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PAPER

Indian IT service industry as a socio-technical transition: A multi-level perspective analysis with case studies

Lakshminarayana Kompella*

Abstract Indian IT-services companies did experience 10 times growth from the mid-1990s till 2005. Companies did achieve growth predominantly with an approach based on aggregation and arbitrage; however, from 2005 to 2015 the growth was different. Going forward, it is imperative to look beyond arbitrage and aggregation, one approach is an emphasis on organizational adaptations to manage in transitions. Transition literature has numerous instances explaining shifting of assemblies of socio-technical systems with a heuristic and analytic view. To assist practitioners, the author extends it for IT-services with a case study from an Indian IT-services company. The current practices of arbitrage and aggregation approaches provide only incremental innovations and are insufficient; the need is in developing adaptation-selection.This requires using latest ICT-innovations and develop organizational capabilities that promote knowledge management and foster collaboration both at intra- and inter-organizational levels. The capabilities that promote knowledge management and collaboration assist in developing an innovative culture within the organization, thereby, enable other entities in the environment to coevolve.

Keywords: IT-services; software development; software methodology; socio-technical systems; innovation.

JEL Classification: M15; O31; O33

1. Introduction

Indian Information and Communication Technologies (ICT) companies, since the early 1990s, focused extensively on Information Technology (IT) services. IT services include software development, deployment, maintenance, and support. Indian IT companies served both business and government sectors. Business sector involved both IT and non-IT organizations. Non-IT organizations represented sectors such as manufacturing, retail, finance, financial services, healthcare and services, telecommunications and so forth while IT organizations focused exclusively on software product development. IT organizations are Microsoft, Oracle, SAP and CA ~~Technologies to name a~~ few. With the advancement of client-server technologies in the

Lakshminarayana Kompella*(✉)
School of Management, National Institute of Technology Warangal, Warangal, India
e-mail: lnkompella@gmail.com

mid-90s and subsequent development of web technologies paved way for IT enablement of their activities. This presented large opportunities for various IT services and several Indian companies competed with one another. IT companies followed a business model comprised predominantly of onsite-offshore model based on aggregation and arbitrage. Offshore refers to services done from India and onsite refers to services from customer locations outside India, predominantly North America, Europe, and the Far East. Indian IT companies expanded their global development approach with aggregation approach by opening offices in other parts of the world such as Latin America, erstwhile eastern bloc countries, the term 'near-shore' came into existence. In the mid-90s and until mid-2000, to meet the increasing demand for IT services Indian companies every year visited university campuses and made employment offers to several students who meet their criteria. To make the atmosphere more conducive, both Central and state governments offered tax waivers to IT companies apart from permissions to start new institutes. IT companies' business model of frequent overseas assignments with some having more than six months' duration encouraged students of non-IT discipline to make a career shift to IT services. The cost parity of IT services companies and reduced resource ramp-up timelines prompted several customer organizations of Indian IT services companies to benefit from labor arbitrage.

A major component of the project cost for IT services companies is resources (labor) cost. The production and transaction costs did influence organizations to opt for IT outsourcing even though financial slack is not a significant reason (Ang & Straub, 1998). To meet the demand, IT services companies focused extensively on their operations, both resource ramp up and IT deliverables. The changes to their operations resulted in several organizations getting the highest levels of the Software Engineering Institute (SEI) Capability Maturity Model (CMMi) and ISO certifications 9001 and 14001. Organizations also used lean principles to improve operations (Staats et al., 2011). The certifications were unique selling propositions for several IT companies. Though these certifications bring improvements to their software engineering practices, competitors can replicate these practices (Winter & Szulanski, 2001).

With ever-increasing demand and margins that IT companies expect, they were focusing on improving metrics related to resources and IT deliverables. The companies aimed to outsmart their competitors on these metrics and identified improvements. Companies that had a history of performing turnkey projects excelled in fixed price projects while companies that focused on activities related to post-deployment of software and products nearing the end of life (in IT services parlance maintenance and services projects) excelled in time-and-material projects.

The ever-increasing demand prompted companies to increase their employees. In their business model, revenue is being directly proportional to the number of employees, therefore, increasing employees displayed growth. To increase their brand image several IT services companies did go public and presented their results every quarter, apart from an annual report. In their results, companies apart from revenue, shared new customers added, customers above the US $ 10 MN revenue, and competed on operating margins.

Operating margin accounts for both revenue and operational efficiency. To leverage cost arbitrage companies continued to recruit fresh candidates from universities; their <3 years experienced employees stands at 40-45% of their total employees. The companies did face challenges and were on increasing wages, competition from IT companies in other countries due to their lesser operational cost (wages) and improving project profitability. To take further advantage of the cost arbitrage, reduced employee onboarding time and re-skilling time by recruiting resources from the market or retrenchment of their employees. Apart from cost, it is essential to emphasize the quality, flexibility, and scalability of the developed product (Mital et al., 2015). An approach focussed on operational efficiency did result in less focus on innovation towards improving product quality. In the subsequent parts of this section, the author discusses diffusion of innovation in organizations and societies which is essential to develop quality products. IT Services with a large ICT component; invariably experience organizational and group dynamics, interactions between and among groups with culture, attitude, and values of individuals, groups, and organizations influencing technology diffusion. Therefore, IT services are socio-technical systems. In the socio-technical system, the characteristics of constituent sub-systems define the overall system characteristic. When sub-systems undergo changes, it results in changes to its constituent elements and its associations with other sub-systems, with changes to the interconnection of elements (Geels, 2002).

These set of actions, though temporal, manifest in different forms and influence the observable characteristics of the actors and the systems. Observable characteristics could be cognitive learning, knowledge creation, belief, insight, social efficiency, sharing of knowledge between and within generations i.e. dissemination of novelty, economic prosperity, group specializations and so forth. Broadly, socio-technical changes happen at two planes. One plane is at the elements, both social and technical, and their linkages based on certain rules develop engineering practices, products, skills, knowledge creation and sharing and embedded in institutions and infrastructure. The interlinkage of elements creates variations, from the variations 'selection' occurs and retention of these selections occur for economic growth. The other plane is with external factors that enable and/or constrain elements and by cultural learning, human cognition, and new knowledge creation and dissemination within and between generations. The first change (or transition) follows neo-Schumpeterian and the second naturalistic approach (Witt, 2008). Society follows a naturalistic approach and has an endogenous characteristic of novelty, emergence, and dissemination. The two approaches initiate change with different ontological stance and heuristic strategies (Witt, 2008). Therefore, to meet demanding customer wants-and-needs, it is imperative for IT services companies to focus beyond operational effectiveness and explore avenues that help in managing transitions by improving adaptability.

