with a focus on efficiency, alternative energy production and clean water. Energy and water security are at the core of China's continued social, economic and political development, and China is well on its way to being the most important energy market in the world. Massive amounts of capital will be required to finance the deployment and development of cleantech in China. The National Defense Resource Council conservatively estimates that $251bn will be spent on domestic renewable energy capacity alone.

For China to move up the value chain, a number of social and technical enablers for entrepreneurial value creation need to be in place. A recent article in the Economist highlighted the main drivers that allow for the emergence of entrepreneurial economies. Social enablers discussed include: (i) Breakdown of managed capitalism resulting in a shift in risk and security attitudes; (ii) Institutional support (e.g. universities), resulting in shifts towards value creation and innovation; (iii) The role of media which has helped to shift entrepreneurship from a niche occupation to mainstream (e.g. 'naming and shaming' competition; World Bank Report); and finally (iv) Government support for broad-based (across the political spectrum) pro-business regulatory and credit access. Technological enablers that were mentioned include: (i) Cheap internet-based platforms for interactive businesses; (ii) Dynamically scalable (and often virtualized) Internet service resources (e.g. cloud computing); and Mobile access to regulated markets such as telecoms, driven by touch-screen technology and fast wireless networks.

It is generally accepted that the preeminence of entrepreneurship in the US is enabled by social elements such as the acceptance of risk taking, the freedom to hire/fire, exposure to rewards for success (meritocracy), and a mature VC industry. The close relationships between universities and industry, transparent IP processes, open immigration policies (25% of US startups; 52% of Silicon Valley startups), and propensity to 'venturesome consumers' (i.e. early adopters) further enable an entrepreneurial economy. Hence, lessons are to be learned not only by developing economies, but also by states that were previously heavily reliant on manufacturing (e.g. Michigan) to move up the value chain (Figure 1), in terms of investments, policies, and cultural shifts that need to take place.

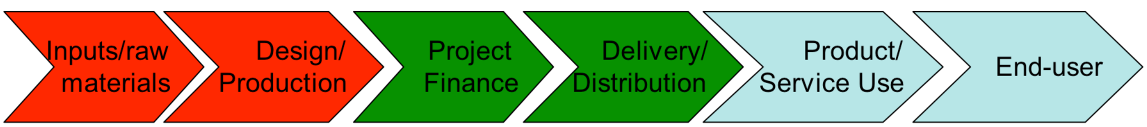

Figure 2. Illustration of shift from manufacturing (green) to product innovation (red) on a generic value chain.

Testimony to China's move up the value chain are the construction of sprawling science and technology parks throughout the country, adaptations in business and engineering curricula to address this new paradigm, and the availability of government underwritten venture funds for startup companies in high tech, biotech and cleantech (Wooldridge, 2009).

Teaching Objectives

The goal of integrating global entrepreneurial business strategies in US and Chinese engineering and business curricula is to discuss and identify differences in entrepreneurial business development strategies and global opportunity shifts in response to economic disequilibria. The specific objectives are to: (i) understand the enabling technological and social drivers that render entrepreneurship successful; (ii) teach entrepreneurial business tools for technology venture assessment; and (iii) apply these tools and drivers to an opportunity space (here: CleanTech).

One of the authors (PA) has developed and maintained business and educational ties with one of the technology parks (Suzhou-Singapore Industry Park, SIP) since 2007, resulting in a current appointment as a Chaired Professor of Entrepreneurship in the Suzhou Institute of Sechuan University (SISU), one of the higher education academic institutions affiliated with the SIP. The focus of the collaboration has been on CleanTech innovation in the drinking water and energy efficiency space. He has held seminars for MBAs from the broader Suzhou-Shanghai region on CleanTech Innovation, and has developed collaborative proposals for technology development and for validation of patent claims of SIP-funded startup companies.

Approach

The methodology for the education program considers the following elements and is briefly described below:

1. Identify technological and social drivers for successful entrepreneurship with application to China as an innovator in CleanTech;
2. Discuss and apply entrepreneurial business fundamentals tools for venture assessment;
3. CleanTech company assessment: US vs. China.

