

Measurement and differentiation of knowledge and information flows in Brazilian Local Productive Arrangements¹

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Abstract:

The central question addressed in this paper is the possibility to measure and differentiate knowledge and information flows in Brazilian Local Productive Arrangements – LPAs. Analysis is based on *very innovative firms` information sources*: (i) universities and technological centres; or (ii) direct exchange with suppliers, customers or other companies in the sector; and *innovation incorporation sources*: (i) direct cooperation with different agents or (ii) machinery and equipment acquisition. Results show interesting trajectories in LPAs` innovative behaviour. This is extremely useful in helping *understanding learning processes*, especially to *differentiate knowledge types in transmitted information and incorporated innovations*. The exploratory exercise was carried out for six arrangements surveyed by RedeSist's in the late 1990s specialised in the production of *ornamental stones, footwear, metal-mechanics and textile and clothing*, located in Northeast, Southeast and South of Brazil. Quantitative data was extracted from *SINAL* (www.sinal.redesist.ie.ufrj.br), the information system on local productive arrangements and innovative systems, developed by RedeSist to widespread its concepts, empirical studies, and data on LPAs` configuration and dynamics.

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1 Introduction: theoretical and methodological foundations

This study presents exploratory measurements and analysis of information and knowledge intangible flows inside selected Brazilian Local Productive Arrangements - LPAs, emphasizing specific character of these flows in each geographical context.

Analysis is based on hypothesis that, in LPAs, information and knowledge systematic interchange generates informal learning processes, which must be distinguished from more formal learning mechanisms based on joint R&D efforts. Learning informal mechanisms refers to information circulation and to knowledge dissemination, which accelerate technological diffusion and organizational innovations. These flows of intangible assets reinforce connections and interdependencies between arrangements firms and institutions. Collective learning processes involve incorporation of individual learning retained by each firm in a knowledge social pool available to all arrangements participants. Thus, LPAs consolidation can be related to knowledge and information creation and circulation through collective learning processes based on complementary competencies and skills integration that widen arrangements innovative potential.

Although innovations generation based on joint R&D activities intentionally developed in co-operation tends to occur only in more structured systems, there are a lot of possibilities to improve LPAs competitiveness due to learning informal mechanisms. LPAs informational density refers to informational flows complexity and to knowledge 'socialisation' among their members. Evidences also show that member's upgraded competencies are associated with capabilities and skills equalisation generated by informal information flows. LPAs informational density can also be associated with communication structured channels between members and information complexity that circulate inside them. Knowledge circulation permits innovation lags reduction and incremental innovations acceleration. These processes assume great relevance in complex environments where permanent issuing signals must be captured and interpreted by economic agents. Another aspect to be stressed refers to information interchange impacts in establishing industrial standards, normalization procedures and quality control techniques that guide integrated agents behaviour in LPAs. These mechanisms play a very important role for strengthening industrial companies competitiveness, being strongly affected by subjacent institutional context characteristics in arrangements (Lundvall and Johnson, 1992).

LPAs informational flows improvement also requires consolidation of language codes and communication channels, in order to allow information and knowledge transference. As informational flows density constitute a crucial aspect of arrangements, it is very important to identify information sources singularities inside them. It is particularly important to consider not only information type but also its complexity. This complexity can be articulated to different aspects. First, it is possible to differentiate knowledge type incorporated in transmitted information. The typology proposed by Foray and Lundvall (1996) is very useful to capture this dimension, stressing differences between four knowledge sources that might be considered: *know-what*, *know-why*, *know-how* and *know-who*. Another critical aspect refers to difference between the *tacit* or *codified* nature of transmitted knowledge (Senker, 1995). Concerning these aspects, available evidences show that, many times, information flows are associated with interpersonal relationships between

individuals or groups, which enable tacit knowledge effective transmission. In some sense, LPAs can be regarded as structures promoting idiosyncratic processes of knowledge codification that take place at arrangements level. Evidences also show that, more tacit is the knowledge required to generate technological innovations, more important will be construction of proper contact and communication channels, in order to allow information systematic interchange between multiples and varied agents integrated in a LPA..

Empirical evaluation of LPAs information and knowledge flows is a complex task, implying adoption of specific conceptual and methodological procedures in order to articulate this dimension with a more general inquiry about arrangements structure and performance characteristics. Recently, **RedeSist**⁶ implemented 28 surveys at different locations in Brazilian territory. This singular research agenda motivated a new project development: **Local Productive Arrangements and Innovative Systems Information System – SINAL**⁷, in order to widespread RedeSist's new concepts and empirical studies results. SINAL project intends to create a new analytical instrument to support understanding of LPAs configuration and local dynamics. Among different dimensions considered in SINAL development, particular emphasis is attributed to data re-elaboration and systematisation related to information interchange and cooperation forms revealed in RedeSist's surveys. Some exploratory codification and aggregation of interviewed firms answers are available to system's users.

In SINAL project current status, data allow examination of *two groups of questions* focusing those main aspects. A first group tries to identify and evaluate *firm's information sources used to promote technological innovations*. At this level, the analysis is based on firms' answers about different external information sources and is possible some tracks about its relative importance, which seems extremely useful to LPAs learning processes understand. Among different information sources mentioned in questionnaire applied in empirical investigations, two main ones can be distinguished: *(i) information from universities and technological centres*; or *(ii) direct information exchange with suppliers, customers or other companies in the sector*. A second group of questions tries to evaluate relative importance of *new technology development and incorporation forms* through firms' answers about its origins: *(i) from direct cooperation with different agents* or *(ii) induced by machinery and equipment acquisition*. Direct cooperation comprises relations with different kind of agents, such as suppliers, customers, competitor companies or other organizations (educational and research institutions, sectorial support entities etc.).

⁶ The **Research Network for Local Productive and Innovative Systems - RedeSist** is an interdisciplinary research net, legalized since 1997, hosted in the Institute of Economics of Federal University of Rio de Janeiro, Brazil. It comprises other universities and research institutes in some Brazilian states, and partnerships in Latin America, Europe and Asia institutions. It interest subjects are related to industrial and technological development new requirements associated to Knowledge Age, as well as public policies in this new context. Arrangements and local productive systems consist in RedeSist's main research focus. Particular attention is given to developing regions and countries.

