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Value creation and the impact of policy interventions: Indian LPG supply chain case study

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Abstract

Purpose – The purpose of this paper is to demonstrate the development of key supply chain capabilities in the Indian public sector-run liquefied petroleum gas (LPG) supply chain. This case study has relevance to emerging markets grappling with problems caused by monopolies and subsidies. Furthermore, this case study not only aims to improve operations of the LPG supply chain, but also re-designs its supply network to meet customers' expectations. It illustrates value creation through growth in non-domestic sales, a reduction in consumption of subsidized LPG as a consequence of better understanding of customer needs and customer diversity, process re-engineering and deployment of ICT systems, and change management and capability building across various LPG stakeholders.

Design/methodology/approach – An interpretive research methodology is applied, using an illustrative single case study of the Indian public sector-run LPG supply chain. The research methodology is iterative and exploratory in nature, consisting of a back and forth process between extant literature and the field, as well as in-depth discussions/interviews with senior management, distributors, and consumers.

Findings – Key supply chain capabilities of an integrated and seamless ICT system, detection and blocking of duplicate/ghost connections, the capping of entitlements, and coordination and collaboration across various stakeholders result in value creation for all stakeholders. When such collaboration across stakeholders' spans both vertically and horizontally through the supply chain, change management and capability building drive value creation through policy interventions and initiatives.

Practical implications – This study provides an illustrative example of meeting customers' expectations, increasing consumer convenience, and improving service levels, amidst the complex subsidy challenges in LPG distribution in India. The economic and environmental benefits, as well as increased customer satisfaction, from policy interventions regarding value creation in supply chains, have implications for similar public sector-run schemes.

Social implications – As a result of the various policy changes, the LPG subsidy was restricted to legitimate customers, reducing the fiscal burden on the Indian Government. Furthermore, seamless ICT-introduced efficiencies for government, distributors, and customers were attained.

Originality/value – This research articulates the capture, creation, and appropriation of value through the deployment of new supply chain initiatives in a large, complex environment, in particular the public sector-run LPG supply chain.

Keywords Value creation, Supply chain management, Coordination, Integration and alignment, Public sector supply chain, Service value network

Paper type Case study



Introduction

Public sector innovation is mainly problem driven (Windrum and Koch, 2008), generally constrained by a lack of resources, possesses limited innovative capacity, and as such is unable to deliver public value (Hartley, 2005, 2006). Likewise, a lack of effective supply chain implementation in the public sector is the primary cause for its inability to deliver value (Humphries and Wilding, 2004). As Eggers and Singh (2009, pp. 6-7) point out, “it is in the last three phases [of innovation, i.e. idea selection, idea implementation, and idea diffusion] that innovation often gets derailed in the public sector”. Nevertheless, Langergaard and Scheuer (2012) see possible increased public value delivered through improved governance and service performance, including improved efficiency through incremental innovations. This would involve solving “complex” and “intractable” societal challenges through unpacking ideas and possessing the capacity to design and implement change. This, in turn, requires leadership and management to transform ways of addressing the many human, regulatory, financial, institutional, and technical issues to achieve practical outcomes.

While implementing innovative ideas and practices in the public sector is challenging, many opportunities do exist. First, in order to derive value, public sector supply chain members need to strategically collaborate and manage each of their segments through partner coordination, partner integration, and partner alignment (Gattorna, 2010; Walters and Rainbird, 2006, 2007; Simatupang and Sridharan, 2002). However, it is common for supply chain member firms to pay attention only to the management and planning of physical and financial aspects, rather than concentrating on collaborative efforts in managing knowledge- and information-related intangible aspects of their supply chains (Ayers, 2002; Westgren, 1998; Agarwal and Selen, 2009, 2011a, 2014). Furthermore, Yu *et al.* (2010) point out that when managers have incomplete information on hand, and lack motivation to share knowledge, a fundamental lack of coordination prevails end-to-end across the supply chain. To address this, firms need to ensure that routine processes, and associated activities, as well as knowledge and information spanning inter- and intra-organizations, are integrated and aligned (Lee *et al.*, 2010) in order to achieve efficient coordination across stakeholders (Lee *et al.*, 2010; Subramani and Agarwal, 2013). This, in turn, is needed to make supply chains agile, adaptable, and aligned (Lee, 2004). Increasingly, integrative planning and management among various echelons of the network provide significant opportunities for stakeholders. In particular, ICT systems provide the ability to integrate inter- and intra-organizational systems and processes enabling a seamless flow of information, reach, and richness across partnering organizations (Agarwal *et al.*, 2012; Liu *et al.*, 2015). Additionally, increased customer focus fosters supply chain relational capabilities, leading to beneficial performance outcomes (Lado *et al.*, 2011; Chen and Paulraj, 2004). A strong relationship between partnering organizations and increased communication, and information and knowledge sharing, mitigates uncertainty, risks and promotes adaptation to change (Kraatz, 1998).

The foundation of a good supply chain comprises two core elements, namely to produce and deliver products and services to meet customer requirements, and working with stakeholders both upstream and downstream to ensure delivery of products and services with quality, i.e. at the right time, to the right place, and in the right quantity (Chopra and Meindl, 2009; Simchi-Levi *et al.*, 2008). Underpinning this, the ability to identify and foster new supply chain capabilities is paramount for efficient supply chain growth in emerging markets, and more so in public sector service delivery (Eggers and Singh, 2009; Green *et al.*, 2014). There is an emerging trend where governments are realizing the potential of ICT system deployment. In particular, the implementation of portals, coordination, and collaboration across various stakeholders of the supply chain, and alignment in implementation of policy initiatives across suppliers and distributors for value creation (Ambe, 2009; Lucon *et al.*, 2004; Asamoah *et al.*, 2012; Cahyaningrum and Simatupang, 2013; Simatupang and Sridharan, 2002; Hendricks and Singhal, 2003).

Furthermore, firms when interacting with each other within a supply chain learn new knowledge from suppliers and stakeholders to advance their competencies (Gupta and Govindarajan, 2000; Agarwal and Selen, 2009, 2011a, 2014). In this context, the importance of the degree of information shared, and the benefits and risks involved on a process-by-process basis, both have an important role to play (Lopez *et al.*, 2004). Tsai (2001) emphasizes that when entities are closely coupled, they share ideas and resources more transparently, resulting in synergistic benefits, including complementary knowledge (Gemünden *et al.*, 1996; Rindfleisch and Moorman, 2001; Sparrowe *et al.*, 2001). As a result of this, inter-organizational ties become an integral component of knowledge sharing, diffusion, and dissemination, resulting in innovative outcomes. As greater coupling surfaces across stakeholders, the inter- and intra-organizational communication and co-operation dynamics result in significant reduction in overall costs (Gavirneni, 2002), and boost the firm's innovative talent pool and competence levels (Goes and Park, 1997; Lee *et al.*, 2009). According to Agarwal and Selen (2009, 2011a, 2014), innovation through collaboration enables firms to achieve mutual aims (Agarwal and Selen, 2009, 2011a, 2014), allowing them to concatenate their core competencies, particularly in the ever-changing context of services (Bititci *et al.*, 2004) and supply chains (Desbarats, 1999). As such, openness to collaboration and optimum relationship building between organizations at a business process level (Bititci *et al.*, 2003) is crucial. In summary, structural mechanisms which are instrumental for the integration of ICT systems and processes across organizational boundaries allow transparency of information and material flow, both in the context of reach and richness of cognitive and informative dimensions, and in business ties and collaborative service networks (Agarwal and Selen, 2009; Simatupang and Sridharan, 2002), as well as ICT productivity (Kundisch *et al.*, 2014). This elevates the capacity to create, capture, and appropriate value (Amit and Zott, 2001; Zott and Amit, 2010).

