Scaling Up the Innovation Ecosystem

Thomas D. Nastas[2]

Overview

BRIC, Chile, Hungary, Mexico, South Africa and others are replicating the strategies that made Israel, the US, Korea and others so successful in the creation of knowledge economies. Do alternatives exist with less risk and better chances of success in taking a seat at the global table of tech developers?

SMEs in partnership with governments and foreign investors are working to create technology capacity and ensure their future in a knowledge-based world. Much energy is directed at replicating the strategies that made SMEs in Israel, Ireland, Korea, Singapore and Taiwan successful: they all focus on the development of technologies for global markets with government and donor support financing technology creation and VC initiatives.

Are these the best strategies with the greatest chances of success? Do alternatives exist, to build from a base of technical needs for the local market instead, to move developing country SMEs up the path of knowledge creation incrementally with greater numbers succeeding domestically, and help position a few for entry into world markets? If yes, how can SMEs, governments and multinationals work together to generate new wealth and prosperity?

In this article I present a GoForward plan to scale up the innovation ecosystem and the investment needed for execution. I draw upon my experiences in transacting VC investments in Africa, Canada, the CEE (Central & East Europe), the CIS (countries of the former Soviet Union), Western Europe and the US.

The Leverage of Venture Capital

In the U.S., companies that raised VC from 1970-2005 created 10 million new jobs and contributed more than $2.1 trillion in revenue in 2005 to the economy. [1] Ten million new jobs are 9% of the total private sector workforce in the US and 16.6% of U.S. GDP, an increase from 8.7 million jobs and $1.5 trillion in revenues in 2000.

Before Hotmail, people communicated by telephone, telex, fax and letter; no big deal. Once Hotmail was launched, communication was turned upside down as users realized huge gains in productivity, simplicity and convenience by accessing e-mail over the Web, 24/7, from any computer, anywhere in the world; with such benefits it's easy to see why new industries formed around this solution.

Before eBay, people bought and sold collectables at auctions for centuries; no big innovation here either. But eBay created an innovative trading platform that combined live auctions, the Internet and collectables that became the biggest online marketplace and seeded the creation of entire industries based on online trading.

Retailing and delivery existed for centuries too. Amazon's big innovation was in the graphical interface to make product ordering simple, combining it with efficiencies in warehousing and distribution.

What these successes have in common is that each created an innovative business model, mostly around a GameChanging technology; disruptive technology with superior performance or high cost reduction features. GameChanging solutions make products and services

Table 1: Some top firms that were supported with venture capital [2]

Company	Venture Investor
Microsoft	August Capital
Intel & Apple	Venrock
United Healthcare	Warburg Pincus
Cisco & Yahoo	Sequoia
Hotmail	Draper, Fisher & Jurvetson
Genentech, Amazon.com, AOL, Intuit & Netscape	Kleiner Perkins
eBay	Benchmark
Google	Kleiner Perkins & Sequoia
Skype	Draper, Fisher & Jurvetson, Index Ventures & Others

accessible to global customers.

Each of these tech and business model platforms spawned business ecosystems of new suppliers and partners. It's estimated for example, that for every $1.00 of revenue that Microsoft earns in Chile, another $11 is made by partners, suppliers, system integrators and the like in the Microsoft Chilean ecosystem; [3] in Argentina, $17 of supply chain revenues are generated for every $1 of Microsoft sales. [4] Such leverage demonstrates the broad economic value generated by integrating new ideas, innovation, technology and VC.

The Allure of Global Technology Markets

Emerging market country governments see the business and financial successes of SMEs solving global needs. They encourage their enterprises to attack world markets with government money like VC to support this strategy.

Large opportunities attract the best scientific minds, entrepreneurs and investors: cures for human health problems in aging and disease, needs for security in a world that is increasingly perceived to be violent and energy alternatives in the face of climate change and rising oil prices. In solving global needs and wants, new wealth and prosperity results as the reward for industrial creation.

Actions of the governments in the CEE, the CIS and Latin America illustrate the commitments that they execute to jump into the global technology, commercialization and VC game. The Mexican Government made a commitment to grow its $3 billion a year IT and software industry into a 'near-shore' destination as an alternative to India for US customers. The Brazil and Argentina Administrations finance innovation through PPPs (public-private partnerships) in healthcare, global biotech and alternative energy. The Hungarian Government seeded the Development and Innovation Program, Microcredit Program for SMEs and Enterprise Promotion.

The Putin Administration is spending billions of petrodollars to diversify Russian growth from oil to knowledge creation, an experiment that other CIS and Latin American oil producing countries are monitoring; is economic diversification possible, with what results and leverage, at what cost and sacrifice? Russia is investing state money in infrastructure including enterprise zones, technoparks and incubators, 'build it and they will come' strategies to catch-up to leap-ahead of competitors in global technology.

Especially ambitious is the creation of the Russian Venture Company, a US$500 million fund-of-funds modeled after Israeli's Yozma fund-of-fund scheme (Box 1). Its PPP mandate is to co-invest with the private sector and create up to twenty new Russian technology VC funds with a total capitalization of $1 billion, half from the Russian Government with the matching of $500 million

Box 1. What is Yozma All About?