⁷ Prototype available in www.sinal.redesist.ie.ufrj.br Commentaries and suggestions are welcome!

To sum up, analysis discusses *information and knowledge interchange characteristics* trying to articulate those aspects with *learning informal processes*, using SINAL data, where RedeSist's empirical studies results about selected LPAs are stored and presented, as was previously mentioned. Analysis comprises *six Local Productive Arrangements*, in *five different Brazilian states*. One of them is an anchored arrangement in metal-mechanics sector, located in Espírito Santo (ES); the other five are from the so-called 'traditional sector', with no explicit local governance, including two footwear arrangements, one in northeast - Campina Grande (Paraíba, PB) -, and other in south Brazil - Vale dos Sinos (Rio Grande do Sul, RS) -; two ornamental stones arrangements in southeast Brazil - Rio de Janeiro (RJ) and Espírito Santo (ES) -; and a last one, a textile and clothing arrangement in Vale do Itajaí (Santa Catarina - SC), in south Brazil, too.

2 Local Productive Arrangements and Innovative Systems Information System - SINAL

SINAL consists of a database and a recovering information system developed with free software (Linux, currently); including mapping and report modules for data on line consulting, printing or downloading (maps or electronic sheets with selected data). System congregates data from RedeSist's surveys and from secondary sources, mainly Brazilian official statistics and administrative registers⁸. So, it offers statistics, indicators and thematic maps that speed spatial analysis and data analysis associated to LPAs configuration. In its complete version, will be available a selected multi thematic indicators set enclosing geographical desegregations of territorial segments referring RedeSist studied LPAs and Brazilian cities (municipalities). Ideally, in the future, the system will present historical series of selected statistics, indicators and maps, introducing Geographical Information Systems - GIS technologies and interfaces that assure quickly and friendly using.

SINAL project focus is exploitation of intangible innovation processes measuring possibilities through new methodologies to define, elaborate and cross *indicators, pointers, and signals* about productive arrangements identified by RedeSist's researchers. For example, comparisons between learning practices intensity and diffusion degree, innovation, cooperation and abilities creation embeddedness, 'success' or 'failure' cases by criteria like new jobs creation etc., in specific cities or sets of cities. Such information,

⁸ The great enrolled subjects are: General Characterization (territory, population, education, health, electricity and energy, basic sanitation, transports, communications, banks and other financial institutions, culture, citizenship, politics and environment); Enterprise Structure; Employment; Wages and Remuneration; Production; Foreign trade; Investments; Knowledge Infrastructure (basic, medium, professional, graduation and after-graduation education; libraries, scientific production, research centres and groups, and institutions for certification and quality); Cooperation, Interaction and governance; Technological capability and innovation effort (learning and R&D expenses), Public and Private Policies (support and foment organs and governmental financing, other official programs etc.); Performance Indicators (innovation, sales, exportations, and patents). Additionally, a Glossary of terms, the questionnaires and Notes Techniques from RedeSist empirical studies are presented.

available in RedeSist studies, is not found in official statistics. This task is necessary to transform RedeSist researchers' practices and tacit knowledge into codified and stabilised methodologies for systematic evaluations of LPAs interactions amplitude and intensity - real or potential - between agents and institutions. In addition, these indicators constitute an important referential for public policies to be implemented aiming at either successful cases improvement or diffusion through its re-elaboration and adaptation in analogous or similar contexts.

SINAL project second priority is interdisciplinary and multi-thematic approach that guides the choice of secondary information source indicators for LPAs and Brazilian cities. Innovation and development phenomena are characterized by spatial simultaneity of different nature processes - cultural, political, social and economic, beside others. Even in current circumstances, when space is submitted to integration logic of communication and information worldwide nets, understanding such processes requires multiple variables to represent their different dynamics, that express a singular interaction web in each singular place of national territory. In addition, a special effort is being realized to define and systematize indicators on *five relevant dimensions* to characterize LPAs and understand structural changes in Brazilian contemporary scene: *population's life conditions, knowledge's infrastructure, new institutionalities, public and private services (externalities), employment and economic activities* (especially in farming, agribusiness, commerce and other services, besides manufacturing industries).

Finally, SINAL project third emphasis is innovation processes spatiality. *Location relational webs* are one of the key elements to understand '*innovation territories*' creation and consolidation processes. The spatial order, besides being one of the basic conditions to those practices existence, is also conceived, simultaneously, as carrying significant meanings; or either, this spatial analysis can produce phenomena original interpretation (Gomes, 2002). Another argument is related to increasing local politics importance in order to accelerate development possibilities and job and income generation. Muller (1990) affirms that local administrations make use of considerable legitimacy reserve and *reticular proximity* created for local elite, leader politicians and entrepreneurs, when they are apt and successful in weaving a original information and communication net that can integrate local interest nets. So, coherence principles and dispersion logic on space of agents, productive and innovative institutions and productive activities can bring to the light a new angle understanding, revealing singularities or common traces to political, social and economic dynamics. Perhaps, it properly constitutes the main geographic contribution to innovation phenomena analysis.

SINAL project products will be: (i) new indicators associated with LPAs learning, innovation and competence building available to arrangements studied by RedeSist, and its methodology, involving concepts, definitions, algorithms etc. It can be done by creating new expertise through efforts to consolidate and codify practices and tacit knowledge of Redesist's researchers and interviewers embodied in questionnaire conception, collected data and Notes Techniques. An ambitious by-product would be to enrol inputs to systematic and continuous quantitative enquiries about these issues in target areas prioritised by public policies; (ii) a special indicators and maps set conceived or chosen from other information sources to complement RedeSist data, in order to provide studied

LPAs main dimensions characterization (the five ones previously mentioned). Those indicators will be available for specific territorial segments considering arrangements locations (one or more municipalities); and (iii) selected statistics, indicators, typologies and maps for all Brazilian municipalities to make possible to different users, with different purposes, and using a wide criteria range established by each researcher or policy maker *to detect signals, traces, indications and exploratory measures that can confer significant meanings to arrangements and cities data in order to identify possibilities of LPAs existence in specific Brazilian localities*. In this context, micro and small enterprises universe, and informal context that prevail in these labour market wide segments is a very important aspect to be consolidated. Those objectives require careful and detailed choice of variables, algorithms, geographic and economic activities classifications and appropriate scales to represent Brazilian reality's diversity. In summary, SINAL project design is an preliminary answer to those multiple challenges, in order to facilitate RedeSist researchers', other experts' and policy makers' analysis.

