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***Para: Ministério do Planejamento
Delegação da CE***

MISSÃO

***Consultoria de Curto-Prazo como APLS Information Technology –
Electronic Services in International Seminar Brasil-European Union on
Innovation of Arranjos Produtivos Locais***

***Relatório Final
Ajay Kumar Gupta***



1 Mission Objectives

In the last decades, the success of the American and European experience addressing to productive specialized agglomerates has suffered an inflection of the productive development in favor of the decentralization, highlighting a concept elaborated by Marshall in the XIX century in England, namely the advantages that the territorial agglomerates of specialized economical activities can offer.

In this context, the local productive clusters have been more and more observed by academicians, governments and international organizations, spotlighting the opportunities linked to the utilization of policies of regional development and contributing to make the productive cluster concept more significant.

Nonetheless, different countries pursue different policies regarding promotion of industrial cluster. In some countries like Japan (such as government-initiated “Industrial Clusters” and “Knowledge Clusters” and Malaysia (as in the case of Multimedia Super Corridor), governments take very much pro-active roles in stimulating (to some extent, creating) clusters. On the other hand, in other countries, the US in particular, clustering initiation mostly come from the private sector and governments only play facilitating and supporting roles. This paper does not aim to answer which policy type is more successful. Instead, it will focus on the role of intermediaries, which can be in many organizational forms, in facilitating the knowledge flow and building trust among different actors in clusters.

In that context, clusters of small firms have attracted growing attention from academicians, governments and international organizations, highlighting the possibilities inherent in the use of regional development policies and developing the concept of productive gathering. That, in a narrower concept of industrial district has evolved into a more general term - industrial groups or clusters, or local productive arrangements, business cooperation, complex more or less interchangeable and cluster. Name one that involves all sorts of agglomeration of activities concentrated geographically and sectorally specialized, independent of the size of productive units and the economic activity developed.

Thus, the generation of sectorally specialized environments and the development and strengthening of institutions that foster spatial integration and cohesion within the region and among the other regions, alongside fostering agility, flexibility and the efficiency of firms operating there, aiming to make them competitive globally, from the place, takes the value of the location, but



with different impacts. The emphasis on locally based company derives from the importance given to skill set, expertise, suppliers and local institutions that make certain locations centers of innovation in specific sectors.

In these spaces, the creation of ideas is a social process that involves interaction and discussion, and by which are created the relevant information to the production. In the local productive clusters, the concentration of productive activities in a spatially defined area is marked by a high degree of user-producer interactions, facilitated by a frequent and spontaneous sequence of face-to-face, which are an effective means for communication knowledge. These interactions enable the creation of an environment conducive to the development of processing capacity and acceptance of product innovations and process, quickly and at lower cost.

As a result of this collective capacity of local productive arrangements to continually learn and adapt in order to enhance its economic performance, the enterprises in the clusters are often more innovative in developing products, production processes and marketing channels. Easy access to specialized information that accumulates within the cluster, provides a continuous collective learning about the technology.

In APL, a culture of innovation translates into a constant flow of technology transfer and upgrading (upgrading technology) within the cluster and the external environment, resulting in increases in resource productivity, through the production of existing products with higher efficiency or developing products with higher perceived value for customers. Still, the network of informal relationships enables delineate more precisely the effects of innovative decisions and control the reactions and behavior of economic actors, by sharing the system of values and visions.

From this viewpoint, technology is an endogenous development directly related to the social structure in which it is located, with two important implications. First, clusters of small firms carry with them an element of tacit knowledge socially coded with regard to technology, skills, products and processes, often specific to that community, and accumulated throughout time. Second, innovation is an evolutionary process, incremental and systemic, as opposed to atomistic, built on existing knowledge, through dynamics of user-producer interaction.

The institutions of GTP APL, coordinated by the MDIC, are developing actions to encourage and consolidate Local Productive Arrangements and, in



partnership with the Ministry of National Integration, the Ministry of Planning, Budget and Management and the General Directorate for Regional Policy of European Commission (DGREGIO), established through a Memorandum of Understanding, structured dialogue on regional policy, establishing communication channels for exchanging information.