The 'Yozma' fund-of-funds was an investment company capitalized with $100 million by the Israeli Government, $80 million for investment into the creation of new VC funds and the remaining $20 million for direct investment into Israeli technology SMEs. Yozma invested $8 million into a private VC fund. A minimum of $12 million/fund was invested as partnerships between Israeli and foreign venture capitalists. Yozma gave fund managers the option to 'buy-out' the government's equity stake after five years.

In the first three years of operation, Yozma catalyzed the creation of ten VC funds with a total capitalization exceeding $200 million. Yozma is correctly given the credit for creating the VC industry in Israel in the 1990s.

'Yozma' fund-of-fund schemes [10] are terrific solutions if a country has a capital markets problem like Israel had in the early 1990s; proven technology but little access to global markets, little capital for commercialization and SME creation. At the time, Israeli technology came from strategic R&D investments made by the military and released to the private sector. Other success factors include an Israeli industrial policy that funded innovative basic and applied R&D to create deal flow, and the unlikely and unplanned creation of entrepreneurs through military training in the '8-200' intelligence unit.

Fund-of-fund strategies are not solutions if a country has a deal flow problem; when the quality and quantity of investment opportunities are just too low to meet the requirements of financial VC investors. Chile has experienced disappointment with its fund-of-funds initiative; few investments transacted by Chilean venture funds due to the low and poor quality of the deal flow, not a lack of money in Chile.

Poor quality or low deal flow is not confined to just the performance of the technology, but also the availability of good mangers and specialists to operate technology start-ups. In Russia for example, it's a challenge to attract good entrepreneurs and managers to technology SMEs. They have employment alternatives with better career opportunities, higher salaries and the potential to get rich quickly through an IPO in non technology like construction, retailing, branded consumers goods and transportation as examples.

from the private sector. All these initiatives are developed with the intention of taking a seat at the table of global technology development.

The private sector is active in the CEE, the CIS and Latin America too. Global powerhouses in multiple industries – Intel, Ford, TI, Nokia, Siemens, Motorola, Microsoft, Boeing, IBM, United Technologies, Samsung, Cadence and Sun – established R&D centers and selectively incorporated domestic technology into their products. A few international VC funds invested in Argentine, Brazilian, Hungarian, Mexican and Russian innovations.

Yet with all this capital and horsepower invested and to-be-invested, something is amiss in many emerging markets. A critical mass of seed and early stage SME investment opportunities do not exist for domestic or foreign VCs. This is not due to a lack of money as these economies are awash with capital and investors looking for opportunities.

Moreover CEE and CIS governments have advantages that their counterparts in Latin America, SE Asia and Africa lack; scientific accomplishments in defense, space and security that fed the Soviet military machine with cutting-edge universities and world class researchers in knowledge creation.

Innovators in Technology

Hungary-born American software developer Charles Simony led the development of Microsoft Excel and Word, products that revolutionized financial analysis and word processing to create billions of dollars of new wealth for his employer and himself.

In the 1950s, 43 horizontal oil wells were drilled in the Soviet Union, one of the most ambitious drilling efforts for the untested technology. Building on this work and that of U.S. scientist Lester Uren, Alexander Grigoryan put theory into practice by branching the oil wellbore, and in doing so, he became the father of multilateral drilling.

In 1953, the Soviets drilled a main bore in the Bashkiria field (Bashkortostan today) with nine laterals and a horizontal reach of 136m (446ft). Although the cost was 1½ times more expensive than other wells, it penetrated the oil reservoir 5½ times better and generated 17 times more oil per day. From 1954-1974 the Soviets drilled 110 multilateral wells; 30 of them drilled by Grigoryan himself. [5]

Other Russian technologies widely used in hydrocarbon E&P (exploration & production) include *in-situ* combustion and vertical seismic profiling (VSP), invented in 1957 by geophysicist Evsei Galperin of the Soviet Institute of Earth Physics. His VSP profiles showed the structure of seismic wave fields, which generated huge productivity gains in locating hydrocarbons more accurately. After 50 years of improvements by Western developers (led by Bob Hardage of Phillips Petroleum), VSP is used throughout the world.

With such technology successes in the petroleum industry and others in aerospace, IT and space exploration, investors and technology customers naturally look to the CEE and CIS for innovation in other spheres.

Few GameChanging Technologies

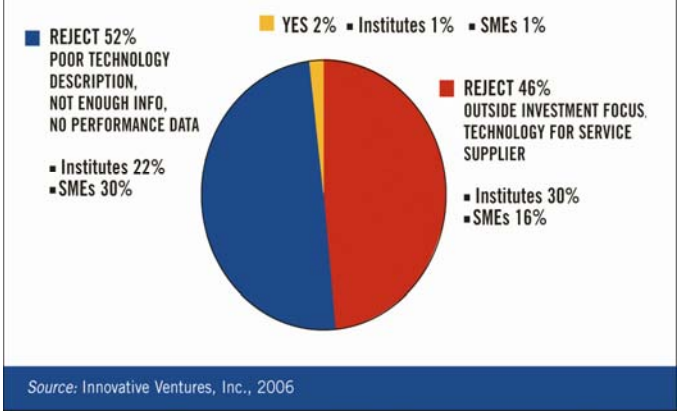
Over the last seven years, Innovative Ventures Inc., or IVI, and other VC investors evaluated hundreds of Russian deals in IT, telecoms, biotechnology, medical and others; yet collectively we have invested in only twenty-five or so. Likewise only a few dozen investments have been transacted in the CEE and the Baltics during the last ten years.

