

A Proposal for studying Decision-making and Spatial Data Infrastructures in the Public Sector in India

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Abstract

This paper is based on a research-in-progress which focuses on public decision-making in a selected Indian city using the case of spatial data infrastructure in citizens' participation in local government budgeting. We are particularly interested in the ways in which spatial information is used in public decision-making and the contributions of local spatial data infrastructures in participatory decision-making in Indian cities. We will do this using the concept of 'frames' to investigate cognition and behaviour to study use of spatial information by decision-makers in the public sector (particularly, public administration). This has implications for upscaling and institutionalisation of spatial data infrastructures in Indian cities.

Keywords: decision-making, frames, spatial data infrastructure, spatial information, public administration, public participation, participatory resource allocation, India

1. Spatial Data Infrastructures and Public Decision-Making

This research focuses on studying use of spatial information in public administration in an Indian city. The Indian public administration has a well-established hierarchical structure with a colonial legacy. An important activity in public administration is the collection of data on various aspects (social, economic, political and ecological) of city life, its population and governed space. This data, depending on the purpose, is collected by street-level bureaucrats through their local networks which may constitute of municipal employees, commissioned contractors and consultants, civil society organisations and/or academic researchers.

Usually, after collection, the data is aggregated, interpreted and passed on (as information) to high-level city bureaucrats, to policymakers in city council and at state level. In India, most data is available in paper-form, although the computerisation of public administration has already begun. Tacit knowledge plays a vital role in information sharing. Most information is communicated by multiple means such as telephone and mobiles, by post and in-person. Policymakers (city and state) frequently demand information, whereas street-level bureaucrats (for eg. water supply engineers) need domain-specific knowledge and ground data for implementation of public works and services. These are issues that involve decision-making on location of municipal services, ideally, such that a maximum the populations are benefitted and local conflicts are minimized.

Information infrastructures – a combination of formal and informal technologies, people and policies – are developed to provide a smoother flow of information (and data) within and across organisations. Spatial information (or geographic information) is an important component of such information. On-time availability of such information to public administrators may help minimize spatial conflicts by assisting in clearer definition of the problem and for finding a more socially acceptable solution to issues, for example, service location issues, and land ownership issues.

Local spatial data infrastructures (SDIs) need to be designed to provide spatial information to the decision-maker on various themes; from various sources; on time; and in a format that is easily apprehensible to the decision-maker. SDIs are a special case of Information Infrastructure, specifically geared towards geographic information (Georgiadou, Puri, and Sahay, 2005: 1113) and are viewed as enabling platforms providing a link between data and people (Williamson, Wallace, and Rajabifard, 2006).

For example, The India-National Spatial Data Infrastructure (India-NSDI) claims that spatial information is good for sound decision-making and that it is available to decision-makers. It also states that decision-makers are using spatial information (India-NSDI portal, 2003). The purpose of the India-NSDI Portal is two-fold (India-NSDI, 2003)¹:

1. Support the businesses of government - almost every aspect of government [...] has a geographic component.
2. Support decision-making - issues occur in places [...] and decisions addressing one issue often have broader implications, sometimes affecting entire communities. Geospatial information allows decisions to be viewed in a community context; and can facilitate cross-agency coordination.

However, there are challenges for SDI development for public administration. It is not clearly known, in the Indian context, how much spatial information is available to public decision-makers at local government level; for what purposes they use it; and how they use it. Also, increasing the use of spatial information in local government decision-making is a challenge faced by promoters of India-NSDI (Sivakumar, Rao, and Dasgupta 2004). Furthermore, recent urban governance reforms in India, such as public participation in local government decision-making brings more challenges for SDIs. This would require sharing spatial data between government agencies and the public. Security concerns provide a major constraint in the use of spatial information such as maps (eg. toposheets) in India (Walsham and Sahay 1999).

Other constraint is lack of coordination among various government agencies. Most data that is available is fragmented, spread across government departments and in varied formats. Since data is collected case-wise and when needed, regularly updated longitudinal data may not be available and thus decision-making may always be based on inadequate data. These are some of the challenges for public administrators and SDI promoters in India. Moreover, it is not well documented, in the Indian context, the ways in which Indian public administrators use spatial information in day-to-day decision-making.

