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Abstract

Information and Communication Technologies (ICT) have become important tools to promote and realize a variety of public goals and policies. The growing importance of ICT in daily life, business activities and governance prompts the need to consider the role of ICT more explicitly in urban administrations and policies. What are the city maker' expectations about ICT? And how do they assess the future implications of ICT for their city? An analysis of these questions is needed to provide us with a better understanding of the extent to which urban authorities are willing to invest in and to adopt ICT policy. This paper offers both a conceptual and an operational model that aims to map out the causes and implications of ICT perceptions and views of urban policy makers and/or administrative officials (denoted as urban front liners). This is followed by the presentation of an operational path model, viz. a linear structural equations model (Lisrel). The model serves to describe and test the relationships between perceptions of the city, policy makers' beliefs about ICT and the associated urban ICT policy. According to the model, respondents that perceive their city as having many urban functions (e.g., commercial centre, service centre, higher education centre) have more awareness to various ICT tools and are likely to consider a multiplicity of ICT measures as relevant to their city. Respondents that consider their city as having severe bottlenecks (e.g., traffic congestion, housing shortage) are less likely to think of ICT measures and ICT-related goals as relevant to their city, nor that the municipality impacts significantly on ICT in the city. Furthermore, respondents that perceive their city as suffering from many socio-economic problems (unemployment, ageing population, industrial decline and so on), are likely to consider many ICT tools as relevant to their city, although they have a low awareness of the specific tools to be deployed. Finally, respondents who believe that ICT will affect significantly (and positively) the city and its administration, tend to attach a high municipal influence on ICT, and consider many ICT initiatives as relevant to their city.

Keywords: ICT, perceptions, Lisrel model, urban decision-makers
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1. Introduction

Information and Communication Technologies (ICT) may be regarded as a collection of technologies and applications, which enable the processing, storing and transfer of information to a wide variety of users or clients. Since these technologies are expected to have a major impact on human life, several fascinating ideas about the role of the city, its features, or even the question of whether it will persist have appeared in many visionary books and papers. These intriguing relationships have provided us with many metaphors, which try to capture the futuristic and far-reaching consequences of ICT on the city and society at large (such as the 'wired society' or 'global villages').

After the introduction of national (and even international) ICT policies, researchers are paying increasing attention to urban or local ICT policies, and to the potential of local public policies to complement, induce and substitute for (or even correct) national policies and private forces (Gibbs and Tanner, 1996; Graham, 1997; Graham and Dominy, 1991). Adoption of urban ICT policies has clearly many facets. One city may leave the field to the influences of private forces and national or international policies, while other cities appear to initiate comprehensive plans for the introduction and adoption of ICT. What accounts for these differences in ICT policy adoption? Various alternative factors may explain these differences, in particular factors that relate either to the city characteristics (or administration characteristics), or to the personal characteristics of the decision makers or administrative officials (urban front liners) in the city. Our research will mainly focus on the perceptional drivers of urban ICT policy. Specifically, we aim at understanding whether and how an urban decision maker's perception of his/her city and his/her beliefs about ICT can contribute to the explanation of the way he/she assesses the relevance of ICT policy to that city. With this focus we hope to shed more light on the personal dimension of urban decision making.

Our research will address ICT policies at the urban level, policies that the local policy maker may consider as relevant to his or her city. We are interested to know how much importance and influence decision makers attach to the municipality in the ICT field, in order to anticipate whether municipalities will play an important role in the ICT area.

A large body of literature regarding the city (and society) and ICT has recently emerged. However, most of this literature tries to analyse ICT as a shaping factor, or in other words, it aims to explore the possible spatial and social implications of ICT. In contrast, the present study aims instead to investigate ICT as a policy tool, namely, the ways in which intended ICT policies can (or would) be part of the ICT forces that will shape the urban future. Clearly, these two issues are mutually related and affect each other. On the one hand, when one is trying to evaluate, hypothesise or forecast the future influences of ICT, one should also take into account possible implications of policies that are mutually related to ICT. These policies (or the absence of policies) may affect the way ICT could shape the city and society at large. On the other hand, ICT policies are aiming at accommodating (present and) future needs and developments of society. Therefore, initiating relevant policies should be based on an evaluation of plausible trends and expectations of these technologies. Clearly, the beliefs of urban decision makers and administrative officials about the effects of ICT on the future of the city will likely affect the policies that they have in mind to accommodate these effects.

Graham and Marvin (1996) claim that much of the ICT discourse is deterministic and simplistic, taking (mostly) a utopian view. This deterministic view sees ICT developments as radically reshaping society, and by extension, cities. However, we can also clearly identify an evolution in the discourse itself. In particular, in the 1970s and 1980s, the dominant voice was the prediction concerning the decline of city importance and the death of distance (Pascal, 1987; Goldmark, 1972; Toffler, 1981; Martin, 1978). Nevertheless, as these new technologies were gradually adopted, most researchers became convinced that the city was not going to disappear. Not only has the attractiveness of large cities not reduced, but also recent developments suggest even that ICT reinforce the position of large cities (Moss, 1991). Kollko (1999) stated that ICT have led to the "death of distance", but not to the "death of cities". Also Glaeser (1998), after analysing processes that weaken and strengthen the city concludes that the city is not going to "die". And finally, Graham (2002) claims that both distance and cities are far from being dead, and that geography still matters.

Against this background, Section 2 offers a short discussion about ICT as a policy tool as well as a few examples of urban ICT initiatives. Section 3 then, explains how to examine perceptions and beliefs. Next, Section 4 sets out more specifically the theoretical framework to study individual public decision-making processes, based on perceptions of the decision maker. In Section 5 we present the conceptual model for urban ICT policy making from an individual perspective. While in section 6 the data that were used in this study are presented. Section 7 is focused on analytical efforts to translate the conceptual model into an operational model, and to identify ways to measure the latent variables of the model. In Section 8 the statistical model is presented and estimated, using a Lisrel analysis. Finally, in Section 9 we offer a summary and conclusions.

2. ICT as a Policy Tool

Since ICT are expected to have significant influences on the city, its shape and its metabolism, one would expect that urban planners and urban decision makers are likely to be major players in the ICT field. Some scholars are urging and hurrying urban decision makers to act in that field (see e.g. Caves and Walshok, 1999). However, as Graham and Marvin (2000) argue, despite the central importance of the 'urban' in cyberspace debates, issues of urban policy and planning have been virtually absent within both the popular and academic sides of the discussion.

Pratchett (1999) stresses that ICT have the potential to fulfil three complementary roles of local authorities: local democracy; public policy making; and direct services delivery. However, as Pratchett claims, there is a systematic bias which favours service delivery applications and overlooks applications regarding the other two roles. The reason for the bias is that the decision makers who initiate the ICT policy are not active in the other policy areas. In other words, they may not be aware of the possible utilisation of ICT in other policy arenas.

The most popular municipal ICT initiative nowadays appears to be building a municipal web-site. Local authorities are increasingly represented on the World Wide Web (Urban, 2002). Access to many municipalities is easily done by clicking www."name-of-municipality"."ending of the country". For example, the address of the municipal website of Amsterdam is www.amsterdam.nl and the web-site of the city of

Paris is www.paris.fr. Municipal web-sites can vary substantially with regard to the information and services that they offer. Some municipal websites just 'broadcast' information about services (Graham, 2002). The size of the municipality website (as a proxy for the level of information and services it offers) varies considerably among cities, implying the different usage of such a tool as an urban initiative (Urban, 2002).

