Learning to Innovate in Distributed Mobile Application Development: Learning Episodes from Tehran and London

Neek Alyani
LLAKES Centre, IOE, University of London
London, United Kingdom
TIR Group, Faculty of World Studies,
University of Tehran, Tehran, I.R. Iran
Email: n.alyani@ioe.ac.uk

Sara Shirzad
Technenovate Associates, Tehran
Islamic Republic of Iran

Email: SaraShirzad@hotmail.com

Abstract—This paper reports on the activities of an entrepreneurial small software firm, operating in telecoms value-added services based in Tehran, Iran, with project partners in London, UK. Mobile and smart phone applications are altering our professional and social interactions with innovative business models, glocal content and eco-systems, fusing the multifaceted aspects of mobile software development. To analyze these types of activities in the context of rapidly changing catching-up economies, development of mobile applications by entrepreneurial NTBFs, initially imitating as a way to innovate, require distributed up-skilling, rapid problem-solving and pragmatic learning. Specifically, we focus on knowledge brokerage and sourcing activities in distributed Scrums. Drawing on longitudinal analysis of projects [2004-2010], an iterative 'learning to innovate' model, entitled DEAL (Design, Execute, Adjust, Learn) within 'project-enhanced learning episodes', is constructed and outlined utilizing knowledge brokers and boundary sources in enterprise challenges. We conclude by reflecting on distributed learning and skills in practice.

I. INTRODUCTION

THE overall aim of this paper is two fold: firstly to report in outline, the longitudinal learning and innovation activities in distributed small teams within the context of global software development (GSD) and secondly, by introducing our learning-to-innovate model, pave the way for a re-examination of the originally integrated (and now evolving) concept of 'learning' in practice. Specifically, in our model's construction, we take account of knowledge creation activities and skills within the service innovation process, by means of knowledge brokerage and sourcing. Mobile and smart phones applications are significantly altering our social domain and professional interactions [1] with innovative business models, content and eco-systems emerging glocally (globally modelled yet locally scaled), outlining the 'mobile big bang' and fusing the business and technical aspects [2-4] of the mobile solutions development.

Since their introduction and uptake, project-oriented agile software development methods, such as Scrum and Lean [5-7], whilst subject to recent conceptual concerns (e.g. brief summary of critique under Section 2.1 of [8]), have been well received in the practitioner community and are starting to significantly change and transform the software industry in small and large firms and projects. Additionally, there has also been some recent movement on exploring agile methods for mobile software applications and equally of interest, multiple systematic and historical reviews related to Scrum and Lean methodologies have found their way into the literature [9] providing a better background on the trajectory of their development, and underlying assumptions.

In rapidly changing external environments of catching-up economies, development of mobile applications by entrepreneurial small firms, initially imitating as a way to innovate [10], requires distributed up-skilling, rapid problem-solving and pragmatic learning [11]. In transitional and catching-up economic climates, Scrum, as a project methodology is viewed to have natural advantages in development of mobile applications based on having a disciplined and limited scope, high customer/end-user interaction, and condensed time to market cycles. Drawing on innovation management and workplace learning corpus, distributed innovation with technologies and developing dynamic capabilities, framed as the engine of the firm's sustainable competitive advantage [12], offers competitive action in an unstable and unpredictable market. Conversely, learning episodes in distributed project activities, such as in Scrums, provides some stabilisers to compete in the market.

The case study analysis, based on the longitudinal scope [2004-2010] outlines a learning cycle in the exploration and exploitation phases of projects [13], identified and expanded upon to highlight the 'project-enhanced learning episodes' as a unit of analysis, utilising knowledge brokers, knowledge creation methods, and networking modes [14-17], and cross-border knowledge sourcing strategies by SMEs [18], particularly micro New Technology Based Firms (NTBFs)[1] in technical and non-technical challenges. We also note that NTBFs in some developing economies (e.g. Iran) endowed with skilled, technology savvy and connected teams, tend to mimic MNC/TNCs' 'skill webs' [19] to survive and prosper.

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[1] Within the high-tech sector, NTBFs regularly operate as the vanguard of product, process and service innovation: the firms are usually formed by highly educated and skilled entrepreneurs, with a high rate of growth and firm mortality significantly contributing to sectoral and national economies.