The purpose of the paper is towards developing a perspective that provides a heuristic and analytic view that helps in understanding socio-technical changes. Heuristic and analytic view assist practitioners to respond with appropriate actions to better manage transitional changes, adaptation-selection. The heuristic and analytic view represent not only the factors acting at various levels and representing it as an ontological reality but

also assists practitioners in better understanding the complex interplay of developments. In doing so, practitioners can desist from taking decisions based on a single parameter such as cost, when inevitable, can better understand the trade-offs.

The composition of this paper is as follows. In the next two sections 2 and 3, the author discusses research questions and methodology. In the subsequent section, section 4 the author discusses the perspective that provides a heuristic and analytic view to analyze IT Services as socio-technical transitions. The author, in Section 5, discusses the details of the selected case study, followed by section 6 that further elaborates the key aspects of perspective and organizational activities. These activities assist organizations in developing capabilities to manage in transitions. Finally, the last section lists the limitations of this research with directions for future research.

2. Research questions

Socio-technical transitions require firms to select from diverse routines and retain routines that help them to stay competitive. This selection process does not follow a deliberate optimizing choice between alternatives. Various pressures influence the organization's selection process and vary based on the domain in which organizations operate. With a multi-level perspective (MLP) researchers can attempt a unique heuristic and analytic view of technological transitions (Geels, 2002). The author attempts a similar MLP for IT Services. Therefore, the author states the research question as, '*For IT Services MLP, what specific interplay of developments are necessary to manage in socio-technical transitions, and how many dimensions of MLP assist in managing transitions?*' To manage transitions, organizational adaptations contribute to the interplay of developments, thereby, assist innovations to cumulate as stable designs.

3. Case study methodology

3.1. Case study selection

IT services companies in India were around a few thousand employees in the mid-90s and by responding to industry changes did reach hundred thousand employees by mid-2000. The author gathered data from five companies that, by 2006, achieved CMMi highest rating.

These five companies for the past five years have consistently figured in NASSCOM's[1] top 10 players of Indian IT services. The author obtained relevant details from the annual report of the five companies, Figure 1, 2, 3, and 4 lists the details. These five companies compete against each. Table 1 lists the patents filed by these companies from the year 2001 to date (US-PTO, 2017). The author feels that patents filed by the companies provide a measure of their focus on innovation.

Table 1 also lists patents filed and listed against software product development companies; all the five companies had worked for these companies. From the Figures

[1] The National Association of Software and Services Companies (NASSCOM) is a trade association of Indian Information Technology (IT) and Business Process Outsourcing (BPO) industry. Set up in 1988, NASSCOM is a non-profit organization.

1, 2, 3, and 4 COMP-VT (real name made anonymous) performed differently from its competitors. From these five, the author selected COMP-VT (real name made anonymous) to examine its innovations, operational efficiency, and collaborations. COMP-VT competes in the global software services industry and its diversifications like its competitors are across technologies and industries. The scope of this work included application development, engineering services, IT infrastructure management, testing, and maintenance. The author did case selection, as mentioned in Yin (2013), and selected cases that COMP-VT provided software services for Government of India; moreover, governments interact more closely with society and COMP-VT has non-disclosure agreements with its private customers.

The IT services dynamics of COMP-VT reflect in its projects, therefore, during case selection, the author selected both Mission Mode Projects[2] (MMP) and projects that are not MMP. Cases with diverse interactions provide rich analytic and heuristic views. The author also ensured that project selection represented all three government scenarios Government-to-Business (G2B), Government-to-Citizen (G2C) and Government to Government (G2G). The author selected two cases for each category to obtain diverse interactions towards adaptations and different analytic perspectives. In doing so, the author achieved external validity by replication logic.

Table 1. Patents filed by IT services and software product companies

Company	Patents [a]		SW Product Company	Patents [a]		Innovation Labs
	Applied [b]	Granted [c]		Applied [a]	Granted [b]	
COMP-VT	518	165	IBM	67,252	14,210	IBM Labs
Competitor-1	263	54	Microsoft	32,766	3,926	Microsoft Labs
Competitor-3	67	6	Hewlett-Packard	6,090	927	HP Labs
Competitor-4	28	1	CA Technologies	1,007	241	Strategic Research team

a – as on 31-Jan-2017; b - 2001 – till present; c – 1976 – till present

[2] National eGovernance Plan (NeGP) formulated by DeitY has defined mission mode projects that have defined objectives, scopes, and implementation timelines and milestones, as well as measurable outcomes and service levels.

