Knowledge Dispersion along the Supply Chain in Pharmaceutical Clusters in North India

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Abstract

Over the period of time, industries have selected geographical locations which provide specific advantages peculiar to that location. This gave rise to Industrial Clusters. Clusters have emerged through strong but informal linkages, both vertical and horizontal amongst various players in an industry having co-location. Ease of access and availability of knowledge in clusters has been one of the key advantages of spatial agglomeration. R&D and knowledge are the backbones of pharmaceutical industry. The active dispersion of knowledge is bound to encourage the pharmaceutical industry to grow in geographical proximity. Supply chain management is usually studied with more physical aspects in mind as it is associated with management and movement physical goods and services. The soft side of supply chain is equally important which deals with the flow and management of knowledge amongst various members of the supply chain. Knowledge and information is of key importance in many industries especially pharmaceutical and biotechnology. The purpose of this paper is to study the dispersion of knowledge along the supply chain in pharmaceutical industry in selected clusters in North India. This study concludes that there is a significant scope of quantitative and qualitative enhancement of knowledge dispersion amongst supply chain members in selected pharmaceutical clusters in Himachal Pradesh and Uttarakhand.

Key Words: Knowledge Dispersion, Clusters, Supply Chain, Pharmaceutical Industry

1. Introduction:

Geographical co-location and proximity can be seen all over the world. There are numerous examples of successful clusters like IT industry (e.g. Silicon Valley), Automobile Industry (e.g. Detroit), Financial Services (e.g. New York), Telecom (e.g. Finland) etc. Marshal (1920) highlights the main causes of industry localization as climate, availability of raw materials, easy access by land and waterways and local demand conditions. Clusters emerge through strong but informal linkages, both vertical (buyer & supplier) and horizontal (common technology) amongst various players in an industry having co-location (Porter, 1990). Porter (1998) further broadened the concept of clusters by including institutions such as universities, standard setting agencies, training providers, trade associations and government institutions.

Clusters are made up of vertical linkages with upstream suppliers and downstream customers (Patti, 2006). The suppliers compete amongst themselves and provide raw materials, equipment and services. The customer may be end customer or an intermediary in the product value chain. Horizontal linkages in a cluster involve the producers of similar or complementary products that require similar basic skill, raw material and machinery.

1.1 Industrial Clusters: Scope & Definition

Over the years, various researchers have defined clusters in their own ways. Porter (1998) has defined clusters as "*Geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities*

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important for competition. Clusters extend to channels and customers and laterally to manufacturers of complementary products and to companies in industries related by skills, technologies or common inputs". DeWitt et al. (2006), define clusters as geographic concentrations of competing, networked supply chains. There are three main characteristics of a cluster: physical proximity, core competencies and relationships. Jansen et al. (2009), define cluster as a composition of at least two autonomous units which are connected. The main properties of a cluster can be determined by ideas, values, codes, rules, norms, rituals and routines. Iammarino & McCann (2006) have characterized industrial clusters in three types distinguishing firms on the basis of nature of firms and relations and transactions undertaken within clusters. These three types are *pure agglomeration,* the *industrial complex* and the *social network.*

There are researchers who are critical of the concept and definition of clusters. Martin & Sunley (2003) criticize the definition of clusters as defined by Porter. They suggest that the term has not been defined with any precision. To them the term "clusters", as defined by Porter, seems "highly and ridiculously elastic". According to Martin and Sunley (2003), at least the following terminologies have been suggested by economic geographers studying clusters: "industrial districts", "new industrial spaces", "territorial production complexes", "neo-Marshallian nodes", "regional innovation milieu", "network regions" and "learning regions".

Hospers et al. (2008) are also critical of Porter's definition of clusters and observe the term cluster, as defined, to be fuzzy and elastic.

Despite all the noise surrounding the idea and concept of clusters, the area has been widely researched by researchers worldwide. The measurement of spatial agglomeration has been accepted as one of the most important aspects in the study of clusters. Ellison and Glaeser (1997) and Maurel and Sedillot (1999) have designed measures of geographic concentration and applied these to manufacturing industries in the US and France, respectively. Both these studies differentiate between geographic concentration occurring from unrelated plants co-locating near to each other and that because of concentration in industrial structure.

Devereux et al. (2004) have measured geographic agglomeration in UK on similar lines. The findings have been interpreted as "excess" of geographic concentration over that which would be expected given the industrial concentration of the industry.