The paper concludes by further highlighting an analytical and empirical tension on whether the concept of learning in Scrum (and Sprints) has evolved and is thus, in need of re-conceptualisation. This is particularly with reference to small firms engaging in technological innovation in services and operating in the new and expanding sectors of the economy, such as the Creative and Cultural sectors [20]. Originally drawn from the game of rugby and applied to New Product Design, initially empirically based on a manufacturing mode of operation in mid to late 1980s [21-25], and transported into and enthusiastically taken-up by the software development community over a decade ago [26-27], we enquire on whether the learning opportunities are still present in Scrum, and if the metaphors still offer useful analytical means in exploring the challenges of inter-professional learning and work in our current era [28-29].

II. CHALLENGES AND ANALYTICAL CONCEPTS

As an entrepreneurial software solutions firm, the overall challenge for the projects and personnel of this case study is simple: to develop and offer value-proposition, by the processes of identifying, evaluating, and exploiting business opportunities to create new digital services [30]. Entrepreneurial activities, following the Schumpeterian economics line of argument [31] differentiates between the invention of new knowledge and its commercialisation, and views the process of commercialising existing knowledge as essential for entrepreneurial activities, bridging as yet unconnected sources of expertise and knowledge and re-combining already known inventions in an effort to create new business opportunities [14].

Additionally, it is becoming increasingly apparent that within the context of globally distributed work and by extension, global software development, the 'production system' team needs to not only deal with cross-functional and inter- and intra-disciplinary work, as extensively studied previously (e.g. as in the evolution and use of the influential SECI model of knowledge creation) [21-25], [32], but also deal with locational, temporal and relational boundaries. These 'boundary crossing' [33] activities require continued orchestration of the firm's effort beyond strategy, structure and systems, and towards purpose, processes and people [34-36]. It is thus our contention that knowledge brokerage and knowledge sourcing, have taken centre stage in fulfilling the requirements of the new *knowledgeability* [28] demanded at NTBFs. We view knowledge brokerage and sourcing in innovation, as formal and informal means to bring people together, and create new purposefully productive and expandable relationships, in order to define, design for, and solve problems in firms. An important by-product of these processes is learning and skill development, which derives out of workplace brokering, embedded in largely episodic, unrecognised and unplanned activities.

As a way of introducing the context, it is critical to note that the study was conducted during a time of unprecedented growth both in the usage of mobile phones and expansion of associated services in Iran (spanning 2003 to 2010), when and where the mobile penetration rates far exceeds the internet usage and many subscribers started to explore and use their mobile phones as personal and often primary communication device. With an estimated current population of 75.5m in a geographic area, approximately three times the size of France, the mobile penetration rates stood at just over 58% [37] in 2009-2010, from next to nothing (0.4% to 0.8% based on ITU figures for 1998-1999 [38]), about a decade before. The increase in penetration rate whilst tapering off, remains robust to date, based on cheaper (variations of 'pay-as-you-go' and pre-paid) subscriptions and contracts, offered by incumbents and newer 3G (and 3.5G/HSPA+) mobile telecommunications license holders.

As the nascent information and communication technology market including the telecom, and telecom value-added services segments, was still shaping, the firm examined in this study, re-labeled here as Alpha Company was formed as a fully private company in 2002. As a small entrepreneurial firm, starting out with a few co-founders with technical (software, science and engineering) and business acumens, it initially engaged in testing the market with a range of software services based on the outsourcing model. Whilst it had initial small successes in securing outsourcing contracts from EU, the internal market and particularly the niche market of mobile application software and solutions looked more promising, leveraging on an implicit 'Blue-Ocean' [39] strategy emphasising strong technical innovation on sought-after global solutions for local needs, as part and parcel of the emerging global 'Mobile Big Bang' model, illustrated below in figure 1.
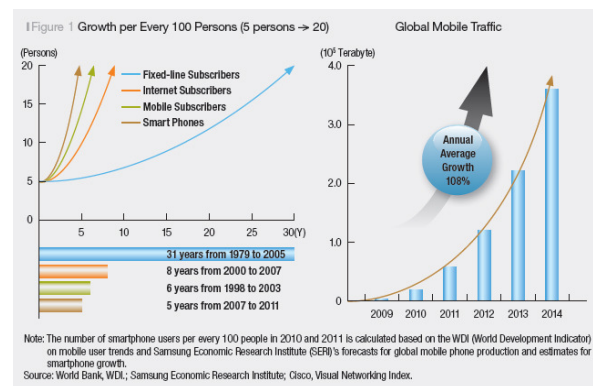

