UNITED
NATIONS

E

Economic and Social Council

Distr.
LIMITED

E/CONF. 92/BP.11
13 April 2000

ORIGINAL: ENGLISH

FIFTEENTH UNITED NATIONS REGIONAL
CARTOGRAPHIC CONFERENCE FOR
ASIA AND THE PACIFIC
Kuala Lumpur, 11- 14 April 2000
Item 9 (k) of the provisional agenda *

REPORTS ON ACHIEVEMENTS IN SURVEYING, MAPPING AND CHARTING IN ADDRESSING NATIONAL, SUBREGIONAL, REGIONAL AND GLOBAL ISSUES, INCLUDING: POLICY AND MANAGEMENT OF NATIONAL SURVEYING AND MAPPING ACTIVITIES

Corporatisation of National Mapping Agencies - Challenge and Opportunity**

(Submitted by International Institute for Aerospace Survey and Earth Sciences (ITC))

* E/CONF. 92/INF. 1

** Prepared by Professor Ir. Richard Groot, International Institute for Aerospace Survey and Earth Sciences (ITC)

Corporatisation of National Mapping Agencies: Challenge and Opportunity.[1]

Richard Groot[2]

Introduction

The motivation for writing this paper is to contribute to more productive debate between policy makers in central government and executives of National Mapping Agencies (NMA) about the issue of privatisation.

In the discussion on privatisation governments often take the position that they are not altogether convinced of their own interest in the services provided by NMAs, and that, whatever that interest may be, it could probably be provided better by the private sector. Hence their position that this proposition should be tested by privatising these organisations.

Needless to say that executives of NMAs take a different view. They claim that their organisations play an infrastructural role in the information requirements of government and society as a whole and that the quality and reliability requirements are such that their activities are a natural monopoly providing a public good and cannot fruitfully be carried out in the competitive marketplace. See for example Coopers and Lybrand (1996). In most cases they will resist going further than contracting out of some production work or some form of cost recovery in the sale of their products and services.

The ensuing conflict between the undifferentiating rallying cry for privatisation from central government agencies and the defensive reaction of NMAs can drag on for years. It causes long term and undesirable uncertainty for NMAs, at a time when they are being faced with complex re-tooling and business process redesign to meet a growing diversity of demands for products and services. The discussions are rarely based on clear principles, points of departure or business objectives. As a result opportunities are missed to create a more effective business environment in which NMAs can meet government's interest in reliable information supply in support of their own essential activities and service delivery and that of the economy as a whole.

In large part based on experiences and theory in the field of regulation of natural monopolies that have been privatised, the author has developed points of departure and principles for this debate. Although rarely the case, the obvious starting point must be to define what the purpose of the privatization is and to determine if this is in sympathy with the purpose for which the National Mapping Agency exists.

In order to govern, governments must have guaranteed access to reliable, timely and up to geospatial information about the country as a whole. How can this requirement be met in

---

[1] This is an adapted version of Groot R. (2000)"Reform of government and the future performance of National Mapping Agencies" in the Special Issue on Cadastre of the Journal of Computers, urban systems and environment. (Pergamon), (in preparation)

[2] Professor of Geoinformatics Management and Infrastructure at the International Institute for Aerospace Survey and Earth Sciences (ITC), The Netherlands.

the most effective way? To fill this necessity in the past governments established national surveys of all kinds, including NMAs, within the regulatory environment of the Public Service. Is this still the most effective environment considering the major technological changes in the NMA as well as the user community which has occurred since the introduction of ICT?

Hence the paper addresses first the question of the effectiveness of meeting the requirements of government and its more recent policies. It derives a set of strategic boundary conditions for the management of NMAs which form the points of departure for the discussion on the desirability of more independence from the Public Service regulations. Outright privatisation is the most extreme form of this independence. It has however serious drawbacks and the author claims that less radical forms of independence have a significantly bigger chance of meeting the complex of government geospatial data needs.

2- What is the interest of government in efficient geospatial data supply?

Governments need geospatial data, referenced and defined in the national context, for their own purposes in legislative and policy development, for the allocation and management of natural resources, for defence and public safety purposes, in support of a variety of regulatory activities, and generally in promoting a better understanding of the physical, economic and human geography of the nation. To satisfy the requirement of the national context, the data is referenced in a national co-ordinate system or "geodetic datum", while the data definitions are consistent for the whole country. There is often a temporal dimension as well signifying how some feature has changed over time.