Aiming to strengthen the exchange of information a seminar was held in Brasilia (DF) on 30th June and 1st July 2010, titled the "International Seminar on Brazil-European Union: Innovation on Local Productive Arrangements", followed by visits to the clusters in Brazil, where in-depth discussion was held related to the European Union experience in formulating public policies to increase the competitiveness of enterprises through innovation.

Brazil is ranked as the third most attractive consumer electronics market from investment point of view among the E7 countries (including China, India, Brazil, Russia, Indonesia, Mexico and Turkey).

The continuous development and digital technologies are revolutionizing the consumer electronics industry. Moreover, the continuously falling prices of consumer electronics with increasing disposable income are giving reasons to more consumers to spend on electronics products and this is indicating that the consumer electronics industry has bright future ahead in Brazil.

- Washing machines, freezers, and personal computers are among the consumer electronics with low penetration rates, indicating ample room for growth in sales in the medium-term.
- In terms of sales volume, refrigerators will have the highest sales followed by washing machines in the white line goods during the period (2007-2011).
- In the images and sound segment, the DVD sales will increase with the CAGR value of 8% and have the largest market in terms of volume by 2011.
- Retailer credit will play a critical role in driving the consumer electronics sales coming from the lower socio-economic segments. Although price will also continue to be a key driver, financing options such as installment plans will drive the penetration into these segments.

In this way the restrict concept of the industrial district to evolve in a wider one as industrial agglomerates, local productive systems, businesses cooperation, industrial parks and clusters, could be studied. This denomination includes a wide type of agglomerates with geographically concentrated and skilled



activities, that are independent from the wider productive units and their economical development activity. The creation of skilled groups in different sectors and the development of organizations aimed at improving integration and spatial cohesion within the region and between the different regions of the country, in parallel to the promotion of agility, flexibility and efficiency of the firms that work in the area, in order to make them globally more competitive, encourages the valorization of the localization, starting from the local context, but causing different effects.

The emphasis on the locally based companies arise from the importance given to the set of skills, specializations, suppliers and local institutions that make some localizations as centre of innovation on specific matters. In this context the creation of new ideas can be considered as a social process involving interaction and discussion by the use of which new informations, really important for the production, can be set up. In the local productive clusters the concentration of productive activities in a spatially defined area is characterized by deep interactions user-producer, facilitated by a frequent and spontaneous sequence of face-to-face, a very useful means for knowledge communications.

The interactions enable the creation of an environment conducive to development of skills for transformation and acceptance of product and process innovations, quickly and at lower costs.

As a result of this collective capacity of local clusters to continually learn and adapt themselves in order to boost their economic performance, the enterprises in the APLs are often more innovative in developing products, production processes and marketing channels.

Easy access to specialized information that accumulate within clusters provides a continuous collective learning on developed technology becoming one of the advantages of these agglomerates in global competition.

In the APLs the culture of innovation translates into a permanent stream of updates and technology transfer (technological upgrading), within the cluster and the external environment, resulting in increases in productivity of resources, through the more efficient production of existing products and the development of products with higher perceived value for customers. Moreover the network of informal relationships enables to outline more precisely the effects produced by innovative decisions and to control reactions and behaviours of the economic actors by sharing the system of values and visions.



From this point of view, technology is an endogenous development directly related to the social structure in which it is located, causing two important implications. First of all, APLs of small enterprises bring with them a tacit element of knowledge socially coded with regard to technology, skills, products and processes, specific to that community and accumulated over time. Secondly, innovation is an evolutionary, incremental and systemic process, that is opposed to atomistic and built on the existing knowledge, through dynamics of user-producer interaction.

In this context, the institutions of GTP APL, coordinated by MDIC, have been developed in the country, actions aimed at encouraging and consolidating APLs and, in partnership with the Ministério da Integração Nacional, the Ministério do Planejamento, Orçamento e Gestão, and the Diretoria Geral de Políticas Regionais da Comissão Europeia (DGRegio), have established through a memorandum of understanding structured dialogue on Regional Policy with the establishment of communication channels for enabling the exchange of information.



2 Duration of the Assignment

The assignment started with the seminar on 30th June and ended with the completion of technical visit at Santa Rita de Spucaí on 9th July.