Fig. 1 '**The mobile big bang**' figures: SERI Quarterly, Kang 2010 [3]

Examining the market and the rapid changing patterns of mobile handsets, AlphaCo set out to develop a stable platform for business solutions, offered to both the public and private sector primarily in Tehran. Technically, drawing

on the partner in London and imitating to innovate, it opted for building applications and solutions on a tested 'common denominator' of SMS (short messaging service) as an embedded, and till then largely redundant feature (due to lack of popular use and small subscriber numbers mainly interested in core service of voice communication), within the Iranian national GSM network. Software development and testing using Java Platform, Micro Edition (Java ME[2]), previously known as Java 2 Platform, Micro Edition (J2ME), as a Java platform designed for embedded systems (e.g. for mobile devices) were undertaken under local and later distributed Scrum. As the mobile telecom market grew in size, the SMS VAS[3] (short messaging service value-added services) segment grow with it. The full force of mobility, as a business service revolution [4], whilst delayed for about a decade compared to Western Europe and Far East, had at last arrived in Iran. With the development of technological tools, NTBFs such as AlphaCo, and a select number of University-Industry based research labs, started to engage in pioneering service science in practice, exploring service design and innovation, in Tehran [40-41].

In telecommunication industry, a value-added service (VAS) is a term for non-core services, i.e. all services beyond standard voice calls and fax transmissions. It can also refer to any service industry, for services available at little or no cost, to promote their primary business. On a conceptual level, value-added services add value to the standard service offering, encouraging the subscriber to use their phone more and allowing the operator to drive up their ARPU (average revenue per user). For mobile phones, while technologies like SMS, MMS and GPRS have traditionally been considered as value-added services, a distinction is made between standard (peer-to-peer) content and premium-charged content. Value-added services are supplied either in-house by the mobile network operator themselves or as in the case of this study, by a third-party value-added service provider (VASP), also referred to as a content provider (CP). VASPs typically connect to the operator using protocols like short message peer-to-peer protocol (SMPP), connecting either directly to the short message service centre (SMSC) or, to a messaging gateway that allows the operator to control the content and speed of delivery better.

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[2] Java ME was designed by Sun Microsystems, recently becoming a subsidiary of Oracle Corporation. There are presently an estimated 3 billion Java ME enabled mobile phones and PDAs used globally (http://www.java.com/en/about/), although the technology is increasingly viewed as 'old' technology as it is not used on any of today's newest mobile platforms (such as iPhone by Apple, Android now owned by Google, Windows Phone 7 by Microsoft, MeeGo, initially supported by Intel and Nokia [now subject to change due to Nokia's major reorientation] as well as Linux Foundation, Novell and AMD; and BlackBerry/RIM's new QNX).

[3] Despite the technological progress on smart phones and mobile platforms in the West and Pacific Rim, based on their market size and large heterogeneity of mobile handsets, SMS VAS remain a significantly healthy segment in markets such as India, China, and much of developing Middle East, Africa and Far East. Smart phones and 3G do not, yet, rule globally.

A. The Theoretical Concepts and Contexts

The core of this study explores the processes of learning that leads to innovation in a small entrepreneurial private firm. Specifically, the role of knowledge brokerage and knowledge sourcing, to assist in and facilitate the process of knowledge creation is examined. The 'wider lens' of the study explores the changing relations between knowledge, learning and innovation in Iran's private sector software development. For instance, tensions that arise within the digital technology sector, when the geo-political forces and national strategies collide were apparent early on. Equally, the paradox of a technically educated, yet unskilled workforce became increasingly a burden for the firm. The empirical case study evolved into focusing on a firm currently operating within the value-added services (VAS) engaged in designing joined-up advertising campaigns, banking and public services on mobile platforms.