1.2 Pharmaceutical Clusters in North India

As per "Directory of Pharmaceutical Manufacturing Units in India", published by the Ministry of Chemicals & Fertilizers, Government of India, India has 10563 pharmaceutical manufacturing units. Out of these 8174 (77.4%) are formulation units and 2389 (22.6%) are bulk drug manufacturing units. This gives a clear indication that the pharmaceutical industry has a strong backbone in India in the form of a strong bulk drug manufacturing base.

Traditionally, Maharashtra, Gujarat, West Bengal and Andhra Pradesh have been the pillars for Indian Pharmaceutical industry as these states account for a major chunk of the total pharmaceutical industry in India. The Government of India, announced a policy stimulus package for the states of Himachal Pradesh, Uttarakhand and Jammu & Kashmir to encourage the setting up of industry in these states and job creation. The main highlight of the package was 100% excise benefit for the first ten years and income tax benefit for 5 years from the date of establishment. The rider in the policy was that the companies were supposed to recruit 60% staff locally hence leading to job creation.

The stimulus package encouraged the growth of industry in these states and most aggressive growth was witnessed by the pharmaceutical industry. The growth was due to migration of existing units as well as creation of new firms. The focus of the growth was both

contractual and 'own' manufacturing. The main reason for such a growth of pharmaceutical industry in this region can be attributed to the fact that the excise is a very significant component in the industry as it is calculated as per the retail price of the product. This leads to very high excise being chargeable hence the spurt in the growth of pharmaceutical industry in an excise free zone can well be understood.

1.2.1 Himachal Pradesh

The state of Himachal Pradesh was created post independence out of the state of Punjab. Himachal Pradesh is rich in natural resources like water and electricity but has lagged behind due to it being hill state and companies avoided setting up industrial units here due to this limitation. Out of twelve districts of Himachal Pradesh, the most significant district from the point of view of Pharmaceutical industry is Solan, particularly Baddi P.O., Parwanoo and Nalagarh. The district Solan has a disproportionate population of 8.2% of Himachal Pradesh's total population[1].

The total number of new Own licenses granted by the state of Himachal Pradesh from the period 1992 to 2007-08 (upto 1.12.2007) stood at 364. Out of these Solan district alone has been granted 257 licenses. This amounts to about 70% of the total licenses issued. Major share of the new licenses granted were in the period 2005-2008.

Table 1: Year-wise number of Own/Loan Licences granted in Himachal Pradesh

Year	No. of Own Licenses Granted		% of Solan to the Total Own Licenses	No. of Loan Licenses Granted		% of Solan to the Total Loan Licenses
	In the entire State	Of which in Solan		In the entire State	Of which in Solan	
As on 31.03.1992	6	4	66.7	0	0	0.00
During VIII Five Year Plan (1992-1997)	34	20	58.8	0	0	0.00
During IX Five Year Plan (1992-2002)	60	33	55	0	0	0.00
2002-03	5	3	60	4	4	100.00
2003-04	14	8	57.1	1	1	100.00
2004-05	5	4	80	6	6	100.00
2005-06	95	83	87.4	83	74	89.20
2006-07	118	77	65.3	100	87	87.00
2007-08*	33	25	75.8	60	35	58.30
Total	**370**	**257**	**69.5**	**254**	**207**	**81.5**

*Upto 1.12.07

Source: Annual Report 2010-11, Department of Pharmaceuticals, Ministry of Chemicals & Fertilizers, Government of India

The reason for such growth can be attributed to the incentive package offered by the Indian government to the state of Himachal Pradesh in the form of location specific excise duty exemption, income tax exemption and one time capital subsidy @15% of investment not

[1] Annual Report 2010-11, Department of Pharmaceuticals, Ministry of Chemicals & Fertilizers, Government of India

exceed 3 Million Rupees. The reason for the focus of pharmaceutical industry on Solan can be attributed to the proximity it has to the important city of Chandigarh. Chandigarh is the capital of Punjab and Haryana and acts as the gateway to Himachal Pradesh.

In addition to the own licenses issued by the state government, 254 Loan licensees were issued in Himachal Pradesh and all were issued post 2002. Out of these 254 Loan licensees, 207 were issued in Solan District alone accounting for about 80% of the total loan licenses granted in the state. Loan Licensees do not directly contribute to the growth of infrastructure as they rely on the pre-existing units, but they do enhance the demand for resources hence leading to development. The rise in the pharmaceutical industry in Solan district has also seen a burst in the packaging industry in the region. The major demands of the pharmaceutical industry are being met by the support industry in the same region.

