Network governance and government technology policy in Brazil: A new methodological approach based on lessons from the software industry

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Presentation:

1. Background
2. Research Question and Methods
3. Innovation Network 1: The Campinas Software Network
4. Innovation Network 2: The Recife Software Network
5. Analysis
6. Conclusions

1. Background

- Networks are a structure of interactions and an intermediate form of governance (between market and hierarchy) (Powell, 1990)
- Network actors do not act in an isolated fashion (Callon, 1999)
- Supposedly 'breed trustworthy relations' among economic actors (Giuliani, 2010, p.264; Granovetter, 1973, 1985)
- Potentially reduce transaction costs and favour the creation and diffusion of knowledge and information (Burt, 2010)

1. Background

1. Conceptual roles of networks and empirical evidence on networks and innovation performance in developed countries have triggered govt TP in developing countries to foster firm-level innovation through networks.
2. Innovation networks are a sub-set of interactions in innovation systems.
3. In developing countries, we still do not have consistence evidence on:
   a. whether **local** firms rely on formal interactions to support their innovation activities.
   b. what drives **local** firms to create formal dyadic ties to support their innovation activities or their ability to engage in innovation networks.
   c. the full meaning behind dyadic ties created by **local** firms

1. Background

Crucial definition:

Network governance and structure: are the inter-organizational *coordination* exerted in a particular setting in which innovation network actors are embedded (based on Jones *et al*., 1997).

Coordination occurs when two (or more) network actors have a common goal and establish a tie in order to pursue it (Bevir, 2009).

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2. Research question and methods

Research Question (RQ): What is the responsiveness of network governance (coordination) and structure to technology policy aimed at the promotion of networks in a developing country context?

- Exploratory RQ and aim analysis of network features referring to contextual conditions and changes over time: these type of relations best explained by qualitative case study methods (Yin, 2003).
- SNA used as a tool to complement the qualitative methods.

2. Research question and methods

- Indicators related to the *structure* of the network

i. well-knit= high interactions

ii. fragmented= low interactions

iii. intermediary stages are a possibility

Table 1 - Summary of network governance indicators and variables for analysis

Indicators	Variable	Potential network features	Possible outcomes
Structure	Number of external ties created by each firm	Well-knit network = Higher number of ties among local firms and network actors	i) Lower probability of missing links among actors
		Fragmented network = Lower number of ties among local firms and network actors	i) Higher probability of missing links among actors

2. Research question and methods

- Indicators related to structural and relational embeddedness:

i. structural embeddedness (institutional setting): consistency of sub-networks

Table 1 - Summary of network governance indicators and variables for analysis

Indicators	Variable	Potential network features	Possible outcomes
Tightness	Motivation for external tie creation by each firm and frequency of ties occurrence	Tightly-connected ties = Higher number and frequency of strong ties	i) Lower vulnerability to break when put under pressure ii) More reliability in the transmission of information within the network
		Loosely-connected ties = Lower number and frequency of strong ties	i) Higher vulnerability to break when put under pressure ii) Less reliability in the transmission of information within the network

2. Research question and methods

- Whenever the indicators showed more positive outcomes we concluded that the governance of the network was more effective; conversely, less positive indicators led to less effective governance.
- Governance effectiveness was related to innovation performance (Oslo Manual) of the sampled firms, allowing propositions about whether more effective governance leads to better firm innovation performance.

2. Research questions and methods

- Selection of case studies: Industry aimed by federal govt technology policy.

In this study the regions were targeted by the same govt programme: SOFTEX Programme implemented in 1993.

Networks were created under similar incentives and regulations, at the same time, that is, were under the same umbrella and therefore allowed comparisons. In addition, the networks were based in two regions presenting different stages of socio-economic and industrial development.