In order to scale the project, and by extension, sharpen the focus of the lens of the study, many choices have had to be made and limitations imposed. These include concentration on a single firm, in a single city, in a single country, namely Tehran, Iran linked to a single external entity in London, UK. Theoretically however, only robust principles and fundamental concepts found in the academic (and at times, consultancy) literature are mobilised, and have guided and informed the directions pursued in the different stages of the study. Methodologically also, choices made around the 'unit of analysis' and the 'longitudinal design' intended to permit a deeper and more nuanced understanding of learning and innovation in the context of a firm operating in a transitional economy. An interdisciplinary approach is utilised outlining the macro- and meso-frameworks and factors, as well as close attention paid to the micro level practices, which breaks away from a one-dimensional and 'cross-sectional' snap-shot analysis. As researchers, we were conscious of exploring methods that avoid primarily snap-shot views. Using a metaphor from traditional photography, we were acutely interested to keep the 'shutter' open for long enough to be able to view and explore changes taking place, and yet, not overexpose the textural composition of the film. Closely congruent with our underlying epistemology and ontology, our methodology anchored around analytic induction [42] within a context of applied qualitative research [43]. The approach, although time-consuming, resource-hungry and iterative, leads to shedding light on interdependencies and interactions of often embedded social factors and institutions existing at the societal, sub-societal and subterranean level.

The study examined, en route, the changing relationship between the local and the global in Iran (and issues around glocality), in particular highlighting the contradictions and tensions in simultaneously promoting an 'insular' and 'connective' approach within its economy and by extension, technological interactions. This is embedded within an

historically ambivalent pattern of political economy of a 'rentier' system, set as far back as the late 1960s to early 1970s, accentuated by the promotion of the self-sufficiency[4] discourse propagated during the Islamic revolution of 1978-1979, and embedded in the establishment of the Islamic Republic in 1979 and further reinforced and consolidated by the 'self-reliance' legacy of the Iran-Iraq war (1980-1988), while dealing with chronic U.S. sanctions [44].

Much has been written on related matters, and journalistic and scholarly literature on Iran has proliferated and there remains a continuing alarmist discourse, in the last decade. This has been further exaggerated by Iran's implicit positioning to regional super-power status following the regime changes in Iraq and Afghanistan and the 'Arab Spring'; insistence on the legality of its right to harness nuclear technology for peaceful purposes as well as an ongoing rhetorical dispute with Israel. Away from geopolitics however, there is a dearth of nuanced and objective accounts on the complexities of Iran's post-revolutionary socio-economical position, especially policies related to human resource development, skill formation and development and knowledge creation [38], [45-46] in its networked organizations and modes of operation, including means to circumvent the effects of long-term economic sanctions on technological and globally sought-after skills, and confronting the gales of 'compressed modernity' [47].

Iran has ambitious plans to become a well-connected advanced regional power, and to have the potential to 'project' its power[5]. This is legally manifested in the '*Iran 2025 Vision*' (locally referred to as "*Iran's 20 year Vision*[6] *document*") which is essentially a brief, yet overarching policy orientation of the next 15 years' development plans, setting the agenda for the four, 5 year development planning cycles (4th to 8th post-revolutionary five year development plans, spanning 2005-2025). The '2025 vision' envisages a range of social justice, revolutionary and Islamic ethos trajectories, and political and economic development programmes, as approved by IMF [48], amongst which a move towards an advanced knowledge-based rapid development and knowledge-creating modes of operations (in science and technology) is to be prioritised and promoted. There also exists a national emphasis and aspiration on developing a knowledge-creating mode of operation within the economy, as opposed to being 'a mere consumer' of externally produced technological knowledge.