The context for the educational elements is based on course elements instructed at UM and SISU to engage engineers/scientists, MBAs and cleantech startup companies. At the Zell Lurie Institute for Entrepreneurial Studies, we believe it is valuable to think of the continuum of new venture formation and growth as a series of development phases: Identifying opportunities and shaping them into business concepts; Feasibility analysis and assessment; Creating an actionable business plan; Launching the business; Growth and exit strategies (Figure 2).

Business Fundamentals   *CleanTech Venture Assessment/SISU*

CleanTech Entrepreneurship/SISU

Figure 2. Business development phases, and alignment of core courses for UM-SISU partnership

Our emphasis in course development is to focus on the early phases, where the complementary skills of both the engineers and the business students are crucial, and innovation opportunities are honed. Opportunity identification, for example, takes two forms: 1. Finding an optimal market opportunity for a given technology and 2. Identifying an emerging market opportunity and determining what technology may be necessary to exploit it. This is encapsulated in the following courses: (1) Entrepreneurial Business Fundamentals for Scientists and Engineers, (2) CleanTech Entrepreneurship, and (3) CleanTech Venture Assessment.

The first two courses capitalize on the core expertise of the two groups of students and professionals we engage at UM: Business students well-steeped in market opportunity identification instruction in their standard curriculum, and engineers who tend to address technological uncertainties while ignoring market needs. CleanTech Venture Assessment leverages the UM/SISU MBA background in corporate strategy and business finance to work with entrepreneurial startup companies in this space. For reasons of brevity, and because of the focus of the REE conference on the Asia Pacific Region, this paper will highlight aspects relevant to China's cleantech development.

1. **Technological and social drivers for successful entrepreneurship and application to China's emergence as a CleanTech innovator**

As indicated earlier, strategies for developing countries (or states) to move up the value chain and transition into a more entrepreneurial economy require that a number of key enablers are in place. The students learn of the impact of these enablers have on driving innovation in the CleanTech space, and compares Michigan to China.

University-Industry Relationships: One of the largest parks developed to date is the Suzhou Industry Park (SIP, http://www.sipac.gov.cn), near Shanghai, in Jiangxu province (Figure 3). Initiated in 1998, in cooperation with Singapore, the SIP has attracted 12,882 projects from foreign-owned and domestic companies since 2006, including 66 Fortune 500 companies. In addition, the SIP is home to over 500 startups, supported in part by a $2.5 bn. venture fund in syndication with domestic and global VCs. One of the reasons for the successful syndications is the 40% match on the dollar China offers to foreign investors, in addition to other risk-sharing guarantees and services.

Figure 3. Suzhou Industry Park

The technical and business innovation pipeline for SIP is derived, in part, from a higher education initiative (Dushu Lake High Education Town, DLHET), which accommodates many key laboratories (Chinese designation for National Laboratories), engineering research centers and dozens of domestic and foreign universities (e.g. University of Science and Technology of China, University of Liverpool, National University of Singapore, Hong Kong University, Cornell University). In addition, within a radius of 250 km from SIP, there are over 200 universities and higher education institutions with a total output of 260,000 graduates every year. Annually, over 30,000 professionals join SIP for their career development. The new industries supported within SIP by domestic and foreign inventions (intellectual property can be held in China, US or Europe) account for 60% of SIP's total industrial output. Approximately 20% of the companies are focused in the CleanTech space, focused on drinking water and energy production production for Shanghai, sustainable aquaculture which makes up 28% of economic output in the Yangtse River Delta, and green infrastructure (building) technologies.

Government Policies: Establishing reliable supplies of domestically sourced renewable energy will be a major challenge and opportunity for China going forward. Biomass generated biodiesel and bioethanol, wind, hydropower and solar energy are all part of this mix, however, they vary in their respective stages of technological and commercial development and relevance in meeting China's social, economic and environmental challenges. By 2020, Beijing has mandated that 15% of the nation's power come from renewable energy sources, as well as, by 2010, mandates for 20% reductions in energy intensity, 10% reductions in key pollutants such as sulfur dioxide, and a 20% reduction in water consumption are to take effect. China's government is providing a favorable environment by granting feed-in tariffs for renewable power, targeting energy intensive enterprises for significant and documented energy efficiency improvements (supported by the Chinese stimulus plan). In addition, water is an increasingly scarce resource with supply constraints set against rising consumption. Pollution is aggravating the shortage, contaminating supplies. Significant growth in private sector ownership and management of water infrastructure is expected. Lastly, the role of agencies charged with energy policy and environmental protection is strengthened, allowing for a more open debate around the environmental impacts that rapid industrialization has had on the country.

