A Generic Innovation Network Formation Strategy

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Abstract Based on a survey of *ad hoc* cases of distal embedding in the ICT sector, some of which have contributed to reshaping entire industries, we distill a model of a generic innovation network formation strategy that we have termed "distal embedding." We find that distal embedding is an innovation network formation strategy that can be used to foster economic development and growth in knowledge-intensive industry sectors embedded in emerging regions of innovation and entrepreneurship. We also present a first "guided" implementation of distal embedding and analyze it using our model.

1 Introduction

Although there is today wide agreement on the importance of innovation networks for the success of innovation processes and entrepreneurship in knowledge-intensive industries, as recently documented by two of the most comprehensive studies of the networks of Silicon Valley (Castilla et al. 2000; Ferrary and Granovetter 2009), considerably less attention has been devoted to the problem of innovation network formation (Casper 2007; Kogut 2000; Powell and Packalen 2012) and its role in the success or failure of both technology start-ups and small technology firms that operate in emerging regions of innovation and entrepreneurship. In this article, we make a contribution precisely in this area by presenting "distal embedding" as a generic innovation network formation strategy especially designed to accelerate the process of growth and expansion of technology start-ups arising out of emerging

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regions of innovation and entrepreneurship. As a theoretical foundation of the model, we use the Comprehensive Neo-Schumpeterian Economics model put forth by Hanusch and Pyka (2007).

Comprehensive Neo-Schumpeterian Economics (CNSE) highlights the importance of the innovation and future orientation not only for the industrial sector in an economy but also for the financial and the public sector. The long-term nature of the innovation processes requires for innovative firms to be embedded in stable network relationships with a heterogeneous set of partners comprising actors at the public, private, and finance pillars of the CNSE model (Hanusch and Pyka 2007). Obviously, in the creation of these innovation networks the public sector can play an active role as network trigger and network enhancer (Schön and Pyka 2012). In many instances, however, such an environment cannot be created, at least not in the short term, because of missing institutions, scarcity of resources, and a missing critical mass. As a result, a vicious circle emerges because the low performance of entrepreneurial activities does not spur economic growth, which leads to a shortage in resources to create the required institutions to support entrepreneurial activities (Saviotti and Pyka 2011). In order to get out of this unholy alliance of missing future-oriented institutions and the shortage of resources leading to the inability to set up innovative new sectors by entrepreneurial activities, we put forward a Keokuk strategy that we have termed "distal embedding." Distal embedding is an innovation network formation strategy that can be executed by actors at the three pillars of the CNSE model to drastically enhance the future orientation of a region of innovation and entrepreneurship and the actors located there.

In Sect. 2, we survey *ad hoc* cases of distal embedding as an innovation network formation strategy. In Sect. 3, we present a model of distal embedding that has been distilled from these and other *ad hoc* cases of distal embedding. In Sect. 4, we describe the implementation of a program aimed at distally embedding technology projects arising out of the emerging regions of technology innovation and entrepreneurship in Chile in complex innovation networks. In Sect. 5, we present our discussion of the present results. In Sect. 6, we present our conclusions and ideas for future work.

2 Ad Hoc Cases of Distal Embedding

In this section, we present the results of two cases of distal embedding in the ICT industry. These cases have not been based on a comprehensive set of public policies driven by governments (public pillar), or on strategic plans driven at the corporate level (industry pillar), or on the coordinated efforts of those actors providing financial backing (the finance pillar).

2.1 Case 1: Israel and Its Quest for Distal Embedding

Perhaps the most salient case of distal embedding has been implemented by Israel for very singular reasons. Israel holds one of the world's highest per-capita VC funding rates and one of the world's highest rates of investment in R&D as a percentage of GDP, has a number of world-class R&D centers producing cutting-edge IPs, and has invested in a local environment where technology entrepreneurship thrives. From this perspective, Israel is quite a departure from the situation of most countries of emerging economies. Israel's need for a distal embedding strategy stems from its geopolitical location, the lack of a large domestic technology absorption market, and the lack of access to requirements from world-class customers in key vertical markets.

The implementation of distal embedding executed by Israel is rather singular in that the distal embedding process did not take place initially by identifying an embedding node in a complex innovation network such as Silicon Valley in order to use this node as a source of embedding for start-ups arising out of Israel. In the absence of such a node, many Israeli start-ups attempted a process of "self-embedding." Since most Israeli start-ups realized the need to access the largest technology absorption markets very early on in their innovation life cycles, they "disembarked" in complex innovation networks, such as the "128 corridor" around Boston or Silicon Valley in California, in an attempt to get themselves "self-embedded" in those innovation networks. In so doing, they have been financially backed by VCs based in Israel. Not being themselves embedded in those complex networks, Israeli VCs did not meet the necessary conditions to embed the technology start-ups they funded in complex innovation networks such as Silicon Valley or the 128 corridor. As a result, the distal embedding process could not take place.

Most successful technology start-ups in Israel were initially funded by local VCs in the emerging innovation networks of Israel. Israeli VCs are insofar very unique as they have specialized themselves in funding early-stage deals, a practice that in complex innovation networks such as Silicon Valley has long become a relic of the past. Given the need for distal embedding, local VCs in the emerging innovation networks of Israel typically incorporated subsidiaries in complex innovation networks such as Silicon Valley, keeping R&D, engineering and back-office operations locally in Israel. Unfortunately, this indirect process did not distally embed the U.S. subsidiaries of Israeli start-ups in those complex innovation networks. As a result, Israeli start-ups—and the VCs that backed them—engaged in a long and tedious process of establishing and nurturing ties with other actors in complex innovation networks such as Silicon Valley on their own. Unfortunately, this process did not yield the desired results for the companies seeking the embedding because of the lack of a node actively engaged in the distal embedding process in the complex innovation network. The process of distal embedding could not unfold even in cases where these companies had advanced to the phase of exploitation in the innovation life cycle.

Despite the lack of a successful distal embedding strategy, the large number of Israeli start-ups financially backed by local (Israeli) VCs with the potential to become world-class companies has reached such a critical mass that Israel, in particular its local VC investor community, has been able to produce some compelling cases of technology companies that not only went public in the U.S. but also became leading technology vendors in the global markets. These highly visible cases have contributed to a process of establishing ties between the VC community in Israel and its counterpart in complex innovation networks such as Silicon Valley.

The events taking place in the emerging region of innovation and entrepreneurship in Israel, namely, the compelling amount and quality of technology start-ups arising out of this region in conjunction with some highly successful technology companies that went on to IPO in NASDAQ and became leading technology vendors, particularly in the ICT industry, have attracted the attention of tier-1 VCs in Silicon Valley in such a way that stronger ties between the VCs in Israel and their counterparts in Silicon Valley have now started to emerge. This reinforcing effect is contributing to the creation of "strong" ties between the local VC community in Israel and tier-1 VCs in complex innovation networks such as Silicon Valley. As a result—and after a long process that unfolded over the last two decades—the conditions for distally embedding start-ups founded in Israel and financially backed by Israeli VCs are only now beginning to emerge, thus allowing Israeli VCs to distally embed their portfolio companies in complex innovation networks such as Silicon Valley in a more formal and systematic way.