Today, so-called Brazil's LPAs maps diffusion is becoming frequent. Any is the adopted methodology, identification of productive agglomerations converges in situations of production or employment higher spatial specialization, in manufacturing industries, usually, because it is the most analysed sector. But maps diverge when one has in sight others industries, companies segments or public policies specific targets. So, maps can change as soon as can change each research or methodology objective.

Using RedeSist's conceptualisation, it can be said that a *Local Productive Arrangement is a productive agglomeration of economic, social and politic agents with focus in specific sets of economic activities with interdependent bonds, even incipient* (Cassiolato and Lastres, 2003). The *Innovative Productive Systems* can be characterized *when and where these bonds are consistent and result in interaction, cooperation and learning, with potential to generate endogenous innovative capacity, competitiveness and local development increment*. These are rigorous definitions, hard to be validated in the office appealing to secondary information and software. Official statistics or any other systematic information about interaction, learning and innovation intangible aspects are not available to municipalities, cities or small areas in Brazil. So, specialized case studies and interviews must be realized to identify LPAs empirical evidence according to RedeSist concept. SINAL project don't intends to contribute with a specific methodology to identify and delimitate LPAs. By the end, its final goal is analyse and evaluate innovation intangible processes to identify potentialities and inputs to public policies toward innovation and local development promotion.

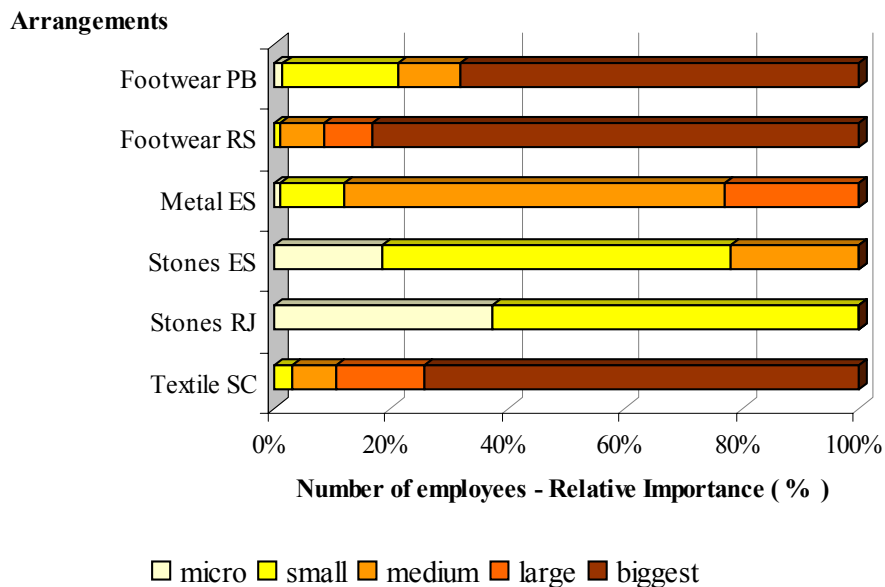
3 SINAL LPAs Data: General Analysis

LPAs analysis developed by researchers integrated to RedeSist is based on case studies, through detailed interviews, like qualitative surveys, in which special importance is attributed to its structural and institutional features identification. Sample selected in each study varies according to local idiosyncrasies being not based on probabilistic criteria. Although results have limited statistical precision, all the studies are based on the same

conceptual and methodological background, using the same questionnaire to collect information from local agents.

Graphic 1

Employment Characteristics by Firm's Size in selected LPAs - 1999



Graphic 2

Enterprise Structure Characteristics by Firm's Size in selected LPAs - 1999

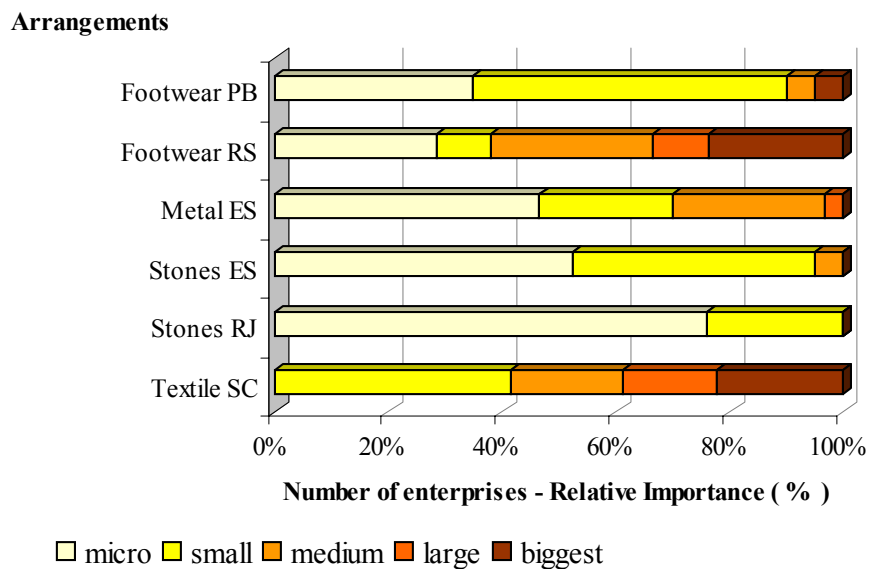


Table 1
Employment and Enterprise Structure Characteristics by Firm's Size in selected LPAs – 1999