Specifically, over the past three years, we have looked at oil E&P technologies for investment. Our findings provide a microcosm and a reflection of current events in the market, and why so few VC investments in technology are made. Leveraging the Soviet science and scientific foundation into knowledge based economies is a real challenge.

In Russia for example, only 2% of the E&P innovations evaluated (**Figure 1**) have the performance characteristics that one might classify as disruptive, with superior performance or cost reduction features. Such Game-Changing benefits are required to attract international customers and investors and compete in global markets.

Even though the technologies evaluated had interesting features, they are not ready for customers or VC. They are R&D stage concepts and require money and time for testing and development, to get them market ready, cus-

FIGURE 1: OPPORTUNITIES AND DECISIONS



Source: Innovative Ventures, Inc., 2006

Box 2. What does VC invest in?

Money, innovation and hard work are the forces that drive entrepreneurship forward. Witness the super profits earned by the founders and investors in Skype, the VoIP telephony company. Skype began operations in 2003; eBay acquired the (unprofitable) company in 2005 for $2.5 billion+, an astronomical return on $20 million invested by Skype investors.

Contrary to myth, venture capitalists fund only a fraction of innovation vs. the investments in R&D by governments ($100+ billion) and corporations ($200+ billion). In clean technology in 2006 for example, corporations invested $22 billion in R&D, governments $24 billion, and VC investors just $2 billion worldwide. [11]

80%-90% of the money invested by VC pays for infrastructure costs required for SME growth, not technology development. VC is medium-term money, to build the SME to a sufficient size until it can be sold three-seven years later to a corporate buyer or to public market investors.

The niche for VC exists because of historical practices and inefficiencies in the capital markets. Technology is IP and banks won't lend unless tangible assets exist as collateral for a loan; the risks of start-up ventures require a higher interest rate than what banks can charge due to usury laws (e.g., in the US) and what SMEs can afford to pay.

Historically an SME needs sales of $10 million, several years of operating history (best with profits) and a balance sheet of several million dollars to access the public equity markets. In the US for example only 4%-5% of US corporations have sales $10 million or more, so newly created and growing SMEs are squeezed into a high risk, but high financial return niche for a particular type of investor; the venture capitalist.

The venture capitalist raises money from financial institutions like pension funds, insurance companies and foundations. VC invests in growing industries; investing in growth is more profitable and easier than investing in a slow or no growth market. While some exceptions do exist (e.g., biotechnology), the job of VC is to pick and invest in the right industry, take the market risk and management's ability to execute, not the technology risk.

Venture capital operates to the 2-6-2 rule of success; for every ten investments, two fail with all money invested lost, six generate a return equal to 1x or 2x of investment, and two are super winners (e.g., Skype) generating financial returns of 10x, 20x or even 100x of investment.

tomer ready and advanced enough for VC investment. Contrary to conventional wisdom, venture capitalists rarely invest in R&D (see box 2).

Our findings disprove the notion that Russian institutes and SMEs have great technologies, but investors are blind to the potential. No, what institutes & SMEs have are great ideas, but customers buy products not concepts, and investors invest in deals, not conceptual stage ideas.

Returning to Figure 1, 52% of the technologies were rejected due to poor descriptions of the value of the idea, inconclusive performance data and competitive benchmarking. Many ideas appear interesting and worth a second look if only reliable performance data was available. Rejection was not due to lack of intellectual property (IP), business plans, management or capital markets; typical reasons given as why so few VC technology investments are made in the emerging markets.

Good test data is essential to prove performance benefits. Once an SME decides to compete in technology markets, it positions itself against global competitors, many with closer and deeper access to customers and a customer orientation that provides buyers with the information they require to make purchase decisions.

Even with good performance data, attacking international markets requires disruptive technologies to overcome the purchasing habits of customers and penetrate established supply chains. However GameChanging technologies are far and few as they frequently result from coincidence and timing vs. planned innovation (**Box 3**)

If the chances of creating disruptive solutions are so slim, what can a country, its scientists, universities and SMEs do to get into the technology and commercialization business? Given so few GameChanging technologies in oil E&P, IT, biotechnology, etc., what can Estonia, Hungary, the Czech Republic, Russia and others with money and lots of talent but only ideas, do to build their place in the knowledge world? And what actions can Argentina, Brazil, Chile, Malaysia, Mexico, Vietnam and others adopt when they lack the technical foundation of Soviet science institutions?

Let's return to Russia to see what an alternative strategy might be and its learning curve lessons for emerging countries to move up the innovation chain.