The rise of highly visible and successful technology companies out of Israel and the compelling flow of "fundable deals" arising out of that region constitute the enabling assets that Israel has been able to develop over a long period of time. This, in turn, has contributed to the VC community in Israel nurturing strong ties with tier-1 VCs in places such as Silicon Valley. As a result, Israel and its emerging technology innovation networks are now in a much better position to articulate compelling value propositions in order for processes of distal embedding to unfold in a much more straightforward manner. Ultimately, the emergence of strong ties between Israeli VCs and tier-1 VCs in places such as Silicon Valley and the 128 corridor are rendering distal embedding a viable innovation network formation strategy for Israel today.

2.2 Case 2: Distal Embedding and the Enterprise Software Industry

2.2.1 The Enterprise Software Industry

Another case of distal embedding emerged spontaneously in the ICT industry in connection with the millennium bug. In this second case, the Big 5 consulting companies[1] played a key role in embedding enterprise software vendors in global innovation networks. In order to understand the process of distal embedding that took place in this industry, we need to explain their business and revenue models in the early 1990s. Prior to this successful case of distal embedding, the revenue model of the enterprise software vendors consisted in selling software licenses and professional services. This second component of the revenue model required that enterprise software vendors built and grew a large professional services organization especially dedicated to deploying large integration projects based on their flagship product.

2.2.2 The Y2K Mitigation Strategies

The millennium bug gave rise to a singular event in the enterprise software industry that dominated the agenda of the information services and technology divisions of the largest corporations of the world throughout the 1990s and resulted in a process of creative destruction in the Schumpeterian sense. There were basically three strategies for large and medium-sized corporations to cope with the threat associated with the millennium bug:

1. supercharging (also referred to as turbination);
2. replacement through an in-house custom solution; and
3. replacement through a best-of-breed productized solution.

Supercharging consisted in testing existing information systems for Y2K compliance, identifying those systems compromised, and then mitigating the compromised systems through rewriting the compromised code. This strategy involved a lesser investment and consisted in engaging the services of boutique IT consultancies that specialized in solving the Y2K problem. This mitigation strategy was adopted primarily by small and medium-sized firms willing and able to assume the latent risk of failure, as in most cases there were no contractual assurances that the supercharged systems would not fail at the turn of the millennium.

Replacement through the development of a new in-house solution, although feasible in some cases for small and medium-sized companies, was not an option for large corporations that had invested massively in IT infrastructure, software, and services throughout the 1960s, 1970s, and 1980s. The Y2K agenda, which had been driven by the Big 5 consulting companies at the largest corporations of the world since the early 1990s, left little room for this strategy. Indeed, not only the costs but also the times needed to execute this second strategy at the largest corporations in tier-1 markets rendered it impractical.

[1] This is a term used to refer to the largest professional services firms that provided consulting services in strategy and management throughout the 1990s, including ICT strategy and execution, to the largest corporations of the world.

The third strategy, namely, replacement through a best-of-breed productized solution, seemed to fit well with the strategy of both the Big 5 consulting companies and the largest corporations of the world. This strategy required the Big 5 consulting companies to position themselves as independent advisors at the world's largest corporations. The Big 5 consulting companies would then advise their clients and provide them with a comprehensive solution following a three-stage process. The first stage consisted in conducting Y2K compliance studies to ascertain to what extent IT infrastructure and systems were compromised by the Y2K problem and to assess the potential business impact of not being Y2K-compliant. The second stage consisted in preparing a strategy to mitigate the problem that met the client's constraints in terms of times and costs. The third stage consisted in executing and implementing the chosen strategy. In looking at the tier-1 ICT absorption markets in the main industry verticals, it became apparent to the Big 5 consulting companies that the third strategy outlined above, namely, replacement through a best-of-breed productized solution, would not only fit well with the challenge posed by the Y2K bug but would also represent a tremendous market opportunity for them. To replace existing enterprise software systems through a best-of-breed productized solution had several advantages for large corporations, including warranties of the chosen independent software vendor as to the Y2K compliance of their product.[2] This would come along with the best business and technical advise money can buy—namely, the advise of the world's leading consulting firms. This strategy also meant that the world's leading corporations would benefit from a world-class enterprise software product, that is, a product that addressed the requirements of the largest corporations of the world in several vertical markets and was continuously updated to meet the new business and technical requirements of such a world-class client base.

2.2.3 Changing the Revenue Model of the Enterprise Software Industry

In order for the Big 5 consulting companies to participate and capitalize upon the third stage of the process outlined above, namely, the execution of the replacement strategy through a world-class productized solution, a change in the revenue model of leading enterprise software vendors was needed. The change consisted in separating the licensing from the professional services component of the revenue model. This was seen as a radical business change by many of the largest enterprise software vendors. Indeed, by the mid-1990s the entire enterprise software industry saw their business primarily as the provision of professional services. According to this model, the professional services division of any major enterprise software

[2] Though these warranties were often limited contractually to the amount of licenses under the contract and did not cover the integration of their product with existing infrastructure, the vendor's "client referenceability" provided in most cases enough assurances to prospective clients in lieu of actual legal warranties.

vendor would utilize the product developed by the engineering and marketing divisions as a way to differentiate their services and drive not only licensing but also professional services revenues at the customer. Although margins from the licensing business were higher, professional services driven out of several industry verticals in tier-1 technology absorption markets took the lion's share of revenues in the entire enterprise software industry.

Many of these vendors, especially those with global reach that had a strong track record of growing a global professional services division, were unwilling to undertake such a radical change in their revenue models due to the dilemma of creative destruction. Smaller enterprise software vendors that operated at a more regional level, though, saw the opportunity to attain global presence through access to world-class clients in tier-1 technology absorption markets that had been so far out of their reach. Unaware of the profound implications that such a radical change did entail, these smaller vendors were more willing to change their revenue models, accommodating in the process the requirements of the Big 5 consulting companies and establishing and managing strategic alliances with them.

With operations in all major technology absorptions markets in most industries throughout the world, the Big 5 consulting companies offered a selected group of enterprise software vendors two fundamental "enabling assets," namely:

1. access to world-class customers in the world's largest ICT absorption markets and
2. execution power to deploy large integration projects leveraging the professional services organization of the world's largest consulting firms.

2.2.4 Changing the Business Model of the Enterprise Software Industry

With this new revenue model and strategic alliances with a selected group of enterprise software vendors in place, the Big 5 consulting companies set out to execute the third stage of the strategy outlined above, igniting a process of hyper growth not only in terms of the professional services revenues for their IT consulting divisions but also in terms of the revenues driven from licenses for their strategic allies, the enterprise software vendors. The hyper growth in license revenues more than compensated for the reduction in professional services that the enterprise software vendors had anticipated.

Interestingly, this much-feared reduction in professional services revenues ended up not occurring. By strategically repositioning their professional services divisions as strategic allies of the Big 5 consulting firms, the enterprise software vendors could avoid this reduction in professional services revenues. The undeclared "new mission" of the professional services divisions of leading enterprise software vendors was to complement the teams of their strategic allies with subject matter experts in order to make sure that a process of knowledge transfer and diffusion could take place from their own professional services divisions to those of the Big 5 consulting firms. Unaware at the outset of the consequences this change in their business and revenue models would have not only for them but also for the entire enterprise software industry, the enterprise software vendors that adopted this new revenue model and successfully managed their strategic alliances with the Big 5 consulting firms saw their licensing revenues grow dramatically.