Size (Employment in 1999)	Selected LPAs						
	Employees or N° of Firms	Footwear PB	Footwear RS	Metal ES	Stones ES	Stones RJ	Textile SC
All Interviewed Firms:							
Employees (thousands)	Employees	2,7	18,4	3,9	1,2	0,4	26,7
Number of Firms	Firms	20	21	30	40	25	36
Firms' Size		Relative Importance (% of each range)					
All Interviewed Firms	Employees	100	100	100	100	100	100
	Firms	100	100	100	100	100	100
Biggest Firms (more than 1000 employees)	Employees	68	83	-	-	-	74
	Firms	5	24	-	-	-	22
Large Firms (500 to 999 employees)	Employees	-	8	23	-	-	15
	Firms	-	10	3	-	-	17
Medium Firms (100 to 499 employees)	Employees	10	7	65	22	-	8
	Firms	5	24	27	5	-	19
Small Firms (20 to 99 employees)	Employees	20	1	11	60	63	3
	Firms	55	10	23	43	24	42
Micro Firms (less than 19 employees)	Employees	2	0	1	18	37	-
	Firms	35	29	47	53	76	-

Source: RedeSist/UFRJ, Empirical Studies, 2000 (www.sinal.redesist.ie.ufrj.br -LPAs: microdata/IC).

Different contrasts can be pointed out from collected data comparison presented in Table 1 and Graphics 1-2. Analysing employment distribution per companies size, it is observed a clear distinction between LPAs where employment is strongly concentrated in biggest firms, such as footwear specialized arrangements (Vale dos Sinos, especially), and the ones where employment tends to be more concentrated in small firms, such as those specialized in ornamental stones (Rio de Janeiro and Espírito Santo). Besides these two extremes, we can mention metal-mechanics case (also in Espírito Santo), where employment is more concentrated in medium size firms. The textile and clothing LPA (Santa Catarina) also differs from others, presenting well distributed employment between different firm's sizes. Probably, this LPA can be associated to a more complex and diversified enterprise structure. When considering data specifically related to enterprise structure, clear predominance of small and micro firms appears in LPAs located in Campina Grande (footwear), Rio de Janeiro and Espírito Santo (both ornamental stones). On the other hand, LPA located in Vale dos Sinos (footwear) have a very asymmetric entrepreneurial structure, with firms being concentrated in the two extremes of size range. In textile and clothing LPA (located in Santa Catarina) there is also some asymmetry in entrepreneurial structure, but with large firms predominance. Finally, metal-mechanics LPA (located in Espírito Santo) presents small and medium sizes firm's concentration.

Table 2
Technological Innovations introduced in the 90's in selected LPAs

Technological Innovations	Selected LPAs					
	Footwear PB	Footwear RS	Metal ES	Stones ES	Stones RJ	Textile SC
	Relative Importance: Answers' Frequency (%) (1)					
All Technological innovations	100	100	100	100	100	100
Product Innovation	33	33	36	25	36	33
Changes in design or style	19	9	10	3	6	13
Changes of Technical characteristics	17	13	11	16	13	12
New product	19	11	11	18	6	11
Process Innovation	67	67	64	75	64	67
New Equipment in Industrial Plant	19	13	18	18	47	14
New Configuration of Industrial Plant	10	11	15	12	6	10
Construction of a New Plant	6	7	8	6	9	5
Organizational Innovation: production cells	2	8	13	5	6	8
Organizational Innovation: external just-in-time	2	9	1	9	-	9
Organizational Innovation: CAD/CAM	2	9	9	2	3	9
New Materials	4	11	4	12	3	10

Source: RedeSist/UFRJ, Empirical Studies, 2000 (www.sinal.redesist.ie.ufrj.br - LPAs: microdata).

Note: (1) Frequency of answers 'Very important' and 'Important'.

Employment and entrepreneurial structure analysis provides a general background to discuss intangible flows of information and knowledge characteristics in selected arrangements. If the more important impact of those flows is strengthening LPAs members' innovative capabilities, we can articulate its analysis with innovative efforts developed by them. Table 2 presents innovative behaviour characteristics of all interviewed firms in selected arrangements, comprising firms' frequency of answers 'very important' and 'important' to correspondent questionnaire item. A first observation is *process innovation preponderance in all arrangements*. Among all innovations, a stronger frequency is found in *new equipment acquisition* what is in accordance with Brazilian trend in 90's (PINTEC, 2002). In footwear LPA (Vale dos Sinos), textile and clothing (Santa Catarina) and ornamental stones (Espírito Santo), new material is also frequent among process innovation, reflecting their efforts to maintain competitiveness in international commodities markets. In metal-mechanics LPA (Espírito Santo), plant configuration and new organizational techniques are also more frequent inside process innovation. Among product innovations, new product introduction is more frequent in footwear LPA in Campina Grande and in metal-mechanics and ornamental stones, both in Espírito Santo. To ornamental stones LPA (Rio de Janeiro) and footwear LPA (Vale dos Sinos), changes in techniques characteristics are more frequent. In textile and clothing LPA (Santa Catarina) and in footwear LPA (Campina Grande) changes in design and style are more frequent, reflecting their efforts to follow more recent fashion tendencies.

4 Innovative Firms and Intangible Flows of Information and Knowledge in LPAs: an exploratory analysis

The follower analysis focuses LPAs more innovative firms. Specifically, data are organized to reveal how those firms deal with intangible information and knowledge flows to improve their innovative capabilities.