Earlier research points toward a lack of effective supply chain implementation in the public sector (Humphries and Wilding, 2004; Ambe and Badenhorst-Weiss, 2011). When building innovative supply chain capacity in the public sector, as Eggers and Singh (2009) point out, innovation often gets derailed. This paper highlights the development of key supply chain capabilities in a public sector project in India. The case study considers Project Lakshya, an initiative launched by the Ministry of Petroleum and Natural Gas (MoPNG) in Delhi, India, encompassing initiatives to not only to improve the operations of the liquefied petroleum gas (LPG) business for Indian oil marketing companies (OMCs), but to also provide a solution to the complex challenges faced by the Indian Government in meeting customers' expectations. This case study has relevance to all emerging markets grappling with problems caused by monopolies and subsidies. It also illustrates value creation (Vargo *et al.*, 2008; Lin *et al.*, 2015) through: a growth in non-domestic sales; a reduction in consumption of subsidized LPG as a result of better understanding of customer needs and customer diversity; process re-engineering and deployment of ICT systems; and change management and capability building across various LPG stakeholders.

As evident from extant literature, integration of end-to-end physical and information flows provide aligned and seamless business processes, culminating in enhanced efficiency and productivity through elimination of activities that do not add value across processes (Tsanos *et al.*, 2014; Agarwal *et al.*, 2012). Tsanos *et al.* (2014, p. 435) define the integration of information flows across supply chain partners as "information integration," while the integration of physical flows is represented by the coordination of decision making among partners across operational processes, and is labeled as "coordination of operational decisions." In view of this, this paper focuses on integrated end-to-end business processes, seamless ICT system deployment, coordination and collaboration across various stakeholders, and alignment of incentives and goals across

suppliers and distributors, resulting in business model innovation and successful implementation of government policy objectives.

The paper is organized as follows. First, the LPG customer market, supply, and distribution in the Indian LPG market are described, along with challenges faced by the LPG supply chain. Next, the research problem and research methodology are addressed. This is followed by a detailed discussion of project Lakshya and Direct Benefit Transfer of LPG (DBTL) (also referred as PaHal), together with an analysis of how the LPG supply chain distribution was made more efficient and transparent, focusing on enablers and capability-building initiatives. Finally, conclusions are drawn and areas for future research identified.

Background – LPG market and distribution in India

LPG has been declared an essential commodity in India under the Essential Commodity Act. In 1955, LPG was introduced in India as a domestic fuel when the then Burmah-Shell and Stanvac companies started production at their refineries in Mumbai – the marketing of LPG was also undertaken by foreign oil companies. In the mid-1970s, the companies were nationalized, and the marketing network taken over by the newly established OMCs of the Bharat Petroleum Corporation, the Hindustan Petroleum Corporation, and the Indian Oil Corporation Limited.

Worldwide, governments have used subsidies as one of many policy instruments to attain economic, social, and environmental value creation (Burniaux and Chateau, 2010) and that they exist in several economic sectors, such as agriculture, fisheries, energy, and gas. Governments choose to subsidize consumption and production by transferring funds to their citizens directly, and by taking on board some of the risk associated with it through selective reduction or increase in the taxes which governments would otherwise have to pay, and also by imposing mandates and barriers to trade. In this context, traditionally in India, the LPG has been highly subsidized as the preferred choice of cooking fuel, and has thus been prone to diversion into commercial segments (International Institute for Sustainable Development, 2014). Initially, it was mainly an urban fuel, and has recently become popular in rural markets. As a result of the monopoly structure of the LPG market and lack of competition, customers faced poor service levels. Over time, with reach increasing and corresponding higher subsidy burden, it became imperative to “leak proof” the supply chain network. In this context, we next discuss the LPG customer market, LPG supply and demand, and LPG pricing mechanisms, to define the challenges faced as well embedded challenges.

LPG customers

LPG has been predominantly an urban fuel with household survey data showing substantially greater reported levels of consumption in urban areas. In the Census of 2011, 65 percent of urban households reported LPG as their primary cooking fuel, against just 11.4 percent of rural households (Patra, 2012). Historically, new connection releases were accelerated to around four million during 1997-1998/1998-1999, and to nine million during 1999-2000. In 2000, the government approved new LPG enrollments of ten million, and the oil industry released 11.8 million new LPG connections. This met the LPG waiting list demand throughout the country and new connections were made available over the counter from October 2000. A growth rate of ten million connections per annum is the average over the recent past. Table I displays the growth in sales of domestic and commercial LPG in thousand metric tons (TMT) over the period 2003-2013.

There has been an increasing adoption of LPG as cooking fuel in rural areas, with a 7 percent rise in the number of rural households using LPG between 2001 and 2011 (Patra, 2012). This rate is likely to increase on account of a recently launched ambitious government program “Ujjwala,” which aims to release 50 million new LPG connections for

Table I.
LPG sales by OMCs
and customer strength

Period	Indigenous sales (in TMT) by IOC, BPC, HPC		Domestic customers at the end of the year (in Lacs ^a)
	Domestic LPG	Commercial LPG	
2012-2013	13,611.5	1,595.5	1,503.9
2011-2012	13,297.4	1,640.1	1,371.2
2010-2011	12,368.7	1,543.1	1,253.9
2009-2010	11,364.4	1,374.9	1,150.6
2008-2009	10,636.5	1,136.9	1,057.3
2007-2008	10,298.6	1,031.7	1,009.8
2006-2007	9,741.9	784.3	942.6
2005-2006	9,447.0	513.3	887.1
2004-2005	9,530.9	381.6	844.9
2003-2004	8,794.1	284.7	771.8

Note: ^a1 Lac = 100,000
Source: OMCs

the rural poor over the next three years. So far, 16 million connections have been released (see www.pmujjwalayojana.com/).

However, in addition to a difference between urban and rural areas, there is also a wide disparity in the distribution of LPG connections between individual states and regions. Four states – Maharashtra, Andhra Pradesh, Uttar Pradesh, and Tamil Nadu – account for over 40 percent of total connections (International Institute for Sustainable Development, 2016), while LPG connections on a per capita basis range from 29.9 per 100 in Delhi to 3.6 per 100 in Bihar state (International Institute for Sustainable Development, 2012).

Domestic LPG as an essential commodity is supplied exclusively through the three state-owned OMCs. This market structure has led to a sellers' market where the consumer traditionally has little or no control over pricing, or the way a product is marketed. Companies focused on managing the demand-supply side, without considering product or marketing enhancements from the consumers' perspective. Thus, there have been many opportunities for improvements through competitive market structures that would have benefited consumers. This paper discusses many of these initiatives that, together, have created value for the LPG supply chain.