A second policy initiative in a large number of cities concerns ICT infrastructure. It is now clear that leaving the infrastructure market solely in the hands of the private sector is not going to deliver equitable social and geographical access to telecommunication infrastructure (Graham, 2002). Thus, in many cases, municipal agencies are now developing strategies to address these market failures and to provide telecommunications infrastructure for less profitable areas.

Another important initiative is to increase access to the Internet in public places as part of the overall strategy to increase access to the Internet. Several cities have built community tele-centres, which are supposed to deliver public access to marginalised populations. In these centres (which can be also schools), in addition to access to Internet and other ICT services, there are often also training and support services. Clearly, in many cases, access is just one aspect of connectivity, since, without the appropriate skills, the availability of equipment and infrastructure is worthless.

Another type of ICT centre is a neighbourhood telecommuting centre, to encourage teleworking (Mokhtarian and Varma, 1998). These centres offer an alternative work arrangement, and provide office facilities shared by remotely supervised staff of multiple employers. Other cities have various telecommuting programmes for their employees (e.g. San Diego, California) as part of their efforts to decrease commuting (Mokhtarian and Salomon, 1997). We also observe tele-activities that are stimulated by the municipality to serve the disabled or other disadvantaged groups in order to help them overcome physical barriers. In some cities (e.g., Berlin) there are tele-video services to pensioners, to enable them to get help and guidance through videophones. In order to stimulate business activity in the city, some municipalities are actively involved in projects that support the introduction of ICT applications in small and medium size (SME) businesses. Berranger and Meldrum (2000) describe such an initiative in Manchester, focused on creative industries in the city.

In conclusion, a wide range of ICT-related activities in the city can be observed, which may be a focal point of public policy. The choice of application, the type of policy initiative or support and integration with urban planning depends on the expected role of ICT in the city, which is in turn determined by perception, beliefs and attitudes of urban stakeholders.

3. Studying Perceptions and Beliefs

The focus of this study is on the perceptions, beliefs and attitudes of urban front liners. In other words, we are interested in the mental processes of an individual decision maker or city official with respect to urban ICT policies. Studying perceptions, beliefs and attitudes is traditionally associated mainly with psychology and sociology research (specifically social psychology; see, e.g., Eagly and Chaiken, 1993). These concepts have been extensively studied in behavioural and experimental sciences. However, many other social science investigations include behavioural aspects in their studies. In fact, one

important contribution of post-modern philosophy is that it has brought these aspects to many other social science disciplines.

Many theories have been developed to understand the behaviour of individuals, groups, organisations, nations or societies. While some studies concentrate on the actual behaviour, others analyse the invisible aspects that are about to affect such behaviour. When studying actual behaviour, the research focuses on the observed choices that were made. For example, demand for transport is measured according to the actual use of transport. Then again, one may argue that the actual use of transport does not reflect the real demand for transport, and thus understanding the real demand requires investigation of preferences and travel needs. Each study supplies us with interesting and important, though different, information.

However, in some cases there is (still) no actual behaviour. This is the case when we are interested in attitudes toward a new product that is about to go on the market or where a toll is being considered for a planned road. This also happens when we want to evaluate the chances of a political candidate in future elections or when we want to evaluate goods that are not tradable in the market. In all these cases, there is no actual, observed behaviour that can be investigated, and thus opinions, beliefs, perceptions, intentions and preferences are used to hypothesise on and predict the future behaviour.

Urban ICT policies are still in their infancy (Servon and Horrigan, 1997, Graham and Marvin, 1996; Graham and Marvin, 2000). In most cases, governmental organisations are just beginning to wrestle with the wider economic and societal implications of the information revolution (Evans, 2002). In many cities, there is neither a clear strategy regarding ICT nor an explicit plan to address ICT as a policy arena. But, some cities are already active in the ICT field, and many cities exist virtually on the web. However, comprehensive plans about the introduction and utilisation of ICT, if they exist, are still in their initial stages. Thus ICT policy may be considered (in many cities) as a hypothetical future activity, that cannot be observed. Similar to the examples that were given above, an effort to hypothesise on future ICT policies may have to rely on the intentions, beliefs and attitudes of the relevant actors. Therefore, a basic assumption in this study is that most of the possible urban ICT initiatives are still yet to materialise. The features of such future policy are still under consideration. Certainly, there are cities that are carrying out some ICT measures, and some of them have even declared to adopt major ICT strategies in order to gain a competitive advantage and become “information cities”. Nevertheless, as the literature suggests, until recently ICT policy has been considered mainly at the national and international level. Urban initiatives are still new, preliminary, and, in most cases, eclectic. Hence, it is logical to assume that urban ICT policies are still a ‘new product’ and in order to anticipate the future of ICT policy, it is useful to study the beliefs and attitudes that surround it.

Following an extensive body of literature in business administration and marketing studies, we propose to investigate the ‘consumer’ (i.e. the urban decision maker in our case) perceptions of a ‘new product’ (urban ICT policy in our case). Such studies measure perceptions of customers about different markets and products (see Roberts and Morrison, 2002; Foxall, 1996; Simonin, 1995) or investigate attitudes and perceptions towards pioneering brands and resistance to innovations (see Alpert and Kamins, 1996). All these studies use stated preferences, attitudes and perceptions in order to forecast or better understand the future demand for new products. Studying attitudes, perceptions

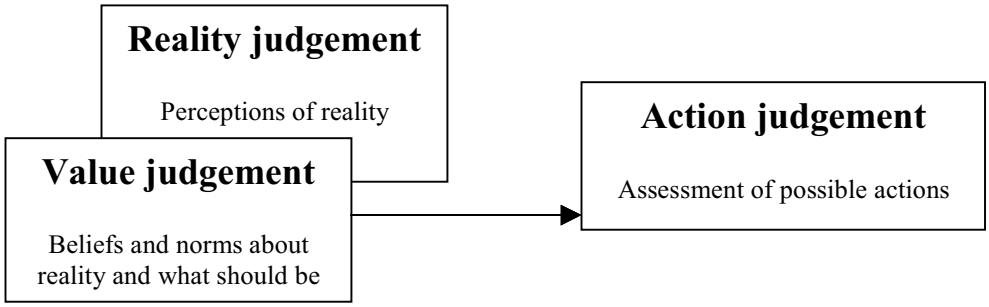
and beliefs can be done by the study of the individual's 'black box'. This black box refers to the (invisible) mental process that constitutes human (visible) behaviour. This will be described in the next section.

4. Elements of Individual Public Decision Making

Our study is interested in the individual decision maker (urban front liner). It aims to explore the way public decision makers perceive the opportunities and challenges of their city as an explanation for their attitudes, behaviour and policies. Policy response is taken as a consequence of these perceptions. In our study we will adopt the cognitive approach, which focuses on how decision makers acquire and use information and how their beliefs, attitudes and preferences affect their decision. Sir Geoffrey Vickers (1965) made a central contribution to such an approach in his study on *The Art of Judgement*. In this book, he elaborates a framework to understand the mental process of decision making as an "appreciative system". He stresses the importance of judgement, i.e. the way the decision maker judges the reality, the norms and the action (policy). Figure 1 demonstrates the relationships between these three aspects of judgement. The appreciative system of a decision maker is part of his 'black box'. Although it is invisible, it is hypothesised to affect the decision maker's choice spectrum and behaviour and, consequently, the policy he considers.