Box 2. Moving Up the Innovation Value Added Chain

Small countries are at a disadvantage to larger ones in creating knowledge based economies. Fewer technology customers results in developers and investors applying their energy, intellect and capital to problems and needs in big markets. Yet within all countries, whether small or big, pockets of opportunities exist for SMEs to move up in the innovation value chain as the following three examples illustrate.

Incremental Improvements

Import substitution is only one aspect to building a supply chain and increasing local content by domestic SMEs. Adding more technology to increase product functionality and user experience is another strategy to build more knowledge based SMEs.

Donnelly Mirrors (DMI, now Donnelly Mirrors Magna) was a small family-held supplier of inside and outside automotive mirrors to the Big Three (Chrysler, Ford & General Motors). With revenues of $10 million, they were in a low tech, low valued segment of the business vs. suppliers of high value power train components (engines, transmissions) and other parts. Moreover DMI was headquartered in Holland, Michigan, out-of-sight, out-of-mind and geographically distant from their customers.

In the 1980s, DMI developed new skills in photo-electronics, glass/plastic fabrication, coatings and plastic molding; engineering embarked on a program to add new product content to mirrors and cost reduce production. Technical staff incorporated interior lighting and informational content to the mirror (through electronic sensors and microprocessor technology) that displays vehicle direction and temperature, both inside the car and on the street.

Not satisfied with just increasing driver convenience, engineering innovated in other directions; electro-chromic glass that keeps exterior mirrors clear from ice, rain, snow and fog, a value-added convenience that improved road safety and security for all. Improvements in small motor performance resulted in exterior mirror assemblies so drivers could move the position of outside mirrors from inside the car without taking their eyes off the road.

Over a ten year period these and other innovations led to an increase in sales to over US$300 million for DMI even as US domestic production slid to new lows as Japanese imports captured the hearts and pocketbooks of US consumers.

Entrepreneurial Resourcefulness

Backward thinking as a holdover of the Soviet legacy restricted growth in countries under their influence, even after the fall of the Berlin War, independence of the Baltics and freedom for states of the Former Warsaw Pact. Where some saw only bureaucracy and limited choices, others saw opportunity.

Riga, Latvia based SAF Tehnika was founded in the early 1990s by an engineer frustrated with the six year wait for a telephone line from the local telephone monopoly. Using his engineering talents learned at a former Soviet institute, he invented a microwave link that bypassed the local telecom. He provided dial tone to his neighbors through his innovation and later raised money from them, friends and family to offer his solutions to others.

Go forward fifteen years and SAF Tehnika now sells its telecom equipment in over forty (40) countries with its equity publicly traded on Riga's stock exchange since 2004.

Make Solutions from Problems

New innovations provide a set of benefits for customers and users. Yet all technologies have problems or inconveniences that set the stage for the creation of new SMEs, for new and more innovation.

Dr. Alejandro Zaffaroni, from Montevideo, Uruguay, earned his Ph.D. in biochemistry at the University of Rochester, the USA. Writing his dissertation on steroids, he started Syntex in Mexico City near a jungle where the plants grew for the raw material used in steroid production. The company grew rapidly as doctors and patents adopted their drugs for contraceptive and dermatological needs.

Pharmaceuticals at that time were delivered into the bloodstream by either inoculations or pills. While effective, their rapid release caused highs and lows of drug concentration in the bloodstream and steroids were no exception. Turning his attention to the side-effects of steroids, Dr. Zaffaroni developed new solutions to more slowly deliver drugs into the body through skin patches and time release pills. He launched Alza to manufacture and sell these products to market, innovations that spawned new thinking in drug delivery techniques.

Turn Personal Passion into Money [12]

Ole Evinrude's family immigrated to the US and he learned about machinery and mechanics by working on the family farm, working in factories and starting his own one-man motor shop. At a picnic on a hot day on the island of a Wisconsin lake, Ole's future wife Bess asked for some ice cream. The Norwegian made the three kilometer journey in his boat and oars, but when he returned, the ice cream had melted.

Thinking that a better way existed, Ole created a lightweight, detachable motor that could power small boats. He started a new company two years after making his 1st test, raised seed capital from a tugboat operator Chris Meyer, and obtained a patent in 1911, four years after his 1st prototype. Soon thereafter the company employed hundreds of employees with the advertising motto: "Don't row! Throw the oars away! Use an Evinrude motor."

Ole was forced from the business due to his wife's poor health and a bad relationship with Chris. In 1912, Ole began work on what would be the flywheel magneto, a major innovation that made starting and operating outboard motors easier for customers. In 1919, Ole showed Mr. Meyer drawings for a new lightweight motor, which Meyer rejected, a major mistake. In 1921 Bess and Ole Evinrude started a new company to market new light twin outboards, which became the industry standard, generating billions of dollars of revenue, making the lives of millions easier, more fun, and needless to say, helping sell more ice cream.

Information without Borders [13]

Larry Page and Sergey Brin initially disliked one another when they first met at Stanford, but they found common ground in solving one of computing's biggest challenges: retrieving relevant information from a massive set of data. In 1996, a year after their 1st meeting, poor, begging and borrowing university computers to build a network, their unique approach to link analysis was building a reputation. In 1998, they used credit cards to purchase a terabyte of memory to build their first data center in Larry's dorm room. Despite dotcom fever, they had little interest in building a company of their own, but instead, to license the technology.