3 Start, completion and location of the Assignment

The assignment started with the Panel discussion during Panel 2: Clusters of Information Technology – Electronic in the International Seminar Brasil-European Union on “Innovation of Arranjos Produtivos Locais” held in Brasília on 30th June and 1st July 2010 followed by technical visits from 2nd July to 9th July in two cities in which the Electronics Industries are mainly concentrated Manaus A/S (Amazon State) and Santa Rita De Spucaí (Electronic Valley)



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4 Activities carried out during the mission

Phase 1: Exploratory phase

An EU expert gave a 20-minutes presentation referring to his own experience in Panel 2: Clusters of Information Technology – Electronic International Seminar Brasil-European Union on “Innovation of Arranjos Produtivos Locais”



The other panelist present during the panel discussions were:

- **Hernan Valenzuela** – Analyst of Institutional Relations Area for Technological Issues of the Superintendency of the Manaus Free Zone
- **Irecê Fraga Kauss Loureiro** – Manager of the Department of Electronic Industry of the National Bank of Economic and Social Development
- **Roberto de Souza Pinto** – President of the Union of Manufacturers of Electrical and Electronic Appliances and Similar of Electronics Valley - MG
- **Naldo Dantas** – Executive Secretary of the National Association for Research and Development of Innovative Companies
- **Pedro Alem Filho** – Manager of the Brazilian Agency for Industrial Development



Debating, consolidating and disseminating the results obtained by the Technical Mission of European Union, with focus on such topics as innovation and government in the clusters;

- Defining lines of action of the institutions of the GTP APL, in order to improve the competitiveness of the enterprises organized into clusters, in continuity with the goals aimed at promoting the economic dynamism of the areas economically stagnant;
- Creating critical mass in the governmental and research institutions for formulating and improving the initiatives aimed at supporting APLs, as for example instruments for regional development in Brazil.

During the presentation in panel by the EU expert, following points were concluded by all panelists which set the agenda suggestion for the technical visits:

1. Exploring the productive arrangements and technical barriers
2. Mechanism of Possible Collaboration and Cooperation between Brazil Clusters with EU Clusters.
3. Learn about the regulation frame work
4. Understanding the present markets of the clusters and exploring relevant markets for future.
5. Linkages between the Brazilian clusters for same type of products and virtual productive arrangements

Phase 2: Technical Visits

At the end of the event, the European experts carried out support visit to the Brazilian APLS with the help of the representatives of the state organizations and of the institution of GTP APL. At the end of the technical visits the consultants will have to write a report containing a diagnosis of the APL as well as opportunities and challenges for cooperation with European Union.

The technical visit was carried out in the geographical areas where these electronics industries are concentrated mainly in Manaus/AM and St. Rita do Sapucaí,

2nd July to 5th July : Manuas

6th Jul to 9th July Santa Rita de Spucaí (Electronic Valley)



In Manaus the technical visit were coordinated by Mr. **Hernan Valenzuela** – Analyst of Institutional Relations Area for Technological Issues of the Superintendence of the Manaus Free Zone. There are 205 numbers electronics industries in the Manaus producing mostly consumer electronics products and support products. The technical visits were made to following industries and institutions and detailed discussions were carried out to understand the cluster dynamics, mapping, analysis and institutional support need.

1. Samsung Electronica da Amazonia Ltda
2. Samsung Institute de Desenvolvimento para a Informatica da Amazonia-SIDIA
3. MASA da Amazonia Ltda (Flextronics)
4. Chegada a Escola de Injecao Plastica da Rede Amazonia
5. Fundacao Rede Amazonica
6. C.S.H. Informatica Ltda



Fig 2. Visiting MASA da Amazonia Ltda (Flextronics)



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Visiting Samsung Institute de Desenvolvimento para a Informatica da Amazonia- SIDIA



Visiting Chegada a Escola de Injecao Plastica da Rede Amazonia Institute



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Visiting Institute Fundacao Rede Amazonica



The second cluster technical visit was coordinated by SINDAVEL which is the representative association of electronics industry in Santa Rita de Spuacai. The President Mr. Roberto de Souza Pinto who was one of panelist on 30th June, planned the entire technical visit coordinated through executive secretary to president Daniella.