Within the focus of this study however, whilst significantly leveraging on the analysis offered and firm foundations laid by Guile [28] in unpacking the issues, we draw on a recent articulation by Lauder and colleagues [49], [19] as part of a UK ESRC programme of research that sheds light on the topic. In essence, Lauder asserts that while many claims about the knowledge economy have been made, few stand the test of empirical scrutiny. One area however that displays a clear and substantiated trend is in the relationship between knowledge economy and innovation: innovation is at the heart of the knowledge economy, as it is about the intensification of competition. As innovation takes centre stage in the economic life of firms and nations, *learning to innovate* becomes a matter of high priority for firms. Learning and innovation in firms however are multifaceted and multi-layered processes, utilising different forms of knowledge/s and *knowledgeability*. A nuanced examination of evidence portrays the contemporary learning in firms as possessing complex, rapidly changing and context-specific characteristics. No firm in isolation, whether large or small, is likely to acquire and maintain the necessary portfolio of expertise and skills required in its development. This was uniquely captured by early research, stating "firms are not islands but are linked together in patterns of co-operation and affiliation" [50, p. 895]. As the source of competitive advantage shifts to human resources, there follows a consequent increased interest in learning and development issues. As Guile [51, p. 470] reiterates, "people, rather than such traditional factors of production as capital, will become the main source of value and economic growth in this new type of capitalism, and that in future, more and more productive activities will make use of employees' intellect and creative capabilities." This is further reflected by a differentiation between four categories of knowledge as: *know-what*, *know-how*, *know-why* and *know-who*, the latter of which is increasingly important in knowledge transfer [52] and viewing skill development [53].

The recent metaphors for learning in firms takes many shapes, such as acquisition, participation and inquiry-based [54] and practically, this is complemented by learning through multiple communities of practice and inquiry [55], [56] via networks (whether 'weak/loose' or 'strong/tight', formal or informal and real or virtual) along with other firms and partners, providing the potential opportunity to collaborate and share material resources and perhaps more significantly, non-tangible resources and new perspectives.

Additionally, within the study's empirical elements observed in the projects, spanning working days in London and Tehran[7], project time (and by extension, hourly costs) and practical collaboration factors is worth reiterating. As

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[4] The closest international model, still actively promoted, to this discourse is that of "*Juche*" *(self-reliance)* in the Korean Peninsula.

[5] We utilize and expand the US DOD definition of 'power projection' and the DIME [-R] model standing for *Diplomatic, Information/Intelligence, Military* and *Economic* and in our addition, *Religious* power.

[6] For more details (in Persian), see *Iran's Expediency Council* website at: www.irec.ir and www.maslahat.ir

[7] Tehran is 3.5 hours ahead of GMT and Thursday (half day in private sector) and Friday are the weekend days. This means that the overlap "real-time" project hours are limited to, at best, 7 hours for 3.5 days per week.

Brown, Lauder and Ashton [49, pp. 136-137] observe: "To reduce the time from 'innovation to invoice' some companies use 24-hour design teams that work around the clock, moving through time zones across Asia, Europe and North America. This is not only intended to reduce the time between invention, application, and market launch, but also to reduce costs, due to lower salary levels in much of Asia… It is also assumed to reflect the importance of embedded capabilities as innovation rarely depends on the skills of individuals working in isolation but on a culture of mutual collaboration and purpose… companies are increasingly experimenting with research, design, market and product development activities in the emerging economies."

Innovation[8] has thus received much attention in the recent years originating from varied epistemological perspectives. The concept of innovation has evolved from being a uni-dimensional, linear process to a systemic approach in which complex interactions between individuals, firms and their operating environment are paramount [12], with recurring themes in business literature that points to the strategic nature of innovation as a source of economic growth and sustainable competitive advantage, both on the national economy, and the firm level [57]. As a caveat that we have highlighted elsewhere [58-60] so we bracket-out here, there is a dearth of 'knowledge work' and 'division of cognitive labour' studies that consider developing or transitional economies. The highly cited examples within the literature are based on firms in the developed and advanced economies [13], [25], [61] and as such, there is a scarcity of exploratory and/or analytical frameworks dealing with developing and transitional economies, and even more so on small firms and learning within those environments.

B. Towards an Analytical Model: 'DEAL' Iteration

Thus in formulating our analytical framework, we took account of this anomaly and attempted to ground our observations. As no single strand of literature provided the necessary theory, we brought together arguments of several theories and soon traced patterns of cyclical exploitation and exploration. Exploitation refers to the firm's refinement and development of existing knowledge with predictable outcomes, whereas exploration refers to the pursuit of new knowledge with uncertain outcomes [13]. We further noted that the nature of learning is in the form of generative interactions between individual and collective inquiries [54]. These are placed on the horizontal and vertical axis of our schematic, outlined in Figure 2. In the center of the figure, drawing on the 'project-enhanced learning episodes', we noted the zone of 'collaboration' and 'coordination and control' activities within projects, as articulated and facilitated by the cycles of Scrums (and Sprints).