A first result of this process caused the global sale forces of the Big 5 consulting companies to develop the consultative selling skills required not only to better advise their customers on the best enterprise software solutions but also to assist their strategic allies, the enterprise software vendors, in the presales and sales efforts at the largest corporations of the world. A second—and more important—result was that the global professional services organizations of the Big 5 consulting firms did also develop the professional services competences required to deploy the product of their allies at the largest corporations of the world, releasing the enterprise software vendors from the problem of having to cope with building a global professional services organization and positioning the Big 5 consulting firms as prime contractors whenever possible. Without these strategic alliances with the Big 5 consulting companies in place this monumental task would have been necessary to deploy large-scale customization and integration projects at the world's largest corporations, especially in those industry verticals that provided the largest absorptive capacities.

In dealing with a rapidly growing customer base for the licensing business, these enterprise software vendors also saw the need to support the professional services divisions of the Big 5 consulting companies and help them in the process of deploying large IT projects based on their product in order to ensure project success and, above all, client referenceability. This "new mission" of the vendors' professional services business units contributed to repositioning them as units whose "new strategic objective" was to support their strategic allies in large-scale deployments and make sure that they (the Big 5 consulting companies) rapidly build the resources, capabilities, and competences required to successfully deploy their (the enterprise vendors') products at the largest corporations of the world. As far as the enterprise software vendors were concerned, the ideal scenario was to have a highly competent team of strategic allies able to deploy their products independently of them.

This change in revenue model resulted in the rapid growth of regional enterprise software vendors such as SAP into large and globally operating companies in a relatively short period of time, prompted a major change in the business model of these vendors, and restructured their internal organizations. The core business shifted from selling software licenses and mostly consulting services to selling primarily software licenses. A new division, the alliances division, was also created and positioned as one of the cornerstones of their new business model in order to make sure that the relationships with the Big 5 consulting companies, and other technology vendors and channel partners, were managed successfully.

2.2.5 The Dilemma of Creative Destruction

It is important to note that not all the enterprise software vendors did pass a qualification process by the Big 5 consulting companies in order for them to be eligible candidates for this process of embedding in the tier-1 technology absorption markets. Eligible candidates needed to be perceived as enterprise software vendors with a highly competitive product and a sizeable customer base in at least one tier-1 market. Executing this process of distal embedding, the Big 5 consulting companies were able to select a group of enterprise software vendors in enterprise software markets such as enterprise resource planning (ERP) and customer relationship management (CRM), to name but a few, offering them not only access to the leading companies of the world but also execution power to deploy their enterprise software solutions at these large corporations. By helping the leading corporations of the world standardize on the products of these enterprise software vendors, the Big 5 consulting companies did contribute to making these vendors world leaders as well.

In this second case of distal embedding, the Big 5 consulting companies were the "nodes" that did exert strong influence on the purchasing decisions of the largest corporations in tier-1 markets in the Americas, EMEA (Europe Middle East and Africa) and APAC (Asia Pacific). The Big 5 consulting companies exerted their influence and deployed their execution power at the largest corporations of the world in order to distally embed the enterprise software vendors in the world's complex innovation networks of the enterprise software industry. They did so because they had a vested interest in such a process of distal embedding. In this connection, it is important to note that it was only by changing their revenue model that "eligible" enterprise software vendors were able to characterize a compelling value proposition in order for the Big 5 consulting companies to have such a vested interest in executing the process of distal embedding.

Large enterprise software vendors that had invested in growing large consulting organizations were, in principle, eligible for this process of distal embedding. Indeed, many of them were seen by large corporations as markets leaders already. But they had the dilemma of creative destruction. In fact, they were unwilling to relinquish the consulting business as their core business, or at least as one of their core businesses. Such vendors did not benefit from a process of distal embedding and were not able to get distally embedded in the emerging and rapidly growing innovation networks of the enterprise software industry throughout the mid and late 1990s.

The smaller but still eligible vendors that did adopt the new revenue model were able to create a compelling value proposition for the Big 5 consulting companies. With such a value proposition in place, the Big 5 consulting companies did actively engage in the process of distal embedding, which in turn did increase the chances of such smaller vendors to drive an aggressive agenda of expansion and hyper growth across regions in the world's largest technology absorption markets. Smaller enterprise software vendors did have a crucial advantage over larger vendors due to the dilemma of creative destruction. With a large consulting organization in place that was actively engaged in deployments in tier-1 vertical markets, large enterprise software vendors that had so far dominated the enterprise software market did face the dilemma of destroying a successful revenue model and changing their organizational structure in order to accommodate the requirements of the Big 5 consulting firms. Smaller vendors were more amenable to this idea and ended up accepting such a radical change in their revenue models. They were therefore able to characterize a compelling value proposition for the Big 5 consulting firms, which in the end led to a process of creative destruction in the entire enterprise software industry.

By getting distally embedded, smaller enterprise software vendors were able to have access for the first time to requirements of large corporations in tier-1 markets in several industries and regions across the world. This not only provided access to client financing but also to requirements from world-class clients in regions of innovation that were not easily accessible to them prior to this process of distal embedding. The Big 5 consulting firms did deploy vast resources through their subsidiaries in these tier-1 technology absorption markets, providing *de facto* not only a global consultative sales force to qualify and close very large license deals for the enterprise software vendors but also the execution power required in order to successfully deploy large enterprise software integration projects at the world's largest corporations, rendering them key reference accounts in the process. As a result, enterprise software vendors that operated regionally at the beginning of the 1990s became global leaders in a relatively short period of time. This case shows the high impact the successful execution of a distal embedding strategy can entail. This new business model, and its associated revenue model, proved to be the right business model for any enterprise software vendor with the potential to become a leading vendor and dominate a segment of the growing enterprise software market.

This successful case of distal embedding, triggered by such a singular event as the millennium bug, unfolded throughout the 1990s and captured the attention of other emerging enterprise software vendors. With the turn of the millennium, this new business model began to be adopted by those emerging enterprise software vendors that qualified as good candidates for distal embedding by the Big 5 consulting firms. This case also provides evidence that distal embedding, as a generic innovation network formation strategy, can not only drive processes of high-value creation for the companies being embedded but also ignite a process of dramatic structural change in an industry. The enterprise software industry underwent such a radical change during the 1990s.

We have surveyed other cases of *ad hoc* distal embedding by analyzing the evolution of small and medium-sized technology vendors in the ICT and other knowledge-intensive industries. Our findings so far suggest that there are very similar patterns behind the process that we have termed distal embedding. This has led us to the distillation of a model of distal embedding that captures the method behind "the magic" of distal embedding. We present this model in the next section.