Studying information behaviour of decision-makers has great significance for information systems researchers and developers. It would help us understand what information decision-makers require, how they search for it and how they use it. Decision-making is a cognitive process and decision-makers apply judgement using the information available to them. Studying cognition and behaviour of decision-makers using spatial information will provide insights into decision-maker's information behaviour. This in turn will assist in accessible and useful spatial information infrastructures.

¹ [...] Author edits in parenthesis; Access India-NSDI portal at <http://gissserver.nic.in/nsdiportal/gos>; Accessed 2 October 2008 (webpage undated).

In this paper we present a proposal to study decision-making and spatial data infrastructure use in India and how it influences decision-making. It is an attempt to address the needs of the Indian public administration related to spatial information. In the following sections, we briefly describe the varied literature on information use and some specific articles that inform this research. In later sections, we present our approach and methodology to study spatial information use in decision-making.

Practices of Information Use

Information² use is of interest to political scientists as well as information systems developers. A rich body of literature in decision-making, knowledge utilisation, policy evaluation, and information systems have focused on information use by decision-makers. From the view of information systems, early critiques (Argyris, 1977; Ackoff, 1967) on the focus of research on decision-maker's characteristics in MIS design led researchers to shift focus on decision-makers' cognitive styles for MIS development in the later decade (Ramaprasad, 1987; Huber, 1983).

Information use depends on type of decision problem (Ackoff, 1981) or decision situation (Schlager and Blomquist, 1996). Public decision-makers use decision situations to perceive and determine the "state of nature" (state of decision environment) and thus it is a key to the structure of public-sector decisions (Clark and Shrode, 1979:345-346). Since we want to understand the different ways in which individuals and collectives use spatial information in decision-making we need to define a decision situation and decision problem.

According to Ackoff (1981:20), a decision problem is a situation that satisfies three conditions: First, a decision-making individual or group has alternative courses of action available; second, the choice can have a significant effect; and third, the decision-maker has some doubt as to which alternative should be selected.

A decision situation is the decision environment in which the decision-maker works. "The structure of a decision situation includes, (1) institutional arrangements - rules - that define what actions are permitted, required, and forbidden; (2) attributes of the physical world being acted upon; and (3) characteristics of the community within which action is proceeding" (Schlager and Blomquist, 1996: 653).

The decision-making literature provides different perspectives on the use of information in decision-making. One is the normative view on how information is needed and used by the decision-maker (Dunn, 2003). Another view perceives that actually available information is always incomplete and this information is not available to the decision-maker on time. The prime concern for the decision-maker is the acquisition and selection of information at the right time and in a digestible format throughout the decision-making process (Sabatier and Whiteman, 1985). Decision-makers acquire and evaluate (process) information to form judgements about choices among alternatives. Information acquisition entails information search, storage, and retention; information evaluation combines the acquired information to arrive at a choice (Jarvenpaa, 1989: 288).

² Information is a very broad term. We distinguish between spatial and non-spatial information. It can be in various forms – physical\digital: maps, images, photographs, etc.; and textual\virtual - opinions, ideas, perspectives, rules, norms, narratives, etc. Information also includes quantitative and qualitative types.

The decision-making process uses these various forms of information. But our interest is specifically in spatial information in the decision making process.

Thus, in individual or group decision-making processes, decision-makers gather, organise, select and review information (Jankowski and Nyerges, 2001:17) using normative (Burnett, Jaeger, and Thompson, 2008) and/or intuitive (Dijksterhuis, 2004) modes of information selection. In doing so, they make judgements (value judgements or preferences) (Brown, 2005; Dijksterhuis, 2004) on selecting the most 'rational' or an 'appropriate' solution to a decision problem. By normative modes we refer to rule-based, rational, or instrumental decision-making where ends and means are known. By intuitive modes we refer to use of common-sense, experience, and enlightenment (Weiss, 1979), and such decision-making takes place in a rather uncertain decision environment.

Researchers from public administration and political science have recently studied the receipt and use of information (citizens' input; public opinion) by Norwegian local government councillors (Askim and Hanssen, 2008) and US presidents (Druckman and Jacobs, 2006). Others from policy sciences have a longer tradition of studying acquisition and use of technical information by administrative agencies (Sabatier, 1978; Sabatier and Whiteman, 1985) and use of information from policy evaluation by policymakers (Weiss, 1977, 2008, various years).