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[8] The remit of this study focuses on *innovation in services* and *service design and development* and not focused on new 'products'.
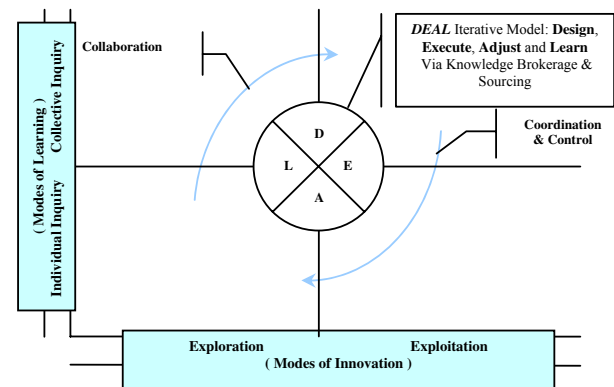
Fig. 2 DEAL iterative model schematic: learning and innovation dimensions in projects

At the heart of the activities however, we noted a range of processes which we labeled as *DEAL*, as an acronym that stands for the cycle of Design, Execute, Adjust and Learn. Within the DEAL model, various activities were enhanced via formal and informal knowledge brokering and knowledge sourcing. A sample series of questions, relating to each problem or inquiry, which are asked at each stage include:

Design: What is desirable and viable, and how feasible?
Execute: What is the expected outcome and impact?
Adjust**:** What worked and what did not, and why?
Learn: What is the core problem and cause? Reframe?

The cycle continues with framing and reframing of the new problem and inquiry, which then leads to a new design imperative, transforming prototype to archetype, till a solution is formulated. Brokerages and sourcing occur initially via formal means (e.g. IJVs) but mainly informally with trust gained, via spillovers, by 1. Visits to technology fairs/workshops, 2. Exposure to global professional/R&D networks, and 3. Participation in online developers' space.

On a practical and longitudinal level, researching small firms has its own unique dynamics, as Guile [62] observes, "Conducting research in SMEs is notoriously tricky… for the following reasons: tight staffing and short deadlines means it is difficult to release people from their work roles; lack of space means that it is difficult to convene meetings; and the lack of a 'learning culture' means that SME owners are often reluctant to give up their time and that of their workforce to participate in a research activity." In attempts to overcome some of these difficulties, the research formulated ways and means around the problem to fit-in with the priorities of the firm and a methodology that reflected some of the firms and staff's concerns and priorities. On a different note, while the concept of design [63-64] (and derivatives such as *design thinking, unified*

design and *design-driven/inspired innovation*) has seen a surge in the business literature, our observation was that in practice, it is often condensed to a 'balancing equation' of desirability, viability and feasibility of the service innovation. This is concisely captured by the sketch below by Tim Brown at IDEO [64]. We outline a vignette of findings in the next section.
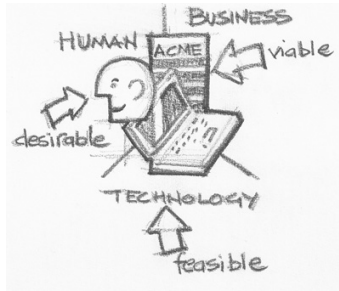

Fig. 3 A rough schematic of design thinking issues (*Desirable-Viable-Feasible*) by Tim Brown, 2008 [http://designthinking.ideo.com/?p=49]

III. RESEARCH METHODS AND FINDINGS IN BRIEF

The empirical elements investigated sharing of problem-setting and -solving expertise on the issues that emerge out of daily business challenges in projects, which is both of a technical (software) and a commercial (business model and service design) nature. Two analytic tools were employed initially to scan the position of the firm within its operating terrain: these were a *PESTLE* analysis; outlining the Political, Economic, Social, Technological, Legal and Environmental factors (fed from the firm's existing SWOT assessment) and *Scenario Planning* outlining where firms viewed themselves in relation to the operating environment and their potential pathways to growth. These analytic tools are commonly used in organizations and are often utilised by organizational consultants and senior managers, as despite shortcomings, are robust in providing a snapshot of the firm's current posture, as a starting position.