3 A Model of Distal Embedding

The issue of embeddedness in social structures and its impact on economic outcomes, originally raised by Milgram and Granovetter in their study of labor markets (Milgram 1967; Granovetter 1973) and later expanded to other areas of the economy (Granovetter 1985; Granovetter 2005), pervades today a number of other areas in the social sciences. Innovation and entrepreneurship are two areas that are poised to benefit from a better understanding of the importance of complex innovation networks and the role they play in the outcomes of innovation and entrepreneurial processes (Ahrweiler 2010; Ahuja 2000; Bathelt et al. 2004; Bresnahan and Gambardella 2004; Podolny 2001; Powell et al. 2005; Powell et al. 2012; Singh 2005; Sorenson and Stuart 2001, 2008; Uzzi, 1996).

If we take the position that successful processes of entrepreneurship and innovation in knowledge-intensive industries are not only determined by the entrepreneur (Schumpeter 1911) and that the success or failure of innovation and entrepreneurship in these industries is primarily the result of multiplex interactions among diverse nodes in a complex innovation network, then the problem of network formation and the embedding of economic actors in those networks should become a top priority for actors at the public, finance, and industry pillars of the CNSE model introduced in Sect. 2. In fact, the importance of developing a strategy for innovation network formation aimed at the embedding of actors in complex innovation networks should be a top priority for emerging regions of innovation and entrepreneurship.

3.1 Distal Embedding

We put forward the term “distal embedding” to denote the embedding of nodes of emerging regions of innovation and entrepreneurship, that is, those regions that do not present the complexity required for innovation processes in knowledge-intensive industries to succeed, in innovation networks of “distant” regions of innovation and entrepreneurship that do present the complexity required. It should be noted that distance in this context has a connotation that goes beyond geographic location and even propinquity, as this term is defined in social and organizational psychology (Festinger et al. 1950). For the purposes of our definition, the term “distal” shall entail a fundamental lack of “access to absorptive capacities.” Hence, also actors geographically located in complex innovation networks could benefit from a process of distal embedding, as the case of Israel discussed in Sect. 2 shows.[3]

[3]Though U.S. subsidiaries of the Israeli start-ups were located geographically in the complex networks of Silicon Valley or Silicon Valley of the East, they were unable to get distally embedded there for the reasons explained in Sect. 2.

3.2 Embedded Nodes

In this section, we present a set of characteristics shown by emerging regions of innovation and entrepreneurship, classifying them according to the three pillars of the CNSE model. Nodes embedded in such emerging regions may qualify as potential candidates for distal embedding.

3.2.1 Public Pillar

In this section, we present some of the characteristics of emerging regions of innovation and entrepreneurship at the public pillar of the CNSE model.

Low R&D Investments as a Percentage of GDP

Most emerging regions of innovation and entrepreneurship have low R&D investments as a percentage of GDP, often below 1 %.

Lack of Future Orientation of the Educational System

This is expressed in terms of a system where actors at the public pillar either play a marginal role that has left the orientation of the educational system in the hand of actors at the private pillar of the CNSE model or lack an strategic plan aimed at promoting the creation of infrastructure and human capital and their embedding in value chains representing future growth opportunities in global markets.

Lack of Involvement of Actors at the Public pillar in Funding and/or Attracting World-Class Basic and Applied R&D Centers to Disembark in Their Region

Emerging regions generally lack the critical mass of publicly funded R&D output, comprised of generated patents and IP, required to establish linkages with industry partners and engage in successful processes of technology transfer and intrapreneurship. The lack of incentives provided by actors at the public pillar to attract the investment of world-class R&D divisions of large diversified companies and R&D centers located in complex regions of innovation does exacerbate this problem.

R&D Policies that Encourage Traditional Push Technology Transfer Models

This is often the direct result of lack of university-industry relationships in the emerging regions of innovation and entrepreneurship. In fact, pull models of technology transfer that initiate entire research agendas starting from important customer and market needs are very rare in emerging regions of innovation and entrepreneurship.

Lack of Technology Innovation Strategies at Regional or National Level

The lack of technology innovation strategies at regional and national level is often the result of following a more neoclassically inspired tactical approach that leaves the question of how to embed emerging regions of innovation and entrepreneurship in knowledge-intensive industries unaddressed. Due to the localized nature of knowledge diffusion, these development approaches often apply a "salami tactic" aimed at incrementally increasing the product space in areas that already provide a comparative advantage (Hausmann and Klinger 2006).

Innovation Policies that do not Allow Public Investing in Foreign Technology Companies Disembarking Locally

Public policies that prevent actors at the public pillar from investing public funds in foreign technology companies disembarking or wanting to disembark in emerging regions of technology innovation and entrepreneurship eliminate not only a potentially important source of knowledge diffusion and transfer but also a potential source of embedding that might otherwise contribute to the creation of more robust technology innovation networks in those regions.

3.2.2 Industry Pillar

In this section, we present some of the characteristics of emerging regions of innovation and entrepreneurship at the industry pillar of the CNSE model.

Low Private Investment in R&D

This is often due to the fact that actors at the private pillar have not yet adopted a successful outbound innovation strategy as part of their business and corporate strategy, that is, they tend to rely more on the global competitiveness of foreign technology vendors by positioning themselves as their channel partners in their local innovation networks. This inbound innovation orientation of actors at the private pillar reduces dramatically the absorptive capacities of the emerging region.

No Local Talent in Strategic Technology Management and Marketing

Technology companies located in emerging regions of innovation and entrepreneurship have often difficulties in attracting and retaining talent with the necessary management skills due to the lack of labor mobility of their local innovation networks (Ferrary and Granovetter 2009).

Lack of Competitive Strategies Based on Differentiation Through Innovation

The lack of importance that companies in emerging regions of innovation and entrepreneurship assign to innovation as a source of differentiation exacerbates the lack of absorptive capacities available to innovative technology companies arising out of these emerging regions. This is highly detrimental to local innovative companies in need of lead customers and early adopters to drive their innovations forward throughout the initial phases of the innovation life cycle.

Inbound Innovation Approaches

As opposed to outbound innovation, inbound innovation is a tactical approach based on local technology companies positioning themselves as channel partners and value-added resellers of successful foreign technology vendors.

Lack of IP Management Competences

The lack of IP management skills is often the result of a lack of a comprehensive body of IP laws combined with the inbound innovation strategies typically adopted by emerging regions of innovation and entrepreneurship, which prevents the creation of an ecosystem of actors in the local networks with an specialization in all the technical, commercial, and legal aspects of IP management.

Lack of Managerial Talent that Can Bridge the Gap Between University Base and Applied R&D and Early-Stage Technology Marketing and Commercialization

In emerging regions of innovation and entrepreneurship we do not typically find R&D divisions and marketing departments of large diversified companies and small and medium-sized enterprises working closely with research staff from research centers and universities on the development of new products, services, and market solutions. In these regions, there will be a tendency to rely on R&D, product marketing, and product development being conducted by foreign companies. This leads to a situation where the competences needed to successfully drive new product development activities cannot be developed by actors at the private pillar in these emerging regions.

Lack of Access to World-Class Clients

The lack of access to world-class clients is often, though not always, the result of a relatively small domestic market lacking the necessary absorptive capacities. The lack of absorptive capacities typically encountered in emerging regions of innovation and entrepreneurship translates into an endemic lack of access to requirements of world-class customers, which is arguably the most important asset to drive processes of high-value creation through technology innovation for companies located in those regions.