Domestic LPG supply and demand

The domestic OMC supply chain is one of the largest supply chains in the world. Everyday more than three million steel LPG cylinders, each containing 14.2 kg LPG, are home delivered to customers. The LPG demand from domestic consumers is huge (15,207 TMT during 2012-2013, of which indigenous production met 62 percent of demand, the remainder being imported). To support this demand, the LPG supply network comprised 186 LPG gas bottling plants and 13,088 distributors who supplied LPG cylinders to more than half the country's population. The LPG subsidy in 2012-2013 was Rs. 416 billion, or 25 percent of the overall fuel subsidy burden. Approximately 90 percent of LPG consumption is domestic, with the remaining distribution as shown in Figure 1. In 2002, private players were also allowed to sell imported LPG in the domestic market. There is a small private sector market of domestic LPG that is de-regulated and operates in small pockets of the country. These suppliers operate under an approval provided by third-party agencies, subject to meeting certain requirements. The reason that this sector is small is due to the fact that government subsidy is not available to these suppliers, thereby making it uncompetitive on price. However, there are other differentiators, such as reach, size, brand, and delivery of the private suppliers which allows them to gain customers who are sensitive to these other considerations.

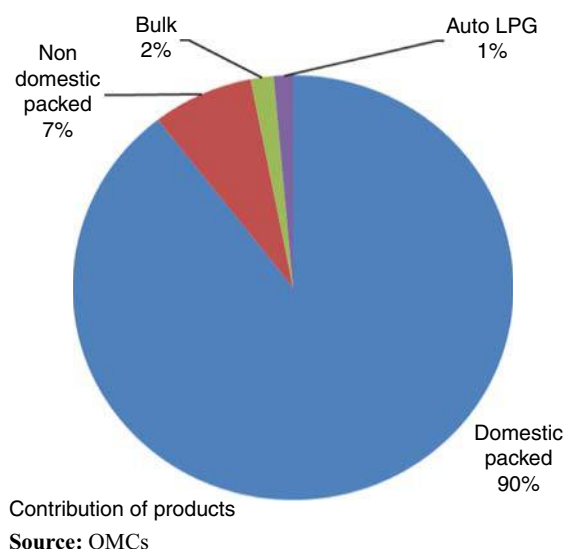


Figure 1.
Distribution of LPG
consumption during
2012-2013

The other fuel product that meets the cooking fuel needs of primarily urban consumers is the piped gas supply also called piped natural gas (PNG). As of March 2016, there are 3.2 million registered consumers of PNG in India, primarily in cities. The scope of this network is limited and slow due to its dependence on relatively sparse network of trunk pipelines of natural gas. The pricing of natural gas is market based and does not carry any subsidy. For this reason too, the PNG remains a little unattractive to the consumers. However, the 24/7 supply is a strong selling point of this fuel, and because of this has found acceptance primarily in urban areas. The private LPG and PNG networks are too small compared to the OMC LPG network, and therefore do not significantly affect the cooking gas market.

With the growing acceptance of LPG as a cooking fuel, and increased and enhanced marketing efforts and infrastructure, LPG consumption has grown at a rapid rate. The shortfall in domestic production of LPG has had to be met by imports, which imposes a burden on foreign exchange reserves.

Domestic LPG pricing mechanism

With a significant population below the poverty line, and households spending a large share of their income on energy needs (National Sample Survey Organisation, 2010), access to energy and its affordability is important to achieve socio-economic development. The price of petroleum products in India has over the years changed from being regulated, based on import parity prices, to a cost-plus basis, and with the massive recent volatility in petroleum prices to being again subsidized. Although petrol, and more recently diesel, has been deregulated, LPG and kerosene continue to be subsidized.

The domestic LPG is currently sold at subsidized rates, as opposed to commercial LPG that is sold at market prices. The continuing challenge has been to prevent diversion in the daily supply of three million cylinders, each currently costing approximately Rs. 1,000, but being actually billed only at half the price. The historical trend of the LPG subsidy is depicted in Figure 2.

Figure 2 captures the rising LPG subsidy resulting from increased use of LPG, and the rising gap between the subsidized rate and the market price of LPG. The situation is not fiscally sustainable and poses a huge challenge for the government.

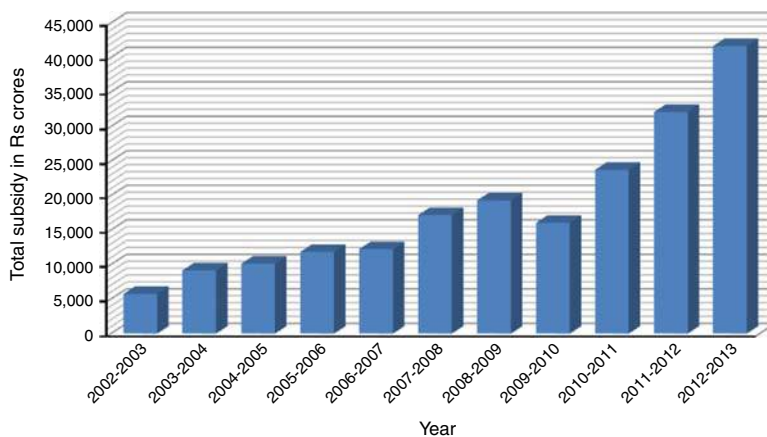


Figure 2.
Subsidy on LPG

Source: OMCs

As over 90 percent of the LPG market comprises domestic consumption, i.e. it is subsidized by the state-owned oil companies, the differential pricing for domestic and non-domestic/industrial applications means that there is an incentive to divert subsidized domestic LPG to commercial use. The rising international prices had also widened the gap between the subsidized domestic LPG and the non-domestic LPG, thereby increasing the incentive to divert, as is evident in Table II. The recent oil price slump has reduced the magnitude of the problem, but not eliminated the incentive to divert completely.

Corresponding to the increase in sales and the increase in per unit subsidy of LPG, the subsidy burden grew significantly over the last decade, as shown in Table III.

Challenges faced by the LPG supply chain

Supply chain initiatives have become an integral part of managing operations and associated challenges faced by industry (Eksioglu *et al.*, 2009). There are two main challenges for the Indian public sector-run LPG supply chain from a demand and supply perspective: the leakages of subsidies and thus no incentive for conserving resources, and the monopoly market structure as a disincentive for service improvements. Actions to address these challenges

Price as on	Selling price and cost per kg of subsidized/commercial LPG cylinder at Delhi			
	Selling price of subsidized cylinder (Rs.) (14.2 kg)	Cost of per kg of subsidized LPG (Rs.)	Selling price of 19 kg cylinder commercial LPG (Rs.)	Cost of per kg of commercial LPG (Rs.)
April 1, 2002	240.45	16.93	416.35	21.91
April 1, 2003	241.20	16.99	699.45	36.81
April 1, 2004	241.60	17.01	568.72	29.93
April 1, 2005	294.75	20.76	685.13	36.06
April 1, 2006	294.75	20.76	767.66	40.40
April 1, 2007	294.75	20.76	766.08	40.32
April 1, 2008	294.75	20.76	1,001.77	52.72
April 1, 2009	279.70	19.70	765.21	40.27
April 1, 2010	310.35	21.86	1,000.99	52.68
April 1, 2011	345.35	24.32	1,160.33	61.07
April 1, 2012	399.00	28.10	1,672.00	88.00
April 1, 2013	410.50	28.91	1,483.50	78.08