Unable to interest the major Internet portals, Larry and Sergey decided to commercialize the technology themselves. All they needed was a little cash. So they wrote a business plan, put their Ph.D. plans on hold, and went looking for money. A Stanford friend introduced them to Andy Bechtolsheim, an angel investor and one of the founders of Sun Microsystems. Impressed with the demonstration but short of time he said: "Instead of us discussing all the details, why don't I just write you a check?' It was made out to Google Inc. for $100,000."

The investment created a small problem. There no legal entity known as 'Google Inc.,' and no way to cash the check. It sat for a few weeks until the two organized a corporation and raised a $1 million on the testimony of Andy's investment from family, friends and acquaintances.

In September 1998 three years after Sergey and Larry first met, Google Inc., opened its doors for business. The door came with a remote control, as it was attached to the garage of a friend's house who rented space to the new corporation. The office offered several big advantages, including a washer and dryer and a hot tub. It also had a parking space for the first employee hired: Craig Silverstein, now Google's director of technology.

Sources: Excerpts from 'The Story of Evinrude, http://www.tecsoc.org/pubs/history/2002/jul12.htm, http://www.boatmotors.com/outboard/evinrude/; "Google History." http://www.google.com/corporate/history.html

Overlooked Opportunities in the Domestic Sector

While few Russian innovations have GameChanging qualities for international buyers, others (Figure 2) have value in domestic E&P. Most were rejected as their technologies are behind those offered by international competitors like Schlumberger and Halliburton. But a few are low cost solutions that give customers (domestic and international oil companies) almost world class performance, but with lower prices compared to Western competitors. Low cost technologies attract price sensitive customers.

What makes this set of opportunities appealing is that they represent an alternative to pursuing a GameChanging strategy. Instead of trying to outperform international competitors on all fronts, one can build a locally competitive SME technology sector for domestic use. Once this base is established, invest new resources to develop their international capabilities for global marketing.

Several countries took a domestic approach to building more knowledge based content as the following examples illustrate:

Years ago the Israeli Government mandated that all Israeli homes have solar water heaters which resulted in an entire ecosystem of local manufacturers and suppliers. With growing interest in alternative energy for the 21st century, dozens of new Israeli start-ups are leveraging their solar expertise and innovating in photovoltaic cells, solar power, heating and lighting for global needs.

Estonia is one of the most wired countries in the world, due to the rapid adoption of technology by citizens and proactive support from the Government. Legislators introduced a number of reforms to bring Estonia into the information age, which stimulated innovation and technology development from the private sector.

E-school is an early stage company that sells a software solution that almost all schools in Estonia have adopted. Teachers send grades and attendance records to parents' computers or mobile phones; they receive an SMS if their child is absent from school. As this product is adopted in Estonia, opportunities open for E-school to sell to regional and global markets since its value is validated by Estonian users.

New Zealand proves that even the agriculture industry benefits from more technology and knowledge creation. New Zealand's transition strategy from low tech to high tech is illustrative of how a domestic focus created a technology SME industry.

In the mid 1990s, New Zealand government planners invested in biotechnology R&D to create more flavorful and different varieties of wine, cows and lamb with more meat and less fat. Their focus was on new solutions for domestic needs in agriculture and animal husbandry, not global biotechnology where New Zealand had little comparative advantage. Five years later, government initiatives yielded results and VC investors financed the commercialization of New Zealand SME innovations.

Today New Zealand meat and wine are found in Australia, Europe, Japan, Russia and the US. Their SMEs sell technology products and services to Australian, European and US wine producers and animal growers, truly a win-win for all.

Opportunities sometimes develop in the use of underutilized, domestic human capital to serve local and international markets and build a knowledge based service sector. In 2005 CzechInvest, the Czech Republic's business development agency and Cadence Design Systems, the US based electronic design house, formed ChipInvest at the Brno University of Technology. The center provides engineering talent from the CEE to chip companies worldwide.

ChipInvest is focused on global needs for engineering skills in analog design, which converts temperature, light and sound into the 1s and 0s needed for digital processing. In the 1980's the digital revolution shifted work from analog to digital with analog relegated to Europe due to its strength to serve its customers in the automotive and telecom with mixed signal designs.

ChipInvest is making use of knowledge learned under Soviet control, talent in short supply now. Closed Soviet and E. European universities emphasized analog skills as they were cut off from the global race to shrink circuits. With limited resources and money, engineers had to find ways to make due with what they had. That skill is in high demand now as cost pressures force work out of W. Europe and transform ChipInvest into a microelectronics R&D magnet for global and domestic customers.

The GoForward Plan in Technology and Knowledge Creation

Given higher probabilities of growing a locally competitive technology sector, a GoForward strategy consists of building technology platforms in and around domestic assets rather than diversifying resources ***away*** from home market advantages like natural resources, energy and commodities. And if overlooked potential exists in technology for the domestic sector, then how does one do a better job in identifying opportunities early, to nurture them into commercialization?