Vickers uses the mental process of an individual decision maker as a factor that explains policy. The way a decision maker judges the reality, and the norms that he has, affects the assessment of possible actions. Policy is a consequence of the action judgement. Vickers' model is particularly suitable for our research, since it emphasises the importance of the relationships between the beliefs and values of the decision makers. The present study addresses in particular the first dimension: the mental dimension of decision making.

Figure 1: Vickers' framework of an "appreciative system"



Source: Parsons, 1995.

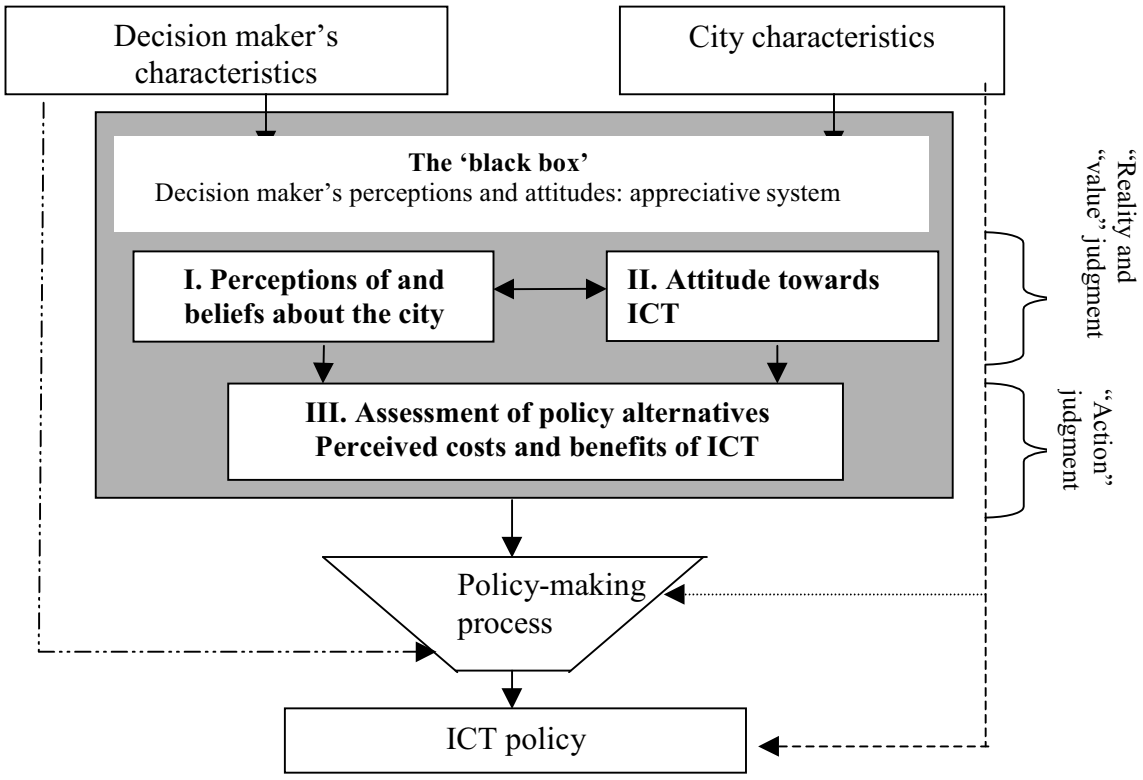
5. A General Model for Urban ICT Policy Making from an Individual Perspective

Dror (1986) has defined policy making as *"fuzzy betting attempting to influence the probability of future situations"* pointing out the uncertain nature of policies, with regard to both the future and the effectiveness of the policies that are implemented. The assessment of future situations is also based on the way decision makers evaluate the current situation and the picture that they have in mind. Thus, both expectations on the

future and the assessment of reality serve as an important input for the policy-making process. As a result, the policy-making process involves the cognitive and normative beliefs of the actors (Timmermans, 2001).

In Vickers' (1965) terminology, it is important to understand the way in which a decision maker constructs *reality* on the one hand (e.g., what is out there? what is the problem? what predictions can be made?) and *values* on the other hand (what values /norms are set? what ought to be? what would I like it to be?). The process of reality judgement and of value judgement leads to action judgement or, in other words, to a concrete idea about the nature or direction of policies that should or could be taken (Vickers, 1965; Parsons, 1995). Especially in the case of ICT, which is full of metaphors and visions it is important to include visions (values) as explanatory factors in the assessment of different policies.

Figure 2: Urban ICT policy-making process: the decision maker's perspective



Perceptions, beliefs and attitudes of a decision maker can be described as his/her 'black box'. It is black (or hidden), since normally we cannot observe this mental process. Perceptions, attitudes and beliefs are invisible. However, we can observe the input to the black box and the output of the black box and thus we may hypothesise about the factors that constitute the black box, as well as the processes within it. In our case, the input to the black box is formed by the hypothesised factors that affect the perceptions and beliefs that are under investigation. The output of the black box is, essentially, the policy itself. As the model in Figure 2 shows, the black box is the moderator between the 'real world' (the city itself, the objective characteristics of the decision maker) and the observed behaviour (the policy-making process and the policy outcomes). Although the

model ends with the policy itself, our analysis focuses mainly on the black box. The underlying assumption is that attitudes are significant determinants or predictors of behaviour, and that a certain way of perceiving the relevance of ICT policy will be followed by a corresponding reaction to ICT-related policies when they are relevant.

The shaded box represents the decision makers' 'black box'. The perceptions and attitudes of the decision maker have three sub-boxes that represent Vickers's dimensions. The upper two sub-boxes (I and II) reflect the reality judgement and the visions of the decision maker with regard to his or her city and ICT. The third sub-box (III) reflects the policy judgement, the way the decision maker assesses the policy alternatives. The perceptions and attitudes boxes emphasise and highlight the importance of the personal evaluation of reality and of the perceptions of the opportunities that ICT may offer.

6. A European Study on TeleCityVision

As part of the EU project TeleCityVision[4], an extensive survey was conducted, targeting urban decision makers (both politicians and responsible administrative staff, as both of them are considered as "city makers" or urban front liners) in more than 200 cities in 7 European countries (Austria, France, Germany, Ireland, Norway, the Netherlands, and Spain). After a set of structured interviews with urban decision makers in several European cities was analysed (Cohen and Nijkamp, 2002), a large-scale survey was prepared. The survey was conducted between May and September 1999. The questionnaires were sent to various departments in the municipality that were supposed to have a direct or indirect influence on ICT-related activities in the city, as well as to elected officials of the city (politicians). The effort to include various municipality department members in our sample was due to the fact that ICT policies and strategies are not made by one single recognised responsible body. In contrast to fields like transportation or education, where there is a clear address that is responsible for policies in the field, ICT tend to form a fragmented activity and there is no single clear address in the municipality responsible for all relevant information (a preliminary analysis of the Dutch survey can be found in Cohen et al., 2002). Approximately 1500 responses were returned (the response rate varied across the participating countries, between 20% and 40%), with half of them coming from Germany. Table 1 presents the distribution of responses according to their country and the number of cities that were sampled.