After several years of studying use of information from policy evaluation by decision-makers, Weiss *et al* (2008) state that "Evaluators sometimes wish for a Fairy Godmother who would make decision-makers pay attention to evaluation findings when choosing programs to implement" (p.29). Weiss (1977) introduced the concept of 'enlightenment' use of policy information by policy decision-makers to indicate that such use has wider influence than it has on the decision-maker.

But all research in decision-making, policy science and information science has primarily considered information in general and does not differentiate information as spatial or non-spatial information used in decision-making. Moreover, most of these studies have been in western environments. From this varied literature, a few articles greatly inform this research.

The work of information systems researchers Walsham and Sahay (1999) describe the various differences in the western and Indian styles of decision-making and use of spatial information technologies (especially, GIS). (Carton 2007) forward-traced the use of maps in the policymaking process in a Dutch local government and found that different actors, namely, the analyst, map designer and policymaker, has different frames (worldviews) of the problem at hand and hence use the maps in different ways.

(Langley *et al.*, 1976) reviewed six decision-making models in organisations namely, sequential; anarchical; iterative sequences; convergence; insightful; interwoven network of issues - and accordingly made five suggestions. They suggest that researchers should trace "issues" forward and not "decisions" backwards; try new perspectives such as zooming in or out on people and processes; follow processes in real-time and retrospectively; focus on people and personalities and not just events; and re-analyse previously analysed decision processes not just new ones.

A similar emphasis on people and cognitive aspects of decision-makers was made by (Eisenhardt and Zbaracki, 1992). They state that decision-making research for long time has focused on processes and hence they call for more "real-world" normative studies focused on cognitive aspects of decision-making.

Thus, following the lead from accessible literature, we understand that studies in decision-making have not adequately addressed cognition in decision-making,

specifically the influence that spatial information has on decision-making and the judgement in choice of spatial information for decision-making. Such studies have applications in a variety of fields including design and development of decision support systems, human-computer interfaces, development of training materials and systems, expert systems and spatial data infrastructures.

The Case of Public Participation in Local Budgeting

The aim of policymaking is to solve problems and to solve problems we need resources. In a policy environment, resources are allocated for policy implementation and these resources can be financial. We can define budgeting as an implementation of a policy, that is, the allocation of resources in a policy environment.

Public budgeting and finance have a social and spatial impact. It potentially changes the geographical and social landscape of a city. In a democratic setup, the public elect their representatives who make budgeting decisions as a public choice on behalf of the 'public'. New forms of decentralised governance promise to involve the 'public' in the budgetary decision-making process. For example, in order that citizens can participate in governance, three major types of reforms would be necessary – structural, institutional and legislative reforms. Specifically in the Indian context, such reforms are mandated by the 74th Constitutional Amendment Act of 1992 (74th CAA of 1992). This allows citizens to participate in budget allocation at local level of governance (both urban and rural). Such a process has been initiated in the case study area. However, it is pending approval of the State government and we anticipate that this may happen in the later half of 2009.

The new process is a decentralised public choice decision process where the citizens make their choices of spending public funds on works that are prioritised by them in their areas of residence. It offers the opportunity to citizens to be involved in decision-making that affects their social lives. Thus, such a choice can be said to be closer to "public choice". This process is similar, but still different, to Participatory Budgeting that has been popularised across the world from Porte Allegre, Brazil in 1989 (Sintomer, Herzberg, and Rocke 2008; Wampler, 2007).

Participatory budgeting is looked at as a process that empowers the poor and marginalised³. It is said to be a mechanism of democratic decision-making. Since this is the first time that the citizens in the case study area (a city in southern India) will be participating in a local budgeting exercise, the city and the participating groups (now committees of decision-makers) make an excellent case to observe and understand the process in the urban Indian context. Another significant aspect of participatory budgeting is that it leads to "considerable informal political learning among participants" (Schugurensky, 2001). Thus in the present study of decision-making and use of spatial information, the role of learning can be explored.

Thus, while the 74th CAA of 1992 promotes public participation in Indian cities, we can still ask, how far is citizens' participation allowed in the formulation of the budget; how does spatial information affect the participatory decision-making; and how does spatial information affect the judgement and decision-making of individual decision-makers and in collectives?