Table 3
Employment and Enterprise Structure comparison between all Interviewed Firms and ‘Very Innovative’ Firms in the 90’s (1) by Firm’s Size in selected LPAs - 1999

Size (employment in 1999)	Selected LPAs						
	Employees or No of firms	Footwear PB	Footwear RS	Metal ES	Stones ES	Stones RJ	Textile SC
‘Very Innovative’ Firms:							
Employees (thousands)	Employees	2,1	5,5	3,5	0,8	0,2	26,6
Number of Firms	Firms	10	15	26	19	12	35
Firms’ Size		Rate: ‘Very Innovative’ / Interviewed Firms (%) (2)					
‘Very Innovative’ Firms	Employees	77	30	91	67	66	99
	Firms	50	71	87	48	48	97
Biggest Firms (more than 1000 employees)	Employees	100	24	-	-	-	100
	Firms	100	40	-	-	-	100
Large Firms (500 to 999 employees)	Employees	-	38	100	-	-	100
	Firms	-	50	100	-	-	100
Medium Firms (100 to 499 employees)	Employees	-	80	88	-	-	100
	Firms	-	83	88	100	-	100
Small Firms (20 to 99 employees)	Employees	37	100	91	65	-	92
	Firms	45	100	86	59	67	93
Micro Firms (less than 19 employees)	Employees	80	59	100	37	46	-
	Firms	57	83	86	33	42	-

Source: RedeSist/UFRJ, Empirical Studies, 2000 (www.sinal.redesist.ie.ufrj.br - LPAs: microdata/IC)

Notes: (1) Firms with one or more ‘Very Important’ product or process innovation in the 90’s. (2) Rate between both firm groups’ frequencies and data (%).

‘Very innovative’ firms are those that had considered ‘very important’ anyone of alternatives mentioned in Table 2 to characterize product or process innovations. Table 3 presents firms’ percentage that attends this criterion in selected LPAs samples. More innovative firms comprise more or equal to 90% of total firms to metal-mechanics (ES) and textile-clothing arrangements (SC), less that 50% of total firms in ornamental stones arrangements (RJ and ES), and are respectively 50% and 71% of total firms in footwear productive arrangements (PB and RS).

Table 4 shows the rate between ‘very innovative’ firms and all interviewed firms’ frequencies of answers to different product or process innovations alternatives. As demonstrated by data, there is not any substantial difference in terms of innovative trends between more innovative firms and total firms in arrangements, being footwear arrangement located in Campina Grande unique exception. In this footwear arrangement,

new materials introduction is less relevant to innovative firms, while this kind of innovation did figure as more relevant for all interviewed firms process innovation in arrangement.

Table 4
Innovative Behaviour comparison between all Interviewed Firms and ‘Very Innovative’ Firms in the 90’s (1) in selected LPAs

Technological Innovations	Selected LPAs					
	Footwear PB	Footwear RS	Metal ES	Stones ES	Stones RJ	Textile SC
	Rate: ‘Very Innovative’ / Interviewed Firms (%) (2)					
All Technological Innovations	73	83	91	69	88	97
Product Innovation	69	81	92	70	88	97
Changes in design or style	70	75	94	75	100	97
Changes of Technical characteristics	67	82	94	67	75	97
New product	70	86	89	72	100	96
Process Innovation	78	84	91	69	88	97
New Equipment in Industrial Plant	70	88	89	52	80	97
New Configuration of Industrial Plant	100	87	87	72	100	100
Construction of a New Plant	100	89	92	78	100	100
Organizational Innovation: production cells	100	80	90	86	100	95
Organizational Innovation: external just-in-time	100	83	100	69	-	95
Organizational Innovation: CAD/CAM	-	75	93	67	100	95
New Materials	50	86	100	72	100	100

Source: RedeSist/UFRJ, Empirical Studies, 2000 (available in www.sinal.redesist.ie.ufrj.br - microdata/IC).

Notes: (1) Firms with one or more ‘Very Important’ product or process innovation in the 90’s. (2) Rate between both firm groups’ frequencies of answers (%).

According to theoretical and methodological framework previously mentioned, knowledge measurement and intangible flows evaluation implies a focus on main information sources used by firms to promote technological innovations in LPAs. Table 5 and Graph 3 resume some characteristics of those flows, presenting data about ‘information sources’ to product or process innovation identified by innovative firms in each LPA. Firm’s frequencies of answers appointed to each information source are proportions of ‘very innovative’ firms that considered it ‘important’ or ‘very important. A more detailed data analysis shows that relative importance of those sources varies according to some idiosyncrasies of enterprise structure and of market orientation in each LPA.

Table 5
Information Sources for innovation in the 90's in selected LPAs: 'Very Innovative' Firms' answers (1)

Main Information Sources)	Selected LPAs					
	Footwear PB	Footwear RS	Metal ES	Stones ES	Stones RJ	Textile SC
	Relative importance (%) (2)					
All Selected Information Sources	100	100	100	100	100	100
Universities or Technological Centres:	6	30	21	25	9	19
in the local region	6	21	14	15	9	14
others regions in the country	-	7	4	7	-	5
abroad	-	2	3	3	-	-
Exchange of information with clients	29	21	26	16	18	28
Exchange of information with suppliers	36	35	22	19	9	25
Exchange of information with other firms from the same industry:	29	14	31	40	63	28
in the local region	29	2	18	17	36	12
others regions in the country	-	5	6	13	27	6
abroad	-	7	7	10	-	10

Source: RedeSist/UFRJ, Empirical Studies, 2000 (www.sinal.redesist.ie.ufrj.br LPAs: microdata).