Table II.
The price of domestic subsidized LPG and non-domestic LPG at Delhi over the last decade

Source: PPAC/OMCs

Table III.
Subsidy burden

Year	Per unit and total subsidy provided to consumers on domestic LPG					
	Per unit subsidy (Rs./cyl.)			Total subsidy amount (Rs. crore)		
	From govt. budget	By OMCs	Total subsidy to consumers	From govt. budget	By OMCs	Total subsidy to consumers
2002-2003	67.75	62.27	130.02	2,398	3,363	5,761
2003-2004	45.18	89.54	134.72	3,635	5,523	9,158
2004-2005	22.58	124.89	147.47	1,783	8,362	10,145
2005-2006	22.58	152.46	175.04	1,605	10,246	11,851
2006-2007	22.58	156.08	178.66	1,554	10,701	12,255
2007-2008	22.58	214.05	236.63	1,663	15,523	17,186
2008-2009	22.58	234.88	257.46	1,714	17,600	19,314
2009-2010	22.58	178.13	200.71	1,814	14,257	16,071
2010-2011	22.58	249.94	272.52	1,974	21,772	23,746
2011-2012	22.58	320.30	342.88	2,137	29,997	32,134
2012-2013	22.58	427.14	449.72	1,989	39,558	41,547

Source: PPAC/OMCs

through innovative solutions in the Indian public sector-run LPG supply chain have included detection and blocking of multiple connections, and the infusion of transparency and competition into the LPG supply chain. These aimed to achieve a reduction in diversion, while improving transparency. The challenges and actions are described in Table IV.

With the above challenges, identified causes, and subsequent actions taken by the Indian public sector-run LPG supply chain executives, this case study seeks to answer the following research question:

RQ1. How has the Indian LPG public sector-run supply chain evolved from a disjointed stand-alone traditional supply chain model into a contemporary collaborative

Challenges faced by the Indian LPG public sector-run LPG supply chain	What were the causes of these challenges?	Actions taken by the Indian public sector-run LPG supply chain
1. Leakage in subsidies have placed a heavy burden on the government budget, while not reaching their intended consumers	Without a cap, there was no incentive to conserve or preserve resources There was no audit possible and hence no scrutiny of deviant consumption There was no Know Your Customer (KYC) requirement prior to enrollment, which led to a possibility of fake/multiple connections to bypass capping Legacy system without consolidated knowledge of customers had led to multiplicity of connections	Through capping of subsidized cylinders Publishing consumption data to enable social audit Introducing KYC scheme By detection and elimination of multiple/ghost connections
2. Monopoly market structure prevented consumer empowerment and incentive to improve customer service	Lack of choice Customer stuck with retailer Poor service delivery	Infuse transparency and competition-inducing mechanisms, such as: Distributor ratings Portability Achieve reduction in diversion Improve transparency

Table IV.
Summary of
challenges, causes,
and actions taken in
the Indian public
sector-run LPG
supply chain

Source: Authors' analysis

supply network model through partnering with key stakeholders, development of key capabilities and competencies, and multi-pronged policy initiatives to address the subsidy challenge and deliver higher customer expectations?

The research approach chosen aims to reveal and elucidate how enablers and capabilities can be deployed in a public supply chain context to improve the distribution and transparency of LPG cylinders, thus creating value for all stakeholders in the new economy (Walters *et al.*, 2002).

Research problem and research methodology

Case study research is viewed as a means to develop “contextually sensitive knowledge of actual management practices” (Keating, 1995, p. 66), and is particularly suited to studying a context-dependent phenomenon (Roome and Louche, 2016), where the boundaries within the phenomenon and context are fuzzy (Yin, 2009). This research deploys a case study approach to empirically evaluate a contemporary occurrence in a real-life context within the Indian public sector, using information from different sources (Yin, 2009).

Our research methodology is interpretive and, through the use of an illustrative single case study (Eisenhardt, 1989; Yin, 1994; Yunus *et al.*, 2010) of the Indian public sector-run LPG supply chain, aims to address not only the research question identified earlier, but to also highlight the evolution path toward an efficient and transparent value network between 1955 and 2013. The case is descriptive and explanatory in order to explore and demonstrate the transformation of the traditional LPG supply chain within a dynamically changing, real-life context. It also demonstrates how government policy interventions are working and why – a case that interprets the phenomenon of focus by reference to contextual features (Murray and Elston, 2005; Shiffman *et al.*, 2004). Furthermore, the adoption of a qualitative case study method to explore and demonstrate the transformation of the traditional LPG supply chain into a DBTL supply chain provides an appropriate methodological fit to investigate a contemporary phenomenon within a dynamically changing, real-life context (Carson *et al.*, 2001; Yin, 2009).

The use of a single case is justified in the context of the public sector, where successful implementation of innovation is rare (Shiffman *et al.*, 2004). In addition, it is difficult to collect data for LPG supply chains due to commercial exploitation risks, and therefore the contribution in this field with reference to logistics and supply chains is significant for government, industry, and consumers. Furthermore, the case is not typical because of the underlying innovations in the Indian public sector-run LPG supply chain, hence it possibly represents an extreme case that challenges existing ideas, or the theory guiding the study (Murray and Elston, 2005). This paper investigates change management and their effects upon stakeholders using a single case study from the public sector, the DBTL enabled through project Lakshya. We gathered information through written sources, such as government and industry reports, document compilations, and gazetteers to offer anecdotal information. Since the study only focused on the DBTL, the findings are specific to a particular case, as such the findings and interpretations may not be specifically applicable to other situations, as is inherent of case study research.

In order to analyze a set of contextual elements to understand the LPG supply chain, as well as enablers and capabilities required to bring about its transformation, a list of potential enablers is identified through the literature and government published reports. This is followed by a Delphi study confirmation from experts experienced in the LPG domain. This methodology is widely used in public administration, policy making, strategic decision making, and in multidimensional and complex situations (Venkatesh *et al.*, 2015). The research methodology is iterative and exploratory in nature, consisting of a back and forth process between extant literature and the field, as well as in-depth discussions/interviews with

senior management, distributors, and consumers (Edmondson and McManus, 2007). The three specific steps by Okoli and Pawlowski (2004) were used as a structured process to ensure stakeholder representation across different domains. The data gathering was based on one of the authors' deep engagement with the sector, along with several rounds of in-depth discussions with top-level managerial and decision-making executives within the government, i.e. the MoPNG, the OMCs and the Petroleum Planning and Analysis Cell (PPAC), all of whom define the LPG supply chain environment. The average experience of the participants is 12 years (with a minimum of four years in a leadership role) and they are part of the team responsible for implementing long-term projects. The process started with the knowledge base of the senior executives in the sector, followed by the identification of enablers from extant literature, and then discussions with professionals and senior identified executives, until there was convergence. After confirmation from the experts in the LPG sector, a pool of four high-level enablers and capabilities was identified, and is elaborated on later in the paper.

The single case study consists of the following major components: a contextual historical evolution of the Indian LPG supply chain over the past six decades; a description of the evolution from a traditional LPG supply chain into a service value network (SVN); and a detailed discussion of the four supply chain enablers and capabilities that were deployed to make the new LPG supply chain more efficient and transparent.