2. Research question and methods

Campinas: Background information

- City is in the most economically developed Brazilian region (Southeast).
- Per capita GDP in 2008 was 75% higher than national average.
- National and state level policies have supported ICT regional industry development since the late 1960s, mainly through the establishment of organisations that are directly related to research and scientific activities.
- Strong and well established regional scientific system: third best research university in Latin America –UNICAMP, develops research and higher education teaching in ICT areas (computing science and computing engineering).
- CPqD: research centre (Foundation) in telecom and ICT areas.
- Other private (non-profit) research centres are present.
- São Paulo State Research Foundation (FAPESP): estimated budget of US$402M in 2009.
- City has become the leading software region in Brazil.
- Government policy has played a role in this leadership position.

2. Research question and methods

Recife: Background information

- City is in an economically lagging behind region (Northeast).
- Per capita GDP in 2008 was 10% lower than national average.
- Has received less support from national policies directed to the development of the software industry compared to Campinas.
- Diminished regional scientific system: local public research university (UFPE) does not perform at the same level in as many scientific fields as UNICAMP.
- Pernambuco State Research Foundation (FAPESP): estimated budget of US$17.2M in 2009 (i.e. more than 20 times lower than the FAPESP budget).
- Low level of socioeconomic development: triggered the implementation of state level technology policy to foster the local software industry through networks in 1999/2000: Porto Digital.
- Since the 2000s the city has become the software industry leader in the Northeast.

2. Research question and methods

- Selection of case studies:
- Campinas: City is in the most economically developed Brazilian region (Southeast), per capita GDP in 2008 was 75% higher than national average.
- Recife: City is in an economically lagging behind region (Northeast), per capita GDP in 2008 was 10% lower than national average.
- Main sources of empirical evidence: face-to-face interviews using semi-structured questionnaires (majority) and open-ended questionnaires. Total of 103 interviews (pilot and full fieldwork).

2. Research question and methods

Table 2 Total number of interviews by type of organization

Type of organization	Number of interviews Campinas	Number of interviews Recife	Total number of interviews
Consultants	2	1	3
Firms	21	17	38
Government representatives	4	2	13*
Incubators	3	2	5
Research centres	7	4	8
Research foundations	1	2	3
Supporting organizations	9	6	13
University faculties	9	2	6
Venture capital fund	2	0	2**
Total	58	36	103

- Legend: *= total number of representative including national government. Number of government representatives interviewed in Campinas=2, Recife=2 and national government= 9.

**= venture capital fund representatives were based in the Campinas city; however their actions covered the Brazilian national territory.

Source: own elaboration from fieldwork data collection.

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3. Innovation Network 1 - Campinas