3.2.3 Financial Pillar

In this section, we present some of the characteristics of emerging regions of innovation and entrepreneurship at the financial pillar of the CNSE model.

Lack of a Local Venture Capital Industry

This is one of the most fundamental gaps in emerging regions of innovation and entrepreneurship. In fact, venture capital firms are the nodes that show the highest complexity in terms of CNT[4] metrics such as “heterogeneity,” “betweenness centrality” and “multiplexity” in innovation networks (Ferrary an Granovetter 2009) and they play a key role in helping technology companies execute outbound innovation strategies and position themselves as world-class technology vendors catering to the global tier-1 technology absorption markets.

No “Enabling Assets” that May Attract Investment of Foreign Venture Capitalists (VCs) or Large Diversified Companies (LDCs) to the Emerging Region of Innovation and Entrepreneurship

Some emerging regions of innovation and entrepreneurship may have “local enabling assets” that compel actors located in complex technology innovation networks to disembark in those emerging regions. We have termed this strategy “local embedding.” Contingent upon a proper characterization of such enabling assets, actors located in such emerging regions might be able to execute the local embedding strategy. Local embedding will result in knowledge being diffused

[4] CNT is an acronym that states for Complex Network Theory (Watts 2004).

and transferred to actors located in those emerging regions. Unfortunately, most emerging regions will not have such enabling assets and will not be able to attract actors located in complex technology innovation networks to disembark locally. Such regions are good candidates for distal embedding as an innovation network formation strategy. We shall point out that local embedding, though the exact opposite of distal embedding, can in some cases be executed in concert with a distal embedding strategy.

Investors Used to High Returns from Investments in Traditional Industries

This is another characteristic of many emerging regions of innovation and entrepreneurship. Many industry sectors in these regions have not yet evolved into hypercompetitive industries. Investors in these industries are often able to exert a considerable amount of control not only over the markets their companies serve but also over external stakeholders from the public sector such as governing bodies and regulatory agencies. As a result, it is not uncommon for investors in these emerging regions to invest in local entrepreneurship projects subject to low strategic uncertainties in industries that are not very knowledge-intensive and obtain much better returns than those a tier-1 venture capital firm located in a complex innovation network would consider outperforming.[5] This is highly detrimental to the local innovation systems in emerging regions of innovation and entrepreneurship for two main reasons:

1. the availability of funding for high-technology ventures is scarce and more difficult to obtain given the lack of incentives for the local investor community to invest in technology ventures and
2. the resources, capabilities, and competences usually associated with venture capital investing are simply not available to the investor community.

If investors do decide to invest in high-technology ventures, they do so lacking the knowledge about how to manage the agency and monitoring costs associated with high-risk technology ventures and are therefore unable to provide “smart money” to their portfolio companies, thus reducing the probability of success of their portfolios.

Investor Focus on Efficiency and Short-Term Financial Success Instead of Value Creation and Market Dominance

This is a corollary of the generalized orientation towards investing in low technology ventures often shown by investors in emerging regions of innovation and

[5] Over an average period of 15 years, an annualized return on investment of over 35 % is considered to be an outperforming return in the VC industry in Silicon Valley.

entrepreneurship. The resulting focus on efficiency and short-term financial success is often maintained even when investing in technology ventures. For technology ventures, the focus of investors should be shifted towards effectiveness and long-term market success. This shift proves highly problematic for traditional investors because effectiveness and long-term market success are often measured not based on short-term financial metrics but on more strategic grounds such as creating connectivity and rapid expansion in a complex innovation network, for which a set of metrics unknown to most of these traditional investors is required.[6]

Lack of Local Technology Investment Funds and Lack of Ties to Foreign Technology Investment Funds in Complex Regions of Innovation

This is in part due to the lack of incentives to form such funds often due to the high returns that investors can obtain from ventures in traditional, commodity-driven industry sectors, on the one hand, and to the lack of competences to manage technology investment funds successfully, on the other. In regions where such technology investments funds are emerging, there is typically a lack of ties with foreign technology investments funds. Knowledge gaps regarding how to manage the agency and monitoring costs associated with high-risk technology ventures are also plentiful in these emerging regions. To the extent that ties with technology investment funds located in complex innovation networks were already established, as in the case of Israel surveyed in Sect. 2, knowledge diffusion processes could unfold from complex innovation regions into these emerging regions of innovation and entrepreneurship. These processes of knowledge diffusion could contribute to closing such knowledge gaps.

3.3 Analysis of Emerging Regions of Innovation and Entrepreneurship from a CNSE Perspective

In regions embedded in national innovation systems sharing some of the characteristics discussed above, the success of outbound innovation, defined as a tactical approach aimed at the creation of world-class technology companies exporting to the global technology absorption markets, will be compromised. In these regions, there is a natural bias towards implementing inbound innovation, defined as a tactical approach aimed at importing products and services developed in more developed countries. Using these inbound innovation approaches, the most innovative companies in emerging regions of innovation and entrepreneurship tend to position themselves as value-added resellers and channel partners of the world's leading

[6] A real-options approach to evaluating technology investment portfolios seems more appropriate to measure effectiveness than traditional financial metrics.

technology companies, thus helping these foreign vendors introduce their offerings in emerging markets. Although in many of these emerging regions some of these companies can grow into large corporations using this inbound innovation approach, it will be difficult for them to adopt a peacefully co-existing outbound innovation approach via the creation of business lines with offerings that can be exported to the global markets. Most of the companies that attempt to follow an outbound innovation approach will typically fail due to lack of access to key enabling assets that are only available in complex technology innovation networks. Distal embedding is an innovation network formation strategy that can help entrepreneurs from emerging regions of innovation and entrepreneurship circumvent this problem.

3.4 The Distal Embedding Process

The distal embedding strategy consists in "embedding" a node of an emerging innovation network (EIN) in a complex innovation network (CIN). A so-called "embedding node" needs to exist in the CIN and the proper incentives need to be articulated by the EIN in order for a distal embedding process to take place. This strategy overcomes the problems that pervade EINs by way of allowing nodes embedded in EINs to access key enabling assets that are only available in CINs. In our model, we introduce a special node, the so-called "embedding node," to perform the so-called "embedding function," the key function underlying this strategy.

3.5 Embedding Nodes and Their Properties

The distal embedding strategy is based on finding and engaging a suitable "embedding node" in the CIN and characterizing a so-called "embedding function." Embedding nodes are a very special kind of node in a complex innovation network. To qualify as such, a potential embedding node needs to satisfy very peculiar conditions:

1. Unlike VCs, embedding nodes do not necessarily need to have strong ties to a wide variety of nodes in the CIN, though weak ties to a wide variety of nodes in the CIN will typically exist;
2. Embedding nodes must have strong ties to nodes that do possess these strong ties to other strongly connected nodes in the CIN, though, most notably to VCs or to nodes in the CIN with high degree of betweenness centrality;
3. Embedding nodes do not necessarily provide financing, although they can connect nodes in the EIN with nodes in the CIN that can provide such financing.