The public sector supply chain case study – Lakshya and DBTL/PaHaL scheme

Contextual historical perspective

A supply chain is a set of organizations directly linked by one or more of the upstream and downstream flow of products, information, and funds from a source to a customer (Mentzer *et al.*, 2001). Our findings show that the traditional LPG supply chain can be classified as a forward supply chain, characterized by a series of activities required to distribute products and services to consumers (Gupta and Pochampally, 2004). Furthermore, the LPG supply chain can also be characterized by activities involved in delivering a product from raw material through to the customer, including distribution across channels or delivery to the customer via an open distribution network (Lummus and Vokurka, 1999). In this study, with a focus on effective distribution of LPG cylinders (move, store, and deliver LPG cylinders from supplier to customer) (Chopra, 2003), such distribution directly impacts on both the supply chain cost and customer experience and responsiveness. The distribution components of the Indian public sector-run LPG supply chain are illustrated in Figure 3.

Figure 3 displays a traditional LPG supply chain with upstream and downstream processes, including LPG material flow in the downstream direction, and the flow of subsidies in the upstream direction. A lack of integrated and connected systems across stakeholders limits the ability of the LPG supply chain to operate at full potential, as previously noted in Table IV.

Contemporary supply chain management extends beyond traditional modes of purchasing to consider aspects of supplier development, leveraging capabilities, and co-creating value (Nelson *et al.*, 2001). From the domestic LPG industry's perspective, efficient delivery of LPG gas at subsidized rates, whilst ensuring delivery of LPG cylinders to its domestic consumers, was the strategic priority of the MoPNG. The cumulative changes in the supply chain culminated in the launch of the DBTL, later christened as "PaHaL." The term stands for Pratyaksha Hastantarit Labh – direct benefits transfer – in Hindi. Through interviews and discussions with senior management and inputs obtained from staff and websites of MoPNG/OMCs/PPAC, we summarize the key periods of the LPG supply chain, as it evolved over the last 58 years, in Table V.

Figure 4 shows how the corporate boundaries have evolved consequently leading to innovative redesign of supply chains (Gadde, 2013). Over time, the focus of the LPG supply

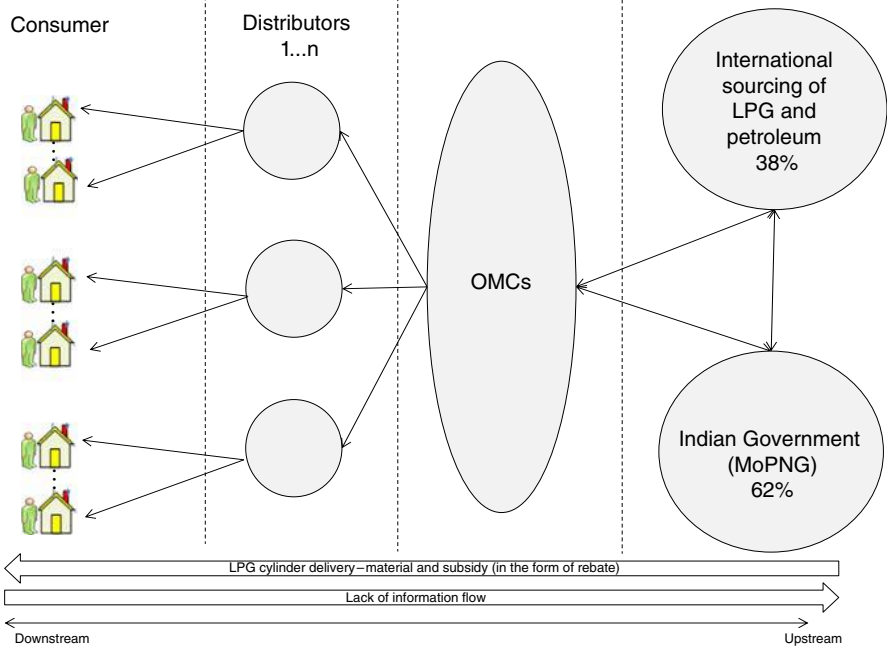


Figure 3.
Traditional forward
LPG supply chain

Source: Authors' analysis

chain has evolved, and how the LPG supply chain became seamless and integrated over time through the use of four pillars: process management, technology management, relationship management, and knowledge management (Walters and Rainbird, 2006; Tsanos *et al.*, 2014). Clearly, the LPG supply chain no longer operates in a traditional sense as a linear supply chain, but more as an SVN (Agarwal and Selen, 2009, 2011a, b, 2014; Basole and Rouse, 2008).

As the supply chain network evolved, it acquired the characteristics of a closed distribution network, composed of both a forward and reverse supply chain, where the reverse supply chain is characterized by a series of activities required to retrieve used/empty products from consumers and re-process them to recover their residual market value. Together, this is termed a closed-loop supply chain (Gupta and Pochampally, 2004). This closed distribution network created a greater need for data transparency, better service response times, and the need to prevent diversion of subsidized LPG cylinders so that only those who qualify obtain the subsidy (Fadillah, 2012). This evolution of the new business model aimed at efficient outcomes, entailing on time accurate delivery of the required number of LPG cylinders to the targeted customer at the right address in one go, thus minimizing overall costs for delivery, and ensuring that consumer service satisfaction levels are met, or exceeded. The above was accomplished through Project Lakshya and DBTL which aimed at transforming the traditional LPG supply chain into an SVN. This aspect is discussed next.

Project "Lakshya" and the DBTL supply chain as an SVN

In the context of the above-mentioned challenges, a number of initiatives were launched in June 2012, denoted project "Lakshya." The market structure of the LPG was largely a

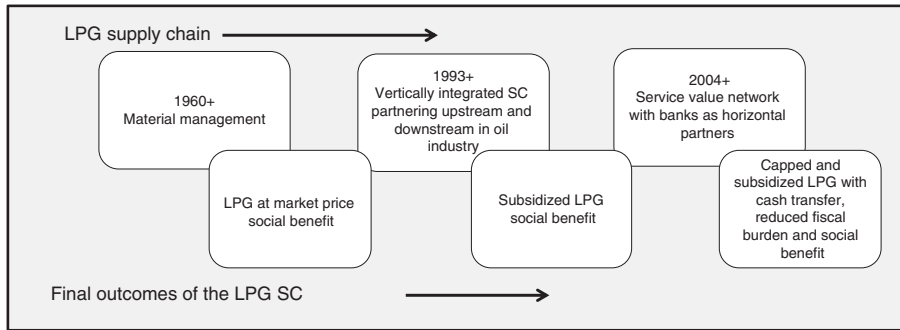
Key periods	Major events	SC characteristics – pricing, delivery and outcomes	Stakeholders
1955-1970	Introduction of LPG supply	LPG at market-driven prices Material management of LPG cylinders Social benefit: clean and convenient fuel to citizens	Indian Government, OMCs, their distributors, retailers, and customers (citizens)
1970-2002	Subsidy in LPG supply	Two separate processes: LPG delivery at subsidized prices and subsidy management via bonds/cash transfer to oil marketing companies (OMCs) from oil pool account (OPA) Material management of LPG cylinders via administered price mechanism (APM) Subsidized LPG, social benefit: clean and convenient fuel now affordable by larger population	
2003-2011	Dismantling of APM for LPG supply	Two separate processes: LPG delivery at subsidized prices, and subsidy management via structured sharing of losses on account of subsidy between upstream and downstream oil companies Vertically integrated SC partnering upstream and downstream across the oil industry suppliers, distributors and consumers Subsidized LPG, social benefit: clean and convenient fuel now affordable to larger population, particularly the economically weaker sections of society	
2012-2013	Introduction of capping and direct benefit transfer of LPG subsidy (DBTL) to customer's bank account via Aadhaar	Structured DBTL via: Delivery of LPG cylinders capped at 9 LPG cylinders per consumer account SC integration through deployment of IT portal and use of Aadhaar unique consumer ID Direct benefit transfer of subsidy via LPG account/Aadhaar validation through bank Service value network established with banks as horizontal partners, and with oil companies as vertical partners Capped and subsidized LPG with subsidy cash transfer, reduced fiscal burden on Indian Government (MoPNG), and social benefit to citizens of India	