The respondents represent various aspects of city governors or administrators. 35% of them are urban or transportation planners, nearly 16% are working at economic development departments, 6.5% of them are working in ICT departments and 15 % of the respondents are elected politicians. The education level of the respondents is relatively high. The vast majority of the respondents in our sample has at least a Bachelor's university degree. Most of the respondents are males (76%) and (apart from the Spanish sample) most of them in the age group of 40 to 60 years. We do not have data about the

[4] TeleCityVision-Project was funded by the European Commission and co-ordinated by BIS; participants are: BIS (Germany), COMTEC (Ireland), ESI (The Netherlands), ETSI-UAM (Spain), ICCR (Austria), THEMA (France), and ZTG (Germany)

real gender distribution of the urban administration in these seven countries, so that we cannot conclude whether our sample is biased in that regard.

Table 1: Number of respondents according to countries

Country	No. of respondents (in brackets, percentage of the sample)		No. of cities sampled
Austria	91	(5.8%)	20
France	114	(7.3%)	29
Germany	795	(51.1%)	74
Ireland	80	(5.1%)	18
The Netherlands	130	(8.3%)	27
Norway	180	(11.5%)	23
Spain	172	(11.0%)	48
		(100%)	
Total	**1562**		**239**

Most of the respondents are from cities with a population of up to 500,000 inhabitants. Just less than 18% of the respondents are from bigger cities. In most of the countries that are included in the sample, the national research teams indicated that the response rate was lower in big cities, compared with smaller ones. Thus, it is not surprising to observe some dominance of small and medium cities in the sample. Moreover, in some countries (Norway, Ireland, the Netherlands and Austria), there is only a small number of cities that exceed 500,000 inhabitants.

7. Building the Latent Concepts: Perceptions of the City, ICT and ICT Policy

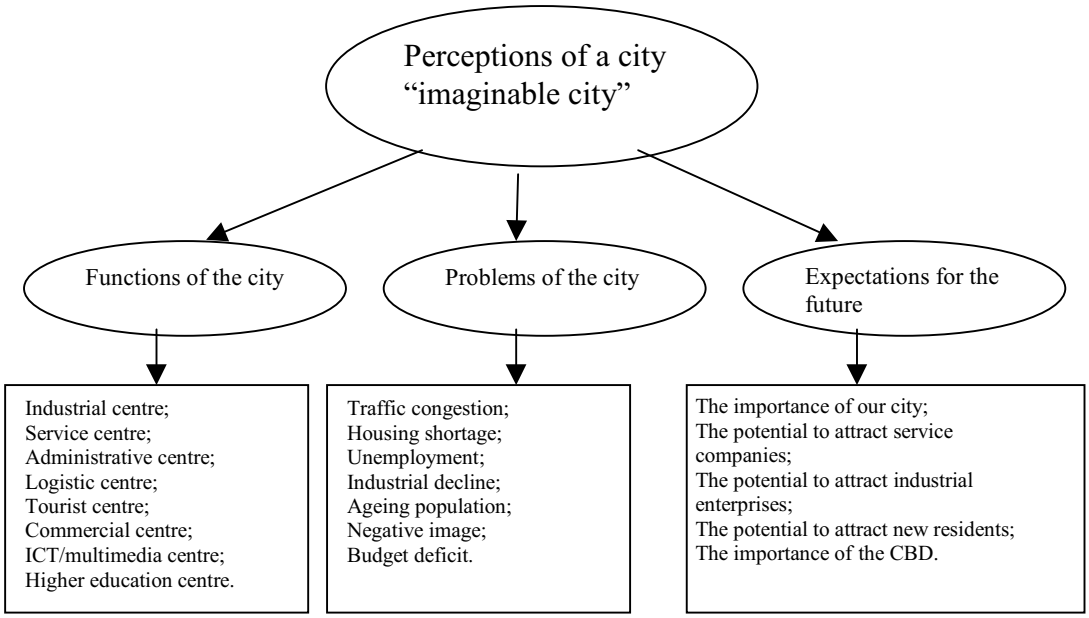
According to Vickers' theory of the appreciative system, reality and value judgement relates to the way a decision maker perceives reality and hypothesises about the future. Action judgment is related to the assessment of policy alternatives. More specifically, in the field of urban ICT policies, the relevant area of judgement are formed by the perceptions of the city (what is the city? what is it expected to become?), perceptions of ICT (how does ICT affect various aspects of life?) and perceptions of urban ICT policies (what are the relevant policies?). We will use these queries to design the building blocks of our measurement model.

7.*1 The "imaginable" city*

Already in the 1960s, attempts were made to create city typologies according to various key variables. Hadden and Borgatta (1965) used 65 variables from the 1960 U.S. census for 674 American cities. They used factor analysis and reduced the large number of variables to 11 factors (the twelfth was the total population size) to characterise these American cities. On the basis of Hadden and Borgatta's database, Jones and Jones (1970) used some of these factors to create 4 typologies of cities according to two core dimensions: the "urban growth and development" construct and the "socio-economic" construct. Using exploratory factor analysis, they found data-driven constructs that were plausible from a theoretical perspective.

In contrast to these city typologies that are built on "objective" indicators (as described above), in our research we aim in particular at constructing a profile based on the way the decision makers *perceive* their city. In other words, we are interested in the city after it has been filtered by the decision maker's cognition. The city is not a given spatial unit, but a social construct. As James Donald explains: "*The living space of the city exists as representation and projection and experience as much as it exists as bricks and mortar or concrete and steel*" (Donald, 1997, page 182). Thus, the city, as the decision maker perceives it, is actually the city for which he/she is making decisions, and hence, for him/her it is the relevant city to be explored in empirical policy research. There are many possible candidate variables for making up the city profile. In our approach we assume that the imaginable city is built from 3 main elements of the city: main functions; problems; and expectations on the future. We have chosen a typological approach based on these 3 main profile elements of the city. Various combinations of these 3 constituents make up different profiles of a city. In this way one may construct a particular city type ('imaginable city'). The 3 aspects of the city are themselves latent concepts since they contain information that cannot be observed by just one variable (indicator). Therefore, each of the dimensions of the city is based on a number of indicators that represent it. The database that was presented in the previous section was used as the basis for indicators for the latent constructs that represent the perceptions of the city. The first dimension, the function of the city, can be measured by a list of urban functions that were listed in the questionnaire (see Figure 3). The respondents were asked to point out to what extent these items were relevant to their city. The second dimension, i.e., problems of the city, is measured by the list of urban problems and is included also in Figure 3.