A key characteristic of these standardised government geospatial data is the potential for multiple often-unpredictable applications inside as well as outside government. These unintended benefits are in economic terms "positive externalities".

At the most senior levels of government, high expectations have been expressed about the beneficial effects of the 'information society' or 'information economy', for example to the delivery of healthcare, transportation management, life-long learning, sustainable development[3], etc. The role of the private sector in providing the communications infrastructure and the so-called 'value-added' information services is emphasised strongly in achieving these benefits. Recognising that the government itself is a very large source as well as user of such data, efficient and easy access to these sources becomes a high priority. Hence these expressions of policy signal that facilitating access to government owned data results in increasing positive externalities by reducing transaction costs to society as whole. These expectations have been articulated in, for example, Bangemann (1994), Executive Order 12906 of President Clinton (1994), and in EC (1998).

[3] Addressing concurrently the economic and environmental dimensions of resource allocation and management.

In this context the notion of the sharing of existing data through Geospatial Data Infrastructures (GDI) emerges as a significant matter of efficiency. See for example Branscomb (1982). Groot and McLaughlin (2000) define the purpose of GDI as to facilitate access to and responsible use of geospatial data at 'affordable' prices. GDI is seen in this respect as a generalised concept which can be implemented at the enterprise level, the level of broad application domains such as coastal zone management, urban management or physical planning, or in the national context. Fig. 1 shows the idea of GDI for the application domain Environment and Physical Planning.

<Fig. 1 here>

On the right hand side are the individual applications with their GIS systems, which all need a routine supply of data. This stream of requirements is being met through a Geospatial Data Service Centre (GDSC). The Framework Data which provide the background for many applications is obtained by the GSDC from relevant sources and harmonised / standardised for its application domain. They also add application specific data in a standardised way for optimal sharing in the application domain. The GDSC also ensures that the application data are described in a national meta data standard to facilitate the sharing of these resources by other potential users. The GDSC sets the pricing policies for this in keeping with overall government policy on this subject.

Generally speaking the National Surveys are the relevant sources for the Framework Data. A special subset of these data is the Foundation Data (FD) which is the fundamental geographical reference for all other thematic application data. NMAs are usually responsible to produce, maintain and distribute the FD.

Within the context of the efficiency and effectiveness of government itself and the mentioned political expectations optimal performance of NMAs and responsiveness to their client community is obviously of paramount importance. Since their inception (mostly in the mid- 1800's) they have enjoyed a monopoly in the technological and industrial organisation of national survey activity.

Beginning in the mid-1970s these monopolies became increasingly challenged due the growing proliferation of Information Technology (IT).
The surveying and mapping technology has become increasingly embedded in software and accessible to non-specialists in the NMAs client community. Furthermore the client community obtained growing access to substitute products for the standardised topographic bases or thematic framework data sets (for example from Remote Sensing[4]). Both challenge the monopoly of the NMAs. Furthermore, the client community is increasingly changing to include users interested in the digital data for application in Geographic Information Systems (GIS).

These effects of the IT coincided with growing government deficits, which for most has led to a 20 year period of budget reductions, demands for revenue generation and, in the context of reform of government, privatisation. See for example Groot(1998). More

[4] Remote Sensing refers to Earth observation technologies from spaceborne platforms.

importantly these radically changing circumstances led to critical review of the relevancy of mandates, for example in Canadian Government (1986), Department of the Environment (1987), Mapping Sciences Committee. (1990), ANZLIC. (1996).

NMAs all over the world have been slow responding to these changes and many are experiencing major problems pushing through the restructuring necessary to move from automation to informatisation[5].

Poor performance by NMAs leads to the client community, especially the GIS community falling back on cheaper and often simpler but more up to date substitute products from whatever sources may be available. This in turn leads to the loss of the positive externalities outlined above, to costly duplication, reduced and incompatible accessibility of existing (government owned data), increased transaction costs, and possibly reduced timeliness in decision making processes. In many ways it negates the full exploitation of ICT to the benefit of society in geospatial data applications.

It is significant that in those countries where NMAs have successfully adapted to the dynamics of the ICT environment and the imperatives of government reform, the informatisation has not only been accompanied by institutional and regulatory reform but in large part also been driven by it. The organisation was thereby placed in a regulatory environment in which both management and staff are motivated to be innovative and efficient and are rewarded for this.