Figure 1. The performance of COMP-VT against its competitors – Revenue

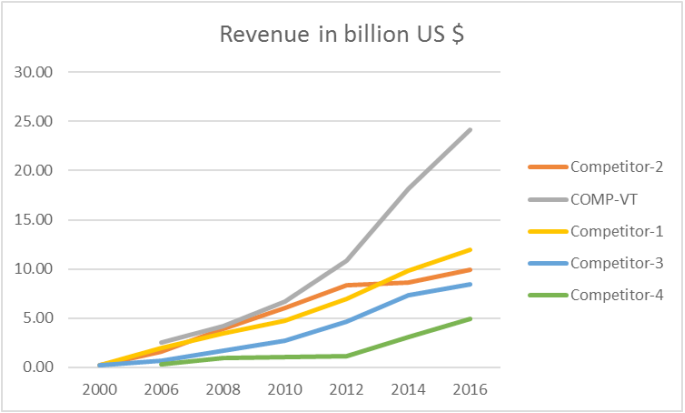


Figure 2. The performance of COMP-VT against its competitors - Employees

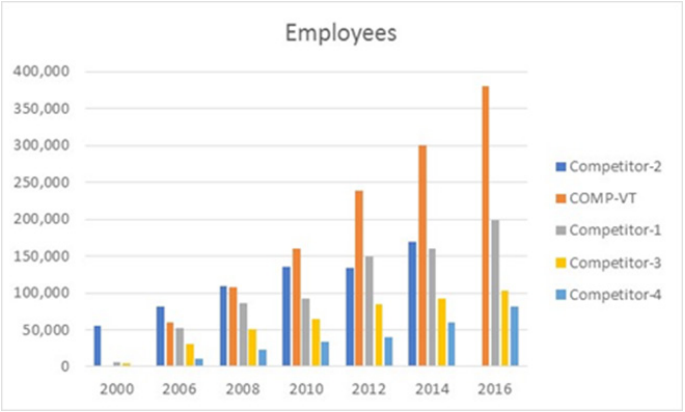


Figure 3. The performance of COMP-VT against its competitors – Operating Profit

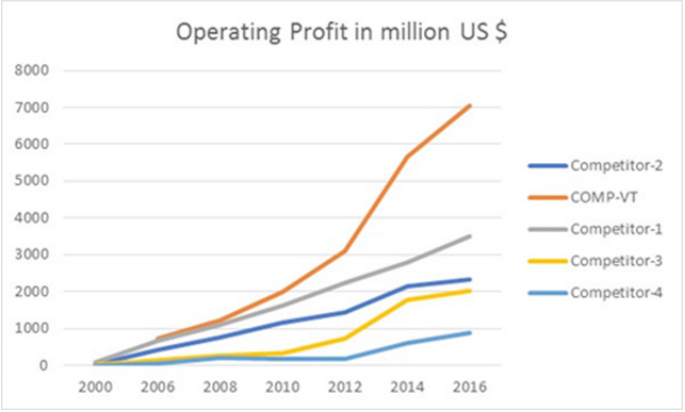
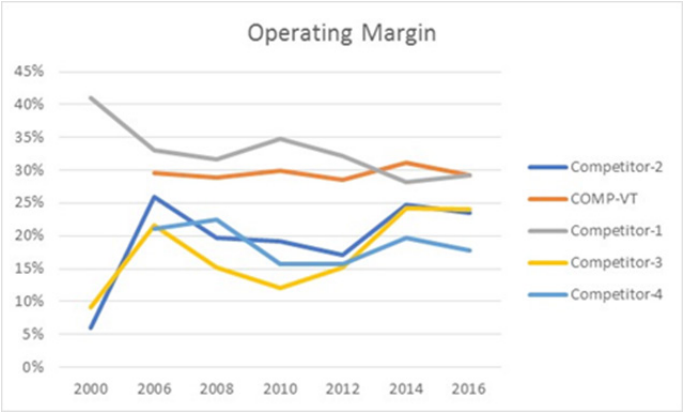


Figure 4. The performance of COMP-VT against its competitors – Operating Margin



3.2. Case study protocol

Fieldwork consisted of interviews, gathering reports, archives, records, written sources, meetings, media reports to source information. In doing so, the author achieved construct validity. With diverse methods, the author achieved data triangulation. Based on snowball sampling, the author interviewed managers from both public and COMP-VT organizations involved at various stages of software development from response-to-proposal to end-user acceptance; interviewed COMP-VT personnel from their research and development department on their objectives, direction, and support for innovation. The selected managers in public and COMP-VT organizations apart from project delivery responsibilities are also decision-makers and can affect necessary organizational changes to influence project activities to meet citizens' wants-and-needs and define product roadmap along with necessary technical architectural changes. The author spent around three to four months on information gathering. Interviews lasted approximately for 60 minutes and the author performed it either in-person or over the phone. The author interviewed respondents on key decisions, contextual situations that influenced decisions, fundamental values that influenced decision-making, use of information systems for sharing information, inter-organizational interactions, socio-technical factors, and various challenges faced by respondents at various stages of software development. With the gathered information, the author performed explanation building to understand the organizational activities with arriving at patterns wherever possible and achieved internal validity.

4. Theoretical foundations

The software development is subject to factors such as changing technologies, societal values, human trends, interaction and complexity, information management, and not to mention the role of the government for government projects. These factors change;

therefore, it is essential for organizations to re-define their existing processes to develop new software products. In other words, both product and process innovations are necessary. To meet end-users wants-and-needs, these innovations need to cumulate as stable designs along with necessary changes to organizational activities and associated interactions. This paper specifically focuses on organizational interactions both within and between organizations and not on personal interactions. In the subsequent subsections of this section, the author discusses the multi-level perspective, specific to IT services, and the influence of interactions in managing transitions.

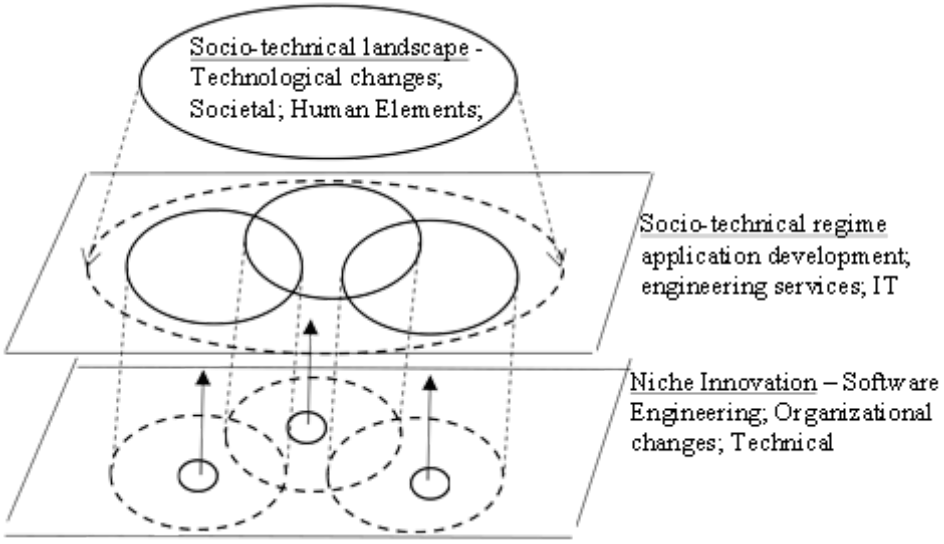
4.1. *Multi-level perspective analysis*

Geels (2002) with the neo-Schumpeterian approach first developed Multi-Level Perspective (MLP) to study transitions on steamships. Later, Geels extended it for aviation (Geels, 2006); biogas (Raven & Geels, 2010), electricity (Verbong & Geels, 2010), Dutch nuclear energy (Geels & Verhees, 2011) and British coal (Turnheim & Geels, 2013).