Figure 3: The 3 dimensions and characteristic (observed) variables of perception of a city

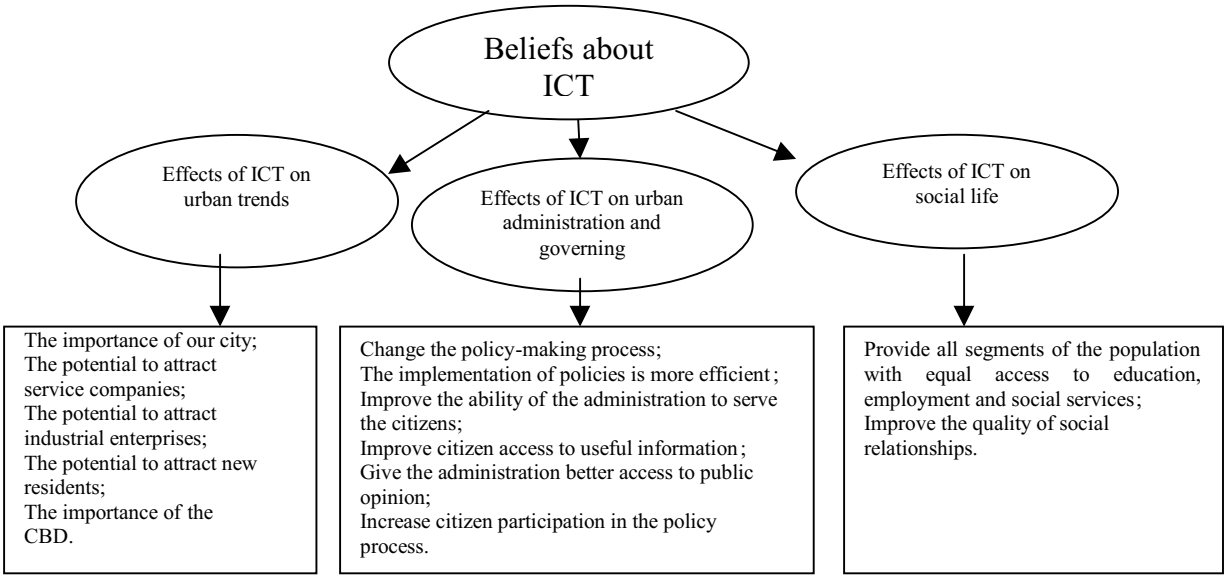


As for the future expectations that represent the third dimension of the city, the respondents were asked to indicate the direction and magnitude of the anticipated trends. We decided to include only the future trends regarding the attractiveness of the city and its strength. Other aspects of possible urban trends were not included.

7.2 Beliefs about and attitudes towards ICT

Opinions on, beliefs about, and attitudes towards ICT do not necessarily have a unified pattern. There may be different opinions about the 'marriage' between the new technologies and different aspects of urban life. Since ICT comprises multidimensional objects, they have more than one recognisable attribute and, therefore, the measurement of such attitudes is also based on various aspects. For example, Druckman and Lupia (2000) discuss and apply multidimensional object measurements. Consequently, we have tried to recognise patterns of opinions about ICT, by using a list of statements regarding ICT relationships with the urban administration, the city and society at large. We used the statements and assessments for the evaluation of the influence of ICT on urban trends, administration and society. We can recognise 3 relevant dimensions of beliefs about ICT and the way it affects the following different aspects: ICT effects on urban future trends; ICT effects on urban administration and urban governing; and, ICT effects on social life.

Figure 4: The 3 dimensions and characteristic (observed) variables of beliefs about ICT



As in the case of the perceptions of a city, here again, the 3 dimensions of beliefs about ICT are themselves latent variables that can be represented by numerous indicating or proxy variables (or, in other words, observed variables). Figure 4 summarises the "ICT" variable, built upon 3 dimensions and 13 indicators.

7.3 Assessment of urban ICT policy relevance

Measuring the variable of policy perception, the assessment of the relevance of ICT policies, is also a challenge, both theoretically and empirically. Often, in empirical studies, the policy variable is binary (in favour of or against policy). In those cases, the policy was already a complete 'package' and the question was whether the policy maker (or voter, in other cases) approves or disapproves of the policy. In our present

investigaton, there is no 'ready-made' policy. On the contrary, the composition of the policy is one of the interesting tasks of the research. Since in most of the cases there is no comprehensive ICT policy, and the experience with urban ICT policy is very limited, there are no 'ready made' ICT recipes. Therefore, the way decision makers perceive the possible ways of interventions in the field of ICT can vary in many respects. We have identified here three prominent aspects of the urban ICT policy:

A. *The role of the municipality*. Some decision makers may think that the municipality has a major role in the ICT field, but others may think differently. The way they perceive the importance of the role of the municipality may affect their support for active interventions.
B. *Goals*. What are the main goals for which ICT should be mobilised? Since ICT can be a tool to achieve a variety of goals (economic, social, governing, etc.), it is interesting to see to what extent the different goals seem relevant to the decision maker.
C. *The relevant tools for ICT policy*. There are many creative ways in which the public sector can intervene in the ICT field. It is important to understand what kinds of tools are perceived by the decision makers as relevant, and whether they are aware of the variety of opportunities that exists.

The first aspect of the above perceptions of urban ICT policy relates to the extent to which the decision maker assesses the influence and the role of the municipality with regard to ICT activities in the city. This aspect is important, since if decision makers attach a high value to municipal ICT activities, it may positively affect their motivation to initiate such activities. The statement from the questionnaire capturing the role of the municipality in ICT policy and activities was: *How much influence does the municipality have with regard to the application of ICT in your city* (high, medium, low, none)?

In many cases the distinction between the next two aspects, viz. the goal of a policy and the tools of policy, is matter of different angles and approaches to the policy. Indeed, according to the 'rational' decision-process theory, there is a clear distinction between the goals of policy and the tools (means) to achieve them, or in other words, between the policy and its implementation. However, policies normally contain both goals and the means to achieve them (Pressman and Wildavsky, 1984). Regarding urban ICT policies, the distinction between policy goals and policy tools is also a complicated task. When the discourse is more ICT-oriented, ICT is regarded as a policy goal. However, when ICT are mentioned as another tool to achieve economic or societal targets, ICT policies are regarded as policy tools. Therefore, such an approach towards ICT policy can lead us to the theoretical and practical decision to make *no* distinction at all between goals and means in our analysis. Therefore, we create variables that measure the perceived relevance of ICT policy *goals* and *tools* and make no distinction between the two.

The second aspect of perception of ICT policy relates to the perceived goals and relevant measures that a decision maker attaches to ICT policy. The questionnaire contained statements that explored the way the respondents perceive the relevance of ICT to achieve general urban goals, as well as the relevance of different ICT measures to their city. The questionnaire itself did not make explicit distinctions between general goals, and nor did it suggest relationships between them. A list of 3 relevant statements regarding possible goals and means was suggested to the respondents, as well as a list of

11 possible tools to employ ICT policies in order to enhance ICT in the respondents' city. The respondents were asked to point out how relevant each tool or goal is for their city (Table A1 in the Annex provides the full list).

Interestingly, a substantial share of the respondents appeared to choose the option DK (don't know), or skipped the items, with regard to the different options, indicating a lack of knowledge, interest or awareness regarding such policy tools. The proportion of DK answers (in some cases more than 20% of the respondents) does not allow us merely to treat these as missing values or to ignore them. On the contrary, they supply important information about the lack knowledge and awareness of the different tools. Therefore, we have decided that an important indicator for measuring relevant tools as perceived by the respondents is the number of DK answers for each respondent. It will be the indicator for the level of knowledge and awareness of relevant ICT measures where O means all answers were DK and 11 implies that there was no DK answer.

Since we decided to combine the statements regarding general goals with the statements regarding specific ICT tools, the third variable to measure policy perceptions is the sum of all the "very much" and "strongly agree" answers to the above 3 statements and the 11 items in the ICT tools list. The logic behind this variable is that the more "very much" answers indicated by the respondent, the broader his/her view about the opportunities that ICT policy can offer to his/her city. Since views about the possibilities for urban ICT vary among urban decision makers, this variable can help to test to what extent they perceive ICT policy as a tool to achieve multiple goals, and tools relevant to urban challenges.