While learning from the experience of regulatory reform for other natural monopolies, NMAs need to answer the following questions in developing their response to these new demands:

- What constitutes their Natural Monopoly in the ICT environment?
- What role can NMAs play in a competitive market for the delivery of goods and services which can no longer be considered as part of the natural monopoly? In other words, how can an NMA compete fairly in the market for these products and services?
- What institutional environment can be created in which the motivation and rewards exist for management to be efficiently responsive in a dynamic technological and client environment and in furthering society's interests in the broadest possible use of government owned data.

3- What constitutes the present Natural Monopoly of NMAs?

The geospatial data business can be divided into the preparation of the foundation data sets for all other public and private thematic applications as a common spatial reference for end-users and for value –adding users. End-users take the foundation data and add

[5] Automation: the introduction of IT to improve efficiency of existing production processes. Informatisation: the introduction of Information and Communication Technology (ICT) to respond to and develop new markets and client-oriented processes.

atttribute values or other thematic data for their own purpose. Value adding users do the same for re-sale to third parties. In a networked digital geospatial data environment, the consistent availability of up to date and reliable foundation data opens opportunities for a broad sharing of this foundation data set with significant positive externalities to society. In addition, it facilitates participation in the information market place by all thematic geospatial data owners who apply the FD and who thus become part of the information economy. This environment is called a Geospatial Data Infrastructure (GDI).

NMAs have been responsible for the production of the foundation data in hard copy form for up to 200 years in some countries. Before the introduction of IT, the production processes were analogue and the output was in hard copy, highly standardised topographic maps serving a multiplicity of users with one product as shown diagrammatically in Fig. 2. This was the old natural monopoly.

<Fig. 2 here>

Ubiquitous availability of digital technology has changed the business environment significantly as presented in Fig. 3. The source of the foundation data is also satellite and airborne imagery which, combined with the national positioning system, produces the national elevation model. To the elevation model can be added the basics of the topography to produce a so-called Topographic Template, Smith and Rhind (1999), which properly structured serves as a geospatial reference for thematic applications. Not all foundation data can be seen from the imagery. Official geographic names or property boundaries require ground surveys or administrative methods for their collection. The foundation data can be seen as an interrelated system, which we shall call the National Foundation Data System (NFDS). However, in response to the new demands for product diversity the constituent parts can also be marketed separately.

<Fig. 3 here>

For the purpose of this paper, the market for the NFDS has been divided (Fig. 3) into two segments. A segment for analogue, special purpose maps made on demand (but using digital methods). Note however that these maps can also be delivered in an internet environment for example. The second segment is of growing importance, namely the market for digital data for the Geographic Information System community. In each market the foundation data is being combined with thematic data for end users or for value-added processes and products in a competitive market for a host of geospatial data applications and systems.

In this concept national topographic maps become value added products, i.e. attribute values relevant to the content and symbology of official topographic maps are added to the topographic template. Entry into the value-added market for both market segments, including for example the production of national topographic map series requires relatively little capital and is no longer part of the traditional monopoly of the NMAs. In fact it is expected that there will be a growing market in this field with many companies

competing to meet the demand for growing product diversity when access to government owned data becomes easier. In part this also reflects the political vision presented at the start of this paper.

4- The National Foundation Data System (NFDS) as a natural monopoly

If output for a relevant market can be produced at a lower cost by one firm than by its competitors, economic theory defines this as a Natural Monopoly (NM). The NFDS must cover the country as a whole to be of use to government. Hence, the 'relevant market' is the demand for foundation data of the country as a whole. The NFDS also has the characteristics of an imperfect public good. Coopers and Lybrand (1996)

Characteristically, the sunk costs in the NFDS are many orders of magnitude larger than the cost of dissemination. Competitive entry into the NFDS business is therefore difficult and could, in fact, lead to duplication of the NFDS, which makes no economic sense whatsoever. If two or more competitors would enter the NFDS market, each would focus on the most lucrative part of the market and thus cause market failure for the other parts. Also within the lucrative part of the market one of the competitors would always be more efficient than the other and this would result in a return of the Natural Monopoly.

The real assets of the NMA are the data and the historical archive for which it has stewardship. It needs a critical mass of specialised management, scientific and technical expertise to provide the economies of scale to produce and maintain the NFDS to the standards and specifications required and to exercise its stewardship of these assets.[6] These are valuable assets not just to government but to society as a whole.

Importantly however, relatively low-cost, ubiquitous electronic surveying and mapping and GIS technology makes market entry into the value-added geospatial information production market (based upon the foundation data) relatively easy and, as a consequence, this is not part of the natural monopoly.

Hence, the sunk cost *and* scale economies together deter entry into the NFDS market by other firms. Therefore of the NMAs outputs, the NFDS qualifies as a natural monopoly

5- The competitive delivery of geospatial products and services which are not part of the natural monopoly.