During the visit to Santa Rita de Spuacai (Electronics Valley) which was founded in May, 23th 1892 (118 years) following industries and institutions were visited:



Electronics Valley Santa Rita de Sapucaí

1. LG Electronica
2. STB Superior Technologies in Broadcasting
3. MCM Controles Eletronicos LTDA
4. Sense (Sensores a Instrumentos
5. Linear Equipamentos Electronicos S/A
6. JFL Alarmes
7. Leucotron Telecom
8. Proativa Logistica Aerea
9. Legon (Incubator Company) in Inatel
10. SINDVEL Electronics Industrial Association / SESI / SENAI Institutes

Santa Rita de Sapucaí is a small town with a population of 40,000 inhabitants; it houses three national level electronics institutes and one international Telecommunication Institution (Inatel). The small town became an electronics hub when Ms. **Luzia Rennó Moreira established first polytechnic electronics institute in the valley. The first generation of entrepreneurs was all the graduates of this polytechnics institute and gradually a natural electronics industries cluster emerged in the town.** Now the town has about 141 electronics industries created 9,500 jobs in sector; The cluster companies



produce around **11,000** products; having an annual turnover of US\$ **1,150 billion** in 2009.

The electronics products produced in the cluster can be broadly categorized:

- Electronics
- Telecommunication
- Security Products
- IT
- Broadcasting Products
- Biomedical
- Industrial, commercial and residence automation
- Productive process: cabinets, assembly line, packaging, tooling
- Raw-material
- Services

This is natural cluster which has added advantage of :

- ✓ Concentration of education institutions;
- ✓ Concentration of researches and development centers;
- ✓ Concentration of technological industries;
- ✓ Active local government;
- ✓ Support of governmental institutions.
- ✓ Research
- ✓ Development
- ✓ Administrative Process
- ✓ Commercial Activity

Competitive Advantages

- Qualified workers;
- Education Institutions;
- Research and development laboratories;
- Governmental incentives

Federal:

- PPB
- IPI Reduced

State:

- DL 43617: Differ of ICMS to sell and import raw-material.

Local:

- Land donation for construction of buildings with basic infrastructure;
- Rent of buildings.



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Educational Institutions provide continuous stream of qualified workforce and new entrepreneurs are added every year from the graduates of these schools



Technological Incubators in the technical institutions play a vital role in developing new start up industries in the area

There is a Business Park in which SINDVEL / Industrial Association / SESI / SENAI are situated and it also has 13 small industries in the park.



5 Findings

During the technical visit, two clusters are visited (1) Manuas A/S and (2) Santa Rita de Sapucaí.

Manuas is a duty free zone area managed by SUFRAMA and due to the various fiscal incentives like zero import tax, VAT benefits and other benefits large MNC¹ and TNC² companies have set their base. Almost all leading electronics players in the world have their assembly units here.

Some of the industries like Samsung have very strong research base in the areas of Digital Media Content, Digital TV software.

Here mostly the production is white good segment and digital electronic like, LCD TV's refrigerators, digital cameras, washing machines, and all white goods electronics products and related services.

There are very big industries like MASA (Flextronics) which manufacture all injection molding components and parts and supply to the main white good industries. The market penetration is mostly Brazil, Latin and South America. There are hardly any small industries except in the packaging segment.

Most of the larger local companies and MNC or TNC companies do not have any 'vendor development programs' to recruit and train local suppliers to develop them as long-term or preferred suppliers for plastic and metal parts, equipment parts and tooling, customized equipment, back-end assembly and electroplating services.

These companies import most of these critical components from their centralised procurements units from China, Taiwan, Japan, Korea, USA. There is hardly an initiative visible to source from local suppliers except very low value and non critical items. The injections molding and plastics and sheet metal components are also sourced from MNC like MASA.

In terms of appointment of local staff to more senior management positions in MNC's/ TNC's companies is visible in Manuas.

¹ Multi National Company

² Trans National Company



As far as the Manaus is concerned, only a few firms use fully manual operations, consisting of conveyors for manual assembly of parts and products. 30% companies have approximately 50% automation level. This means that firms use a mix of conveyors and manual assembly, automated insertion for printed circuit board assembly, and a few surface mount assembly (SMT) machines. 50% companies have 'hands-free' production operations that are fully automated, usually involving a relatively large number of SMT machines, robotic arms and robots, automated movement of work-in-progress goods, or/and computer-integrated manufacturing.