VCs are by definition potential embedding nodes in our model. In fact, a company located in an emerging region of innovation and entrepreneurship that succeeds in securing funding from a tier-1 VC in a complex innovation network would get distally embedded in such network in a straightforward way by its funding VC. Unfortunately, most technology firms located in emerging regions of innovation and entrepreneurship will not be able to receive funding from a tier-1 VC in a complex innovation network. More realistically for such technology firms, nodes embedded in the CIN and strongly connected to other nodes exerting power over investment and technology-purchasing decisions in the CIN could play the role of embedding nodes. These embedding nodes could include key reference accounts and channel partners.

3.6 Analyzing the Role of Embedding Nodes

Ferrary and Granovetter (2009) argue that due to the systemic nature of complex innovation networks, the presence or absence of a few types of nodes in an innovation network, especially those highly connected in the network, can seriously compromise the functioning of the network. Even though complex networks show resilience to changing conditions, the removal of nodes with high betweenness centrality in the network can lead to systemic failure (Callaway et al. 2000; Newman et al. 2006). The role of embedding nodes in our model is of such an importance that the absence or removal of an embedding node can lead to a systemic failure and compromise the process of distal embedding. In this section, we analyze the special role of embedding nodes. Using the five functions put forth by Ferrary and Granovetter (2009) to analyze the role of VC firms in innovation networks, we investigate the multiplex roles of embedding nodes for a successful execution of a distal embedding strategy.

3.6.1 Financing

Embedding nodes do not need to fund nodes in the EIN but should give access to nodes in the CIN that provide funding.

3.6.2 Selection

Embedding nodes select start-ups in the EIN long before distally embedding them in the CIN. They contribute to saving resources in the EIN by identifying nodes in the EIN with high potential for either regional or global competitiveness and by diffusing this information in the EIN. Distally embedded nodes that are located in the EIN undergo a selection process that saves resources in the CIN as well, particularly for VCs potentially interested in funding start-ups originating outside the CIN.

3.6.3 Signaling

Distal embedding sends a signal to nodes located in the EIN and the CIN to work with and fund distally embedded nodes both in the EIN and the CIN. Once distally embedded in the CIN, the "embedded nodes" become more likely to receive VC funding in the CIN.

3.6.4 Learning

Embedding nodes are industry veterans that accumulate and diffuse the knowledge required to create successful start-ups and provide the role of a non-funding super angel investor to nodes in the EIN. Embedding nodes also serve the process of accumulating knowledge about investing opportunities and technologies arising out of the EIN, diffusing this knowledge through the CIN.

3.6.5 Embedding

A node from an EIN that gets distally embedded in the CIN by an embedding node will get embedded in the CIN without being geographically located there. If distally embedded, nodes from the EIN are more likely to receive VC funding in the CIN and, if successful in receiving such funding, the embedding will get reinforced in the CIN. Eventually, the embedded node will have subsidiaries in the EIN or will move its headquarters there. Though the process of distal embedding can have as a result the relocation of the entire firm to the CIN, such relocation might not always be intended as end result. In some cases, the embedded node will become a globally operating company with subsidiaries in the CIN but will keep its headquarters in the EIN.

3.7 Embedding Functions

The cornerstone of the distal embedding model is the so-called embedding function. An embedding function for a node in the EIN is defined as a function performed by the embedding node in the CIN with the aim of embedding a node located in the EIN (the embedded node) in the CIN. The availability of such an embedding function depends on whether or not a "compelling value proposition" can be articulated between the embedding node in the CIN and the embedded node in the EIN that is seeking to be embedded in the CIN. In some cases, not the actors seeking such embedding provide the "enabling assets" for the embedding function to be characterized. Indeed, actors from the public or finance pillars such as government agencies or venture capital firms, respectively, can act on behalf of the embedded nodes located in the EIN and provide the "enabling assets" for this value proposition to be generated.

It should be noted that the embedding function creates a strong tie between the embedding node in the CIN and the embedded node in the EIN. Such a strong tie can be established only if a "vested interest" is created for the embedding node to engage on a long-term basis in the embedding process such that a value creation process ensues in the CIN for both the embedded and the embedding node. Both the embedded node and the embedding node need to capitalize upon this process of value creation. Invariably, the embedding node will need to embrace the risks associated with the *ex ante* possibility of failure and losses. This will make it necessary for the value proposition underlying the embedding function to provide the necessary incentives for the embedding node to assume this risk. If this is not the case, a suitable embedding function will in all likelihood not be characterized and the embedding process will not unfold in the CIN.

4 Implementing Distal Embedding

In this section, we report on the implementation of a recent program aimed at embedding high-technology projects arising out of the emerging regions of innovation and entrepreneurship in Chile in complex innovation networks. The agenda for the implementation of this program was proposed at the first international seminar on technology innovation strategies. This international seminar was the first of its kind in Chile and was organized by the Faculty of Economics and Business at Diego Portales University in Santiago de Chile with the sponsorship of the Chilean Economic Development Agency (CORFO).[7]

4.1 The Agenda

A first international seminar entitled "Towards a technology innovation strategy for Chile" took place in Santiago, Chile, in March 2011. Although general technology innovation strategies were discussed by some of the international speakers, the main focus of this international seminar was to discuss technology innovation strategies that could be applied in order to increase the regional and global competitiveness of the innovation networks emerging in some of the knowledge-intensive industry sectors in Chile. The agenda for an implementation of the distal embedding strategy presented by the first author at this seminar aimed at overcoming some of the structural gaps of the emerging technology innovation networks in Chile and identified the elements involved in the model of distal embedding discussed in Sect. 3. This seminar also contributed to initiating a series of negotiations between the Chilean

[7]CORFO is an acronym that stands for "Corporación de Fomento de la Producción", the Chilean Economic Development Agency.

Agency of Economic Development and the embedding node proposed by the first author at this seminar (see Sect. 4.5 below). These negotiations ended up in a series of agreements between these two parties that were instrumental in creating the "Go To Market" program by the Chilean Agency of Economic Development. Although the actual implementation of this program deviates in some respects from the original implementation of distal embedding proposed at the seminar, we will analyze this implementation using the formal model of distal embedding presented in Sect. 3.

4.2 The Emerging Innovation Network

The emerging regions of innovation and entrepreneurship proposed for the implementation of the Go To Market program were entrepreneurial projects arising out the emerging innovation networks in knowledge-intensive industries in Chile. The program implemented by the Chilean Economic Development Agency deviated from the original agenda proposed at the seminar in that there was no technology or industry focus specified *a priori* for this program.

4.3 The Complex Innovation Network

The complex innovation network originally proposed at the seminar corresponded to the complex innovation networks of Silicon Valley. Such a proposal had been put forth based on the observation that many of the emerging innovation networks in Chile are arising in knowledge-intensive industries that have been pioneered by actors located in the complex innovation networks of Silicon Valley. Although rather agnostic in this regard, the program implemented by the Chilean Economic Development Agency did require that the entities acting as "facilitating entities" (corresponding to the embedding nodes in our distal embedding model) had a series of characteristics that made them "eligible entities for the program" only if embedded in complex technology innovation networks.