Venture Investment: Current global investment (2008) in CleanTech is on the order of $8.4 billion, making it the third largest investment space. Chinese companies raised $430 million in venture capital (5.1 % of global), as compared to $ 4.6 bn in the US. Solar companies accounted for more than half of the investments in China. To date, public markets have exhibited a strong appetite for cleantech offerings from China's solar PV manufacturing sector. The exit market for domestically developed technologies, energy efficiency plays, or developers of domestic clean energy capacity may reemerge along with advances in the broader IPO markets as the global economy improves. That said, most investment has been in the business expansion stage of CleanTech companies, rather than on early stage ventures. In the 2008 China CleanTech Investment Forum in Shanghai, discussion centered around the opportunity and differentiation for Chinese innovations in CleanTech. Currently based on low cost manufacturing alone, this is not sustainable, necessitating a move to technological differentiation and high margin products (as opposed to low margin volumes). Since CleanTech is dominated by private equity, investors have high expectations for "A round" venture capital investment and generally low risk tolerance for technology and market uncertainties. Excitement about investment in China's CleanTech industry is high because of its clear policy signals, China's stimulus package, and government support in this space, according to a recent Deloitte report. In 2009 the Obama Administration has since lauded in a major policy change (encapsulated in its own stimulus bill) to ensure that the US will not be left behind in the global drive to 'green the economy' and create jobs.

One of the major challenges in industry parks focused on incubating startup companies, as identified by Dr. Xijun Zhang, Business Development Director of SIP, is the absence of a core competence for entrepreneurs and investors to screen entrepreneurial venture opportunities for attractive exit strategies. This is in part due to the current emphasis in later stage companies, which are in growth mode and are profitable in China. If China wants to move up the value chain, venture capital has to acquire the expertise to vet early stage companies. This is particularly true in CleanTech, because of the challenges for successful venture deals in this space: (i) long development and investment cycles; (ii) large scale infrastructure investment; (iii) dependence on uncertain energy and environmental policies; and (iv) immature knowledge and connectedness of entrepreneurs and investors in the industry. For the last year or so, the SIP in general and SISU in particular have been reaching out to US and European institutions, and initiated the development of 'enterprise institutes' to help develop a core expertise on entrepreneurial business fundamentals in general, and to support analysis of strategic opportunities for China and Suzhou in the CleanTech space in particular.

2. Entrepreneurial business tools for technology venture assessment.

Technology-based entrepreneurship, regardless of the opportunity space, requires a mixture of technological and business skills. Our aim in teaching global entrepreneurship, which focus on CleanTech, is to (i) enhance the blended strengths of engineering and business students, not turn each into the other, and to (ii) provide the students with the flavor of the impact of regional cultural and policy incentives on the business design.

Most entrepreneurial curricula begin with a course on some form of writing a business plan. The message to students is that all their ideas are worthy of converting into detailed operating documents. They are not. These ideas must be screened and assessed. The entrepreneur's time, after all, is the most precious resource of all. There is no sense wasting it on an idea that is unlikely to be economically successful, based on business fundamentals. Similarly, many startups, even those that have received funding, are often searching to articulate the value proposition, in part because they (at least in early stages) too technology-centric. The good news is that there is increasing attention being paid to determining the feasibility of the business. More and more institutions are beginning to look at teaching methodologies to assess the feasibility of a proposed new business.

To address the need for having the student understand the value of early entrepreneurial business assessment, and to allow the engineering student to de-emphasize the technology-based perspective of entrepreneurial business development, we have developed a series of teaching modules. These modules systematically test the business hypothesis formulated by entrepreneurial ventures in their business plans, and help to reposition the company and its product development. These modules include (i) value chain assessment, (ii) sustainable differentiation, (ii) entrepreneurial marketing, (iii) entrepreneurial finance, and (iv) determining the optimal business vehicle. Content-specific lectures are supplemented by live cases of early startup companies, culminating in a student-team based assessment, analysis and repositioning of the business. The sequence and tools are illustrated in Figure 4 and Table 1.