Most of the companies have automation adopted from their parents companies. Some of them have local innovation for automation in screen printing on the injection moulded components and adopting the production organization of flexible, one-man production cell used in consumer electronics to develop multi-functional robot cells that can process the raw material to produce a finished product. Another area of innovation for automation is in testing, such as the development of automated multi-product line testing software tools and jigs (patented and sold to sister plants worldwide), and burn-in rooms with automated sensors.

Brazil is the leader in Latin America and South America and in terms of the Digital TV Protocol, Broadcasting equipment, Relay stations and advanced equipment the companies in Santa Rita de Sapucaí have clearly established an edge in the region.

In Manaus following two institutes are providing TV Broadcasting training and plastic injection moulding training in same campus along with software and IT training programs.

In the TV broadcasting the training is mainly in the relay and studio technologies and have advanced programs. In the Plastic injection molding and components training institute in the same campus, the skilled technicians for the electronics industry are prepared. The training equipment and machinery in the plastic injection molding and components institute are outdated and there seems to be no linkages with any MNC or TNC industry in Manaus.

There is local tie up for the IT and software development training with a local company which seems to be doing fine.

1. Chegada a Escola de Injecao Plastica da Rede Amazonia
2. Fundacao Rede Amazonica



In Santa Rita de Sapucaí -

Santa Rita de Sapucaí is a natural electronic cluster which has been gradually developed starting with the first generation local entrepreneurs who started their electronics industries after graduating from the polytechnics and slowly all the related electronics processes and component industry was developed.

Here only approx. 15% companies use fully manual operations, consisting of conveyors for manual assembly of parts and products. 35% companies have approximately 20-30% automation level. 25% use more than 50% automation level and 25% have fully automated production lines.

This means that firms use a mix of conveyors and manual assembly, automated insertion for printed circuit board assembly, and a few surface mount assembly (SMT) machines. 50% companies have 'hands-free' production operations that are fully automated, usually involving a relatively large number of SMT machines, robotic arms and robots, automated movement of work-in-progress goods, or/and computer-integrated manufacturing.

The companies have local innovation for automation is in inventing flexible, one-man production cell used to develop multi-functional robot cells that can process the raw material to produce a finished product. The area of innovation for automation is in testing, such as the development of automated multi-product line testing software tools and jigs (patented and sold to sister plants worldwide), and burn-in rooms with automated sensors.

The companies visited and interviewed show that automation is highly correlated to innovative technological capability. This is because most of the automation is the result of innovations developed in-house, or in-collaboration with equipment suppliers, software firms, or university students and professors. This is especially prevalent in the area of material handling, such as automated conveyor systems with real-time sensors linked to the manager's desk, ingenious conveyor designs that links from one plant to the next, automated assembly and movement from in-coming raw material to assembly to packaging of finished goods, and flexible lines that minimizes lead time and accommodates multiple models.



The electronic valley has following four factors of success:

- ✓ First, factor input conditions in a Santa Rita de Spucaí, like the quality of the infrastructure, the skill base of the labor force, and the access to capital, are clearly important for the level of productivity that companies can establish and flourish here.
- ✓ Second, rules and regulations surrounding the nature of competition at this location, like competition laws, trade policy, incentive effects of taxes as well as the strategies that companies compete with, the transparency of their corporate governance, and the presence of dominant business groups are critical to enable and push companies to use existing assets and factor input in the best way.
- ✓ Third, clusters (the local presence of specialized suppliers, services providers, etc.) are catalysts for providing companies with inputs, pressure, and incentives in the most effective way. The portfolio of industries which support in terms of components and have excellent vendor base for plastic injection to PCB boards present creates unique opportunities for new activities to emerge at their intersections.
- ✓ Fourth, local demand conditions, the sophistication of advanced local needs that foreshadow global preferences, are another driver to push companies to higher performance and, even more importantly, to generate an environment in which new ideas can develop.