4.4 The Embedded Nodes

The embedded nodes corresponded to innovation projects arising out of universities, R&D centers, and small enterprises with a clear outbound innovation orientation. Eligible beneficiaries of the program, acting as "embedded nodes" according to our model, needed to comply with a series of requirements, including having a set of core IPs based on competitive technology, a clear outbound innovation orientation, a compelling value proposition, the potential to export products and services to regional and global markets, and a competent skeleton management team.

4.5 The Embedding Node

The implementation proposed at the seminar called for a node strongly connected in the innovation networks of Silicon Valley to play the role of embedding node. The embedding node proposed corresponded to SRI International (SRI), a contract R&D center with global headquarters in Menlo Park, California. Founded in the 1940s, SRI was an applied R&D center linked to Stanford University up until the 1960s, at which point it became an independent R&D center with no ties to Stanford University other than the fact that many of its research staff studied there. Since the emergence of the networks in Silicon Valley, SRI has been playing a major role in generating cutting-edge IPs and spinning out technology firms in Silicon Valley, some of which have gone on to IPO in NASDAQ or have been acquired by other Silicon Valley firms. SRI maintains strong ties to most tier-1 VCs in Silicon Valley. All these characteristics made SRI meet most, if not all, the criteria for an embedding node in our model. Its "strong embedding" in the complex innovation networks of Silicon Valley made SRI an ideal candidate for the role of embedding node in our model.

The Chilean Economic Development Agency ended up implementing a program that did not specify a unique or preferred facilitating entity (the embedding node in our model). Eligible candidates for the program could either select one of the facilitating entities from a list of preapproved entities or propose another entity meeting the stringent criteria stipulated by the program to qualify as facilitating entity. SRI International, the embedding node originally introduced at the seminar, was part of the list of preapproved facilitating entities and played a key role in the creation of this program, as originally envisioned at the seminar. Initial qualification meetings between the first author and management of SRI took place in California in 2010. A preliminary agenda was agreed upon to organize the first seminar on technology innovation strategies in Santiago de Chile. Upon receiving a grant from the Chilean Agency of Economic Development, the first author prepared, jointly with management and staff of SRI International, the agenda for this seminar during 2010 and 2011. The seminar took place in Santiago in March 2011 and had an attendance of over 400 small and medium-sized technology companies and entrepreneurs. Policymakers and high-ranking government officials were also in attendance. A workshop on innovation management methodologies was also organized as part of this event for a group of government officials from the Chilean Agency of Economic Development (CORFO) and a group of emerging technology companies in Chile.

4.6 The Embedding Function

For this particular implementation of the program, the active involvement of an actor at the public pillar in the Chilean innovation system was required. The Ministry of

Economy, and more specifically the Chilean Economic Development Agency, did play this role in the implementation of the program. Initially, the engagement model was construed as a consulting agreement whose objective was to identify and qualify prospective Chilean technology companies with the potential to export products and services to regional and global markets. In doing so, the embedding node should deploy subject matter experts to perform technical and market due diligence and select a number of qualified embedded nodes arising out of the emerging technology innovation networks in Chile. In order to fill an initial funnel with a large number of prospective companies as potential embedded nodes, this process was to be executed in two stages.

In an initial qualification process, the Chilean Agency of Economic Development conducted an initial qualification of eligible candidates. To this end, members of management and staff of this agency underwent training on innovation management methodologies. Initial training had taken place as part of the workshop organized by the Faculty of Economics and Business at Diego Portales University and SRI International in March 2011. Subsequent training was provided by SRI International throughout 2011 and 2012. After this initial prequalification of eligible candidates, subject matter experts of the embedding node jointly with staff of the Chilean Agency of Economic Development conducted further qualification in Santiago and eventually identified those qualified candidates that could act as beneficiaries of this program (the "embedded nodes" in our model). The final step consisted in selecting and bringing a group of qualified technology companies to the premises of the facilitating entity (the embedding node located in the CIN in our model) for further training and induction to processes of fund raising and early-stage commercialization.

The implementation of this program did not officially foresee any direct involvement of the facilitating entity in the full process of distal embedding, as described in our model. Although the "embedding node" did not provide any funding to this selected group of companies and did not play an active role in finding such funding either, it did play a role in providing further training on its premises and in identifying both client and investing opportunities in the complex innovation network. Contingent upon beneficiaries of the program meeting all the requirements to qualify as an "embedded node" in our model, the embedding node would be in a position to make the necessary introductions to tier-1 VC firms and help with the preparations of road shows with investors in the complex innovation network. In this particular implementation, meeting such requirements meant that the selected group of beneficiaries that underwent further training in the complex innovation network needed to be qualified by the embedding node as potential "fundable deals" for venture capitalists in the complex innovation network. Contingent upon raising a series A round with a tier-1 VC in the complex innovation network, the process of distal embedding, as defined in our model, would be performed by the VC firm without any further involvement of the embedding node.

5 Discussion

In this section, we discuss the *ad hoc* cases of distal embedding shown in Sect. 2 and also analyze the first guided distal embedding implementation introduced in Sect. 4.

5.1 Analysis of ad hoc Cases of Distal Embedding

Table 1 characterizes the distal embedding case of Israel according our model. Table 2 characterizes the distal embedding case of the enterprise software industry according to our model (in Tables 1 and 2, EIN and CIN stand for emerging innovation network and complex innovation network, respectively). As opposed to the first case of distal embedding shown in Table 1, the second case of distal embedding shown in Table 2 followed closely the model of distal embedding we introduced in Sect. 3. As a result, once all the components of the proposed model of distal embedding put forth in this article were in place, including a highly compelling embedding function for the embedding nodes, the distal embedding process unfolded rapidly and produced high-impact results in a relatively short

Table 1 Distal embedding in the case of Israel

Element	Description
EIN	Emerging regions of innovation and entrepreneurship in Israel
CIN	Silicon valley and silicon valley of the East
Embedded nodes	Start-ups financially backed by Israeli VCs in the EIN
Embedding nodes	Israeli-based VCs (in stand-alone mode through a process of self-embedding)
Embedding function	Large flow of high-quality deals with a high potential to be syndicated with tier-1 VCs in silicon valley

Table 2 Distal embedding in the case of the enterprise software industry

Element	Description
EIN	Innovation networks of enterprise software vendors in emerging regions of innovation and entrepreneurship
CIN	Complex innovation networks of the enterprise software industry, especially those located in the tier-1 ICT absorption markets in the Americas, EMEA, and APAC
Embedded nodes	Regional enterprise software vendors
Embedding nodes	Big 5 consulting companies
Embedding function	Positioning the Big 5 consulting companies as the prime contractors in charge of deployments of enterprise software solutions

period of time. In the case of software vendors such as SAP, the results were of such magnitude that the company became a world-class company and eventually the world's largest enterprise software vendor in less than a decade.