1.2.2 Uttarakhand

The Indian state of Uttarakhand was created by bifurcation of Uttar Pradesh and has thirteen districts. Out of these, the most significant ones from the pharmaceutical industry point of view have been Dehradun and Haridwar. The details of licences issues by the state administration in the state and these districts have been given in the table below.

Table 2: Year-wise number of Own/Loan Licences granted in Uttarakhand

Year	No. of Own Licenses Granted		% of Dehradun & Haridwar to the total Own Licenses	No. of Loan Licenses Granted		% of Dehradun & Haridwar to the total Loan Licenses
	In the entire State	Of which in districts of Dehradun & Haridwar		In the entire State	Of which in districts of Dehradun & Haridwar	
2001	8	6	75	0	0	0.0
2002	5	4	80	1	1	100.0
2003	5	4	80	4	4	100.0
2004	23	14	60.9	6	6	100.0
2005	23	19	82.6	18	17	94.4
2006	80	68	85	31	25	80.6
2007*	65	51	78.5	21	14	66.7
Total	**209**	**166**	79.4	**81**	**67**	**82.7**

*Upto June 07

Source: Annual Report 2010-11, Department of Pharmaceuticals, Ministry of Chemicals & Fertilizers, Government of India

The state government has issued 209 Own licenses in the state. Out of these, 166 have been issued in the districts of Dehradun & Haridwar only which accounts for about 80% of the total licenses granted. Out of the 81 loan licenses granted in the state of Uttrarkhand, the districts of Dehradun & Haridwar account for 67 (83%) of the total loan licenses.

Again, it can be seen, the majority of the licenses have been issued since 2004 onwards. Since 2004, 191 Own licenses (90% of the total) and 76 Loan licenses (94% of the total) have been issued. The reason for the sudden spurt of pharmaceutical manufacturing activity in the state can attributed to the incentive package offered by the Indian government to the state of

Uttarakhand in the form of location specific excise duty exemption & income tax exemption. The reason for growth of the industry in the districts of Haridwar and Dehradun is due to the proximity to the state capital and connectivity to the national capital New Delhi.

1.3 Knowledge Dispersion along Supply Chain in Clusters

The Council of Supply Chain Management Professionals[2] defines Supply Chain Management as "encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies".

The Oxford English Dictionary defines *Knowledge* as (i) expertise, and skills acquired by a person through experience or education; the theoretical or practical understanding of a subject; (ii) what is known in a particular field or in total; facts and information; or (iii) awareness or familiarity gained by experience of a fact or situation. Döring & Schnellenbach (2006) describe knowledge as collective cognitions and abilities that individuals use to solve problems, make decisions and to understand incoming information.

Knowledge can be of two types, *explicit* or *tacit.* Explicit knowledge is the one which can be conveyed and communicated consciously whereas tacit knowledge is more commonly used unconsciously and hence cannot be put into words or communicated.

The distance and relationship between the creator and recipient of the knowledge is crucial for the spillover. Explicit knowledge can be transmitted over long distances without actual direct contact but for implicit knowledge dispersion, direct interaction and close spatial proximity is mandatory (Anselin et al., 1997). Various researchers have questioned the concept of *tacitness* of knowledge. Breschi & Lissoni (2001) call it a "fuzzier conceptual category".

There are two types of knowledge spillovers leading to regional economic growth. The literature identifies these as *local* externality and *urbanization* externality. Glaeser et al (1992) coined the term MAR-spillover to elaborate the local externality. The term MAR-spillovers was coined after the classical contributions of Marshal, Arrow and Romer. MAR-spillovers take place between researchers, entrepreneurs and businesses within one industry. MAR-spillovers are essentially within the same industry. Urbanization externalities, on the other hand, symbolize the effect of the size and heterogeneity of an agglomeration (Döring & Schnellenbach, 2006). These are mostly inter-industry spillover taking place amongst different industries.

There have been numerous studies to understand and measure the extent of knowledge spillover in clusters. Jaffe (1989) has undertaken studies on knowledge spillover from academic research in America whereas Peri (2002) has studied the knowledge spillover between regions in Europe and United States. Funke & Neibuhr (2000) have studied the spatial pattern of knowledge spillover in 71 regions in West Germany over the period 1976-1996.