5.1- Why the NMA should be allowed to compete.

[6] Many NMAs in developing countries or countries in economic transition have serious problems in creating this critical mass of expertise and keeping it, mainly due to the lack of incentives and reward systems offered by civil service organisations.

The previous section leads to the conclusion that the core business of the NMA is to ensure that the NFDS is designed, implemented, maintained and made accessible at transparent prices in response to the client community.

As indicated earlier, the foundation data are used for a growing array of geospatial data products and services which are not part of the natural monopoly of the NMA. In many countries serious objections are made to the NMA competing in this market as it is feared that unfair competitive advantage will be taken by the NMA of its monopoly, i.e. its ownership of the foundation data. The philosophy in the European Community in respect to this issue is laid down for example in CEC (1989), *Guidelines for improving the synergy between the public and the private sectors in the information market.* Basically it is not allowed for any monopolist to take unfair advantage of his monopoly power. This is in many countries also regulated by various forms of Anti Trust Legislation. But in the case of government information agencies it is also forbidden to participate in the competitive market on the basis of cross subsidies from their government monopoly activities.

All things considered these are valuable arguments but they overlook the argument of *economies of scope* which is as follows. We stated earlier that the sunk cost *and* scale economies together deter entry into the NFDS market by other firms and that this leads to the NFDS being a natural monopoly. Due to the monopoly position there are economies of scale to be exploited in the operation, especially if the property registers and cadastral mapping is included in the NFDS as indicated in the model shown in Fig. 3.

If, as a result of the economies of scale of a natural monopoly, it is more efficient to produce product x and product y together in the monopolist's facilities instead of separately in different companies, society benefits from these economies. Given the specialised know- how and capacity in an NMA due to its natural monopoly position, we should expect it to be a successful competitor, although this is by no means assured.

Mathematically this can be represented as follows:

It is in the interest of society if

$C(x;y) < C(x;0) + C(0;y)$ where C(x;y) equals the cost of producing product x and product y in the same facility; while C(x;0) and C(0;y) are the costs of producing them in separate facilities.

$$C(x;y) - C(x;0) < C(0;y)$$

Or:

$$IC(y) < SAC(y), \qquad (1)$$

Where IC(y) equals the incremental cost of producing product y in addition to x in the monopolist facility and SAC(y) is the stand alone short run average cost of producing product y in another facility.

Hence (1) states that the incremental cost of producing product y in the monopoly is smaller than the stand-alone cost of producing product y. These net gains to society are *economies of scope*.

Let product x be the foundation data which are necessary input for the production of product y. If the NMA could operate in a fair and competitive environment in the value-added (non-monopoly) part of the business, the market forces will determine if (1) holds and thus if economies of scope are being realized. This is a clear and uncontestable mechanism to determine if economies of scope can be realised. Hence from the point of view of society there should be no objection for the NMA to operate in this fashion.

However, a problem arises when competitive firms need the foundation data which are owned by the NMA if the latter is also one of the competitors. Unless prevented from doing so the NMA will take advantage of its monopoly and charge itself less for the use of the foundation data than it charges the competition. To benefit from the economies of scope it will therefore be necessary that all competitors must be guaranteed equal access to the foundation data if the NMA is one of the competitors for the same business. This is called providing a level playing field for all competitors in the value-added business. That is, access to the NFDS, i.e. the assets of the monopolist (NMA) needed by competitors to function in the market place if the NMA is one of the competitors.

5.2-How to provide a level playing field?

Providing the level playing field is an access problem to an asset controlled by the monopolist which he may not derive unfair advantage from as this would distort competition. This is not unusual in monopolistic situations, for example, consider competing railway companies who must use a railway bridge that is owned by one of them. In economics this is the problem of 'bottleneck pricing'.

If the NMA were not also a supplier of value-added products in the competitive market, charging one price for the foundation data to all value-added producers that compete with one another would not constitute a competitive impediment. By avoiding differential pricing in the sale of bottleneck products or services to final product providers, they are left free to compete for customers strictly on the merits.

Society will benefit only from economies of scope, if the NMA who sells the bottleneck product is also a seller of value-added products, provided equal access to all competitors including the NMA to the NFDS (the bottleneck product) can be assured.