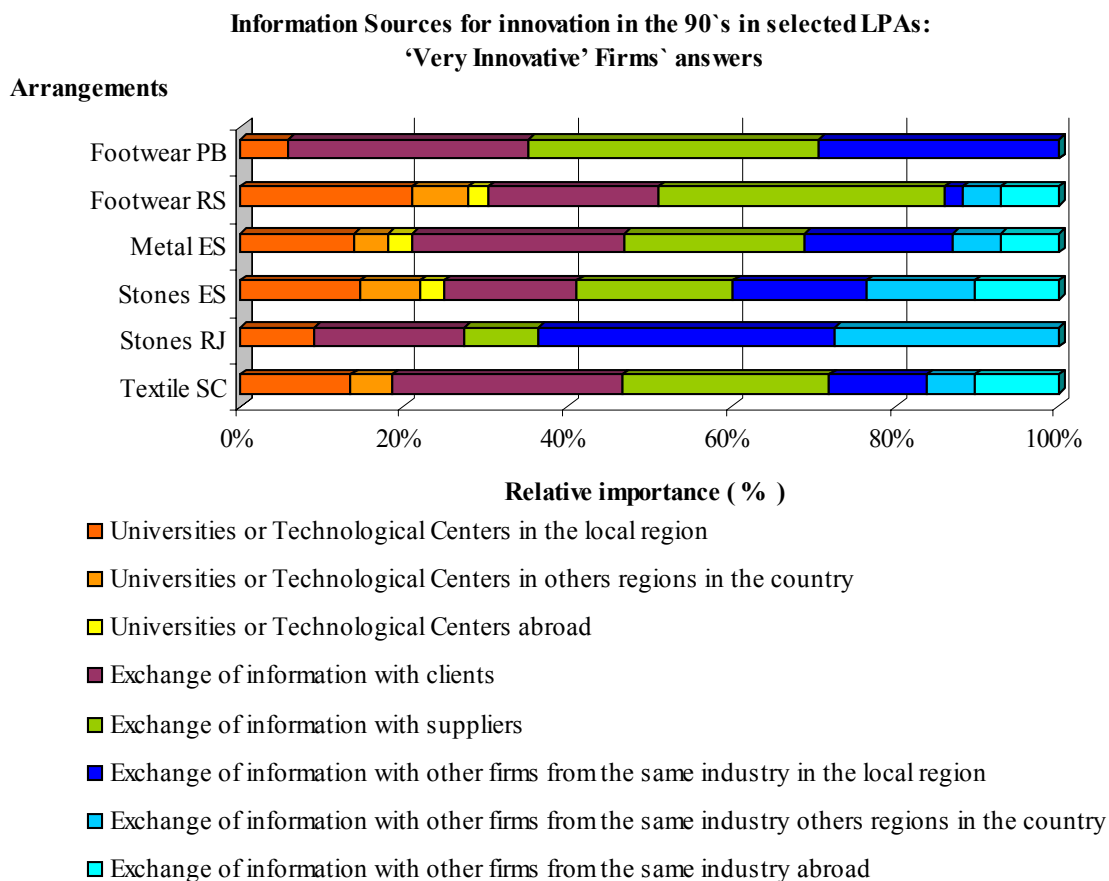
Notes: (1) Firms with one or more 'Very Important' product or process innovation in the 90's. (2) Frequency of answers 'Very Important' and 'Important' to all firms that answered the selected items in questionnaire.

Metal-mechanics productive arrangement (ES), for example, is an anchored arrangement, with four local commodities producers oriented to international market. Information sources are predominantly information exchange with clients firms (large anchored firms- 26%), suppliers (22%) and competitor's in the same consortia (18%). Firm's interactions with local university (14%) are constrained to some tests developed in university laboratories, not involving joint research or direct project development. In other hand, firm's interactions with technological centres are more frequent, especially to personal training. In textile and clothing LPA (Vale do Itajaí, SC) more frequency towards information sources are attributed to information exchange with clients (28%), suppliers (25%) and universities and technological centres in local area (14%). Interactions with this last source that involves a more technology contend are relative weak, being concentrated in personal training. Interactions with universities are based in tests, certification, materials characterization and selection procedures related to new product development. These services are also demanded from institutions outside the arrangement.

The ornamental stones productive arrangement in Rio de Janeiro has Brazilian market as their principal focus, particularly São Paulo and Rio de Janeiro States that figures around 80% of this demand. Interactions from firms in ornamental stones sector with other agents inside arrangement and with themselves are less intense. Many firms do not have any type of cooperation with other firms (clients, equipment and raw materials suppliers or competitors), and so is weaker cooperation with other agents (technological centres, universities or other organizations). Inside arrangement, mechanical firms and firms that work with two types of stones are the ones with more disposition to cooperate, to learn and to innovate. The information sources more relevant to innovative firms are exchange information with competitors in local area (36%) and outside the arrangement (27%) and with clients firms (18%). Interactions with clients firms generally involve support services

that are offered and constitute a learning and information exchange indirect flow. It is also common exchanges of old machines to new ones, based on local suppliers' accumulated experience, from which they can alter original projects. The ornamental stones productive arrangement in Espirito Santo differs in some way from the above as its production are export driven, being 40% of Brazilian exports. In terms of information sources to product and process innovation, the more frequent sources are exchange information with suppliers (19%), clients firms (16%), competitors in local area (16%), and universities and technological centres in local area (15%). Visits to other firms (competitors) are common practices among producers. This practice is facilitated by proximity, but information exchange with competitors outside arrangement is also frequent. Information exchange among local producers also occurs in social meetings in bars and clubs, comprising in some way *technological learning* of informal type.

Graphic 3



The footwear productive arrangement in Vale dos Sinos (RS) is responsible to 80% of total Brazilian exports, mainly to United States. The more relevant information sources are information exchange with suppliers (35%), with university and technological centres in the local region (21%) and with clients firms (21%). To larger innovative firms, information exchange with clients from abroad are considered particularly relevant, suggesting that more sophisticated informational flows takes place in those relations.

Among suppliers, relevant contributions are from information exchange with components and raw material suppliers. In the other hand, footwear productive arrangement in Campina Grande (PB) is specialized in shoes for local market. The more important information sources are information exchange with suppliers (35%), with competitors in local area and with clients firms (29% each). Information collected in empirical study points to the existence of a social network in leather and shoes traditional production, based on family, friendship and culture linkages. These relations generate a dynamic process through which informational flows become inherent to formal or informal employers and manufactures relations. Specialized labour circulation among local firms can also be added to this picture, permitting transference of experiences and tacit knowledge. Evidences points to a learning process trough which informal tacit knowledge and production practices might be transferred among persons and firms.