MLP consists of three structural, not hierarchical, levels. These levels are macro, meso and niche-innovation levels. In this paper, the author refers to niche-innovation as niche. The macro level applies pressure on the meso, and niche levels, actors at the meso and niche respond to these pressures. To respond to the pressures, innovations invariably occur at niche levels. These innovations need to cumulate and stabilize into designs at the meso level or the socio-technical regime, in this paper referred to the regime. The definition of the regime is '*an analytical concept that can be applied to empirical topics of different scope*' (Geels, 2011), pg. 31. The cumulation and stabilization of designs compel actors to directly negotiate rules in the regime (social-institutional) and rules in the regime change indirectly by selection process (evolutionary economics). The factors that induce innovation are both sociological and evolutionary economics; the term 'socio-evolutionary' coined by Geels and Schot (2007). Meso level provides normal innovation patterns while radical innovations happen in niche innovations (Smith et al., 2010). Radical innovations produced by niche-innovations do influence regime but based on differences in timing and nature (Geels & Schot, 2007). When external factors trigger transitions in the regime, the extent of development of niche-innovations decides the timing. The dimensions of MLP are structural, temporal, and spatial (Raven et al., 2012). The macro level also referred to socio-technical landscape, applies pressure on the regime and niche levels. The factors that apply pressure at a macro level are technological changes, social, human elements, and regulations. In this paper, the author refers to the socio-technical landscape as landscape. Figure 5 depicts the three MLP levels.

In IT services, the organizations that perform software development either offshore, near-shore or onsite form the regime. Actors gather requirements, develop, test and release the software. Post-deployment and operations activity also occur at the regime level. The scope for innovation varies based on the phase of the activity in the software lifecycle from requirements to deployment and operations. The macro level pressures and end-user wants-and-needs drive innovations at the niche and regime level with radical innovations at the niche level.

Figure 5. MLP framework for socio-technical transitions for IT services



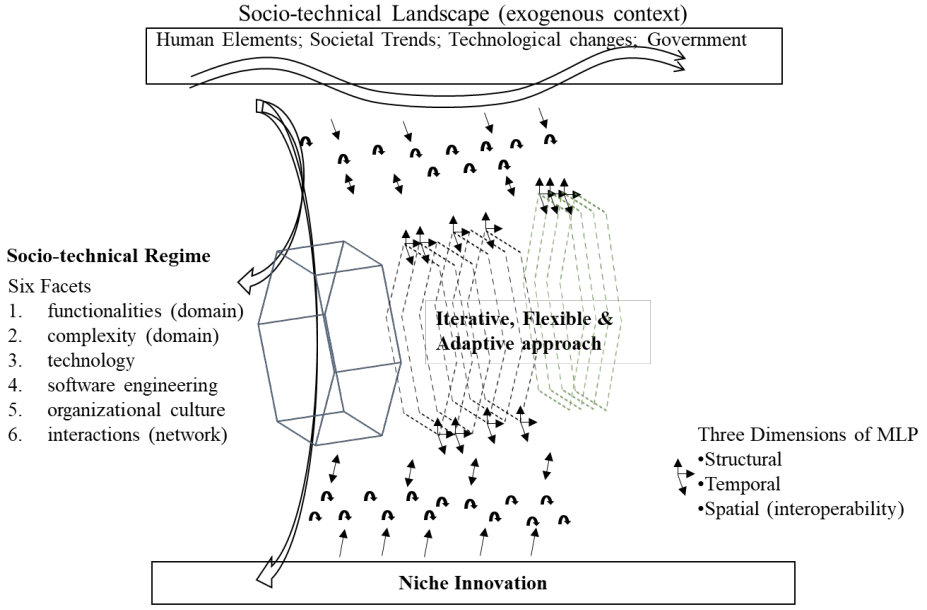
Source: Adapted from (Geels, 2002)

Technological changes include the latest developments in ICT involving cyber-infrastructure, security, architecture, mobility, virtualization, analytics and so forth. Along with technological developments changes do occur in social interactions between and among groups, communities, and societies. The societal trends to address demographic and economic changes along with issues relating to digital-divide, political and social tensions. Changes at the technological and social level also trigger changes to human elements. Privacy, identity, adjustment and learning, trust, autonomy, and the integrity of human elements play a crucial role. Technological and social changes influence human elements, influence each other. Finally, the governments in the geographies that IT services companies operate do influence the strategic, tactical, and operational activities of IT services companies. The challenge for innovation no longer rests solely in economic potential but also in the societal changes induced by innovative activity and the consequences of this for environmental and social sustainability (Smith et al., 2005). Therefore, societal sustainability defines the cumulation of innovations into stable designs.

The regime level actors interact with actors within their organization and with actors in customer organizations. Actors interact with rulesets, referred to as interoperations. The software consists of knowledge work, rarely with any physical manifestation to aid actors as they solve problems; moreover, tailoring of software development does occur to meet customer wants-and-needs. Therefore, it is imperative for software services interoperations to account for unevenness, heterogeneity, and asymmetry. Spatial dimension refers not only to physical relating to structured interaction between social and economic entities but also to unevenness, heterogeneity, and asymmetry (Raven et al., 2012). Software being knowledge work, knowledge management and

information sharing play a key role in the spatial dimension. Therefore, structural, temporal, and spatial dimensions of MLP capture the complex dynamics of IT services. Figure 6 represents MLP for IT Services. IT organizations do provide IT services to both businesses and governments, a similar MLP framework for E-Governance does exist and developed by Kompella (2017, pg. 7); however, Figure 6 is specific to IT services by IT organizations.