The reasons why we choose resource allocation decision process and particularly budgetary decision-making is that budgeting is an annual recurring

³ Use of terms: 'poor', and 'deprived' is used synonymously; and reference to 'urban poverty', also means 'urban deprivations'.

process and hence we can observe the same participants in the same process through a longitudinal study. Budgets reflect many things – policies, policy environments, properties of committees, collective behaviour, and factors that influence judgement. At the same time, participatory budgeting makes an exciting empirical case as it involves the interaction of active citizens, elected representatives and bureaucrats. Also in the case study area, citizens will participate in local budgeting decision process for the first time and hence it will offer a first-hand, “process-in-progress” view of decision-making.

Cognitive and behaviour in decision-making

Decision-making is a cognitive process of applying judgement to make choices that takes place within the decision-maker. A decision is an outcome of such a cognitive process. For individual decision-making, it is individual’s judgement and for a collective it is an output of all the participant decision-makers that is spelled out in the decision-making process. Therefore, we can say that individual decisions in collectives eventually lead to a collective decision over time through deliberations (arguments and narratives).

By decision-making process we refer to the socio-cultural environment that includes the rules, norms, beliefs, values, policies, procedures, participants (decision-makers), institutions, agenda (problems or issues), solutions (alternatives or choices) and technology (Simon 1965). Thus, in a decision-making process there are multiple actors and it is a social process. In this process decision-makers present alternative solutions to issues, argue on appropriate ones, deliberate (weigh and consider) some alternatives and finally make a choice of one supposedly most appropriate solution to a problem.

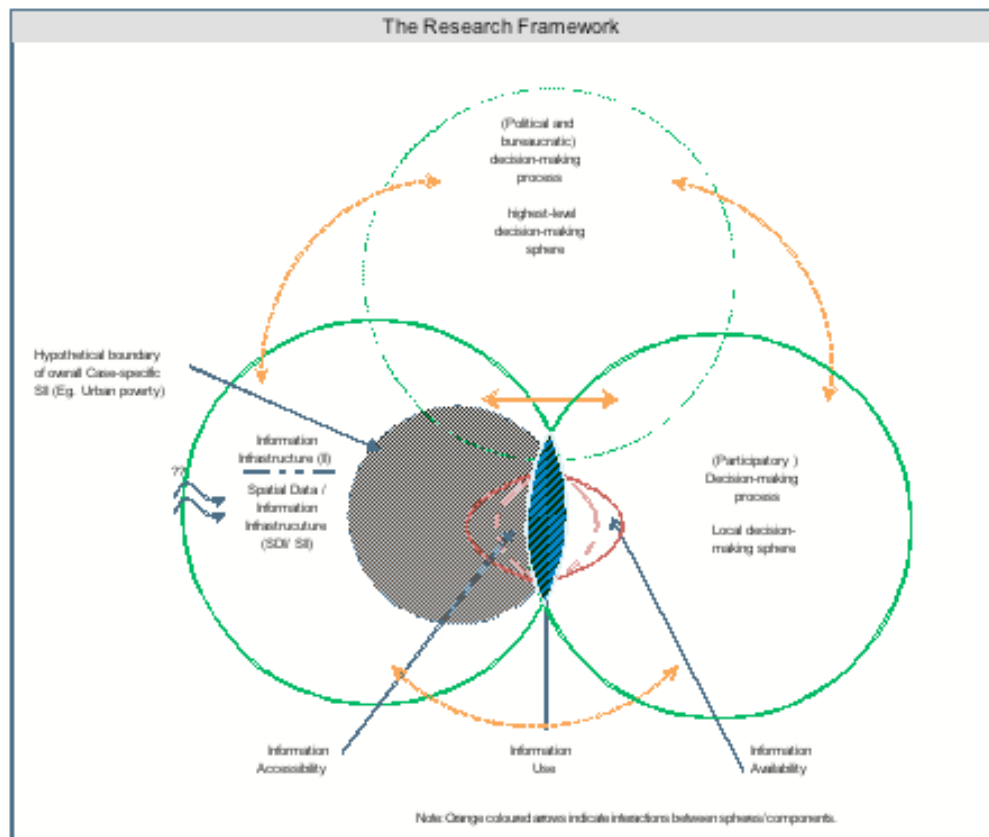
Although cognition and behaviour play an important function in decision-making and have received attention in decision-making literature there are a few gaps in understanding the role of cognition in decision-making. In addition, most studies have been conducted either as laboratory experiments or in western countries. The research studies the use of spatial information in decision-making by individuals and by collectives in the Indian context.