Baumol *et al* (1997) provides the theoretical basis for dealing with this issue. This principle is called the "Parity-principle formula for bottleneck-service pricing". As applied to the NMA it would mean the following:

The minimum price P of the final(value added) product of competitor C equals the price of the bottleneck product (foundation data) P(b) *plus* its incremental cost Ic(C) of the value adding activity:

$$\text{Minimum } P(\text{final product},C) = Pb + Ic(C) \qquad (2)$$

In the case of a level playing field, the minimum price P of the final (value added) product of competitor C is equal to the price of the final value added product charged by the monopolist N *minus* the incremental cost Ic(N) of the value adding activity by the monopolist N *plus* the incremental cost Ic(C) of the value adding activity of competitor C:

$$\text{Minimum } P(\text{final product},C) = P(\text{final product}, N) - Ic(N) + Ic(C) \qquad (3)$$

(this equation defines the level playing field).

Solving (2) and (3) for Pb gives:

$$Pb = P(\text{final product } N) - Ic(N) \qquad (4)$$

where C = competitor
N = NMA (bottleneck producer, i.e. foundation data owner)
Pb = price of botttleneck service (NFDS)
Ic(C) = incremental cost of the value adding activity for C
Ic(N) = ditto for NMA.

(4) States that a level playing field is provided if and only if the price for the foundation data charged to the competitor C is the same as the price, which the NMA charges itself. Of course the NMA as a monopolist will not do so out of its own volition. Therefore an independent regulator needs to oversee that this principle is being adhered to.

5.3- What should be a consistent price setting behaviour of the NMA on the NFDS?

We shall assume that government has three strategic goals:

i- For its own purposes and efficiency it must have guaranteed access to the Foundation Data at *the lowest possible cost;*
ii- In the interest of society Government should pursue the broadest possible use of the foundation data because this would multiply the *positive externalities* mentioned earlier and avoid the inefficiencies to society arising from the use of inferior substitutes which do not meet the minimum standards and specifications of reliable foundation data;
iii- In the context of reducing deficits and following the *"user pay principle"* governments will demand that the NFDS must become independent of government subsidies within a reasonable time frame, say 5 years.

These goals point to a strategic objective for the management of the NMA, namely that of maximising output subject to the constraint that economic profit cannot become negative.

In other words: to ensure the broadest possible use of the NFDS the price should be as low as possible but not so low that it requires continued government subsidy. Against this background we should have another look at pricing and market segmentation.

Figure 4 demonstrates the difference in pricing under the constraint of profit-maximising and output-maximising. The condition for profit maximising is that the long-run marginal cost (LMC) equals the marginal revenue (MR). Hence, with a given technology a monopolist would produce the quantity Q* for which the LMC is equal to MR. For that quantity, the demand curve indicates the price P*. Profit is indicated by the area Π. The output-maximising manager will set production at the point where the demand curve (D) intersects the long run average cost curve (LAC), that is at Q' for which a price P' is indicated. Clearly profit is zero but output is up at a lower sales price benefiting customers. Shareholders in this company would lose Π. If government is the sole shareholder, as in the case of an NMA it may be willing to forego these profits in favour of providing lower cost access to the foundation data, and achieving the positive externalities generated by broader use of the foundation data. *At the point (P',Q') profit is zero, hence if government wants to set a constraint of full cost recovery it must stipulate prices where economic profit may not be negative.*

<Fig. 4 here>

5.4- Management discipline in defining the content of the NFDS.

Even at the price P' the NFDS products may be so expensive that large parts of the potential client community would turn to cheaper and non standardised substitute products and thus obviate some of the positive externalities.

P' is a function of the LAC. This in turn is a function of the complexity of the NFDS products such as the Topographic Template. The more complex, the higher the LAC and the higher P'. To prevent government from having to resort to subsidies to bring the price down and thus increase demand and so increase the positive externalities it should hold management to the objective of zero subsidy to be achieved over for example a five year period. This will force management to reconsider the content and complexity of the NFDS. It is very difficult for NMAs to see the Topographic Template as a more simplified and specialised product than the digital copy of a topographic map. The latter is too complex and takes too long to produce and subsequently maintain to be of interest for example to serve as a consistent spatial reference for most GIS users. Department of the Environment (1987, p. 67) Hence the economic constraint on the monopoly pricing combined with a "no subsidy in five years " policy provides management with the discipline to critically review the content definition of the NFDS and guard against the unnecessary addition of data which are not essential to the effectiveness of the products. In many NMAs this discipline does not exist as the conventional topographic map content in digital form is assumed to meet the requirement of the new user community. Also the tendency exists to uncritically add new data content without real hard demand justification, thus adding to already difficult to meet timeliness of production and maintenance.