Action Item #1: Target Domestic Users First

SMEs and governments cite the low absorption rate of technology by domestic users as the reason to pursue a GameChanging innovation strategy for world markets. Yet every country has industries that are knowledge based; some are clusters formed around a particular industry while others exist from natural advantages.

The automobile industry is a technology cluster with excellent growth in Latin America, the CEE and the CIS as Ford, General Motors, Toyota, VW, Peugeot and others increase production in Argentina, Brazil, the Czech Republic, Hungary, Russia and Slovakia to meet customer demand. These auto multinationals need to build the domestic auto component supply chain to a Western equivalent to meet their business plans just as Shell, Chevron, LUKoil, KazMunaiGaz, PETRONAS, Petrobras, Pemex and others seek more and better oil field service suppliers in the CIS, SE Asia and Latin America.

When all fails, some creativity and initiative may be necessary

Both industries struggle to localize more local purchasing and satisfy local content commitments. "The local car industry 'is handicapped by the quality of local suppliers, who are far below world standards,' said Carl Hahn, chairman emeritus of Volkswagen. 'That's the most challenging part for our team' Skoda chairman Detlef Wittig said." [6] In Argentina, the auto parts sector attracted new firms and investment of $1.75 billion, but the number of domestic suppliers fell from 1,200 to 400; [7] their demise was due to a lack of product quality, investment and technology.

Yet the GoForward plans of many governments are to build knowledge based sectors like IT, bio & nanotechnology, etc., but not technology investment for domestic needs in auto components, oil field services, mineral extraction/processing and alternative fuels; sectors with immediate payoffs to catalyze a chain reaction in domestic technology absorption.

Israel is well known as a powerhouse of GameChanging technologies for global markets. What are less known are the innovations of Israelis for domestic use, e.g., solutions for clean and pure water. Israel could have had a water shortage as its population surged from less than one million in 1948 to more than seven million in 2006. [10] But it didn't due to actions of the Government in technology.

To provide the fresh water needed for life, the Israeli Government sponsored R&D in low pressure irrigation systems (for agriculture), rain harvesting, wastewater treatment and desalination. The private sector built on these foundations to innovate water security/management, on-site biological treatment of solid waste, medical waste and biologically contaminated materials to name a few. While the focus was and is on domestic demand, pure water needs from global customers stimulated the crea-

tion of an new Israeli export sector for clean water technology that now exceeds $800 million/year.

With a proposed new government investment of $160 million over the next five years, Israeli firms are projected to increase exports of clean water technology to $2 billion by 2010, $5 billion by 2015 and $10 billion by 2020 in a world water market estimated at $400 billion a year with growth of 7%/year. [9] With citizens of Planet Earth forecasted to have a 35% water shortfall over the next 15 years, luck (opportunity + preparation) and timing again work to the favor of Israeli SMEs and their VC investors.

Other SME development approaches are possible to build technology sectors for domestic needs, when single technology hubs are less obvious, e.g., in logistics, where multiple technologies intersect. For instance, Latvia sits on the Baltic Sea with new technologies required in IT, warehousing and transportation to grow a nascent logistics platform into a regional distribution powerhouse.

Russian and international corporations are establishing back office administrative centers in Siberia, Budapest, Tallinn and other cities to escape high cost Moscow thereby stimulating new clusters and VC investment opportunities. The city of Kirov a small Russian regional city with a population of about 500,000 and 1,200 kilometers from Moscow is funding bio-clusters to manufacture creams, lotions and emollients used in the domestic production of everyday cosmetics.

Action Item #2: Provide 'Mini Grants' to Document Business Opportunities

Once domestic industry technology hubs are identified, fund a 'mini-grant' program to define the business opportunity for proposed technologies. A mini-grant of $3,000-$10,000 is not intended to fund an entire business plan, but a 3-4 page document detailing the technology's potential.

Action Item #3: Capitalize a 'Proof of Concept' Fund

Commercialization of new technology starts with R&D and product development to demonstrate 'proof of concept' and the value of novel ideas. SMEs are only able to approach customers and investors when they clearly present technology strengths and weaknesses, conducted through a comprehensive analysis under different user conditions.

A 'proof of concept fund' finances the costs of testing a technology and benchmarking it to direct competitors, alternatives or substitutes. To invest capital wisely, mandate that developers and SMEs benchmark the technology early and often to products/services that buyers purchase from domestic or international competitors.

Action Item #4: Inventory SME/Institute Technologies and Publish as a Database

Provide an Organizational Service (OS) that gives customers and investors the information needed to consider technology from your country:

SMEs/institutes organized by technology, product & market segment, with full contact information

Benefits of the technology with performance & cost benchmarked against domestic and international competitors with data generated to international testing standards

Stage of development, meaning R&D, product development, alpha or beta testing

Product development plan with timetable & milestone inflection points, line item budgets

Patents issued or filed, by country, date and number, & competing technologies similar in form or function

Publish this information as an Internet database and searchable by keywords like technology or market.

Action Item #5: Establish an IP Facility to Protect Your Country's Intellectual Assets

The IP Facility pays legal costs of filing domestic or international patents with costs reimbursed through revenues generated from product sales. Royalty repayments replenish the Facility so it becomes a revolving instrument with a one-time investment.