Knowledge spillover in a cluster setting certainly is a beneficial phenomenon for the recipient of the knowledge but the extent of usage of the gained knowledge vastly depends on the knowledge previous gained or accumulated through various means of creation or absorption. This is an additional barrier for diffusion of knowledge (Döring & Schnellenbach, 2006).

The common mechanisms for knowledge transfers within clusters are labour mobility, physical and direct transfer of production technologies, social networking and patent

[2] (http://cscmp.org/aboutcscmp/definitions.asp)

licensing. Almeida & Kogut (1999) suggest that the knowledge created in a cluster spills only imperfectly amongst firms and nations. In terms of knowledge spillover, the spatial borders of a region (cluster) are less permeable than the proprietary boundaries of the firms. The main reason here again is that the labor mobility is high within the region and minimal among regions. Almeida & Kogut (1999) have replicated the exercise carried out by Jaffe et al., (1993) with semi-conductor patents and found the patent holders to be highly localized in the Silicon Valley. Their mobility tends to affect the innovative capabilities of the firms substantially.

Clusters may lead to creation of 'labor-pool' of skilled employees, but if the cluster is very dynamic then there is extensive job switching from one firm to another which acts a source of wage spiral but enhance knowledge sharing (Shiele, 2008). Firms frequently use informal events to set up personal contact for various reasons like new product development etc. Usually it is seen that such interaction is already present in clusters as many members share similar educational background (Shiele, 2008). Clusters provide better and preferred access to specialized information about technology, markets and competitors by active participation of members of participating firms in local associations, religious and other volunteer organizations (Patti, 2006)

The pharmaceutical clusters mix a pattern of localized learning with dynamics of external learning as the latter provides access to global knowledge creation and diffusion (Hamdouch & Feng, 2009).

Three important sources of external knowledge in cluster are the suppliers of machinery and equipment, suppliers of trends and market analysts and suppliers of R&D knowledge. Feser et al., (2008) argue that the independent small businesses in a cluster, managed by individuals, have limited access to external information networks and hence are more dependent on the spatial knowledge assets as compared to the bigger multiunit counterparts.

2. Methodology of Research

A questionnaire was prepared to measure the parameters which can be considered as factors aiding knowledge dispersion along the supply chain in the clusters. The parameters which were selected were related to indirect and direct forms of knowledge sharing. The respondents were given the questionnaire having questions on parameters of knowledge dispersion in the selected clusters.

A sample size of 50 firms was taken by Judgmental Sampling so that the firms were selected in close geographical proximity to each other. The area undertaken for research was Baddi (Distt. Solan), Himachal Pradesh and Selaqui (Distt. Dehradun), Uttarakhand. The sample from individual clusters was taken in the ratio of 3:2 (Himachal Pradesh: Uttarakhand) to have a sample proportionate to the number of firms in these districts. Hence, 30 firms were selected in the Baddi cluster (Himachal Pradesh) and 20 firms were selected in the Selaqui cluster (Uttarakhand).

The data obtained was then analyzed using SPSS. The statistical tools employed are the means of all parameters & Mann-Whitney Test, to analyze the significance of difference in the means of the two groups.

3. Findings

The responses of the pharmaceutical firms were analyzed using SPSS. The reliability of the questionnaire was checked using Cronbach's Alpha and its value came out to be .720. The respondents were asked to give their responses on a 5-point *Likert* Scale ranging from 1=Worst to 5=Excellent. The responses were sought on five parameters which contribute to dispersion of explicit and tacit knowledge. These parameters were *Sharing of Labour with*

Local Buyers/ Suppliers, Sharing of Transportation for Labour, Sharing Information with Local Buyers/ Suppliers on New Product Development, Sharing Knowledge and Information on Activities & Products of Competitors & Meeting Socially with Buyers/ Suppliers. The means of the responses given are presented in the table below.