5.5- Other price setting behaviour and cross subsidies

We have suggested earlier that the market can be split into end users of the NFDS (users who apply the foundation data for their end use) and value-adding users (clients who take the foundation data and add other data to create new products, either directly for single clients or for sale in a broader market) (figure 3).

Let us suppose that the NMA does not participate in the value-adding market. Then it would stand to reason that it charges the price P′ (fig. 4). This policy would lower the prices of value-added products and services and generally have the desirable effect of stimulating the geospatial data production industry, which would be in line with contributing to meeting the high expectations of the benefits of the information society.

As we have shown above, from an economics point of view the NMA should be allowed to participate in the value-adding market if a level playing field can be guaranteed for all competitors. The condition for this is that the NMA can only charge its competitors the price for the NFDS it charges itself. This price would for the same reasons as explained in the former paragraph be the price P′.

The competitive segment of the market will determine if economies of scope can be extracted. Although the NMA is expected to be a successful competitor, this is by no means guaranteed. In its zeal for budget reductions, governments may be tempted to cross-subsidise the NFDS from the commercial activities. In light of the inherent uncertainties in the competitive segment of the market this should be prevented. The NFDS must stand on its own financially, either on the basis of total cost recovery or partly subsidised. Cross subsidy would also detract from he management discipline required to meet all 3 strategic goals mentioned on page 11.

What happens to the profits from the value-added market? These should be re-invested into the enterprise to improve its efficiency. Undoubtedly some will see this as an indirect cross-subsidy to the NFDS, but we do not accept this argument. If it is in society's interest to exact economies of scope, it follows that it is also to its interest that this is done as efficiently as possible. Reinvestment of profits from the value-added segment of the market would improve the economies of scale in the NFDS production environment, which is a positive effect of the economies of scope. However, cross subsidy implies higher than necessary output or uncritically increasing data complexity and that must be avoided.

It would be easiest to administer one price (P′) for the NFDS products for all users. However, NMAs will be tempted to practise price discrimination for end-users. For institutional users, price elasticity of demand is often high. They need quality data and within bounds of willingness they will pay for it. In part this is due to the fact that relative to the financial implications of the activities for which the data are needed, the cost of the data is low. The willingness to pay can be discerned in negotiations, and in most cases a deal can be struck, for example, for issuing subscriptions to updated NFDS products as opposed to one time sales. It would require a very careful analysis of the market segments and their relative financial importance to say in how far this price discrimination would

conflict with output optimisation, necessary to meet the goal of achieving the broadest possible use of the NFDS.

5.6- The role of regulation

Natural monopolies need to be regulated in order to ensure that they do not exploit their market power, for example by setting monopolist prices. Much has been said and written about this subject, more recently addressing a degree of overkill and the high costs of regulation. See, for example, Posner (1969) for an extensive critique of regulatory practice, or Train (1991) or Baumol and Sidak (1994) all of whom incorporate much international experience of standard regulatory mechanisms. Baumol *et al (1997)* provide a sort of bottom line for regulatory involvement as explained earlier which appears to be applicable to NMAs.

They present the principles of 'the new approach' to economic regulation. "The sole purpose of economic regulation is to facilitate and encourage effective competition where feasible, and to provide an effective substitute for competition where that is not possible, at least for a substantial period. The underlying premise of the new regulation is that where competition is effective it can do a better job of protecting and promoting the public interest than any government agency. Therefore where, and only where, competition is either absent or too feeble to do the job, it is appropriate for the regulator to step in. But in doing so, the regulator's obligation is severely limited. It is to supply as near a substitute for the missing ingredient as can be devised, that is, to determine means to elicit the business behaviour that effective competition would have enforced if only it had been present."

In regulating the NMAs monopoly one must keep in mind the 3 strategic goals of government. It appears then that the lowest level of independent regulation must focus on:

- the level playing field.
- the desirable pricing behaviour (based on output-optimisation) of the NMA;
- the ban on cross–subsidising the NFDS from the commercial value-adding activities;

As long as NMAs continue to be a standard part of the public service there are many impediments which make it next to impossible to carry out such regulation not the least of which is the absence of complete cost-accounting systems in most government organisations. Another issue is the preferential position of government organisations with respect to the taxation system.

We can now address the third question (page 4):*What institutional environment can be created in which the motivation and rewards exist for management to be efficiently responsive to the changing client environment and in furthering society's interests in the broadest possible use of government owned data?*

6- Points of departure and principles for the debate on privatisation.