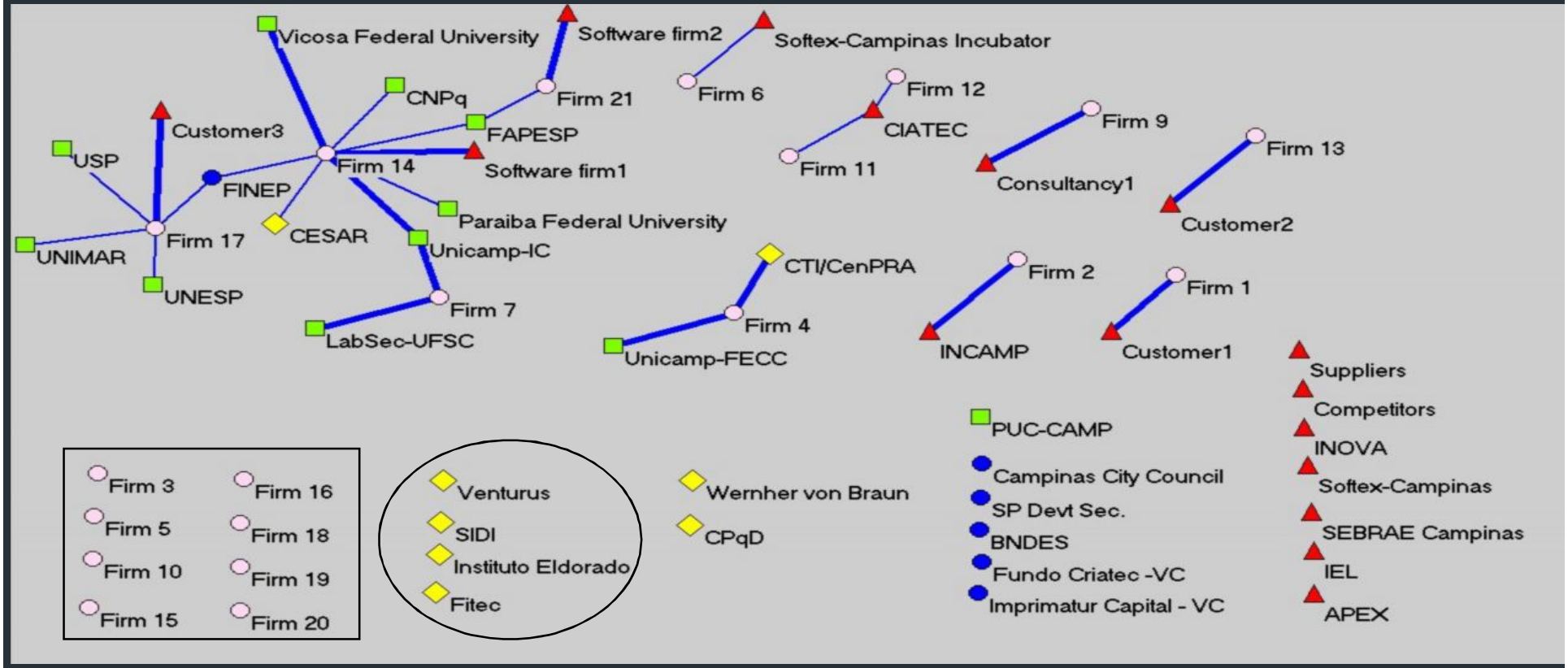
Indicators		Network features
Consistency (overlap)	Business Sub-net	• Mostly frequently accessed • High consistency • Actors with highest number of ties: incubators, customers and other software firms • Unexpected results: acquisition to knowledge and technology rarely cited
	Skills Sub-net	• Second mostly frequently accessed • Intermediary consistency • Actors with highest number of ties: universities • Unexpected results: absence of acquisition to knowledge in dyadic ties with universities. Acquisition of technology scarcely cited
	Technology Sub-net	• Third mostly frequently accessed sub-net • Intermediary consistency • Unexpected results: absence of acquisition of knowledge and acquisition of technology
	Financial Sub-net	• Fourth mostly frequently accessed sub-net (actors rarely accessed) • Low consistency • Unexpected results: absence of innovation cooperation, acquisition of knowledge and acquisition of technology (exception, cited only by one firm)

3. Innovation Network 1 - Campinas

Indicators	Network features	
Tightness	Tightly-connected x Loosely-connected	• Mostly tightly-connected. • Existence of loosely-connected ties with technology sub-network actors was an unexpected result; • loosely-connected type of ties involve the creation of new knowledge or technology, which supposedly are motivated by trust, collective identity.
Structure	Well-knit x Fragmented	• Fragmented. • Forty percent of interviewed firms innovated in their own, without connections to other actors

3. Innovation Network1 - Campinas

Figure 1- Campinas software network of innovators, 2006-2009



● Firms; Firms; ♦ Technology sub-network; ■ Skills sub-network;

▲ Business sub-network; ● Financial sub-network;

3. Innovation Network 1 - Campinas

Campinas Results: Indicator for innovation activities:

Campinas software firms showed higher level of innovation in software services than software products.