Table V.
The key phases in the evolution of the LPG supply chain

Source: Authors' analysis

monopoly at the retail level, where consumers were tied to a retailer for life. This led to poor service standards with the consumer not having any recourse or knowledge of their retailer's service levels. There was no Know Your Customer (KYC) – requirement prior to enrollment as an LPG consumer, which led to a possibility of fake/multiple connections. ICT was deployed to bridge the information asymmetry through the setting up of a portal to

Figure 4.
Evolution of the
LPG supply chain



Source: Authors' analysis

detect fake/multiple connections, and to introduce competition among retailers. To control the ballooning subsidy burden, two initiatives were taken, namely capping of subsidized cylinder entitlement, and the sale of market-priced cylinders with transfer of subsidy into the bank accounts of the consumers (DBTL). The DBTL initiative involved collection of a biometric-enabled citizen ID to link the LPG database and the consumer bank account number. This allowed sale of cylinders at market price with the subsidy being directly transferred into the bank account of the consumer. These initiatives increased transparency, brought in competition, enabled removal of multiple/fake connections, and removed the incentive of retailers to divert subsidized LPG (International Institute for Sustainable Development, 2013).

A paradigm shift is taking place in the way in which organizations create value, in that managers are adapting their alliance networks dynamically to sustain competitive advantage (Teecce, 2009) and developing collaborative relationships external to the organization (Hammervoll, 2009). Extant literature highlights that SVN partners play a pivotal role in coming up with service innovations as a result of their complementary assets, capabilities, resources, and competencies (Agarwal and Selen, 2009; Teece, 2009). In addition, emerging technologies are seen as an enabler for service innovation, where the deployment of such technologies in innovative ways transpires into unique solutions for markets (Enkel *et al.*, 2009). Furthermore, the traditional longstanding approach of “value-in-exchange thinking from a producer perspective” has shifted away to the more contemporary “value-in-use thinking from a customer perspective” (Vargo *et al.*, 2008); and this shift has only been possible because of increasing trends in collaboration with customers and suppliers. Henceforth, increasingly, firms are operating as in collaborative networks to build collaborative competencies and sustain competitive advantage (Achrol and Kotler, 1999; Das and Teng, 2000; Kogut, 2000; Simatupang and Sridharan, 2002).

No doubt, networking and collaboration is not limited to just internal stakeholders, rather collaborating with external stakeholders arms firms with an ability to expand the understanding and knowledge base of both internal and external relationships (Cohen and Levinthal, 1990; Leiponen, 2005). Furthermore, interactions in a network allow entities to acquire new knowledge enabling them to advance their competencies and build higher-order capabilities (Agarwal and Selen, 2009; Gupta and Govindarajan, 2000; Mahmood *et al.*, 2011). This new relational capability, the new skills and knowledge base, and the ability to maneuver resources across partners which was otherwise lacking across the individual partners have empowered partnering organizations with a collaborative ability to cope with decision making in uncertain and complex situations, as well as

manage risks and challenges more promptly and efficiently. (Cravens *et al.*, 1993). No doubt, these strong relationships across partnering organizations mitigate uncertainty and enhance increased communication, information sharing, and transparency across processes (Lee *et al.*, 2009). Extant literature shows that, when entities are loosely coupled, they are more motivated to share ideas, resources, and competencies (Tsai, 2001), thus allowing inter-organizational knowledge pooling, leading to innovative outcomes. Managers who foster complementary knowledge through structured collaboration (Rindfleisch and Moorman, 2001; Sparrowe *et al.*, 2001) enable open and transparent communication, leading to significant reductions in total costs for all stakeholders (Gavirneni, 2002), evaluation of collaborative alternatives to develop a good understanding of expected costs and benefits (McLaren *et al.*, 2002), and enhancement of overall service innovativeness (Goes and Park, 1997). As such, underpinning the fundamental premise of collaboration Agarwal and Selen (2011a, b, p. 1167) define such a network of partners as an SVN, as:

A network of value chains, which vibrates its essence from the combined core competencies of the stakeholders in the chain, mobilizes the creation and reinvention of value of its assets, requires strategic focus and revives roles and responsibilities amongst different stakeholders. Through the use of relationship, technology, knowledge and process realignment and management, a SVN connects to the customer via the channel of choice, heightens the transformation of the nature, content, context and scope of the service offerings, opens up new market opportunities, keeps the social infrastructure intact and secures competitive advantage.

In this case study, supply network-enabled innovation (Narasimhan and Narayanan, 2013), the underlying IT infrastructure of the LPG supply chain (Liu *et al.*, 2015), and the close involvement of all stakeholders (Oke *et al.*, 2013; Rahman, 2004) were pivotal to the success of the DBTL-enabled LPG supply chain. Figure 5 shows how the Indian public sector-run supply chain has evolved in an SVN through: a change in policy; change management and commitment by MoPNG and OMC leadership; deployment of technology and the unique customer ID; integrated and seamless processes; the application of knowledge and learning;

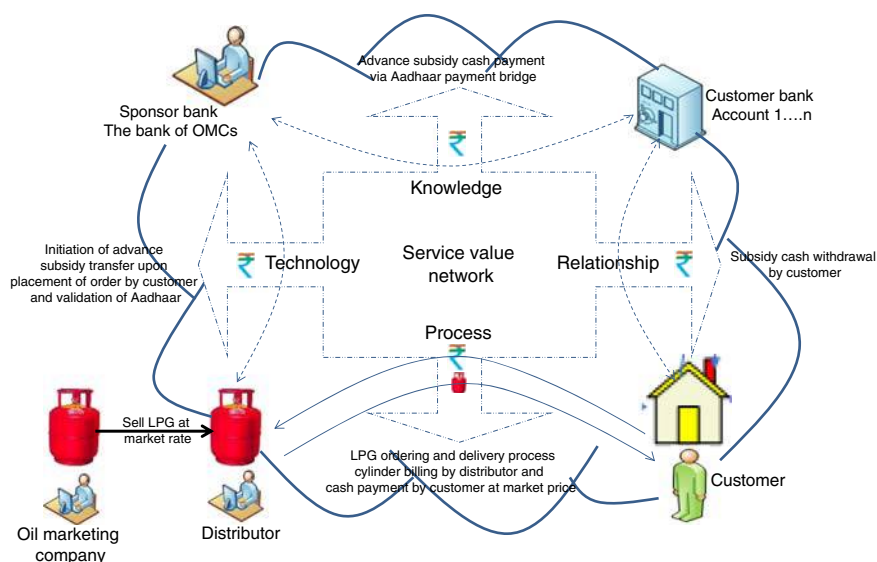


Figure 5. A notional representation of the DBTL supply chain as a service value network

Source: Authors' analysis

and, crucially, a partnership with banks (Tsanos *et al.*, 2014). In Figure 5, different LPG processes are shown via curved arrows centered on the four pillars of technology, process, relationship, and knowledge. Seamless integration of these new processes, technology, and the relationship with banks into the LPG supply chain, enabled through information and knowledge management, allowed subsidy benefit disbursement and charging customers for LPG at market prices.