Action Item #6: Offer Targeted Business Development Support

Innovations too often sit on the shelf since scientists lack the knowledge to make the business case for the technology, the energy and drive to move them into the market. Many scientists and (some) development stage SMEs lack the skills to make the transition from development to commercialization and growth.

Establish a business development office which actively 'scouts' for opportunities in the SME community and academia. This office identifies and develops projects for financing by the 'mini-grant' program and 'proof of concept' fund, and helps sell innovations from academia/SMEs to customers.

One responsibility of the business development office is to identify IP early in the development cycle and work with legal council to protect it. Scientists and businessmen are rightfully proud when they create new innovations. Yet they sometimes announce their solutions in the public domain before protecting them and inadvertently weaken their legal rights. Business developers must educate scientists and SME managers to the issues of IP, what can and can't be said in public.

Action Item #7: Organize R&D & Supply Chain Competitions for Users of Technology

R&D competitions are used in combination with VC forums or a substitute when deal flow is too scarce to attract VC investors. R&D competitions present technology, to generate interaction between technology developers and the R&D staff from corporations. R&D competitions are organized in areas like nanotechnology, alternative energy, green technology, engineered materials and biotechnology as examples. The audience is corpora-

Box 3. Integrating Multinationals into the Innovation Ecosystem

Corporations are entering a 3rd stage of evolution, a change that bodes well for emerging market SMEs and their governments. The 1st stage was the 19th century's 'international model' when corporations established sales offices in foreign countries, with minimal economic impact on host countries.

When I worked at Ford Motor Company in the 1970s, it grew by replicating itself with small versions of 'me-toos' in foreign countries, each with their own management, manufacturing, logistics, purchasing, HR and supply chain operations and staff. This 2nd stage is being replaced by 'globally integrated enterprises,' executing their strategies, operations and investments where work is best done.

Instead of having separate supply chains for different markets, 3rd stage global enterprises have an international footprint with a single supply chain. Such innovation means new opportunities flowing to countries and SMEs with the right skills and a focus on expertise, openness and/or cost.

Cheap is not the only strategy for growth; if it were, pharmaceutical multinationals would not be building new R&D centers in Europe, Japanese auto firms would not be adding manufacturing capacity in the US and companies like IBM would not be conducting R&D in Bangalore and operating their financing back office in Rio De Janeiro.

Internationalization of the supply chain benefits all; it enables emerging market SMEs to learn from global players, accelerating skill transfer and knowledge creation to start locally and grow globally, it enables multinationals to capitalize on local resources and talent.

Multinationals hunt for technologies and ideas independent of their origin, and they are able to benchmark technologies from one country to another, to help developers identify strengths and weaknesses of their technology to global competitors. Others have a strategic priority to integrate technology as supply chain linkages, thereby stimulating innovation, growth and job creation in ways such as:

1.) to be the technology platform that helps SMEs model and scale their solutions in advance of customer demands
2.) to reduce development time and get to market quickly
3.) to lower investment risk and help SMEs secure funding
4.) to enable the jump-start of sales
5.) to expand the market reach of SMEs by integrating them into corporate & international business ecosystems.

Untapped potential exists in many developing countries. So how might a globally integrated enterprise increase its contribution to emerging country innovation ecosystems and benefit itself at the same time? Let me make this suggestion.

Mix and match domestic and foreign technology to create new business models—Western companies frequently learn that their solutions are better but too expensive for domestic buyers when they sell to local customers. Consequently their products are confined to niche applications with limited revenue potential.

In order to reduce cost, combine domestic technology with complementary technology and people skills from the West. For the measurement of pressure and temperature in oil wells, the price of a distributed pressure/temperature system from a UK- based SME was reduced by 20% thanks to a Russian SME innovation in fiber optics. This cost reduction expanded sales to oil companies operating in the CIS and abroad.

Linking these two companies generated other benefits. It accelerated commercialization for the Russian counterparty since it lacks the international sales, distribution and service networks of the foreign SME. This supply chain partnership builds their international reputation and demonstrates their dependability as the prelude to selling directly to end users in oil producing regions of the Middle East and North Africa.

Governments not need start from scratch when it strives to integrate the domestic economy into the global knowledge economy. Instead it can tap Western ideas, management and system skills and link them to domestic counterparties—institutes and SME s—through appropriate economic incentives and by investing in the education and the technical skills of its people.

tions and corporate venture capitalists, not financial VC investors.

Attracting large corporations to R&D competitions has many benefits. They are able to invest in promising technologies, guide development with customer feedback, speed commercialization and help access opportunities in the supply chain (box 3).

The venture capital arms of multinationals are especially helpful to scale up the innovation ecosystem. They create leverage in the market like Intel Capital's dedicated $50 million VC country fund to finance Brazilian technology, and Microsoft's Innovation Centers, stimulating interaction in the infrastructure resulting in more innovation and more Brazilian software startups being funded. And they add-value in ways that financial venture capitalist can't.