Table 6
Activities Related to Product or Process Innovation Introduction in the 90's in selected LPAs:
'Very Innovative' Firms' answers (1)

Activities related to Product or Process Innovation	Selected LPAs					
	Footwear PB	Footwear RS	Metal ES	Stones ES	Stones RJ	Textile SC
	Relative importance (%) (2)					
All the Activities	100	100	100	100	100	100
Acquisition of machinery and equipment:	62	36	23	32	52	26
at the national market	38	18	19	21	42	8
abroad	25	18	5	11	11	18
Cooperation with:	38	53	71	55	48	57
suppliers of equipment	13	19	14	14	11	15
suppliers of raw materials	13	18	8	14	-	14
clients	13	-	21	8	11	14
competitors	-	2	13	8	11	6
other institutions (Universities, business associations, etc.)	-	15	16	11	16	9
Intramural research (R&D Laboratories)	-	11	3	5	-	16
Exchange of personnel with group's main office	-	-	3	8	-	1

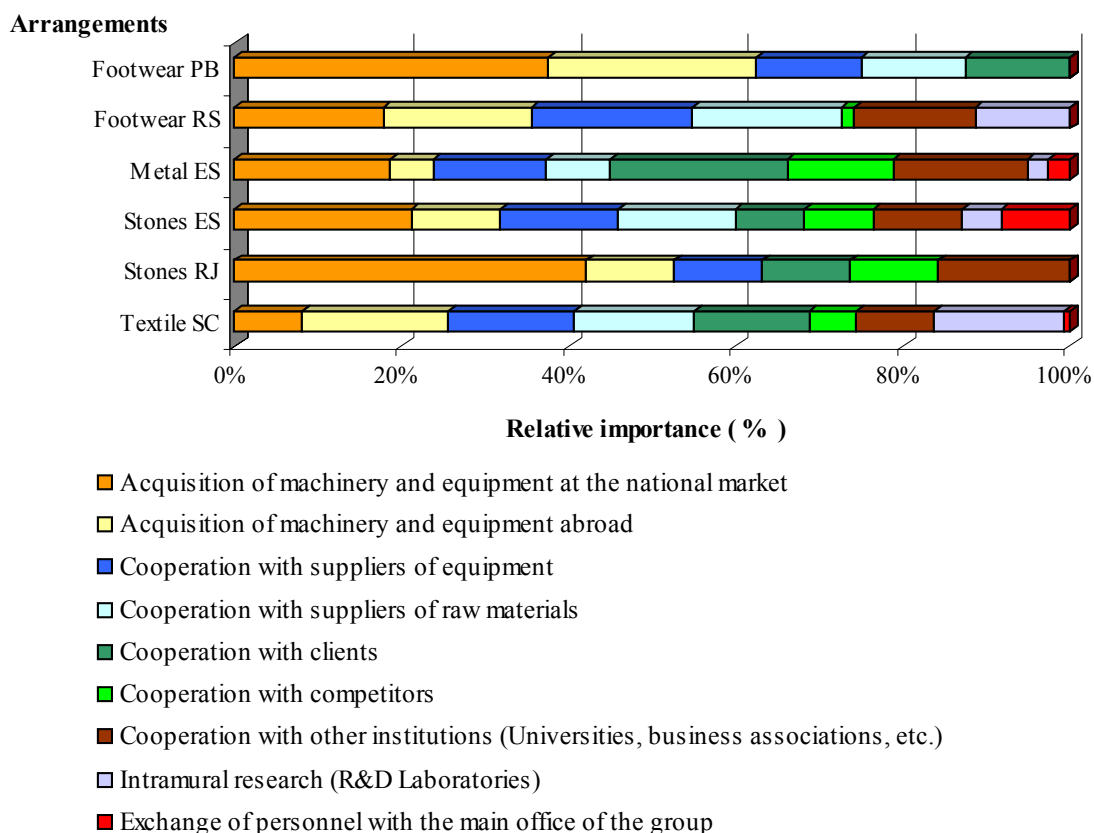
Source: RedeSist/UFRJ, Empirical Studies, 2000 (www.sinal.redesist.ie.ufrj.br LPAs: microdata). Notes: (1) Firms with one or more 'Very Important' product or process innovation in the 90's. (2) Frequency of answers 'Very Important' e 'Important' to all firms that answered the selected items in questionnaire.

Table 6 and Graph 4 illustrate cooperative practices intensity and others alternatives used to promote technology development and innovations incorporation by 'very innovative' firms. Table 6 shows relative importance of firm's answers, considering the frequency of 'very innovative' firms that considered 'important' or 'very important' selected items in questionnaire. In metal-mechanics productive arrangement (Espírito Santo), more frequency is attributed to cooperation with clients (21%), to equipment suppliers (14%), and to CDMEC, a sectorial support institution (16%). Equipment acquisition is also important to technology development (19%). The majority of equipment suppliers are located outside arrangement, and relations are based on visits, events and publications. Trade liberalization in 90's brought pressure to this arrangement, and the

larger metal-mechanics goods and services' users developed significant efforts to improve local suppliers' capabilities.

Graphic 4

**Activities Related to Product or Process Innovation Introduction in selected LPAs – 1999:
'Very Innovative' Firms' answers**



In textile and clothing productive arrangement (SC) more frequency is attributed to equipment acquisition in international markets (18%), as well as to cooperation with equipment suppliers (15%), raw materials suppliers (14%) and client firms (14%). Technological flows from abroad are particularly important to this arrangement, not only because of export orientation but also due to specific linkages with equipment and raw materials suppliers. These linkages with abroad in some way explain less relevance of cooperative links with local universities and technological centre to technology development and incorporation. In-house efforts through R&D laboratories to technology incorporation and development are also frequency, what is also expressed in Table 7, where can be seen that this LPA' s R&D/sales ratio is around 1%. Firm' s innovative efforts take two main directions: first, try to promote some adaptations induced by changes in consumers preferences; second, tend to incorporate technological advances which come from equipment and raw materials suppliers. In this arrangement, we can establish a contrast between some firms where principal technological flows come from abroad (larger and medium firms) and firms (small firms, mainly) where more important flows are those

that circulate inside arrangement. This distinction is an aspect that affects arrangement technology capabilities towards product development.