3. AN ETHNOGRAPHIC APPROACH TO STUDY SPATIAL INFORMATION USE IN DECISION-MAKING

As mentioned earlier, there are very few studies that focus on the use of spatial information in decision-making and these are primarily in western countries. One such study is worth mentioning here. This research conducted by Carton (2007) uses maps as a specific type of spatial information that is used in policymaking in the Netherlands. She states that the map changes form in a multi-actor environment (ie. in the policymaking process) and is viewed differently by different actors in the policy process. That is, for each of these actors, the map has a specific function to perform. Based on the ways these actors used maps (i.e based on the functions that the map had for these different actors) Carton uses the concept of frames and framing and reports the existence of three types of archetypal frames in a Dutch spatial planning process – the analytic frame, the design frame and the negotiation frame.

The current research is close to this research but significantly divergent as it studies the influence of frames (judgement) on decision-making and the influence of spatial information on the decision-maker’s frames in a “real-world” decision environment in a non-western environment (specifically, India).

Figure 1: The Research Framework – Through this research we will investigate what spatial information is available, what is accessible, and what and how much is being used. But the focus of our research is on use of spatial information in participatory decision-making, particularly, in municipal budgeting.



Carton looks at the purpose of the maps as one type of spatial information but she does not investigate the influence the map has on the decision-makers' frames or the decision. This is another point of departure from her work. We look at spatial information in general and the influence spatial information has on decision-makers' frames (judgement) and how decision-makers apply judgement (ie. value) spatial information in decision-making. For Carton and Thissen (2008: 2) "maps are not neutral 'mirrors' reflecting what exists and what happens on the ground, but they reflect a culturally, socially and politically shaped view on reality. As such, maps frame the world, offering its viewers a particular conceptual lens on spatially related phenomena." We extend this concept to spatial information in general. Thus we look at frames (judgement) and their influence on selection of spatial information and decision-making in a different cultural, social and political environment and in individual and collective decision-making environments (ie. decision-making by individuals and decision-making by these individuals in a collective). This means there are two outcomes – one is the outcome of the individual cognitive process and the other is the output of the collective).

Furthermore, Carton and Thissen (2008) also look at maps as 'boundary objects', that is they are common to the three frames (namely, the analytic frame, the design frame and the negotiation frame and hence the three categories of actors). Hence, forward tracing the map in the policymaking process allows Carton (2007) to understand different functions of the same map/s for different actors in the same policy process. Again, since we are not looking at maps per se, but spatial information in general, we do not look at this spatial information as boundary objects

but rather as information that is inherent in the arguments of individuals in collectives that deal with spatial problems (such as poverty and deprivations). The 'information frames' that these arguments affect are to be studied and the ways (mechanisms) in which they influence the 'decision frame' of the individuals in a collective is to be investigated.

We use three prime groups of concepts in this research, which is guided by relevant literature from decision sciences, policy sciences, and information sciences. As the concepts we use have fuzzy boundaries they interactively fall in all three of the literature fields.

First, we use the concept of 'judgement' and 'cognition' from decision science to understand the decision-maker in the context of a 'decision situation' and the 'collective' in a specific cultural, social, and political environment. Second, we also use the concept of 'frames' from framing theory and 'issue framing' from policy science to understand how decision-makers use judgement to frame issues through the process of cognitive frames. Third, we use the concept of 'spatial information' to differentiate between the different types of 'information'. We distinguish between spatial and non-spatial information. Information can be in various forms – physical/digital: maps, images, photographs, etc.; and textual/virtual - opinions, ideas, perspectives, rules, norms, narratives, etc. Information also includes quantitative and qualitative types. We are specifically interested in spatial information.

Using 'frames' to understand cognition in decision-making

We use the concept of frames to understand how individuals and individuals in collectives make local government budgeting decisions. This concept will also allow use to understand how individual decision-makers use spatial information to allocate budgets and the influence spatial information has on judgement of the decision-makers. We will also investigate how decision-makers apply judgement in the choice of spatial information.

To begin with we use the following definition of a frame. "To frame is to *select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation* for the item described (Entman 1993: 52)". From an information perspective frames are "mentally stored clusters of ideas that guide individuals' processing of information (p.53)." But this is not the final definition of a frame. It is subject to change, but having one at the beginning of the research gives us a lens to look at real-world events. Also, we use frames from decision-maker's behaviour as proxy to understanding cognition. Thus, 'frame' is a tool to understand behaviour and cognition in decision-making.