Corporate VCs take technology risks by investing VC in the R&D of young SMEs, and invest directly in IP with technology right-of-use, a structure that accelerates the diffusion of technology to markets and customers. They also provide access to corporate R&D budgets for the funding of technologies at their early stages of development, before financial VCs are able or willing to invest.

Corporations help SMEs apply their technology to customer needs. As Esther Dyson, an investor in emerging market startups remarked: "One thing that the [emerging] market requires is a more demanding customer base. They need to become better buyers and users. They have all the necessary technical skills, but they don't have the business experience to apply the technology as well as they should."

Concluding Remarks: The Role of Governments in Technology Creation

Knowledge-based and entrepreneurial economies can't happen without the political will and investment of federal and national governments. Knowledge creation touches on so many of their duties like education, public investment in basic and applied R&D, economic incentives to invest in private R&D, innovation, trade and investment policies and the enabling environment, just to name a few.

Achieving political consensus on the mission and the means to fund the execution of this facilitator role can be a challenge. Therefore, some governments take intermediate and smaller steps that are achievable and realistic in the move towards knowledge creation.

In the case of Israel, the Government legislated to save energy and reduce dependence on foreign hydrocarbons, to increase its security in an insecure region of the world. The Estonia Government acted to speed its integration into the global economy after decades of being a closed society under Soviet domination. The Government of New Zealand funded R&D for agricultural applications to improve domestic products. Initiatives of all three set the stage for new knowledge creation by the private sector; start-ups formed to satisfy market needs, provide more innovation and creativity with positive effects far beyond their original missions.

African governments want more knowledge creation for their countries and citizens too. Yet the development of home-grown African technologies is unlikely to happen until more of the building blocks of an innovation ecosystem are present, e.g., research institutes collaborating with like-minded international universities in collaborative research, doing contract research for large and small companies alike, and grant making schemes to provide the R&D financing that SMEs need to upgrade their technology and technical skills to compete for supply chain contracts as examples.

Small but measurable steps are being taken by African entrepreneurs themselves to integrate into the global community. Export oriented flower suppliers imported foreign technologies, adopted new ideas and business processes to improve yield, reduce cost and the time to get fresh flowers from the field into the vases of customers around the world. Domestic SMEs in agriculture, natural resources and minerals invested donor monies to adopt best practices in production and processing to win more supply contracts and used profits to fund new product development programs; all with the intention of dominating small, local markets. Such efforts build a reputation of quality products and services with the reliability, performance and cost standards that global customers expect.

About the paper and author

[1]This article is an adaptation of the author's article that appeared in the July/August 2007 edition of the Harvard Business Review (Russian edition) and the November 2007 issue HBR, Hungarian edition.

[2]Venture capitalist Thomas D. Nastas is president of Innovative Ventures Inc., the USA & Russia (www.IVIpe.com, Tom@IVIpe.com). He also organized three funds in Africa for the World Bank/IFC. Mr. Nastas is also Instructor of Marketing, American Institute of Business and Economic College, Moscow.

Endnotes and references

1. National Venture Capital Association, Arlington, Va., (www.nvca.org) & Global Insight Inc., Waltham, MA., (www.globalinsight.com)
2. Venture Economics, Boston, MA, (http://www.thomson.com/solutions/financial/privateequity), National Venture Capital Association, Arlington, VA., (www.nvca.org), ThinkEquity Partners (http://www.thinkequity.com) & CapitalIQ (http://www.capitaliq.com)
3. Blog posting of Dan'l Lewin titled 'Innovation vs. Invention,' 16 November 2005, (http://alwayson.goingon.com/permalink/post/1508). Dan is VP, Net Business Development, Microsoft
4. Blog posting of Dan'l Lewin titled 'Travels with Dan'l. Part 1, The Perception & Reality of Innovation Abroad,' 8 Feb., 2006, http://alwayson.goingon.com/permalink/post/1510
5. Source: Society of Petroleum Engineers Web site (www.spe.org), Oil & Gas Basics
6. 'A Lot of Car Plants but not Enough Parts,' by Anna Smolchenko, Moscow Times, page 1, 30 March 2007
7. http://209.85.129.104/search?q=cache:pRVcnI8zP3YJ:www.brazil.ox.ac.uk/confreports/Conf%2520Report%2520%2520Auto%2520Industry%2520Reform%252015.11.04.pdf+Developments+in+Auto+Sector+in+Brazil&hl=en&ct=clnk&cd=17
8. 'Innovations in Water Solutions: Where Israeli Companies are Making Waves,' Israeli Venture Capital Journal, May 2007
9. Ibid, Israeli Venture Capital Journal, May 2007
10. See web site ifise.unipv.it/Convegno/Evolution%20of%20th%20-%20Kaufman.ppt for a review of the Yozma scheme
11. 'Global Spending on Cleantech R&D to Rise,' by Andrew Quong, Red Herring, 31 May 2007 Red Herring
12. Excerpted from 'The Story of Evinrude, http://www.tecsoc.org/pubs/history/2002/jul12.htm, and http://www.boatmotors.com/outboard/evinrude/
13. Excerpted from "Google History." http://www.google.com/corporate/history.html