The deployment of IT and related business process changes enabled a new and elevated service offering through the unification of the LPG supply chain and the banking value chain (Agarwal and Selen, 2009, 2011a, b, 2014). This innovative way of service delivery has changed the role of the MoPNG, OMCs, and OMC distributors, and has established a new relationship with the banks, i.e. both customers' banks and the banks served by the OMCs. The functioning of the LPG supply chain as a value network requires the co-operation and coordination between all members of the network such that related end-to-end processes across the two separate value chain industries are synchronized and aligned. The benefits include: less inventory, improved service levels, reduced leakages of the subsidy, and targeting the subsidy to eligible customers. Next, we elaborate on the various enablers and capabilities utilized during this era of organizational transformation.

This case study shows the strategic partnerships that MoPNG built with the OMCs, distributors, the banks, and other stakeholders which resulted in a win-win proposition for all stakeholders as a result of IT-enabled capabilities and innovativeness (Agarwal and Selen, 2009). Transformation was required from various perspectives, using the following four enablers and capabilities outlined below.

Enablers and capability building

Understanding customer needs and customer diversity between rural and urban markets

Integrating customers as co-creators of innovation (Von Hippel, 2001, 2005; Moller *et al.*, 2008; Edvardsson, Gustafsson and Witell, 2010; Chesbrough, 2011) is fundamental in today's networked service-led business environment. This encourages organizations to collaborate with customers as a means of understanding customer needs and leveraging external resources in the innovation process (Chesbrough, 2003, 2006; Michael *et al.*, 2008; Vargo and Lusch, 2004, 2008a, b; Russo-Spena and Mele, 2012). It is in this context that the LPG supply chain is customer centric, promotes collaboration with its customers, and ensures promotion and quality service delivery to the mass customer base, both rural and urban (Edvardsson, Gustafsson, Kristensson and Witell, 2010).

Although the rationality of removing/reducing the subsidy is well understood by all stakeholders, the timing of such removal/reduction remains a challenge in view of continued volatility in prices of petroleum in international markets. The problem was compounded by initiatives to popularize and encourage use of LPG in rural markets, which were served by low turnover – rural distributors.

The advent and application of modern marketing systems allowed better understanding of customer diversity, whilst addressing the discriminating expectations of customers from both rural and urban citizen communities. This understanding translated into an effective segmentation supply chain strategy, forced OMCs to focus on meeting customers' expectations, whilst tackling the problems of leakage of subsidy as a result of subsidized pricing. Project Lakshya extensively used focus group discussions to identify desirable consumer features on the portal.

Process re-engineering and deployment of ICT systems

Business process re-engineering implies radical design of business operational processes (Hammer and Champy, 1993). Roy and Dhalla (2010) documented the required business

process re-engineering of LPG supply chains as operated by the Petroleum Corporation in India to maximize its customer reach with an aim to connect with the LPG demand chain (Seetharaman *et al.*, 2004), as well as make its supply chain environmentally sustainable (Sarkis, 2003). Additionally, Liu *et al.* (2015) offered empirical evidence that a firm's high-order organizational capability, namely its internet-enabled supply process and demand process integration, can directly improve its performance. They also note that internet-enabled supply and demand process integration is significantly impacted by both IT operational and transformational capability (Liu *et al.*, 2015). Project Lakshya aimed to achieve this through re-engineering several of the existing LPG supply and demand processes through internet capability. Some of the key processes are discussed below.

KYC process. On the demand side, in order to detect/prove multiple/ineligible connections, a KYC process was introduced. Every LPG consumer had to provide their proof of identity and proof of address, along with basic information, such as their full name, date of birth, name of father, mother and spouse, address, telephone number, and e-mail in a standard format. The databases of all three OMCs were changed to accommodate new KYC fields.

Portal development – an ICT web portal that made the supply chain transparent and visible. Access to real-time information across a supply chain is paramount, and instituting data update on a real-time basis was a major challenge in the implementation and roll-out of the portal for the DBTL supply chain. This was easily addressed through populating the data from transaction data, thereby eliminating the need to update data specifically for the portal. The main challenge was resistance from vested interests and new learning required by a change in the software interface. This was addressed through education and training. Another challenge occurred in rolling out a quasi-similar functional interface across the three OMCs, with each having a different background, business process, and database. This was met through coordination by MoPNG which resulted in the deployment of a web-based portal <http://mylpg.in>. The key benefits for consumers/citizens of such portal are:

- visibility of booking/deliveries of LPG cylinders, available subsidy, comparative LPG usage, and a first-come-first-served release of refills and new connections;
- enhanced consumer service based on perceived service levels, delivery performance, and online grievance filing/service recovery;
- a five-star rating for delivery efficiency of each distributor;
- consumer connection online and its completion tracked by the OMCs;
- portability across the OMCs for competition across retailers;
- civil society partners can audit subsidy disbursement, multiple connections, and detect high consumption of LPG; and
- improved government subsidy administration via a more agile and transparent DBTL supply chain.

Multiple LPG connection detection. On the supply side, the scale and size of the database and legacy nature of the records were a significant challenge. The huge volume of data prevented easy visual detection of duplicates, or door-to-door inspections, while poor-quality legacy data prevented easy software detection. As such, false positives were assumed to exist in the outcome of software exercise to detect duplicate connections. With LPG being an essential commodity, consumers were given sufficient time/notice to ensure that genuine consumers were not blocked.

Change management and capability building across LPG stakeholders. In today's supply chains, many firms partner as a result of a trade-off between specialization and integration (Hammervoll, 2009), while other firms partner because of the interaction between the

internal capabilities of the firm and the ability to leverage assets, capabilities, and competencies from business partners (Agarwal and Selen, 2009; Teece, 2009; Simatupang and Sridharan, 2002). In this case, the new DBTL supply chain brought together stakeholders in a vertical partnership involving the Indian Government, MoPNG, OMC distributors, and retailers, and in a horizontal partnership with the banks, as shown in Figure 6. This unique partnership enabled the alignment of policies, integration of information and knowledge flows, and collaborative coordination across stakeholders.

In order to manage such a complex value network, change management and leadership of the MoPNG were fundamental, along with the dedication and continued efforts of the internal resources of the OMCs. The strategy was crafted by a dedicated project management group which comprised IT and functional personnel from the three OMCs, personnel from the Ministry, and the banks. These policy initiatives, in particular prevention of duplicate LPG connections, were subsequently institutionalized through government policy initiatives and orders.