8. From a Conceptual Model to a Lisrel Model

As indicated already above, we will consider here 3 aspects of the 'imaginable city': its functions; problems; and expected trends. In the same way, there are 3 dimensions representing beliefs about ICT. Thus we use a latent variable for each aspect. For statistical reasons, in some cases (as we will discuss in detail in the next section), we will use 2 latent variables to represent an aspect, and, in other cases, we have merged 2 dimensions into just 1 dimension. To operationalise the above latent variables into an integrated model, we will use multivariate path analysis. We will in particular develop here a Lisrel model.

Lisrel is a statistical software package developed by Joreskog and Sorbom (1996). It is a statistical methodology which combines two techniques: confirmatory factor analysis (the measurement model) and path analysis (the structural model) (Kline, 1998). The confirmatory factor analysis enables us to represent unobserved concepts by creating latent variables. The path analysis is represented by a series of structural (i.e. regression) equations.

8.1 The measurement model: confirmatory factor analysis

Social scientists, as well as economists, are often interested in exploring theoretical constructs that cannot be observed directly and can only be approximated by observable or measurable variables. These abstract phenomena are termed "latent variables" (Byrne, 1998). The creation of latent variables is done with a confirmatory factor analysis, where

we have to specify which variables define each factor (i.e. latent variable). The observed variables are also coined "indicators" in the measurement model, since they indicate the latent constructs (Hair et al., 1998). The measurement model for the vector X of observed exogenous variables is described as follows:

$X= \Lambda_x \xi+\delta,$

where ξ is the latent endogenous variable, δ is the measurement error in x, and Λ_x is a q*n matrix that relates n factors to each of the q observed variables designed to measure them. In confirmatory factor analysis, the purpose is to test whether the hypothesised construct is indeed confirmed by the data. There are several statistical tests that can indicate whether the observed indicators do, indeed, correctly represent the hypothesised latent construct. Other statistical tests aim at measuring the reliability and validity of the indicators as representing a common factor (e.g. Cronbach's alpha, which is recommended to have a value of at least .7 and the variance-extracted measure, that should exceed .5 for a construct).

Latent variables for "City", "ICT" and "ICT Policy" constructs

As mentioned earlier, both the perceptions of the city, the attitudes towards ICT and the ICT policy are latent concepts that cannot be measured directly. With the help of 33 observed variables, we have tried to create latent variables that represent the perceptions of the city and ICT. The construct of ICT policy is assumed to be based on the 3 policy variables that were discussed earlier.

There are 5 latent constructs that represent the perception of the city and 2 latent variables that represent beliefs about and attitudes towards ICT. Originally, according to the 3 dimensions of city perception, we would expect 3 corresponding latent constructs. However, after examining the data, we discovered that both the functions of the city and the problems of the city could not be represented by just one construct. In the list of urban functions, 2 functions were distinct from the others: the industrial function and the logistic function. The industrial and logistics functions appeared to have a low correlation with the rest of the function indicators. Indeed, it seems plausible that the industrial and logistic functions differ from the other functions, i.e. the post-industrial functions of the city. Therefore, although it is an empirically-driven decision, it may also confirm a theoretical aspect of the contemporary city: industrial aspects of the city are perceived differently from the other aspects.

With regard to the problems of the city, the empirical tests also discover 2 distinct kinds of problems: on the one hand, problems that are related to spatial characteristics (traffic congestion and housing shortage), and, on the other, problems that are related more to the socio-economic conditions (unemployment, industrial decline, ageing population, negative image and budget deficits). Here again, the empirical findings convinced us that these two aspects of urban problems could also be distinguished theoretically. Consequently, the dimension of urban problems also has two separate constructs.

Attitudes toward ICT are represented by 2 latent constructs. The first construct includes the opinions on and expectations of ICT as affecting urban trends and the urban

administration. The second construct represents the opinions about how ICT affects society and social life. As in the case of the constructs of city perceptions, here again, the decision to have 2 distinct constructs is a result of the empirical tests.

In our model, the variance extracted by the latent variables is between .56 and .64. Thus, between 56% and 64% of the common variance of the model's observed indicators is explained by their latent constructs. This is a reasonable approximation for the latent concepts, which is recommended to exceed 50% (Hair et al., 1998). As for the reliability measure for each latent variable, all variables appeared to exceed the recommended Cronbach's alpha value of .7.

As in the case of the "imaginable city" and the beliefs about ICT, the policy aspect was also expected (and hypothesised) to be represented by a latent construct. However, the two dimensions of policies, i.e. the role of the city and ICT policy's goals and tools (represented by 3 different variables), cannot statistically be considered as indicators of one common construct, the supposed policy construct. A preliminary and basic condition of a latent construct is that its indicators are correlated to a certain degree. When the indicators have a low correlation, they cannot be represented by one latent variable. In the case of the policy construct, we observed a very low correlation among the 3 variables that are hypothesised to be the proper indicators. Moreover, one factor could explain just 36% of the variance in the indicators, a rather weak power of explanation. Since we cannot represent all the indicators in one latent variable, and since all variables are important to measure the perceptions of ICT policy, we have decided to split the endogenous variable into 3 separate variables. Therefore, instead of testing just one model, we will test 3 separate models, each model with a different policy variable:

**Policy 1 = Influence of municipality on ICT*

(How much influence does the municipality have with regard to the application of ICT?)

**Policy 2 = Relevance of ICT goals and tools*

(The number of all the "very much" and "strongly agree" answers to the 14 statements regarding the ICT-related goals and tools list)

**Policy 3 = Awareness and knowledge of ICT tools*

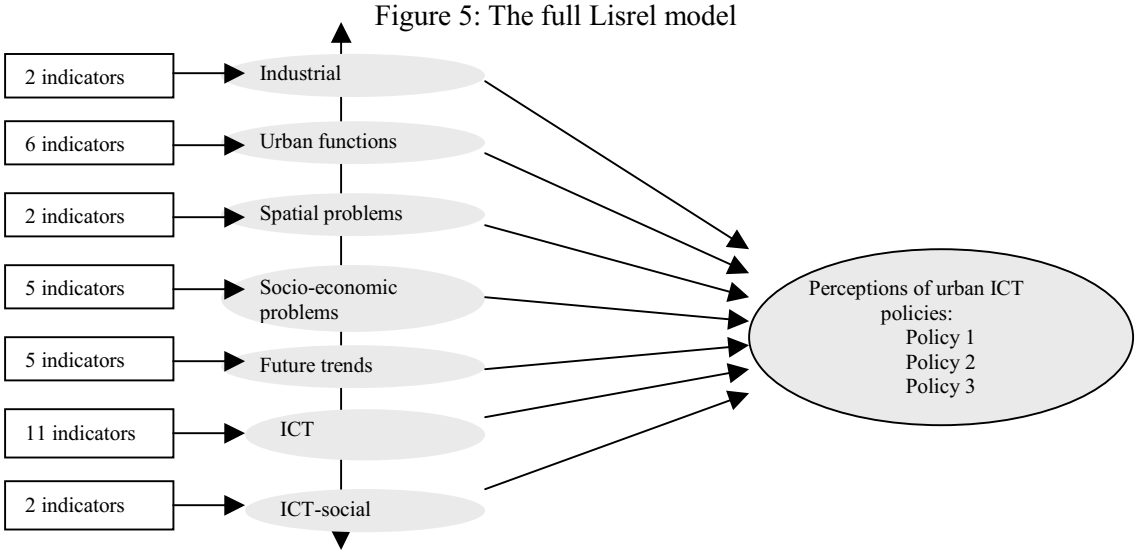
(11 minus the number of DK answers for the listed ICT tools)

After building the latent constructs that represent the perceptions of the city and ICT, and deciding about the variables that represent the policy variable, the next section will now present the structural model.