These points of departure are proposed as the basis for the "privatisation" discussion concerning NMAs.
The context is provided by the three strategic goals of government which are repeated here:

i- for its own purposes and efficiency it must have guaranteed access to the Foundation Data at the lowest possible cost;

ii- in the interest of society Government should pursue the broadest possible use of the foundation data because this would multiply the positive externalities mentioned earlier and avoid the inefficiencies to society arising from the use of inferior substitutes which do not meet the minimum standards and specifications of reliable foundation data;

iii- in the context of reducing deficits and following the "user pay principle" governments will demand that the NFDS must become independent of government subsidies within a reasonable time frame, say 5 years.

To contribute to meeting these strategic goals, we have developed the following principles and points of departure which will form the management framework for the NMAs:

1- For the NFDS segment of the market the NMA is a natural monopoly. Due to the government's objective of having the broadest possible use of the NFDS and thus increase positive externalities in society, the NMA operates as an output maximiser.

2- The consequence of this is that the price for NFDS products must be equal to the long run average cost at a point where economic profit is not negative.

3- In order to benefit from the economies of scale and for the benefit of society, to extract economies of scope, the NMA will be allowed to compete in the value-added market segment. This will be on condition that the parity-principle formula for bottleneck-service pricing is being applied. Following this principle, the NMA would charge itself and competitors the price mentioned under 2, subject to regulatory supervision.

4- The NMA must be constituted under corporate law such that accounting and financial reporting requirements are enforced to calculate those costs, and the legal and taxation rules apply equally as for the private sector.

5- As it is uncertain whether the NMA will compete successfully in the value-added segment of the market, society's interest demands that there cannot be a cross-subsidy from that market to the NFDS.

6- The NMA may practise price differentiation in the end user market for the NFDS.

7- Management of the NMA will be given (for example) five years to make the agency financially self-sufficient and cease being a charge on the taxpayer. To this end, it must find a balance between complexity of content of the NFDS and long run average cost (and thus price), in such a way that output is maximised. This will be the motivator for management to implement the necessary procedures with the client community to rationalise the content of the NFDS.

8- Management incentive plans must be designed to emphasise this objective.

9- The NMAs independent regulator will:

a) oversee the implementation of the 'level playing field',
b) ensure that there are no cross-subsidies from the value-added competitive segment of the market to the NFDS,
c) ensure that pricing is in sympathy with the requirement for output maximisation

10- Profits from successful competition in the value-added segment of the market may be re-invested in the agency to improve its efficiency.

We have already observed that it is impossible to meet these points of departure in the normal regulatory environment of the public service. *Hence, it is at this point and only at this point that the discussion on privatisation or other lesser ties to public service regulation have a rational context of principles.*

7- Regulatory Reform and the future performance of NMAs.

Any form of increased independence from public service regulations must be in the context of meeting the principles and points of departure presented as prerequisites of meeting the stated strategic goals of government with a well functioning NMA.

Outright privatisation of National Surveys would place the ownership of all data assets in private hands, including the exclusive right to exploit these. Governments would thus lose complete control over strategic information assets to which they need unlimited access to govern.

It is also highly questionable if any private enterprise would entertain a serious bid on an NMA if the requirement is that it act as an output maximising monopolist and have no exclusive right to exploitation of the monopoly.

Furthermore, there are many uncertainties caused by the lack of commercially relevant and reliable management information about most NMAs to assess viability in the new regulatory setting. Potentially interested companies would hesitate to bid on a franchise, license, or concession, and would expect governments to pay a large risk premium.

The critical questions are really :
-What does government want to achieve with respect to the NMA?
-What would be the best regulatory environment for this?
-What price is it prepared to pay for it?

There are choices for solutions such as issuing a management contract, tendering for concessions or franchises, or establishment a special agency status whereby political accountability for the performance remains with a Minister of Cabinet. In different institutional environments and countries the answers may be different in finding an adequate solution for reinventing the regulatory environment for he NMA. But in all cases the three basic questions cited here must be adequately answered.

In a number of countries some form of special agency status has been developed successfully. For example, the Netherlands' Cadastre, Services New Brunswick (SNB), the Ordnance Survey of Great Britain (OS), the Danish National Survey, the NMA of New Zealand, and there may be others. Services New Brunswick and the OS were given about five years to put their house in order and become self-sufficient or almost so. Similar targets were given to the others. In all those cases political accountability for the performance of the NMA has always remained with a Minister of Cabinet. Those organisations that have the large scale and property data in their NFDS seem to have a greater chance of achieving their 'independence' and self-sufficiency than those who do not.