Table 3: Means of Responses on Parameters Selected

	H.P.	Uttarakhand
Sharing of Labour with Local Buyers/ Suppliers	1.27	1.00
Sharing of Transportation for Labour	1.20	1.00
Sharing Information with Local Buyers/ Suppliers on New Product Development	1.80	1.55
Sharing Knowledge and Information on Activities & Products of Competitors	1.97	1.40
Meeting Socially with Buyers/ Suppliers	2.97	2.30

The respondents in both the pharmaceutical clusters have rated most direct and indirect methods of knowledge dispersion below average. The mean of *Sharing of Labour* is 1.27 for Himachal Pradesh respondents and 1.00 for Uttarakhand respondents. The means for *Sharing of Transportation* are 1.20 and 1.00 for Himachal Pradesh and Uttarakhand respectively. *Sharing of Information with Local Buyers/ Suppliers* has been rated 1.80 by Himachal Pradesh respondents and 1.55 by Uttarakhand respondents. *Sharing Information of Competitor's Products/ Activities* has been rated 1.97 and 1.40 by Himachal Pradesh and Uttarakhand respondents respectively. Only *Meeting Socially* with the buyers and suppliers has been rated above average and that too only for Himachal Pradesh. The means for *Meeting Socially* the buyers and suppliers are 2.97 for Himachal Pradesh and 2.30 for Uttarakhand respondents.

On all parameters Himachal Pradesh respondents have given higher ratings. This is indicative of better knowledge dispersion amongst supply chain amongst Himachal Pradesh set of respondents.

To have a clear and better understanding, a single variable denoting the selected five parameters was computed using SPSS. The means of this computed variable for Himachal Pradesh and Uttarakhand are 1.84 and 1.45. The means suggest that Himachal Pradesh respondent perceive better knowledge dispersion than Uttarakhand respondents along the Supply Chain. To validate the statistical significance of the difference between the means, Mann Whitney Test was used.

Table 4: Mann Whitney Test

	Knowledge Dispersion
Mann-Whitney U	198.000
Wilcoxon W	408.000
Z	-2.054
Asymp. Sig. (2-tailed)	0.040

The Mann Whitney Test gave a significance value of 0.040 which is indicative of the fact that the difference in the means of Himachal Pradesh and Uttarakhand is statistically significant at 95% confidence levels. The results of the Mann Whitney test suggest that the Himachal Pradesh respondents do actually perceive better knowledge dispersion along the supply chain. The overall means though indicate that the knowledge dispersion aspect seems

to be lagging in the cluster supply chain and much needs to be done to have a livid and vibrant knowledge hub in the form of pharmaceutical clusters in these states.

4. Conclusions:

Labour plays active role in knowledge diffusion in a cluster (Shiele, 2008). The sharing of labour and common transportation acts as modes of sharing knowledge. Social interaction also promotes knowledge sharing amongst supply chain members. The respondents in both Himachal Pradesh and Uttarakhand rate sharing of labour and transportation quite low, though they have relatively better social interaction with supply chain partners. These parameters encourage knowledge dispersion along the supply chain members within the cluster and hence should be promoted.

The main reasons which might be leading to lack of knowledge dispersion can be lack of trust amongst the supply chain partners. As the clusters mature, the relationships amongst various partners strengthen leading to creation of atmosphere of trust and cohesion within the cluster.

On the parameters of direct and explicit sharing of knowledge amongst the supply chain partners, the respondents again have rated the parameters below average. Hence we can conclude that direct sharing of knowledge amongst supply chain partners is also negligible in the selected clusters.

5. Recommendations:

The role of knowledge in long term viability and sustainability of a cluster is certainly beyond any doubt. The tax incentives have given a boost to the physical infrastructure in these states and have led to the development of pharmaceutical clusters in these states. The knowledge infrastructure has also taken shape in the form of skilled labour, educational institutions, industry associations etc. What lacks is the dispersion of the knowledge amongst the members of the cluster.

Supply chain offers existing pathways for easy knowledge dispersion amongst members. The industry associations or the individual industry members need to actively take up the issue of labour training and need based sharing of labour. The social interaction amongst the various supply chain members also needs to be enhanced to the levels where the mutual trust begins to set in. These steps are expected to boost the knowledge dispersion and transmission within the cluster.

The development of new as well of existing products is the key to evolution and sustainability of the pharmaceutical industry. The cluster participants need to co-develop the related products with their supply chain partners. This will reduce the cost of development of the products. The R&D departments need to interact with their counterparts from other related industries more frequently to channelize the resources in right direction and better co-ordination. The role of supply chain partners in product development is of extreme importance.

The clusters need to be developed more as knowledge hubs than as tax incentive hubs. The tax rebates can last only for a short while whereas the knowledge creation, dissemination, re-absorption and recreation cycle, if once established, is bound to stay vibrant for a long period of time thus acting as a magnet for industries in the future to reap the benefits of the same.

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