Table 1 sums up the level of local decision making and control in production and innovative activities in Manaus and Santa Rita de Spucaí. It is clearly visible that the innovation and technology development in Santa Rita de Spucaí is more indigenous compared to Manaus where most of these practices come from their parent companies.



<i>Level of local decision making and control</i>	<i>Actual examples of activities to indicate local decision making and control</i>	Manuas A/S	Santa Rita de Sacupai
Limited or passive role & capability	Recruitment of production workers, human resource training. Supervisory of assembly and routine operations.	High	High
Basic active role and capability	Active monitoring and control of technology choice and sourcing of equipment or material. Direct material procurement. Vendor development program to identify and train local suppliers. Senior management positions by locals	Medium	High
Intermediate active role and capability	100% local management. Direct customer interface. Assume wider responsibility over conceptual planning, product development, marketing and distribution. Local managing director, a 100 per cent local management, or local staffs seconded to head world-wide facilities.	Medium	High
Advance active role and capability	For MNC's / TNC's subsidiaries, this meant that local staff has responsibility over the start-up and management of new large investments, production plants or subsidiaries, either in the country or overseas.	High	Most of the companies are local

Table 1 : Capability Understanding Matrix

To further understand and diagnose the levels from Basic to Innovative and advance computer integrated manufacturing and IT based interventions in the various functional process of manufacturing, and automation level of the industries visited during the technical are tabulated in table 2.



SL. No.	<i>Automation level</i>	Manuas A/S	<i>Santa Rita de Sacupai</i>
1.	Manual	Nil	15 %
2.	20-30% of automation	Nil	35%
3.	~ 50% of automation	30%	25%
4.	Full Automation or Computer Integrated Manufacturing	70%	25%

Table 2. Automation Level

The Inter Organizational Links for technology and market based innovation interaction level in Manaus and Santa Rita de Spucui is compared in table 3. Santa Rita de Spucui scores high on most of the links compared to Manaus

Technology-Centric Inter-organizational Links	Manuas A/S	<i>Santa Rita de Sacupai</i>
	<i>Linkage Level</i>	
No links		
MP-links: links centred on market transactions	Low (2)	High (5)
LP-links: Links centred on knowledge flows to learn existing technology	Medium (3)	High (5)
LI-links: Links centred on knowledge flows to learn to innovate	Medium (4)	High (5)
I-Links: Knowledge links in collaborations in innovations	High (5)	High (5)

Table 3. Cluster Inter organizational Links



6 Conclusions:

- ✓ Intense cooperation organized through various institutions for collaboration such as professional organizations, chambers of commerce, cluster initiatives, etc.; dynamic clusters also exhibit intense informal interaction based on personal networks;
- ✓ Access to increasingly specialized and advanced factors of production (human capital, financial capital, infrastructure) and for many clusters, linkages with universities and public and private research institutions;
- ✓ Linkages to related industries, sharing pools of talent and new technological advancements;
- ✓ Proximity to sophisticated and demanding buyers.

One of the main conclusions from this report is that geographical specialization will and should continue to increase in Brazil. Higher levels of specialization and concentrations are critical to raise levels of productivity and innovation in these clusters.

The Ministry of Development, Industry and Foreign Trade and other stake holders should focus on following issues to strengthen the electronics industry cluster in Santa Rita de Spucaí :

- Interaction with European Union clusters on technology and standards issues and spreading the market from regional (Latin America and South America) to Europe and Middle East.
- The critical raw material like IC's mostly comes from China and there is no centralized procurements assistance mechanism in the cluster (more concerning to Santa Rita de Spucaí) to import in bulk and distribution among the local companies.
- The linkages with Manaus Electronics Cluster are almost non-existent. Most of the MNC and TNC companies in Manaus hardly source any components from Santa Rita de Sapucaí and prefer sourcing it from their parent sourcing hub. Santa Rita companies have capability to supply these components in best quality and competitive prices to Manaus big companies.
- The institutes under the SINDVEL, namely SESI / SENAI Institutes, needs advanced instruments in PCB prototyping and Computer aided design and computer aided manufacturing. The institutes have good programs and mostly cater to the employments needs of local industries. But when it comes to high



and advanced technologies, it is in the companies only that the employees learn while on the job.