Albeit in an *ad hoc* way, this second case of distal embedding took place in one of the most industrialized regions of Europe, a region that is notorious for having formed highly complex innovation networks in several knowledge-intensive industries. This reveals an important finding, namely, that distal embedding can also be successfully executed as an innovation network formation strategy in highly developed regions of innovation and entrepreneurship. In this second case, the embedding nodes comprised of the global consulting organizations of the so-called Big 5 consulting firms caused the process of distal embedding to occur in a relatively short period of time, mobilized vast resources located outside the network in which the organization being embedded was located, and effected a transition of embedded companies such as SAP from being a regional player in a tier-1 technology absorption market in the DACH region[8] to becoming the world's largest enterprise software vendor in about a decade. This process of value creation, ignited by three highly compelling value propositions addressing important needs of the clients, the vendors, and the Big 5 consulting firms, respectively, produced also a radical change in terms of a completely new business model, and its associated revenue model, within the entire enterprise software industry. By the late 1990s, this new business model had become the *de facto* standard for any enterprise software vendor with the ambition and the potential to achieve a position of global market leadership.

Conversely, the distal embedding process executed by Israel did not follow the model proposed in this article. In the absence of a proper embedding node and an associated embedding function, distal embedding could not take place initially. The case of Israel followed a brute-force approach to self-embedding that has proven to be successful in the end due to the continuous investment and future orientation of the finance pillar in the Israeli innovation system over a long period of more than two decades, on the one hand, and some very singular events and conditions of the national innovation system of Israel, on the other. It was the rather unusual combination of these two factors that led to the creation and consolidation of a number of Israeli technology firms as global leading vendors in their respective markets in a relatively short period of time.

[8]DACH is an acronym used in German-speaking countries that stands for Germany, Austria and Switzerland.

5.2 Implementing Distal Embedding

To our knowledge, the case described in Sect. 4 corresponds to what we could construe as the first guided implementation of distal embedding. Though still too early to ascertain the final results of this process, we can drive some initial conclusions from this implementation.

As far as a successful implementation of distal embedding is concerned, the case of Chile is particularly challenging for a number of reasons. Firstly, the number of qualified deals arising out of the emerging technology innovation networks in Chile is still too small. A more active role on the part of actors at the public and private pillars of the national innovation system in Chile is required to increase the number of qualified deals. The goal of public policies at the interface of the public and private pillars should be to increase the flow of qualified deals, that is, of technology companies with the potential to get distally embedded in complex innovation networks. Secondly, incentives need to be created for the finance pillar to engage actively in the process of distal embedding. Solving the deal flow problem is one first step towards creating these incentives for the finance pillar. In fact, to the extent that the number of qualified deals increases and the successful cases of distal embedding commence to unfold, actors at the financial pillar will regard them not as isolated cases of serendipitous technology innovation and entrepreneurship with an interesting upside financial potential but rather as an emerging industry in which they need to participate.

Actors at the public pillar in Chile have already taken initial steps in this direction by setting up matching funds that provide interested actors at the finance pillar with financial incentives to create technology investment funds. Actors at the public pillar will need to redouble their efforts to create a technology investment industry and an emerging venture capital industry in Chile. We expect that the need for distal embedding in the case of Chile will arise much earlier in the innovation life cycle than in the case of Israeli technology start-ups due to the current lack of competences on the part of the Chilean investor community and their local networks to manage the agency and monitoring costs associated with high-technology ventures. This adds complexity to the implementation of distal embedding in Chile.

Finally, the embedding function in this first guided case of distal embedding is still too weak. We do not yet see the incentives for the embedding node to engage more actively in the distal embedding process. We believe that the provision of consulting fees, even on a long-term, ongoing basis, will not be sufficient incentives to characterize a strong embedding function, at least not at the present stage. If the number of qualified deals increases and actors at the finance pillar engage more actively in the process of funding a larger number of qualified deals at the early stages of their financial life cycle, then the required enabling assets might start to get generated in the emerging regions of technology innovation and entrepreneurship in Chile in order for the "robustness" of this embedding function to increase, as required by our model.

6 Conclusions

As argued by other researchers (Castilla et al. 2000; Ferrary and Granovetter 2009), the complexity of an innovation network is a key factor that determines the chances of success of processes of innovation and entrepreneurship taking place in that network. Unlike other research in this area, we focus in this article not on the study of such complex networks but on the rather elusive problem of how the process of innovation network formation takes place. Our work focuses on generic innovation network formation strategies that can be implemented to increase the chances of success of processes of technology innovation and entrepreneurship taking place in innovation networks lacking the necessary complexity. The concept of embedding plays a central role in this connection. In our model, the success of processes of outbound technology innovation driven by actors located in emerging regions of innovation and entrepreneurship will strongly depend on the possibility of these actors getting distally embedded in complex innovation networks. The economic outcomes such an actor can achieve will strongly depend on the “robustness” of the distal embedding function.

While the cases described in Sect. 2 did not follow a systematic approach to distal embedding driven by the embedded nodes, as defined in our model, they demonstrate the feasibility of distal embedding as a process of innovation network formation. The second case, in particular, is the quintessential manifestation of an *ad hoc* distal embedding process. This second case exemplifies the impact that a process of distal embedding can have on the economic outcomes of an innovation process. The magnitude of the success of this second case was predicated on the magnitude of the singular event that gave rise to the process of distal embedding, namely, the millennium bug. This singular event gave rise to a highly compelling value proposition for the embedding function to be characterized. Such a strong embedding function provided the necessary incentives for the embedding node to deploy a vast amount of resources in the execution of the distal embedding process.

We put the case that the process of distal embedding is not only relevant to companies in emerging regions of innovation and entrepreneurship, especially those that are not endowed with the local “enabling assets” required to successfully execute a local embedding strategy. Indeed, distal embedding can also be used in more complex innovation networks located in regions of technology innovation and entrepreneurship of developed countries, as exemplified by the second case of distal embedding discussed in Sect. 2.

Although we might argue that the embedded nodes involved in the cases of distal embedding analyzed in Sect. 2 were initially unaware of what mechanism was at work and how it operated, they were very much aware of the results this mechanism was producing. Albeit implemented and executed in an *ad hoc* way, these cases show that there is a mechanism at work behind the process of distal embedding. We claim that there is method behind the magic of distal embedding and that technology companies from both complex and emerging regions of innovation and entrepreneurship can benefit from understanding how the process of distal embedding works and how a distal embedding strategy can be implemented.

Our work has important implications for theories of economic development and the approaches to implementing them. Empirical evidence shows that mainstream approaches aimed at incrementally increasing the product space in areas where emerging regions of innovation and entrepreneurship do already possess comparative advantages may face a higher probability of augmenting the productivity and the knowledge pool of these regions (Hausmann and Klinger 2006; Bahar et al. 2014). Unfortunately, these approaches fail to address the problem of how to embed these regions in industry sectors in which they do not yet present such comparative advantages. For emerging regions of innovation and entrepreneurship, these are often the most attractive sectors as far as future growth and diversification opportunities are concerned. We find these "salami tactics" somewhat shortsighted and, more importantly, more prone to leading to potential dead ends due to its fundamental lack of future orientation. Although the mainstream approach in most emerging regions of innovation and entrepreneurship, we find that these neoclassically inspired tactical approaches to economic development might peacefully co-exist with a more comprehensive neo-Schumpeterian strategy of innovation network formation such as the one advocated in this article.

Our future work will focus on expanding our model of innovation network formation by postulating three generic innovation network formation strategies called "replication," "local embedding" and "distal embedding" and integrating them in a comprehensive model of innovation network formation.

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