Figure 6. MLP framework for socio-technical transitions of IT Services.



Source: Adapted from (Geels, 2002)

External triggers not only influence the transitions, but also the pathways the transitions do take. Geels and Schot (2007) arrived at trajectories or pathways that the transitions can take place. Transitions happen, and actors do not plan and coordinate transitions to occur. This paper is on the assumption that transitions are not controllable but only managed. Smith et al., (2005) arrived at a different typology based on two axes, resources, and coordination with four trajectories namely endogenous renewal, re-orientation of trajectories, emergent transformation, and purposive transitions. Smith et al., (2005) assumed that transitions are controllable by resources and coordination. To manage transitions, actors coordinate their actions based on the alignment of their visions. The alignment of their visions needs investigation rather than assumed. The reasons for the alignment of visions is out of scope for this paper.

The trajectories arrived by Geels and Schot (2007) and used in this paper are 1) reproduction, 2) de-alignment and re-alignment, 3) transformation, 4) technological substitution, 5) reconfiguration and 6) sequence of transitions or crossover of trajectories. The sixth trajectory sequence of transitions involves the combination of the five trajectories. Actors due to budget, timelines, and the dearth of resources do plan a

crossover of trajectories to reach the desired trajectory. These trajectories influence software development phases especially, requirements engineering. Transitions happen in spatial, structural, and temporal dimensions with various combinations of social-science ontologies coming into effect resulting in highlighting certain aspects of social science and background others (Geels, 2010).

4.2. Interactions and innovations

Requirements engineering occurs before and during product development. Requirements define the product vision and strategy and develop product roadmaps. Before finalizing requirements for a project, actors perform activities that analyze business opportunities and arrive at market analysis, business plan, risk assessment, and trade-off analysis. Author terms these as upstream activities. Activities that commence from requirements finalization as downstream activities. Decision-making in upstream activities involves heterogeneous communities of an organization. When heterogeneous communities involve, actors' interoperations to address the factors of spatial dimension with collaboration and communication. Actors can bring value propositions to customer's product line by combining interoperation with software engineering practices and domain knowledge. Interoperations that address spatial dimension factors also assist in performing iterative development. An iterative software development helps in addressing a few challenges of traditional development (Boehm, 2000) and (Nuseibeh, 2001). Iterative development requires not only changing mindsets of both actors in public and COMP-VT organizations but also necessitates increased interaction.

Regarding mitigation of all requirements engineering risks, it is not attainable with iterative development (Ramesh et al., 2010). Iterative methods do bring agility, but exhibiting emergent agility is essential to create change or proactively or reactively embrace change and learn from change (Iivari & Iivari, 2011). Therefore, to meet the changes demanded by the landscape and end-users coupling iterative development with increased interaction and novel engineering methods and practices are necessary to display emergent agility.

Actors at the regime level perform interoperations with the combined knowledge of software engineering practices, technology, and the domain. Software engineering practices refer either to traditional or iterative software development methods where technology refers to programming languages and testing with the associated framework and its components. Domain refers to the functions performed by the customer with the developed software, for example, manufacturing, retail and so forth. These are the three areas where IT services organizations can incubate ideas and develop innovations. Based on the organization's vision and emphasis on innovations, organizations develop innovations that are either radical or incremental. In these three areas, organizations perform innovations either in separate entities or by merging with organization's delivery business units. With these innovations, organizations can aim either incremental or radical innovation. In certain scenarios, innovation focus areas are on the downstream side of software development, for example, providing qualification and compliance for testing of products for their customers. Indian IT services companies bundle these as

service units to provide service offerings to their customers. These downstream level innovations are incremental innovations to bring service level improvements that competitors can imitate. Innovations at upstream level require unique a combination of software architecture, interacting with heterogeneous communities and translate vision into product roadmap; therefore, when organizations attempt innovations at the upstream level of software development, innovations assist organizations to not only solve customer problems with novel ideas but also provide lead over their competitors. These innovations are hard to imitate by competitors.

Using interactions when organizations develop absorptive capabilities, organizations can respond to coevolution requirements (Van den Bosch et al., 1999). Absorptive capabilities require organizations to collaborate with the environment and develop collaborative capabilities. Organizations policies, manuals, and procedures refer to their system capability. Organizations with system capabilities collaborate between organizations (coordinative) and among multiple organizations (combinative). Two views can explain organizational interactions, namely 1) market-and-action, and 2) network-and-interaction (Ford & Håkansson, 2005). One is based on action and other on interaction, with different approaches to structure and processes. In Table 2 author highlights the differences between the two views in the context of IT software services.

Table 2. Market-and-action and Network-and-interaction

Characteristic	Market-and-action	Network-and-interaction
Actions emanate from	Single actors	Network of actors
Behavior	Atomistic - Focus on common modes of behavior	Particular – Encourage uniqueness
	Stable and predictable	Dynamism – flexible and agile to meet diverse situations
Solutions	Homogeneous	Solutions customized based on domains complex dynamism.
	Architecture – evolving, dynamic, complex and integral.	Architecture – evolving, dynamic, complex and modular.
Communication	Hierarchical	Open and collaborative
	Compartmentalized	Boundaries are flexible and change as necessary
Motivation	Command and control	Mentoring and Empowerment
Experimentation	Limited	Encourage experimentation; fail early fast.

Decision-making	Centralized strategic and tactical decisions with few stakeholders involved. At the operational level, decentralized.	Strategic and tactical decisions involve various stakeholders, final decision with key stakeholders. At the operational level, decentralized.
	Finalize at the start; subsequent stages less scope for changes.	Decision-making encourages delayed binding with scope to allow last-minute changes
Relationship:	Competition drives relationship	Collaboration drives relationship
	Inter-organizational interactions are sporadic	Orchestrate inter-organizational interactions
Links and Bonds	Technical linkages (demand-driven)	Technical – Leverage linkages to resolve problems (Problem-driven)
	Administration – bureaucratic	Administration – less bureaucratic
Links and Bonds	Commercial – a key component in decision-making	Commercial – Relationship key for decision-making
	Actors – history influences opinions at multiple levels	Actors – history influences opinions at multiple levels
	Economic – Compensating actors' efforts is essential	Economic – Compensating actors' efforts is essential
	Resources – agreed resources committed to activities	Resources – agreed resources committed to activities
Innovation	Commercial aspects are key. Innovations to produce immediate results	Organizations obtain competent resources, willing to commit resources for a long-term and focus on differentiation by innovation.