The figure shows a sequence of activities across the opportunity and solutions space, aligned with the tools needed to get to the next step. The divergence/convergence diagram allows the students to analyze the proposed solution and business concept of the startup company in the context of the opportunity space the company is attempting to enter, and the need the company addresses to capture value. At the end of the iterative analysis of the company, the business hypothesis is modified for optimum theoretical value capture. The top companies are considered for angel or venture investment by two funds managed by the Ross School of Business: the Frankel Commercialization Fund and the Wolverine Venture Fund.

The question that needs to be asked here is: what is the product concept that will be brought to market, or allows for value capture from this solution?

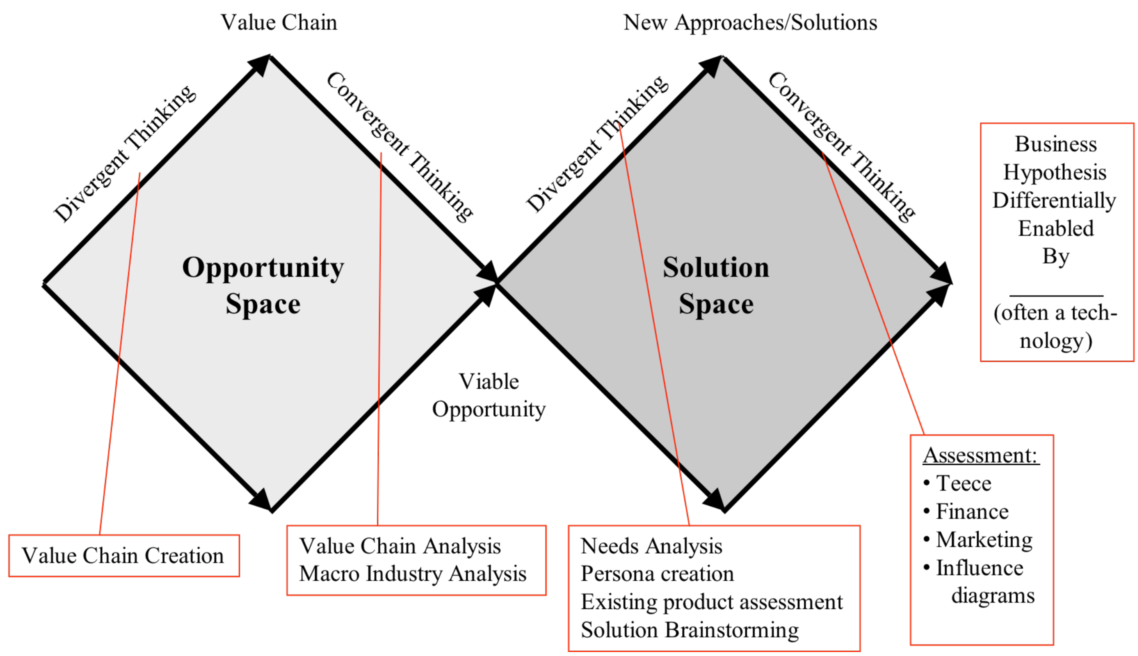

Figure 4. Course structure: From Opportunity to Technology

The students need to understand that for a technological solution to become valuable, business (How are you going to make money?) and market (How do you strategically position your business?) uncertainties need to be addressed. Following the participating company pitch, the students articulate the business hypothesis they will test using the tools taught during the content lectures. The hypothesis is based on the answers to the following questions as they understand it from the company's business plan: What is the product or service? Who are your users? Why will they use your product? How does your business make money? They then set out to conduct a number of 'tests'. The first test analyzes the operating margins of the industries currently operating in the value chain segments of the opportunity space the company is addressing. The students will compare the segment the company is positioned in to the highest margin segment, and analyze the reasons for the margins (incl. among other data a Porter's analysis). The next step involves an analysis of the challenges and pains in the actual industry segment based on credible referenced reports, and compares the company's solution to the incumbent and alternative solutions.