Table 7
R&D Expenses by Firm's Size in the 90's in selected LPAs: 'Very Innovative' Firms answers

Firms' Size and R&D Expenses	Selected LPAs					
	Footwear PB	Footwear RS	Metal ES	Stones ES	Stones RJ	Textile SC
'Very Innovative' Firms (1)	10	15	26	19	12	35
R&D /Sales 1999 (%) – number of firms that provided information and correspondent medium						
Biggest Firms	1 (0,1%)	2 (0,4%)				1 (2,0%)
Large Firms	-	1 (2,0%)	-	-		3 (2,2%)
Medium Firms		-	-	-		4 (2,5%)
Small Firms		-	1 (10%)	-	-	9 (1,3%)
Micro Firms	-	1 (25%)	-	-	-	
R&D / Sales 1999: increase of expenses between 1999/90 – number of firms that provided information						
Biggest Firms	-	1				1
Large Firms	-	1	-	-		3
Medium Firms		2	-	-		2
Small Firms	-	-	-	-	-	7
Micro Firms	-	2	-	-	-	

Source: RedeSist/UFRJ, Empirical Studies, 2000 (www.sinal.redesist.ie.ufrj.br LPAs: microdata/IC).

Note: (1) Firms with one or more 'Very Important' product or process innovation in 90's.

In the ornamental stones LPA located in Rio de Janeiro more frequency is attributed to equipment acquisition in national market (41%) and to cooperation with other organizations (16%). Relative importance is also attributed to cooperation with equipment suppliers, client firms and competitors (11% in each category). Interactions with other institutions include a technological centre in local area (CEFET/Campos) and AEDP, an association from local producers. The only identified initiative aiming to stimulate and articulate local cooperation is from RETECMIN, which comes from outside arrangement. As was stressed before, low level of cooperation among firms inside arrangement blocks development of dynamic innovation processes.

In the ornamental stones LPA located in Espirito Santo, more relevance is attributed to equipment acquisition in national market (21%) and to cooperation with equipment and raw materials suppliers (14% in each category). Cooperation with suppliers is related to information exchange and tests to product development and improvement. Less frequent is cooperation with competitors. This cooperation assumes an informal character, involving equipment borrowing. Cooperation with other organizations is restricted to a technological centre (CETEMAQ), being inexpressive cooperation with universities. Personnel interchange with group's main office appears in this arrangement, being restricted to largest firms. Innovations in this arrangement are predominantly imitative, being developed and incorporated through raw materials and equipment development.

In the footwear LPA located in Vale dos Sinos, more relevance is attributed to cooperation with equipment suppliers (19%) and with raw materials suppliers (18%), as well as to equipment acquisition in both national and international markets (18% in each

category). The relative importance of cooperation with raw materials suppliers for innovative firms is already expressed in new materials introduction for process innovation (see Table 4). Firm's interactions with raw materials and equipment suppliers involve exchange information, technical assistance in productive process and joint actions to design and style development. Cooperation with other organization, as well as in-house R&D efforts, can also be observed in this arrangement, but knowledge and information flows are still limited. Importance attributed to information exchange with external sources (located abroad) can be explained by equipment acquisition, which requires a more intense articulation with equipment suppliers, as well as by cooperation with competitors firms, reflecting arrangement articulation with international markets. The intense pressure, suffered since the 90's, to maintain LPA's competitiveness is reflected in growing expenses dedicated to innovation, as can be seen in the R&D/sales ratio, which is located around 2%, in medium (Table 7).

In the footwear arrangement located in Campina Grande, more relevance is attributed to cooperation with equipment and raw materials suppliers (13%), client firms (13%) and also to equipment acquisition in national (38%) and international market (25%). This arrangement comprises the major national supplier of low-price rubber sandals, what explains increased equipment acquisition relative importance in national and international markets. Nevertheless, there are no evidences about interactions between this largest firm and other firms and members inside arrangement. Cooperation with local technological centre (CTCC – Leather and Shoes Technological Centre) and university (UFCG) is rarely frequent, being limited to information exchange and some actions through product improvement by design, testing and human resource education and training.

5 Concluding Remarks

This study is an attempt to characterize, measure and interpret information and knowledge flows that circulated in Local Productive Arrangements – LPAs using some empirical evidence from RedeSist's surveys to emphasize these flows specificities in different industries and locations. Analysis has tried to stress SINAL data potential to discuss how those flows are articulated with innovative activities patterns in each one of the six studied LPAs.

Due to analysis exploratory perspective, any conclusion has to consider limitations of methods and instruments used to collect data. In fact, the original questionnaire used to collect information in those empirical studies didn't have specific purpose of generating systematic and detailed quantitative information about LPAs intangible flows. The questions structure of questionnaire tried to present a list of aspects that might orient interviews and analysis carried by researchers, such as governance structure, learning mechanisms and institutional context of each studied arrangement. Despite the fact that original questionnaire, sampling and information validation methods are not tailored for our specific focus, data transferred to SINAL have proved to be very rich, stressing differences between arrangements informal learning mechanisms. In the sense, efforts already done by RedeSist to refine and improve the questionnaire seem particularly useful. After that, it will

be possible to construct better indicators and other analytical tools well adapted to measure knowledge and informational flows complexity in LPAs.

To finish, we can also mention some steps to move ahead-developed analysis. First one consists of further studies to identify other knowledge and informational flows aspects that might be incorporated in LPAs systematic analysis. In this sense, the construction of a more elaborated indicators system to evaluate the complexity of those aspects seems to be a very important task. The development of further studies based on LPAs comparative analysis also seems to be relevant, particularly with new data extracted from the new RedeSist questionnaire. A cross-time analysis also seems relevant to understand arrangements trajectory in terms of those flows. We can also mention the possibility of confronting LPAs knowledge base evolution with changes in those arrangements governance structure, as well as with specific incentives from government policies. Finally, another important issue would consist in developing geographical analysis in order to evaluate how local institutions - especially those related to scientific-technological infrastructure - could help to improve LPAs knowledge base.

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