8.2 The structural model

The structural segment of the Lisrel model estimates a series of separate, but interdependent, multiple regression equations simultaneously. Since there are 3 separate endogenous variables (3 variables that indicate different aspects of the perception of ICT policy), we will have 3 different models, where in each model there will be one of the three endogenous variables. Figure 5 shows a schematic representation of the overall Lisrel model (both measurement and structural components). On the left-hand side, there are 33 variables that serve as indicators of the latent constructs. In the centre, there are 7 latent constructs that were estimated through the observed indicators. Finally, on the right-hand side of Figure 5, there is 1 construct that represents the policy variable. Since there are 3 different policy indicators, each is estimated in a separate model.

Figure 5: The full Lisrel model



8.3 Model estimates

In this section, the Lisrel model is estimated, while the results will be critically reviewed. In the model we have estimated the relationships between the 7 latent variables and the 3 policy variables. Table 2 presents the estimations of the 3 models, where the relationships of each policy variable (policy 1 to policy 3) with the latent variables are estimated. In addition, since in each model the extracted variance of the latent variables is different (the Lisrel optimises the statistical fit of the model), the extracted variances are presented with regard to each model. The results will now successively be interpreted

Table 2: Estimation of the three separate models

	Policy 1		Policy 2		Policy 3	
Latent variables	Extracted variance	Structural relationships (t-value)	Extracted variance	Structural relationships (t-value)	Extracted variance	Structural relationships (t-value)
Industrial function	56%	-.05* (-1.64)	50%	.01 (.21)	56%	.05 (1.77)*
Urban functions	64%	-.07 (-1.56)	63%	-.21** (-5.43)	64%	-.12** (-2.5)
Spatial problems	64%	.14** (4.34)	59%	.09** (3.24)	61%	.18** (5.2)
Socio-economic problems	58%	.04 (1.17)	57%	-.18** (-6.72)	58%	.18** (4.7)
Expectations for the future	61%	-.13** (-3.02)	60%	-.17** (-4.97)	62%	-.12** (-3.1)
Effects of ICT on urban trends and the municipality	60%	-.33** (-6.67)	59%	-.42** (-9.93)	60%	-.17** (-3.5)
ICT effect on social life	54%	-.11* (-1.91)	55%	-.06 (-1.15)	54%	.11 (1.84)*
Fit indexes	RMSEA=. 071; NFI= .85; CFI=. 87; RMR=. 17; GFI=. 95; PGFI =. 79; R^2=. 31		RMSEA=. 077; NFI= .85; CFI=. 86; RMR=. 16; GFI=. 94; PGFI =. 79; R2=. 37		RMSEA=. 072; NFI= .85; CFI=.87; RMR=. 16; GFI=. 95; PGFI =. 79; R^2=. 13	

* significant at .10 level

** significant at the .05 level

As for the relationships between the latent variables themselves, Table 3 presents the correlation between latent constructs. As the table shows, the relationships between the 7 latent variables are all significant at .05 level. The latent variable that represents socio-economic problem has negative correlation with all the other constructs. Therefore high degree of socio-economic problems is associated with low degree of industrial functions, general functions, spatial problems, attractiveness trends and anticipation for major influences of ICT.

Table 3: interrelationships between the 7 latent variables

	Industrial	Functions	Pro_spatial	Pro_social	Trends	ICT	ICT_soc
Industrial	1						
Functions	.51*	1					
Pro_spatial	.20*	.48*	1				
Pro_social	-.15*	-.59*	-.25*	1			
Trends	.28*	.55*	.19*	-.50*	1		
ICT	.18*	.42*	.32*	-.42*	.62*	1	
ICT_soc	.20*	.42*	.24*	-.35*	.62*	.76*	1

Model 1: The influence of the municipality on ICT in the city

The first model estimates the relationships between the perceptions of "city" and "ICT", and the way the decision makers perceive the role of the municipality with regard to ICT applications in their city.

Of the 7 latent variables, 4 have t-values smaller than 1.96: "industrial functions", "urban functions", "socio-economic problems", and "ICT effects on social life" (both "industrial function" and "ICT social life" are significant at the .10 level). The other three variables are significant at least at the .05 level. The R^2 value implies that 31% of the variance in the policy variable is explained by the 7 latent constructs. Given the complex model and the nature of the variables, we may be satisfied with the explanatory power of the model.

In order to interpret the model estimations, one should bear in mind the order and the scale of the observed indicating variables. All the indicators variables (the exogenous observed variables) range from 1 to 4, where 1 means "very much", "strongly agree" or "high" and 4 means "not at all", "strongly disagree" or "decrease". On the other hand, for the policy variables (Policy 1, Policy 2 and Policy 3) a high value means an important role, high relevance for the goals and measures, and so on. Thus, negative relationships between the exogenous variables and the endogenous ones actually reflect positive relationships, and positive relationships mean that when the one value is high the other one is low.

The coefficient of the construct *industrial functions* suggests that when respondents perceive their city as having industrial functions, they tend to see more influence of the municipality on ICT in their city. Respondents that attach a low industrial role to their city think that the municipality has a low influence on ICT. However, as Table 2 indicates, this relationship is significant just at the 0.10 level. As to other *urban functions*, the model also implies negative relationships, but since the relationships are not significant they cannot be interpreted meaningfully.

Moving to the next variable, we can see that when respondents see their city as having severe *spatial problems*, they do not think that the municipality has an important role regarding ICT in their city. The relationships between *socio-economic problems* and the municipality's role are similar but not significant. According to Model 1, a high level of urban problems is associated with a lesser role of the municipality. One explanation for such relationships can be that when a decision maker thinks that the city suffers from "real" visible problems, the municipality is not engaged in ICT-related polices that may not have an immediate and direct influence on these problems. In the case of spatial problems, this makes even more sense, since a city that suffers from such problems is expected to concentrate on policies that are likely to have more direct effects. On the other hand, when decision makers believe that their city does not suffer from severe spatial problems, they may think that the municipality takes initiatives that mitigate the future needs of the city.

When the respondents think that the positive *expectations for the future* are likely to increase, they tend to think that the municipality has a high influence on ICT. But when positive trends are not likely to increase, or are even expected to decrease, the respondents believe that the municipality has a less important role in affecting ICT in their city.

The way the respondents perceive the *influence of ICT on the city and municipality* is strongly correlated with way they perceive the role of the municipality in the ICT field. When they think that ICT has a strong influence on these aspects, they tend to attach an important role to the municipality. When these ICT seem to have less dramatic effects on the city, the perceived role of the municipality also decreases.

The last construct, *ICT and social life*, is also negatively related to the policy variable. The model suggests that, when the respondents expect positive social effects from ICT, the respondents tend to see the municipality as having a high influence on ICT in their city.

Model 2: Relevance of ICT goals and tools

In the second model, the policy indicator is the number of "very much" answers to the list of goals and tools that was given in the questionnaire. Here, a high value of Policy 2 means that the respondent considers many ICT goals and tools as relevant to their city, while a low value means that he or she could hardly find any ICT tools relevant to their city.