Using a product analysis (from a differentiation perspective), the students will conduct a Porter's analysis on the solutions segment, and identify means to sustain its differentiation. We consider here that all segments operating along a value chain are in a continuously changing equilibrium, and ask the students what the company could do to shift the equilibrium in their solution's favor. At this point, the students will evaluate the strength of the actual intellectual assets of the company (patents, knowledge, trademarks, etc…) and the type of complementary assets required (generic or specialized) to decide on the optimal business vehicle (product, service, license, partnership, etc...). The question then becomes whether this is a venture-backable company from the perspective of returns for investors and valuation of the company. The students learn to apply the levers in a custom-developed Excel-based capitalization table tool, and a valuation tool (based on the analysis of the enterprise value of the company using pure-play proxy companies). Pending the outcome of this analysis, as a function of product price, cash flow, market size, growth and technology risk assumptions, the company may or may not be attractive to investors based on the current business hypothesis. The final outcome of the project is an iteration on the hypothesis, accompanied by suggestions of how the company or product can be repositioned to capture value and be an attractive investment.

Table 1. Course modules, tools, and assessment

Module	Tool	Evaluation	Timeframe
1. Value Chain Assessment	Margin analysis (public sources)	Team	Week 1-3
2. Product Assessment	Differentiation (intellectual assets, complementary assets required)	Team	Week 4
3. Industry Assessment	Porter's 5 Forces (across value chain segments; modification of Porter, 1978)	Team	Week 5
4. Sustainable Product Differentiation	Porter's equilibrium shifts	Team	Week 7
5. Business vehicle assessment	Teece (1998) analysis	Team	Week 8
6. Market Needs	Persona (specific target customer) analysis	Team	Week 9
7. Market Segmentation	Influence diagrams	Team	Week 10
8. Integrated strategy analysis	Mullins (2003) framework	Team	Week 12
9. Entrepreneurial finance	Capitalization tables and enterprise valuation	Individual	Throughout the term

The global component in this teaching program comes in through in class discussions of how business environment parameters (e.g. policy, strength of IP, investment strategies, government support, cross-border partnerships and license agreements) would influence the business model and attractiveness of the industry segment in which the company is attempting to create value.

At UM, we have looked at US-based startup companies because of availability of business plans, engagement opportunity with the entrepreneurs, and language issues. These companies are distributed across all CleanTech segments, and have included thin film and crystalline silica-based solar, wind, electrochromic windows, batteries, smart grid, water treatment, and biomass-derived energy. Two companies have received investment from Wolverine Venture Fund (with two more in consideration) following this analysis, and six CleanTech-based business plans submitted by students that took the courses have won top-three prizes in national business plan competitions.

3. CleanTech Venture Assessment: US vs. China

One of the objectives of the course is to identify and communicate the impact of the Chinese industry parks on global entrepreneurship opportunities in CleanTech. The course modules are aimed at educating US engineers and MBAs on the one hand, and MBAs at SIP on the other hand in entrepreneurial business development skills in the CleanTech space. Differentiating elements between China and the US focus on the business and policy environment, the investment culture, and the strength of the IP.

As part of the UM-SIP-SISU interaction, for the Chinese MBAs there is a focus on the specifics of the entrepreneurial CheanTech venture enablers in China in general, and on the specific incentives at SIP in particular. For example, the park has a $ 2.5 bn. government underwritten VC fund, and a strong investment team, but no structure in place for due diligence analysis of the companies applying for the funds. Particularly due to the steep growth in CleanTech investment, and the lack of knowledge in this investment domain, the quality of the deals has dropped significantly. Hence, the focus in the SISU course modules is on pre-money company valuation methods, and structuring of investment rounds by way of capitalization tables. Specific questions include, for example: How does foreign IP influence investment rounds and exits? How does the deal quality compare to US ventures and how does this influence valuation?

As noted before, the business model of SIP and other technology parks is investment through syndication, whereby the government-backed VC fund invests in first rounds, the park provides building lease payment deferrals, and may offer a 40c on the dollar (up to $ 3 M.) co-investment for private investors (domestic or cross-border). Currently, there is a lack of exposure of the SIP-backed companies to global cleantech investors, and a lack of knowledge on CleanTech company quality for foreign investors, a need we address by teaching the screening process and tools described in 2. As more data and information becomes available on the SIP-based companies, the course modules at SISU will increasingly be based on ‘real life’ cases developed from the SIP experience.

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