Inter-organizational (IO) interaction improves when organizations use IT and use ICT innovations to organize around information and arrive at new ways of getting things done (Zammuto et al., 2007). To organize around information, it is essential for organizations to shift from traditional forms of organizing to new forms of organizing (Zammuto et al., 2007). Literature refers to IT systems that enable organizational interactions as inter-organizational information systems (IOS). When organizations do add knowledge management to their IO and IOS, organizations can enhance the system, coordinative, and combinative the three components of absorptive capabilities; however, organizational actors need be aware that the applicability and usefulness of the knowledge can decline over a period (von Krogh, 2009). With absorptive capabilities, organizations can develop unique interoperations that are quite difficult

to imitate. When these unique interoperations combine with either incremental or radical innovation, organizations can better respond to external triggers to influence transitions. The unique interoperations also assist them to provide value propositions for their customers and achieve differentiation that is difficult for their competitors to imitate. Interactions considered in this paper are only from the inter-organizational point of departure and not from the inter-personal point of departure. Anyway, for a better understanding of interoperations, an eclectic mix of inter-organizational and inter-personal departures is essential (Goduscheit, 2007).

To achieve the first mover advantage, Indian IT services companies focus areas for innovation are invariably the latest market trends, for example, Bigdata, automation, infrastructure related to cloud and DevOps. Competitors of COMP-VT had their innovation as a separate entity and later aligned it with delivery business units of respective domain. With unique interoperations, it does not matter whether innovation exists as a separate entity or aligned with the delivery business unit; however, an organization can achieve special attention by aligning objectives and budgets for the innovation group. Currently, COMP-VT is continuing with its structure of innovation unit as a separate entity reporting to Chief Technology Officer (CTO). The respondent from the group remarked saying,

"*CTO group identifies research areas, and these are aligned with the latest trends in technology. Research teams require to articulate their objective, problem statement with the latest research trends in that field, progress is periodically reviewed. Apart from research output in terms of patents and publications, we are also measured on the developed software tools and collaborations with business units*".

Respondent of COMP-VT CTO group. Unlike, its competitors, architects, and other software development engineers are not in CTO organization nor do they report to managers in CTO organization. Members of the CTO organization focus only on innovation without any business unit deliverables responsibility. In the next section, the author discusses the case study findings of COMP-VT, to further understand their interoperations.

5. Case details and findings

5.1 Details of selected cases

The author selected cases that require developing a software product for the customer with a large emphasis on upstream product development. In doing so, the author can examine instances that involve a combination of innovation and interactions that provide unique interoperations that are not easily imitated by competitors. Of the five trajectories, upstream product development plays a key role in transformation and re-configuration.

In Table 3, the author discusses the case details, rationale, characteristics, and the trajectories. The author lists the MLP dimensions and its factors for all the selected cases.

Landscape: Societal trends (citizen wants-and-needs for G2C); Human elements; technological changes;

Regime: Information management; interaction and complexity
Niche: Innovative ideas in technological and business aspects.
Spatial Dimension: Pronounced unevenness, heterogeneity, asymmetry and physical.

Table 3. Selected Cases, trajectory, and key information

Objective	Key Characteristics	Challenges
Registrar of companies and workflow automation; {Trajectory – Transformation} [G2B] Government: Central Government of India Rationale • Reach out to a wider audience especially organizations: emphasis on information sharing for shared decision-making. • Consensus building among diverse groups such as legal, audit and so forth. • MMP		
Regulation of corporations and workflow automation • 45 MN pages of digitizing legacy documents; • 24*7*365 system availability ▪ 26000+ applications processed per day; 24*7 multi-lingual call center that can handle 25000+ calls per day;	▪ Web-based architecture connecting 52 front offices and 105 offices ▪ Entire workflow with a secure environment with PKI (Public Key Infrastructure) digitized with the latest verification. ▪ Integrating internal and external stakeholders ▪ Dashboards and reports with customizable details for officers at various levels ▪ Significant improvements (>250%) in transactional services ▪ Automated workflow operations related to filing, faster retrieval, managing queues, improved information sharing, improved response times, compliance monitoring, and improved payment options.	▪ An efficient legal process backed by corporate governance is necessary to make strides in ICT enabled regulation of corporates ▪ Factoring changing Landscape factors. ▪ Along with rapid changes to acts, an approach of solicitation and consensus building is essential. ▪ International legal corporate law ▪ Extensions to harness the support of well-established professional bodies.

Objective	Key Characteristics	Challenges
Ministry of External Affairs- Passport Services; {Trajectory – Re-configurations; Reproduction} [G2B and G2C] Government: Central Government of India Rationale: • Integration of various departments by process re-engineering • Emphasis on information sharing for shared decision-making • MMP		
Automate passport application	▪ Operations: Partnership with a private organization in BOOT (build own operate transfer) model. ▪ Smooth workflow segregated into three zones A (data processing), B (Verification) and C (Grant). Complete transparency with status tracking Passport Seva Kendras' (PSK) interact with citizens and process 1000 applications per day. ▪ Improved citizen experience ▪ Integration of Ministry offices across India in various states.	▪ Improvements to solicit process improvement suggestions. ▪ Further integration with police and postal departments.