- Total of 233 innovations period 2006-2009
- Closeness to the technological frontier:
  - most firms introduced innovation at the firm level
  - fewer introduced innovations to the national market
  - those that introduced new to the world innovation (6 firms): only two had exported the service at the time of data collection

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4. Innovation Network 2 - Recife

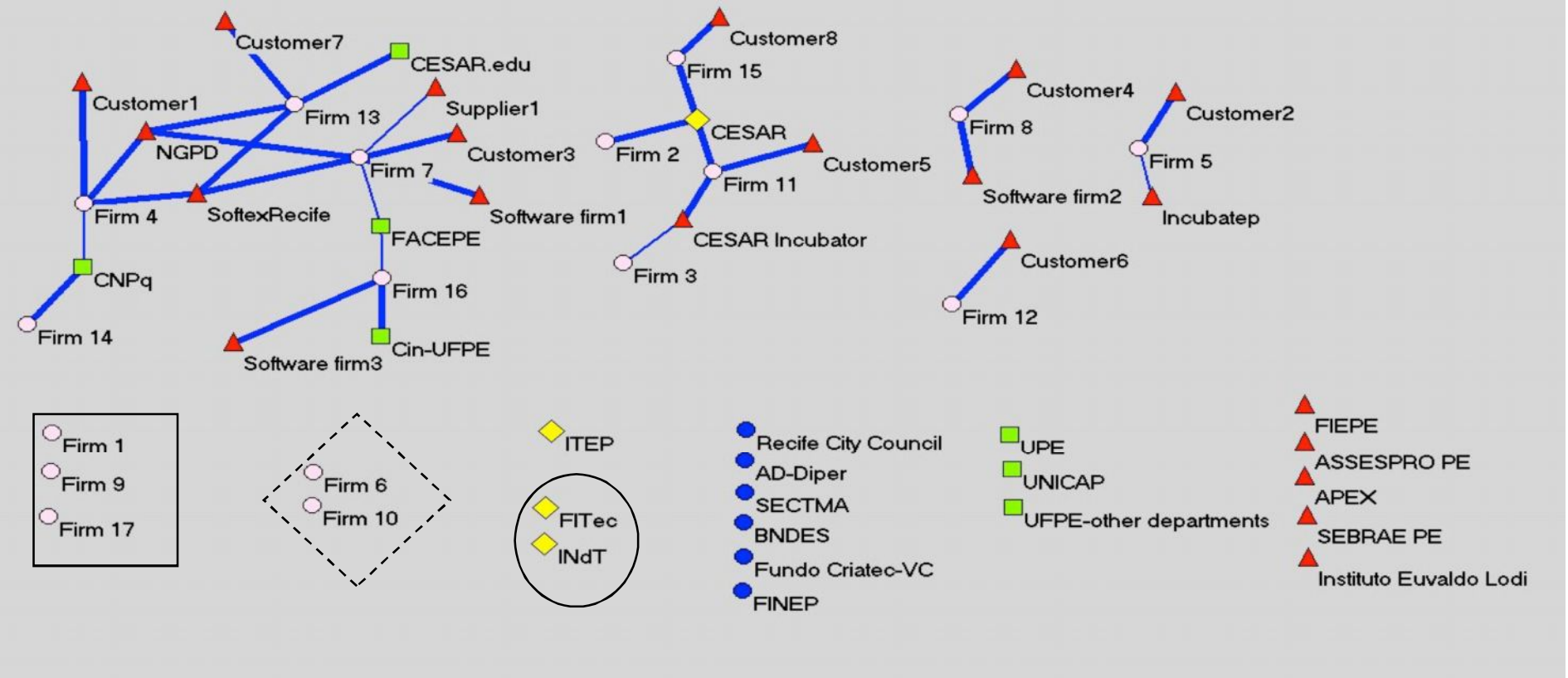
Indicators	Network features	
Consistency	Business Sub-net	• Mostly frequently accessed sub-net • Full consistency • Actors with highest number of ties: customers, other locally based software firms, non-profit organisations
	Skills Sub-net	• Second mostly frequently accessed sub-net • Intermediary consistency • Actors with highest number of ties: universities and research foundation/council • Unexpected results: absence of acquisition of knowledge and technology in dyadic ties with research foundation/council.
	Technology Sub-net	• Third mostly frequently accessed sub-net • High consistency • Actors with highest number of ties: universities and research foundation/council • Unexpected results: absence of acquisition of knowledge and technology in dyadic ties with research centre
	Financial Sub-net	• Financial sub-net actors were not engaged in the network