Value creation as a result of the new LPG DBTL supply chain. The DBTL supply chain was a culmination of multi-pronged initiatives in order to meet customers' expectations, increase consumer convenience, improve service levels, and address the complex subsidy challenges in LPG distribution. The DBTL supply chain has resulted in a more efficient LPG distribution system, thus providing benefits of immediate growth in non-domestic sales (of up to 20 percent), reduction in consumption of domestic LPG primarily due to blocking of inactive/dormant customers, identification/blocking of multiple connections, and capping of subsidized cylinder entitlement. The measurement of the delivery performance of the distributors, and sharing of information on the portal, led to a 20 percent shift of LPG distributors into top rating categories in a short period of time.

The DBTL initiatives and their implementation show savings in the subsidy. Duplicate connections are continuing to be detected and blocked, and the demand for subsidized LPG has declined where DBTL has been implemented, which can partly be attributed to

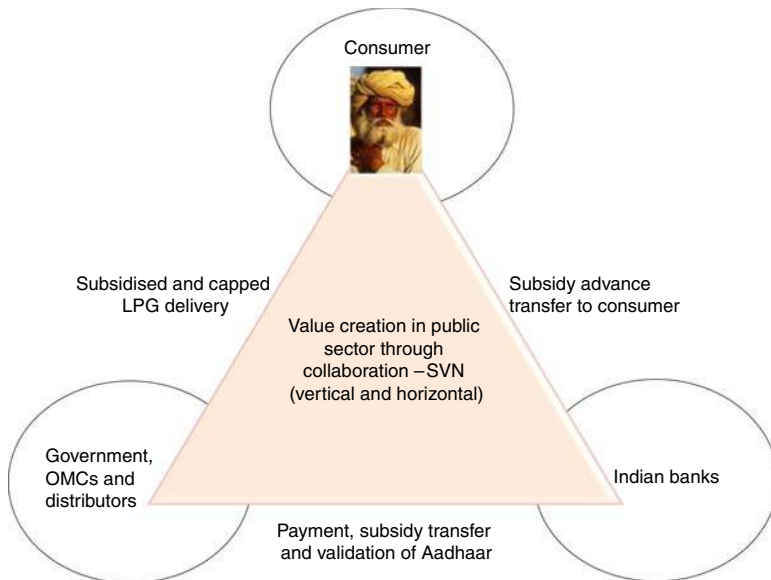


Figure 6.
Vertical and horizontal collaboration between stakeholders

Source: Authors' analysis

reduction in diversion of LPG into commercial markets. This has also led to reduction in foreign exchange outlays for imports of LPG – scheduled LPG imports worth US\$1 billion[1] were canceled during relevant period. The DBTL has also led to self-selection of customers, a desirable aim for many social sector schemes. It is expected that around 10-20 percent of LPG consumers may choose to remain outside the scheme, or will not be able to join the scheme if identified as fake/duplicate. Beyond the case study period, a new scheme “GiveItUp” has led to over ten million LPG consumers voluntarily giving up their LPG subsidy and receiving LPG at market prices (see www.mylpg.in/#give_up_form). The Government of India has in its press release (see <http://pib.nic.in/newsite/PrintRelease.aspx?relid=147384>) estimated that 33.4 million ineligible consumers who were blocked from receiving subsidy led to a savings of INR212,610 million over a two-year period. The scheme is also expected to have led to increased awareness of the subsidy involved. This would, in turn, lead to increased energy efficiency behavior while cooking. The benefit to consumers, even in the early review of the scheme (Dhande, 2014), was that customers would receive the subsidy directly into their bank, and the scope for diversion of their entitlement was significantly reduced by the transparency of the scheme and its systemic measures. LPG consumers would find that supply times reduce as more LPG cylinders became available in the eco-system for domestic use.

In particular, the case analysis demonstrates that, besides the three enablers of understanding customer needs and customer diversity between rural and urban markets, business process re-engineering and deployment of ICT systems, as well as managing change and building capability; the supply chain structure and value network relationships do directly impact on value creation.

The following main drivers of value creation emerged:

- integration of customers as co-creators and resources in the supply network;
- process re-engineering of end-to-end business processes and deployment of seamless ICT systems; and
- collaboration across stakeholders', both vertically and horizontally in the supply chain, with change management and capability building through policy interventions and initiatives.

Conclusions and areas for future research

This paper identifies and discusses enablers and capabilities required to make a public sector-run LPG supply chain effective and efficient. This was demonstrated through a case study of LPG distribution in India, examining the changes the Indian public sector-run supply chain had to adopt to create a win-win prospect for all stakeholders involved. The paper presents an overview of the LPG traditional supply chain running over six decades, followed by identification of issues and problems faced during each era as structural reforms took place. Next, challenges were addressed by various supply chain stakeholders through collaborative partnerships, leadership, and the commitment of the MoPNG and OMCs. The MoPNG introduced policy initiatives which included the capping of LPG cylinders, the introduction of a new subsidy advance payment process, and the implementation and roll-out of an ICT integrated system across all OMCs. The use of a unique customer ID number was deployed to manage customer details, and to make the supply chain leak free through minimizing any duplications. The transition from an open distribution LPG delivery system to a closed distribution model was only possible through the partnership of MoPNG and OMCs in the operationalization, and the connectivity of knowledge and information flow across both the customers' banks and the banks served by the OMCs. In particular, this study provided insights into which factors – capabilities and

enablers – led to successful implementation of the DBTL LPG closed distribution system. It demonstrated how the Indian public sector-run LPG supply chain devised an innovative solution through collaboration with stakeholders, customer co-creation, and use of seamless and integrated ICT systems to solve several of the intractable problems. The response of consumers to these initiatives has been very positive as they now receive their subsidy directly into their bank accounts. They are empowered by the portal and are able to demand better service from the distributors and in control of the LPG delivery services. The web portal mylpg.in is quite popular among users to seek services, and receives three million unique views every month (see <http://mylpg.in.composite.com>).

Some limitations and areas of future research emerged from the study. As the new DBTL supply chain is a recent deployment, data availability was limited, with future detailed quantitative analysis and longitudinal studies needed for further analysis. Future research areas include gathering consumer-, LPG supply-, OMC-sourced data sets and conducting further in-depth interviews (Arlbjørn and Paulraj, 2013). This would enable a deeper quantitative analysis of the subsidized DBTL closed distribution system to identify the root causes of success or failure in achieving the desired service levels, including agent-based modeling and simulation. Further detailed research analysis will assist selling agents and retailers to better understand the true potential of the public sector-run LPG closed distribution system to prevent shortages, manage leakages, and meet customer expectations, thus leading to supply chain excellence (De Waart and Kemper, 2004). Finally, this study opens the pathway to further exploring the influence of structural reform and policy initiatives on value capture, creation, and appropriation, through qualitative and quantitative research methods.

Glossary

BPC	Bharat Petroleum Corporation
DBTL/PaHal	Direct Benefit Transfer of Liquid Petroleum Gas
HPC	Hindustan Petroleum Corporation
ICT	Information and Technology Communication
IOCL	Indian Oil Corporation Limited
KYC	Know Your Customer
LPG	Liquid Petroleum Gas
MoPNG	Ministry of Petroleum and Natural Gas
OMC	Oil Marketing Companies
PPAC	Petroleum Planning and Analysis Cell
TMT	Thousand Metric Tons

Note

1. Exchange rate: US\$1 = INR68.

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