Objective	Key Characteristics	Challenges
Department of Excise, Entertainment and Luxury Tax; {Trajectory – Re-configuration; Technology substitution} [G2C] Government: Government of Delhi Rationale: • Integration of various departments by process re-engineering • Emphasis on information sharing for shared decision-making • Not MMP		
Automate workflow of excise department's supply chain	▪ Tag and track all stock units from distillery or brewery units to 1650 retail outlets ▪ User-friendly dashboards and reports enable easy monitoring of data ▪ Electronic collection of revenue from manufacturers, distributors, point-of-sale sites (corporations, hotels, and restaurants) ▪ Compliance to Time Bound Delivery of Services, Act 2011	▪ Adoption of ICT enhanced routines ▪ Software development using waterfall methodology and implemented effective change management.

Objective	Key Characteristics	Challenges
Home Department Integrated IT Solutions (HDIITS); {Trajectory – Re-configurations; Reproduction} [G2G] Government: Government of Gujarat Rationale: • Integration of various departments by process re-engineering • Emphasis on information sharing for shared decision-making • Not MMP		
Build a crime and criminal information database to achieve effective crime control by enforcing law enforcement.	▪ Integrated 19 departments in Home Department of Government of Gujarat ▪ Interfaces with external (citizen, crime records bureau, courts, vendors, and so forth) and internal stakeholders ▪ Workflow automation of internal services (payroll, inventory, document management and so forth) ▪ 1,000+ offices, 70,000 police personnel ▪ Reports can capture the entire lifecycle of all the cases ▪ Post implementation support for 48 months	▪ Adoption of ICT enhanced routines ▪ Effective change management in traditional waterfall development ▪ Legal support for certain business process re-engineering (BPR) ▪ Back-up and disaster asset recovery

5.2. Interactions and innovations

The selected cases had complexity and the dynamics of any IT services projects. Software involves knowledge-intensive activities, therefore when the atmosphere encourages network-and-interaction actors can better harness individual and organizational locus of knowledge and aim at problem resolution. The challenges listed in Tables 3, 4, 5, and 6 require network-and-interaction approach. COMP-VT gathered requirements not only from the Ministry of Corporate Affairs (MCA) but also from other stakeholders. The author during the semi-structured interview did enquire the COMP-VT respondent about requirements gathering and information sharing at various stages of product development, the respondent remarked saying,

"*projects of this complexity require not just solving technical issues but require extraordinary skills such as stakeholder balancing, political skills, diplomatic skills and to push the project forward. Technical solutions we could arrive at, for other issues we could somehow pull it off because of few key committed individuals at the customer side*' – COMP-VT Respondent MCA.

"*though we have expertise with iterative methods, actors in the government organizations are reluctant to move to iterative methods of software development.*" – COMP-VT Respondent MCA.

The respondents from other public organizations echoed the same view and had apprehensions on the technical solutions. Respondents felt that the technical solution

offered by collaborating organizations need to be secure, flexible, scalable, and responsive. Though COMP-VT has patented technologies that provide required security, more confidence-building measures are necessary for meeting other non-functional requirements. The respondents remarked saying,

"*with their patented encryption algorithms, we could easily complete document signatures and other authentication and authorization activities. It meets the scalability and reliability requirements but not sure on changes required to stay ahead of the demand.*" – Public Respondent MCA

"*With full use of technology, we could easily complete some routines that were earlier time-consuming, but we require a lot of other technical integration changes to move the E-Governance frontier forward"* – Public Respondent Passport

"*Though we did provide end-user training to users, it is essential to extend it to other departments that Excise department interacts. Excise interacts with lots of departments, it definitely requires exploring novel methods of knowledge assimilation and distribution*" – Public Respondent Excise.

COMP-VT resolved technical issues that assist in completing the agreed scope of the project. IT services companies not only need to identify customers' current problems but also look forward. In the author's semi-structured discussions with COMP-VT respondents, respondents did mention that novel requirements engineering methods are necessary. The innovations lab of COMP-VT apart from latest technological trends such as the Big data, automation, cloud infrastructure, and so forth has already started work on requirements engineering especially on the non-functional requirements and filed patents with US-PTO and did start using in non-government projects. Incremental innovation in COMP-VT did resolve certain technical problems, especially in the downstream of product development but had limited actions in the upstream of product development. When the author enquired with the respondent of the COMP-VT's CTO group on their way forward, especially, on radical innovation, the respondent remarked saying,

"*Currently, employees in the CTO group are <1% of the total company employees; CTO group is looking at having unit groups that are closely aligned with the business units. It remains to be seen whether we will continue to have separate responsibilities as compared to the business units.*" - Respondent CTO COMP-VT.

Apart from the resolution of technical issues, the COMP-VT respondents also felt that the mindset of customers is important. In HD-IITS COMP-VT and customer had excellent interactions, respondents had the following to say,

"*For complex projects like HD-IITS, standardization and centralization at appropriate levels ensured achievement of the government vision along with successful completion of the project, thereby meeting objectives of both organization*." – COMP-VT Respondent HD-IITS.

"*Changes could be incrementally introduced and helped the government to move their frontier of technology adoption.*" – COMP-VT Respondent HD-IITS.

"*Home Ministry no longer considers us as a vendor but as a technology partner, contrary to other government projects.*" – COMP-VT Respondent HD-IITS.

On the contrary, respondents from Excise and passport project had the following to say,

"*Business-driven change agenda cannot sustain government actions for long, for a few instances, it may work but does not guarantee repeatability, it is dependent on the maturity of the organization."* – COMP-VT Respondent Excise.

"*Though contracts mention certain clauses, government officers expect collaborating organization not to follow it and bear the entire risk.*" – COMP-VT Respondent Excise.

"*Private organizations have a high focus on completing projects on time. With vendor mindset being more prevalent with customers, based on the project situation we need to employ innovative methods to solicit information. These innovative methods decide the project success. Any cultural transformations to overcome the mindset will be a large bonus.*" - COMP-VT Respondent Excise.

"*To address atypical cases, it is necessary to arrive at deep technical integrations with coordination with other departments, currently, we cannot participate in discussions that are beyond the boundary of our operations; they do solicit feedback once a month, and we do provide."* – COMP-VT Respondent Passport.