4. Innovation Network 2 - Recife

Indicators	Network features	
Tightness	Tightly-connected x Loosely-connected	• Mostly tightly-connected. • Existence of loosely-connected ties with business and skills sub-network actors was an unexpected result; • Loosely-connected ties involves the creation of new knowledge or technology, which supposedly is motivated by trust and collective identity
Structure	Well-knit x Fragmented	• Intermediary fragmentation: • 70% of interviewed firms created external ties to support their innovation activities

4. Innovation Network 2 - Recife

Figure 2- Recife software network of innovators, 2006-2009



● Firms; Firms; ♦ Technology sub-network; ■ Skills sub-network;

▲ Business sub-network; ● Financial sub-network;

4. Innovation Network 2 - Recife

Recife Results: Indicator for innovation activities:

Recife software firms showed higher level of innovation in software services than software products.

- Total of 122 innovations for the period 2006-2009.
- Closeness to the technological frontier:
  - most firms introduced innovation at the firm level
  - a few introduced innovations to the national market
  - those that introduced new to the world innovation (3 firms): two had exported the service at the time of data collection.

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5. Analysis

RQ: Campinas

- Fragmented structure suggests low level diffusion of formal interactions within the network. Rate of response of Campinas software firms to govt policies to promote network formation is low compared to the potential of interactions among actors. Firms prefer learning-by-experience rather than learning-by-interaction.

RQ: Recife

- Structure is slightly less fragmented than Campinas, although fragmented, there are key local actors engaged in the network keen to support the development and growth of local software firms. Hence the results show a broader interaction between technology policy and network governance and structure.

5. Analysis

Campinas

- Network governance and structure had a mixed influence on the effectiveness of govt technology policy directed at firm-level innovation.
  - Structural embeddedness indicates inconsistencies in crucial sub-networks, low engagement of crucial actors, and low level of interactions.
  - Relational embeddedness: most ties are tightly-connected, crucial for interactions aimed at knowledge exchange and learning among actors.
  - Hence, relational embeddedness had a more positive influence than its structural embeddedness on the effectiveness of technology policy aiming firm-level innovation through network formation.

5. Analysis

Recife

- Network governance and structure had also mixed influence on the effectiveness of govt technology policy directed at firm-level innovation. Again, results for structural and relational embeddedness differ.
  - Structural embeddedness indicates inconsistencies in the skills sub-network. There is also low level of engagement of crucial actors.
  - Relational embeddedness: most ties are tightly-connected.
  - Hence, relational embeddedness had a more constructive influence than its structural embeddedness on the effectiveness of technology policy through network formation.

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6. Conclusions and Policy Implications

Conclusions

- Findings show that high-technology firms in developing countries which has large regional disparities engage differently in networks and present different innovative performance.
- Firms less engaged in networking – Campinas, show higher level of innovation performance in absolute terms and produce innovations closer to the technology frontier. However, in Recife, networking seems to have supported regional catching-up.

6. Conclusions and Policy Implications

Contribution to knowledge on TP effectiveness:

- Adoption of general TP prescription for the formation of networks as mechanism to improve firm-level innovation and regional catching-up requires careful consideration of the intended effects.
  - Firms' engagement in networks may not be a necessary condition for firm-level improvements to innovation.
  - Regional path-rigidity and contextual as well as network specific influences must also be considered in technology policy formulation.