- The linkages of these institutions with EU advanced similar types of institutions may be explored.
- Concept of CFC³ or Anchor company would be excellent to support the technological backup of local companies in Santa Rita de Spucaí.

Some of the industries in Santa Rita de Spucaí are of the opinion that European companies do not respect technologies.

Some of the companies need assistance in terms of international contract review help to spread their business in other market regions in the world.

Some of the companies who have pioneered continuous research and development and developed advanced technological products are facing difficulty in human resources quality and advocate some kind of innovation fund support from the Government to continue keeping the research ahead.

Fiscal incentives in R & D and some institutional mechanism through which state funds the institutions for industry research which then can be transferred to industry.

In terms of applying for technology or products patent for the various new and innovative products and technologies most of the companies in Santa Rita de Spucaí do not favor opting for the same for the reasons:

- (1) It is too long and complicated process to get a technology patent
- (2) The fear that when applying for the patent their process and technology might be available to other industries and competitors who then can take advantage and copy the technology and products.

In terms of Basic operational level as per Electronics Industry world norms the Manus is surely above the basic level and has most advanced level of production practices which are in line with latest trends in industry.

In Santa Rita de Spucaí technological capabilities are developed mostly through inhouse and localized through own R & D adopting the learning through various market and technological interactions within the cluster and outside.

³ Central Facility Center



Table 4. Technological Capabilities in the Santa Rita de Spucaí Electronics Industry

Types of Capability Levels of Capability	Project Management	Equipment Tool & die, metal stamping, plastic molding	Process and Organization Centered	Product-centered
BASIC				
BASIC OPERATION Level 2	Installation, maintenance, servicing, Simple customizing of existing systems. Basic plant erection	Routine maintenance of tools and equipment. Total Preventative Maintenance (TPM). Total Productive Maintenance. Replication of unchanging items of equipment.	Process flow, line balancing. Assemble separate parts into complete assembly CKD (complete knocked down): complete assembly: PCBA and product assembly. Efficiency improvement from experience in existing tasks. Routine testing.	Replication of fixed specification Routine QC to maintain existing standards: in-line QC Minor clean-up of design to suit production or market.

Innovative Practices:

The innovative capabilities are judged in project management, equipment, tool and dies, metal stamping , plastic moulding, process innovation and product centric.

Santa Rita De Spucaí Electronics Valley has all the innovative practices developed locally by experience where as in Manaus it is adopted latest as per the parent companies practices in their respective countries.

In terms of Innovative practices Santa Rita de Spucaí industries are mostly at Level 3 and Level 4, however Manaus electronics industries are mostly at level 5 and 6 as summarized in Table 5:



INNOVATIVE				
Types of Capability Levels of Capability	Project Management	Equipment Tool & die, metal stamping, plastic molding	Process and Organization Centered	Product-centered
BASIC INNOVATIVE CAPABILITY Level 3	Systems integration. Provide project management services to customers. Providing customized software solutions	Repair & trouble-shoot equip problems. Copying and simple adaptation of existing designs and/or specifications. Set-up Equipment Design, Tool, Die & Mould Development centers Engineering/fairly precision metal and plastic parts.	Set-up of Process, Production or Industrial Engineering Dept/s. Improved layout & debugging to optimize production. ISO9001, SPC, QCC, TQM, Six Sigma. Do in-circuit testing, burn-in. MRP or JIT systems.	Set-up of Product Engineering, Product Design dept/s. Product design for manufacture (DFM), Cost-effective, incremental product development for local or different markets. Cosmetic and mechanical design.
INTER-MEDIATE INNOVATIVE CAPABILITY Level 4	Software development. Project management of large-scale investment projects, international investments.	Develop automated equipment. Equipment Design Centre upgraded to separate firm. Mould & die design. High precision tooling, progressive metal stamping, plastic injection molding.	Automation of processes, Flexible & multi-skilled production. Business process re-engineering. Dev new process specifications. Able to transfer to production directly from R&D design or drawing by HQ.	Design Centre upgraded to separate firm. Own product design for local or regional markets. Electrical, PCB, Chassis, Chip-on-board, Platform designs. Design for testability and debug-DFT/DFD ISO9001, Software development, systems engineering.
ADVANCED INNOVATIVE	Projects management on	R&D for specifications	Radical innovation in	Rapid prototyping,