Apart from 2 constructs (industrial functions and ICT effect on social life), all the constructs are significant at the .01 level. According to Model 2, respondents who think that their city has many urban functions also tend to see many ICT measures and goals as relevant to their city. Here, the perception of strong functions of the city corresponds with beliefs that ICT can serve various urban goals, and that there are many relevant tools to achieve it. When a city is perceived as having less relevant functions, less tools seem to be relevant.

Another interesting result of the model is the distinction between spatial problems and socio-economic problems. On the one hand, when a respondent thinks that spatial problems are dominant in his/her city, he/she tends to see less relevance in ICT measures.

On the other hand, when socio-economic problems seem to be relevant, ICT measures are likely to be relevant to the city.

As in Model 1, the variables that represent opinions about ICT correspond negatively with the policy indicator, i.e. when the respondents think that ICT does indeed affect the city, its administration and society at large, they also think that many ICT measures can be relevant to their city.

Model 3: Awareness of knowledge and ICT measures

In the last model, the endogenous model is 11 minus the number of DK (don't know) answers that were given to the list of ICT measures. This variable is supposed to indicate the awareness and knowledge of different ICT measures. This variable, along with the policy variable in Model 2, enables us to get a more complete picture about the way the respondents evaluate and assess the relevance of different ICT measures for their city. Here also, a high value means less DK answers, and thus implies higher awareness or knowledge about ICT measures and goals. As expected, the correlation between Policy 2 and Policy 3 is positive, but not very high (.18). Thus, these two models are measuring different sides of the way decision makers perceive the relevance of ICT tools to their city. In Model 3, a total of 5 of the latent constructs are significant at the .05 level, and the other two are significant at the .10 level. The model explains 13% of the variance in Policy 3 and thus the vast majority of the variance is explained by factors other than those in the model.

Comparing the results of Model 3 with those of Model 2 raises a few points worth mentioning. Model 3 suggests that when the respondents think there are severe socio-economic problems in their city, they tend to have less awareness or knowledge of different ICT measures. However, Model 2 suggests that when respondents think that their city is having serious socio-economic problems, they tend to perceive ICT tools and goals as more relevant to their city. One possible explanation lies in the slightly different composition of the two policy variables. As mentioned earlier, the variable Policy 2 includes, in addition to 11 different ICT tools, also 3 statements about the relevance of ICT policy to achieve general urban goals. In the variable Policy 3, these 3 goals are not included (mainly because the percentage of DK answers was very low). Thus, the Policy 3 variable accounts solely for the awareness of tools. As a consequence, it is plausible that, when the respondents perceive severe socio-economic problems, they tend to think that many ICT-related goals are relevant to their city, and that they are less aware of the relevant tools.

9. Conclusions

When studying policy making from the perspective of the individual decision maker, empirical research often takes a case-study approach based on various documents and publications as well as in depth interviews. Our study has taken a different approach, more analytically oriented, and has made an effort to adopt quantitative methods to investigate the perceptions and views of individual decision makers. Instead of focusing on particular decision makers, we have tried to identify decision makers through the way they perceive their city and their beliefs about ICT. The present study found that there

are relationships between these two aspects and the way the decision makers perceive ICT policy. Understanding these perceptions may help us to evaluate the chances that a decision maker will be involved in ICT-related policies in his city and, to some extent, the type of policy that is expected to be adopted. The statistical models that were based on the large database allowed us to get a general picture of the likely relationships between the three most prominent aspects that belong to the decision maker's cognitive domain.

Although public policy research is usually undertaken with qualitative research methods, we decided to conduct research that involves solid quantitative methods and, more specifically, multivariate analysis. The systematic and stable statistical estimates that were established in this study suggest that it is possible (with the appropriate data) to infer statistically generalised conclusions in a rather complex research area. Therefore, alongside qualitative research that can provide a profound insight into a complicated phenomenon, our research offers a quantitative approach that enables such insights to be tested statistically. The model tested the relationships between the latent constructs that represent the perception of the city and the latent constructs that represent beliefs about and attitudes towards ICT and the perceptions of ICT policy. As the model estimates show, there are significant relationships between some of the latent constructs and the policy variable.

The latent variable that represents the *industrial functions* of the city appears to have insignificant relationships with all 3 variables that represent urban policy. However, the latent variable that represents various classic *urban functions* has a significant effect on the perceptions of ICT policy as represented by Policy 2 (relevance of ICT goals and tools) and Policy 3 (awareness and knowledge of ICT tools). In both cases, the more urban functions are perceived as relevant, the more urban ICT policy is considered to be relevant, and the municipality is considered to be effective. The latent variable *spatial problems* of the city has, in most of the cases, significant positive relationships with the policy variables. In all policy variables the more there are severe spatial problems, the less ICT policies are considered relevant. Analogously the municipality has a lesser role, and the awareness of ICT measures is lower. The relationships between the construct *socio-economic problems* and the Policy 2 variables are significant and negative, while with the Policy 3 variable they are significant and positive. Therefore, according to the model, the more socio-economic problems are perceived, the more ICT goals and tools are regarded as very relevant to the city. However, according to the model, more socio-economic problems are associated with a low degree of awareness of various ICT tools. The fifth construct that represents the perceptions of the city, *expectations of future trends*, also has significant relationships with the policy variable. The relationships with all 3 policy variables are negative.

The two constructs that represent the beliefs about and attitudes towards ICT (the sixth and the seventh latent variables) have significant relationships with most of the policy variables. The way respondents perceive the *influences of ICT on urban trends and the city administration* is significantly negative. Therefore, the more they perceive ICT as effective, the more they think that the municipality has a high influence on ICT, that the private sector is affected by municipal ICT activities and that there are many relevant ICT goals and tools.

The other ICT construct *ICT effects on social life* appears to have no significant relationships with the policy variables.

As the R^2s of the three models indicate, the explanatory power of these constructs is rather satisfactory. The model with the highest R^2 is Model 2, which explains the extent to which the respondents assess ICT goals and tools as very relevant, where R^2 equals 37%. Bearing in mind the type of data in the analysis, Model 2 is considered to have a satisfactory power of explanation. Also Model 1 supplies us with a reasonable explanation of Policy 1, the influence of the municipality on ICT in the city; here R^2 equals 31%. The third model has less impressive R^2's, although in this model the relationships between the latent constructs and policy are also significant.

We may conclude that knowledge of the perceptions of a city and beliefs about ICT contribute to the explanation of the assessments and perceptions of urban ICT policy. Perceptions of policy appear to have a few dimensions (as expressed by the three Policy variables) and not all of them have the same pattern of relationships with the seven latent variables that represent the perceived city and beliefs about ICT. However, in most of the cases, we did find systematic and stable relationships between the variables that were estimated.

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Annex

Table A1: List of ICT-related goals and tools

Economic development is very a important area for the deployment of ICT;
Improving citizen-municipality relations is a very important rationale for the municipality's deployment of ICT;
ICT enables better networking with other cities;
Improving telecommunication infrastructure;
Promoting or supporting computer availability in public places;
Promoting research about ICT;
Promoting or supporting ICT training;
Supplying municipality information via telecommunications;
Promoting municipality services via telecommunication;
Promoting ICT use in the planning process;
Using ICT in transport planning;
Promoting or supporting tele-working programmes;
Promoting or supporting tele-medicine;
Promoting or supporting tele-education.