The research was conducted as a case study [65-69], within the interpretive tradition, and in addition to the organisational ethnography and interviews (which leveraged on previous research in similar orientation [69-70]), a line of historical analysis was undertaken to enrich the context of the case and supplement the findings. In essence, based on analytic induction [42], an historical analysis, i.e. 'historicity' elements within the firm, sector and national/international factors embedded in the case study approach have guided the methods of data collection and analysis. The primary-sourced data is of a longitudinal nature and comprises of two focus group meetings, 18 semi-structured interviews and ongoing organisational ethnographic observations across 2004 to 2010, plus ad-hoc London-based meetings and updates. The longitudinal research design involves more than one episode of data collection, in line with a 'panel design', where (as far as possible) the same people are contacted, observed and/or interviewed more than once [71], with the orientation and focal questions mirroring previous research [70]. This design strengthens the shortcomings of a single case study [72] and is of particular value when time-critical processes such as learning are observed. These included four weeks (December 2003- January 2004), two weeks (June 2007) and one week (June 2008) 'immersion' based in Tehran, followed by various days accumulating to two weeks (between July to September 2009 and in Spring 2010) as final follow-up in and from London, as well as ad-hoc virtual contacts and "issues' tracing", as necessary. As an exploratory study on how learning and innovation unfolds, this account captures a connected slice of reality, via the lens of activities on projects that facilitate what is labelled as *project-enhanced learning episodes*. Learning episodes are taken as the primary unit of analysis within the outlined model: they are here defined as "an occasion in which a [project] team learned something significant that advanced the project" in line with previous studies [69, p. S20]. Within the episodes, attention was directed at identifying circumstances when and where project team reaches a 'break-through' and/or a 'cul-de-sac', falling within the spheres of explorative or exploitative learning spheres. In the context of the episodes, ambidextrous learning was spotted on occasions, defined here as simultaneously exploring new knowledge and expertise domains while exploiting current ones, and derived from the unique co-configuration and design, drawing on prototyping and reflection (*Hansei*). As it was summarised by a team member "Our learning here is all about 'beta': learning and innovation are coupled and yet learning comes first".
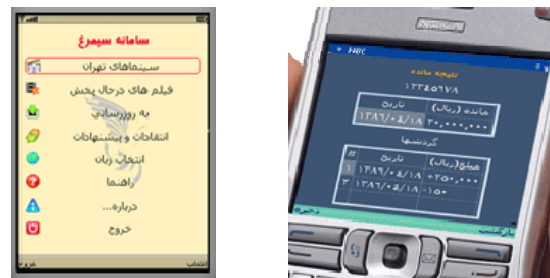

Fig. 4 An example of screenshots for public service offerings outlining a list of current programmes on Tehran's cinemas (left), and a mini-statement by mobile banking in 2006 (enabled via SMS and J2ME)

IV. RETROSPECTIVE AND REFLECTIONS

Within the context described above, namely undertaking project-based tasks, within a rapid and transitional societal and sectoral change, the study explored the following research propositions: firstly, the activities (as observed in 'learning episodes' and brokerage) that the project team members of the firms undertake in their joint projects that facilitate their ability to innovate; and secondly, how the

firm designs strategic learning approaches in practice, with due considerations for the firm's operating environment, as solutions to these latent needs. In addressing the research propositions, we aimed for fidelity in the analytical model and rigor in the analysis, as our prime methodological objective. While 'unpacking' the learning episodes, three interconnected processes were identified embedded within the DEAL iterative model as follows: firstly, conducting the inquiry; secondly, framing and/or reframing the problem/s (problem setting); and thirdly, mobilizing learning episodes to cultivate potential solution/s. Use of informal 'skill webs' [19] for knowledge brokerage and sourcing is also evident.

Our model is aligned with recent research both in SMEs [18], [57] and larger firms focusing on phronesis and acting with an 'idealistic pragmatists' [32], [73] mindset, required to tackle problems, in practice. As a concluding note, Nerur and Balijepally [74, p. 81] have recently cogently compared agile development to maturing design ideas in strategic management and design: "the new design metaphor incorporates learning and acknowledges the connectedness of knowing and doing (thought and action), the interwoven nature of means and ends, and the need to reconcile multiple world-views". This study has aspired to capture some of the delicate inter-connectedness between knowing and doing, in practice via Scrums, in the context of NTBFs in Tehran.

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