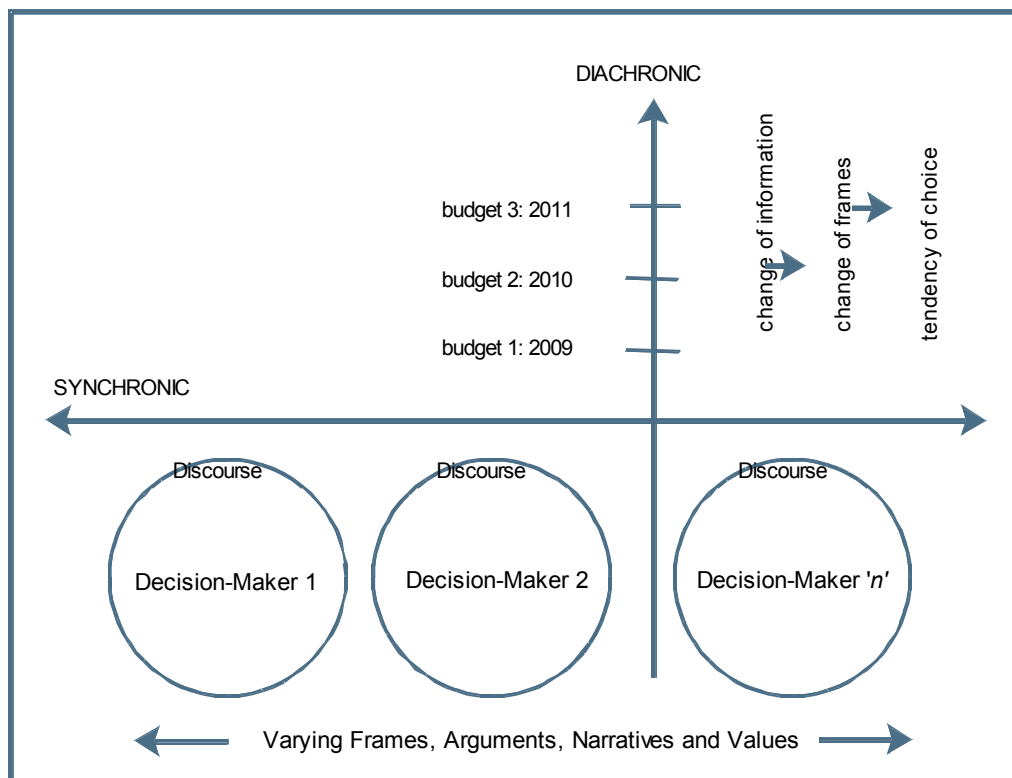
Frames may be classified as issue frames (such as policy frames) and cognitive frames. In the policy arena, frames refer to normative and sometimes cognitive ideas that are located in the foreground of policy debates (Campbell 2002: 26). It is a type of idea as are cognitive paradigms, worldviews, norms, and policy programs (p.21). In policy decision-making arena, frames are used to affect attitudes by influencing the importance individuals attach to issue-relevant beliefs rather than just as a means of persuasion via change in belief content (Nelson, Oxley, and Clawson, 1997; Nelson and Oxley, 1999:1040).

The definition of framing we follow here is similar to (Goffman, 1983: 10-11) who describes social frames as social representations in which we are subjectively involved; (Tversky and Kahneman, 1981: 453) define decision frames; and (Rein and Schon, 1996) define policy frames and differentiate between rhetorical frames and action frames.

The process of framing involves making judgement on what information could be used or what information would be most appropriate for making a decision related a particular decision problem. Thus we will investigate the role of spatial information in making judgement and the judgement that is applied (framing) to choose spatial information that is deemed suitable for the particular decision problem (and our decision problem is budget allocation).

Thus by establishing the frame by which people judge information we can say what data is available and accessed and why particular data (information) is informative to the decision process and the decision. It also needs to be seen why a particular decision is important from the perspective of the frame and whether frames change between decision situations (diachronic) and within the same individual (synchronic) (see figure 2). This can be achieved by conducting pre- and post-interviews and through participant observation during deliberations and outside group meetings and by shadowing key informants.