<p>CAPABILITY Level 5</p>	<p>a global scale. Full turnkey solution. Recognized training & service centers to TNC Group, customers or suppliers.</p>	<p>and designs of new high precision tools, complex automated equipment or production systems. Patents. Set-up of recognized training institutes in precision tool & die, or precision plastic molding with universities</p>	<p>organization. Own-developed CIM with customers, vendors or Group. In-depth Failure Analysis. Developing manufacturing, FA and TestCAD software tools, Patents.</p>	<p>VLSI design. Package electrical design. Substrate and piece parts design. Materials and surface analysis. Upgraded to regional or worldwide Design Centers or world product mandates. Providing design services to TNC Group or customers.</p>
<p>RESEARCH-BASED INNOVATIVE CAPABILITY Level 6</p>		<p>Fast time-to-design cutting-edge and hi-prec equipment to produce latest or cutting-edge products and components Is among regional or global leader of CNC complex equipment, high precision tooling, stamping, die & mould, prototype models.</p>	<p>Process and software development to produce & test high yield, miniaturized and higher performance HDD products and chips. Time-to-volume production. Research into advanced material and new specifications to produce future or cutting-edge products.</p>	<p>Is a leading regional or international R&D, product development, ASICs or software design centre/s. R&D into new product generations using leading-edge technology, larger wafers, higher performance HDD & chips. R&D into more uniform crystal growth, improved magnetic orientation, advanced materials.</p>

Table 5 Innovative Production & Technology Practices in Cluster



7 Recommendations

Areas of improvement:

Manuas A/S	Santa Rita De Spucal
Development of more local vendors	Natural local cluster evolved over the years and have internal suppliers linkages complimenting business. Sustainable Technology flow to Vendors required.
Linkages with local institutions for development of advanced digital technologies like HD TV , software and language contents etc	Strong linkages with local institutions in terms of human resource development should also be complimented through advanced research in the areas like smart cards, RFID, telecommunication, broadcasting relay equipment, multi layer PCB assemblies etc.
Development of sourcing linkages with industries from the other electronics cluster like Santa Rita de Spucal	Market spread to other clusters like Manuas to develop as sourcing hub of high tech electronic assembly to the MNC and TNC situated in Manuas

Opportunities:

Manuas A/S	Santa Rita De Spucal
Strong R & D base created in most of the companies can be leveraged to technology sourcing.	Local inventions and research needs to be documented for patent through institutional mechanism supported by all stake holders
Companies can increase local content to cut down the costs and become competitive compared to China.	Can leverage its local development capacity to become sourcing hub for new development of assemblies to be used in white goods industry in Manuas
Patenting of technologies and increasing the market spread for catering from regional to international through local development and sourcing.	Excellent local content development practice through years of existence can be used in development of more advanced products in the areas of security, RFID based smart cards, chips and assemblies

Potential risks:

Manuas A/S	Santa Rita De Spucal
Overdependence on components and technology sourced from parent companies can be costly and non competitive compared to local companies from Santa Rita de Spucal	Lack of international exposure and technology tie up for latest research in the Electronics can put the cluster out of pace in terms of latest technology products and innovations



<i>Strengths:</i>	
Manuas A/S	Santa Rita De Spucal
Advancement of technologies in their parent countries are assessable immediately to them.	Mostly home grown companies having strong technology development through years of sustaining research and their products have proven in the regional markets.
Companies are very large and have huge production set ups supported by local research and linkages with local Universities.	Local sourcing strong for PCB's, sheet metal and plastic components and small assemblies. Good vendor base which is aligned to technology changes.
<i>Weaknesses:</i>	
Manuas A/S	Santa Rita De Spucal
Dependence on parent companies and low localization.	Lack of linkages with other similar clusters in world.
Local vendor base in PCB's, small but critical assemblies almost non existent	Sourcing of components from China; lack of common import platform for better bargain and keeping low inventory for each unit.
	Lack of linkages with leading research institutions for standards, validations, testing and reverse engineering and prototyping.