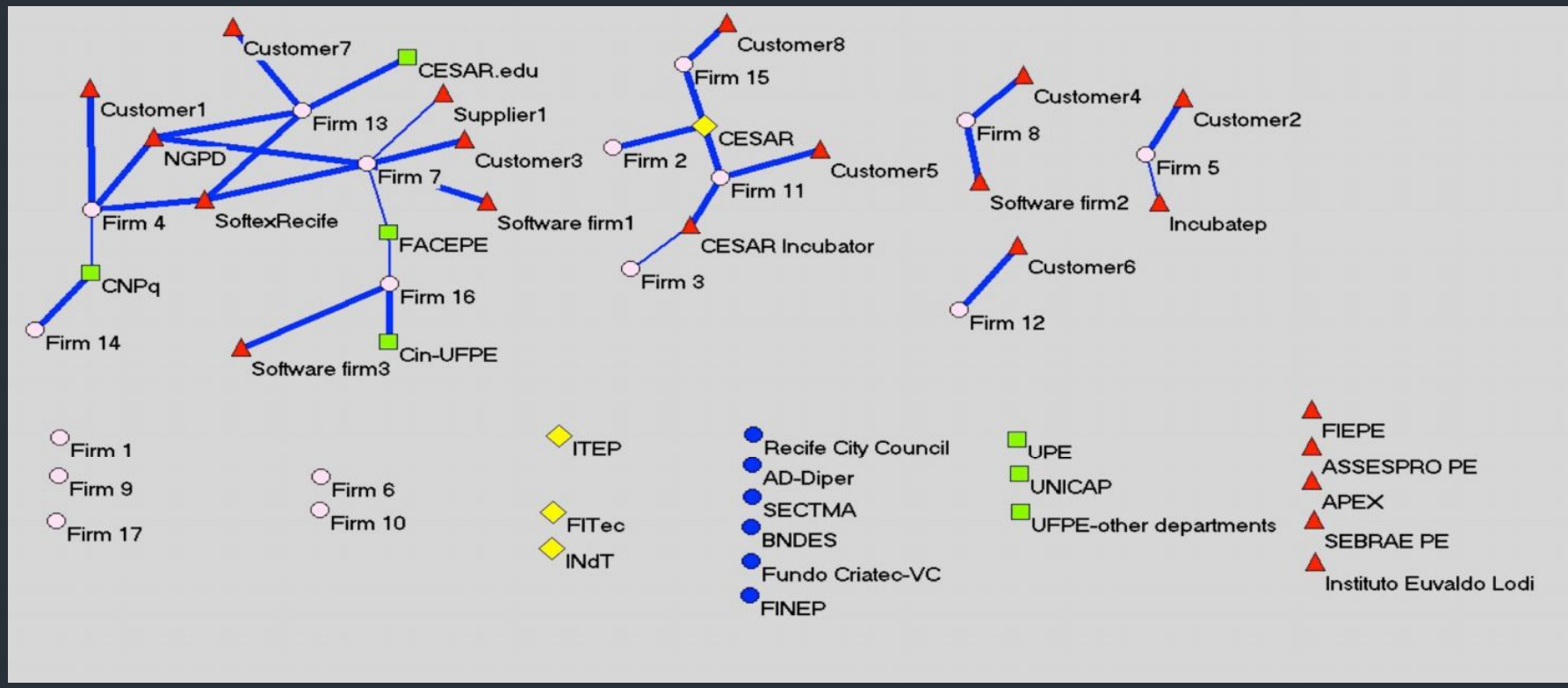
6. Conclusions and Policy Implications

Contribution in methodology: combination of qualitative methods with SNA

- Representation of network of innovators does not do full justice to the role played by some actors. Example: CESAR's role in Recife.

Implication for policy:

- Institutional, cultural and economic settings may differ among regions and policies should take into account that reproducing network governance and structure of successful regions may not be appropriate for (all) other regions.
- Inconsistency of sub-networks and poor engagement of crucial actors: suggest that reformulation of organizations missions are needed.


Customer7
CESAR.edu
Customer1
Firm 13
Supplier1
NGPD
Customer3
Firm 7
Firm 4
SoftexRecife
Software firm1
FACEPE
CNPq
Firm 16
Firm 14
Cin-UFPE
Software firm3
Customer8
Firm 15
CESAR
Firm 2
Customer5
Firm 11
CESAR Incubator
Firm 3
Customer4
Customer2
Firm 8
Firm 5
Software firm2
Incubatep
Customer6
Firm 12
Firm 1
Firm 9
Firm 17
Firm 6
Firm 10
ITEP
FITec
INdT
Recife City Council
AD-Diper
SECTMA
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Fundo Criatec-VC
FINEP
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