Figure 2: Different decision-maker has varying frames and values and generate varying arguments and narratives. These frames vary over time as new information is received. Thus, a synchronic and diachronic investigation is required. The annual budgeting process provides an appropriate entry point for such an investigation.



We believe that one decision-maker can have different decision-making styles depending on the decision situation. In this research we hope to discover varying decision-making styles ranging from analytic or normative where ends-means are known to intuitive (such as naturalistic) which are at the other extreme where a

choice may be made by heuristics, common sense or by experience. A decision-maker may exhibit a combination of styles and this depends on the decision situation (environment). However, how this happens and how spatial information influences this shift has not yet been investigated. Since we also intend to discover these varied modes of decision-making, we do not adhere to any particular decision-making theory or model.

This, in turn, influences information search and use in decision-making and the judgement (framing) applied in the selection of information. Further, this can have significant implications for SDIs to support decision-making by informing SDI development regarding the cognitive and behavioural aspects of (individual and collective) decision-making.

Methodology to Understand Information Use in Decision-making

The uniqueness of this research is that it studies decision-making as a practice of use of a local SII (Richter, 2008). By using the case of municipal budgeting, we are studying the use of a local thematic SII that would support local government budgeting decision process, which involves public participation. Unlike other studies in SII research, we propose to use an interpretive approach to studying the use of SII in decision-making in the city located in south India.

We propose to use an exploratory–interpretive theoretical approach to our research. We will explore using the case study approach to fieldwork and will use ethnographic methods. There are two units of analysis: individuals and collectives (groups). For individual decision-makers, we will have two levels of analysis: cognitive and behavioural. Specific research methods to be used include participant observation, structured and semi-structured interviews, neighbourhood walks with various respondents and discourse analysis.

Cognitive analysis will include an investigation of how decision-makers think, what they know and how they think. Data would be collected from in-depth interviews and by asking respondents strategic questions such as “What would you have done if you were in a similar position”. Whereas, behavioural analysis will include studying decision-making and information sharing behaviour of individuals in collectives. This will be achieved by an analysis of the arguments they make (and use) in the decision-making process regarding spatial information. Discourse analysis will be used for this purpose. It will also be useful for frame elicitation.

We propose to use ethnographic techniques such as participant observation and structured interviews to elicit information use by decision-makers. Here, the concept of a ‘frame’ is particularly useful to understand the use of spatial information and the influence of spatial information on decision-making by individuals in collectives. We look at a frame as an instrument that is used to apply judgement in selection of spatial information and to make arguments related to issues by using selected information. As discussed earlier decision-makers use frames to ‘see’ and value information and thus to frame the decision problem in a decision situation. Hence, making a decision means processing and using selected information. When we see the frame in advance (pre-) and then in the collective (post-), we can differentiate between the two frames. Simultaneously, we will look at the whole argument - how much was contributed by spatial information to the outcome that is in the form of frames and arguments and whether they match.

We will look at these person-bound frames and collective frames and see the making of a collective frame, that is, the frame before, during and after collective

(again, pre- and post-) deliberation. This means looking at how this frame is set in a collective (again, how do collectives reach at a common frame) and what spatial information is used in this framing and what spatial information results (influences) the creation of that frame. Within the case study area, we will follow the empirical case of 'citizen participation in local budgeting' decision process.

3. CONCLUSION:

Fewer studies focus on cognition in real-world situations and investigate real decision tasks. Although it is difficult to know what is in the decision-makers mind, ethnographic methods of inquiry may prove to be promising and may provide a robust conceptual framework to investigate decision-making in such situations. Taking hints from the decision-making literature, we will investigate cognition and behaviour of decision-makers in an empirical case of public participation in local government budget allocation process in an Indian city. The concept of 'frames' may provide us with a universal instrument. This approach can be used to replicate the study to understand similar situations elsewhere in the world.

This research intends to add to a diverse body of knowledge across crosscutting fields of decision science, information science, policy science, and cognition. The research has implications, particularly for the development, upscaling and institutionalisation of SII in countries such as India which have a diverse cultural environment (social, political, economic and ecological cultures) and where decision-makers may be using multiple modes of decision-making not previously known. However, this is a humble beginning in the investigation of the vast field of decision-making in the Indian context and this task is not an easy one given that there is no 'modern' precedence.

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