The selected cases followed a waterfall methodology and not iterative. An iterative methodology such as Agile require interactions like network-and-interaction. Actors are accustomed to enacting values such as safety, security, privacy, confidentiality, trust, public access, efficiency, and the effectiveness of non-ICT operations. With ICT re-engineering of activities invariably takes place; moreover, intertwining and interlinking of activities with values occur in complicated ways (Hellberg & Grönlund, 2013). Therefore, re-operationalization of values is essential. Excise project had difficulties during project execution, during the author's discussion the respondent remarked saying,

"*Renegotiation of values doesn't really happen.*" – COMP-VT Respondent Excise.

In certain scenarios, the managers had to complete their activities in subterfuge, lest the deployment and subsequent actions of activities get hindered. Respondent remarked saying,

"*Complete transparency refers to sharing selectively even with your supervisor.*" – COMP-VT Respondent Excise.

Apart from Excise and HD-IITS, other projects were MMP. Due to high command and control, MMP projects invariably exhibit governance mechanisms and rigor leading to intra and inter-organizational coordination. Competition and operational efficiency parameters did contribute to rigor and governance mechanisms in COMP_VT's operations. COMP-VT to complete the projects did synergize its intra-organizational coordination, governance mechanisms, and software engineering practices some of which are imitable. These can attribute to lead over its competitors as shown in Figure 1, 2, 3, and 4; however, COMP-VT did not use IO and IOS to enhance its interactions. The respondents did confirm to the author that, as mentioned by von Krogh (2009), as the information ages its applicability does diminish.

6. Discussion

From an approach based on arbitrage and aggregation perspective, both market-and-action and network-and-interaction are effective. When the emphasis is towards innovation and leveraging individual and organizational loci of knowledge, creating

unique interoperations become important. COMP-VT did perform interoperations and more in a market-and-action setup. The selected projects followed the waterfall, but COMP-VT for other customers does follow iterative methods such as Agile. COMP-VT did not borrow interoperations from non-waterfall projects to improve their interoperations in waterfall projects. The interactions between innovation labs and delivery business units were on a need basis and limited to the problem on-hand. COMP-VT management mandates innovation labs to interact with delivery business units and make their innovations contribute to delivery business units. The employees of innovation labs, apart from filing patents, are also evaluated on socializing and use of their ideas in delivery business units.

At the regime level, actors use software engineering practices and develop applications with development frameworks agreed with customers. Actors do arrive at innovations while performing interoperations. Competitors do replicate software engineering practices and methods, thereby, the advantages of making quality deliverables by such initiates do get easily replicated. To reduce the imitation of quality initiatives, in 2004, at the organizational level an IT services company did initiate Lean software development into their software engineering practices (Staats et al., 2011). From 2004, the IT services organization's (competitor-2) position with its competitor did not improve significantly, rather declined on parameters as shown in Figure 1, 2, 3, and 4. Organizational culture does play a key role. Transformations to organizational culture to go beyond an individual's pure interpretation of changes. Dialectical hermeneutics consider both individuals own historical understanding, in terms of the changing social structures and the individual's interpretation. When organizations attempt transformations with IT, dialectical hermeneutics become essential as they examine both social and organizational aspects (Myers, 1995). Schein (2010) defines organizational culture in three levels, the first level consists of artifacts, audible and video patterns of culture, the second level is the employee beliefs and values with the third level the basic assumptions. Kompella (2014) suggests an approach for changing organizational culture to achieve emergent agility as defined by Iivari and Iivari (2011). Network-and-interaction can assist organizational cultural change transformations.

The selected organization did encourage inter-departmental interoperations; and encouraged the use of knowledge management, system and coordinative capabilities of absorptive capability, use of ICT and knowledge management. These were more towards the aggregating their spatially distributed development centers (or resources) and in the arbitrage of information retrieval costs. In the selected cases, the interactions, though ICT-based, were more towards activity completion and not on organizational adaptations that consists of searching and learning cycles. For differentiation among their competitors, the searching and learning cycles contribute to activities that are not easily inimitable by their competitors. To develop such a searching and learning cycle, organizations need to explore new ways of doing things and includes developing unique software development interoperations and enhancing their IO with IOS. The objective of the unique software development interoperations can be towards developing an emergent agility as defined by Iivari and Iivari (2011).

The IOS does assist in developing the three components of absorptive capability and emergent agility. Along with IOS, organizations can search and learn new ICT innovations and explore new forms of organizing. In the selected cases, COMP-VT did trigger searching and learning cycles but more for arbitrage and aggregation instead can expand its innovations to develop unique interoperations. This requires its innovation group to contribute beyond the delivery business units' specific goals, which are invariably on cost-effectiveness and business growth. When organizations extend their adaptations beyond arbitrage and aggregation, it assists in the coevolution of other entities, namely society; only organizations can take that lead.

7. Conclusion

IT service companies for 15 years from the mid-90s did leverage their arbitrage and aggregation approach and posted excellent results. Government pressure to recruit no or less experienced resources from universities will continue. Companies have the option to continue to base their decision-making on transaction cost and improve their transactional efficiency. Such an action is not bereft of risks, where organizations in their attempt to increase year-on-year less than five years experienced employees may focus only on certain pressures from landscape leading to compromise on other parameters and losing their differentiation among their competitors. It is mandatory for organizations to respond to external triggers by responding with timely developed innovations that can cumulate as stabilized designs. In doing so, organizations can manage transitions where their existence is not in jeopardy. The author developed MLP with the aid of case studies. MLP provides rich heuristic and analytic views that help practitioners to understand socio-technical transitions and manage in transitions by taking informed decisions. In this paper, the author did not create a theory of how to develop or evolve or dissolve on forms of organizing to develop capabilities or approaches to change organizational culture. This is left for future research.

The author selected cases that involved government and followed the waterfall development methodology. Though the author did include projects that had defined objectives, scope, timelines and milestones, cases that exhibit more agility with iterative development methodology can provide insights into arriving unique interoperations involving interactions and innovations necessary for differentiation. A study that involves an interpersonal point of departure can also provide insights in arriving unique interoperations. The author chose COMP-VT that had instances of transactional effectiveness and incremental innovation, with no radical innovation in the selected cases. By selecting cases that have a good component of radical innovation further insights into innovations cumulating as stable designs are possible.

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