The extent to which these agencies have followed the rather rigorous model we have proposed is not known. For example, little to nothing is known about their price setting mechanisms and their accounting systems. It will certainly be worthwhile to test the model against these real world examples and report the findings publicly.

In our view any solution which meets the given principles and points of departure will create the positive and motivating management environment NMAs need to fulfil their modern mandates.

8- Epilogue

The real world is of course not as clear and tidy, as the principles and points of departure developed in this paper appear to suggest. Many assumptions may be somewhat optimistic, for example governments will almost always attempt to cross subsidize the NFDS from the NMAs participation in the commercial value added market. Also in the setting of prices governments may decide not to be as consistent as has been suggested. For a discussion on these pricing issues see for example Rhind (2000). Furthermore the backdrop of the stage on which the performance of NMAs is played out is continuously changing.

Technology gallops forward and novel private sector capabilities will emerge that can provide a fully integrated geospatial data service at high accuracy, which is expected to even satisfy some municipal level applications. When such services do become available and are proven reliable, consistent and affordable, the pressure will mount on governments to justify their continuing involvement in national surveying production.

For example, there are currently three US consortia being created, each owning their own satellite with high resolution (1 m), remote sensing capacity, who claim to be able to provide data but also vertically integrated value-added services. The pricing structure for these services is still not known, but having three in the market would suggest some competition. We need sound principles upon which to judge the impacts of these developments on the extent of government services. In the absence of these principles the reaction will be one of improvisation, which could be to the detriment of the country and the public.

We believe that it will be in the interests of government and of society as a whole that this future can best be dealt with from a position of strength of the NMA. The alternative is a position of incompetence, in which solutions are being forced on governments by powerful external forces which give no assurance of control over the performance of information that is of strategic importance to governments.

Another aspect of emerging technological opportunity lies in the linkages between the NMA and the provincial and municipal agencies which are responsible for the local Foundation Data Systems. These new technologies will offer opportunities for increasing efficiencies by automatically or semi-automatically deriving lower resolution data at the national level from higher resolution data which have been prepared at local levels. The development of these approaches will require co-ordination between those organisations which may be better motivated if they were to be more independent of government than they are now.

It would be imperative for NMAs to respond to these challenges out of a position of strength and with thorough scientific and engineering know-how while operating in a business like environment. Only then will new developments be perceived as new opportunities to meet the requirements of their mandates instead of as threats. All the more reason to proceed with innovative approaches to provide these organisations with

the regulatory environment in which innovation and efficiency in serving new and as yet unpredictable markets can flourish.

There is no suggestion that the role of government needs to be exactly the same in every country. The government involvement in spatial data infrastructure development and the regulatory position of the associated government agencies depend on the culture in each country or jurisdiction. There are issues of copyright protection of government owned data in most countries which do not exist in the US. Similarly the protection of the privacy of individuals and companies is not dealt with in the same way in different countries. See, for example, Buchwald (1995). Yet, in spite of these differences, it seems logical that models such as the one we have proposed would assist the decision-making process in a practical way, leading in each case to appropriate local solutions.

Even though much emphasize has been placed on the need for approaching the future of NMAs out of a position of strength, the paramount question is always: How can a government's requirement for access to geospatial data of the country be met in the most reliable, effective and efficient way? This a different approach than arguing from what NMAs are capable of or are being allowed to do, which is the more dominant way in bureaucracies. The proposed principles and points of departure are intended to at least provide a rational starting point for the discussion between policy makers and executives about the continuing relevance of National Mapping Agencies.

Acknowledgement: Thanks are due to my colleagues Ian Masser, Martien Molenaar, Colin Reeves and Walter de Vries for their valuable comments on earlier drafts of this paper. I am also grateful to Wim Feringa for the preparation of the figures.

Bibliographic References

ANZLIC. (1996). Australia New Zealand Land Information Council, Spatial Data Infrastructure for Australia and New Zealand, a discussion paper.

Bangemann et al. (1994). *Europe and the global information society: Recommendations to the European Council, May 1994,* Office for official publications of the European Union, 1994.

Baumol W. J., Ordover J. A., Willig R. D., (1997); *Parity pricing and its critics: A necessary condition for efficiency in the provision of bottleneck services to competitors.* Yale Journal of Regulation

Baumol, William. J. and Sidak, J. Gregory (1994). *Toward competition in local telephony,* MIT Press, Cambridge, Mass.

Branscomb, A. (1982). 'Beyond Deregulation: Designing the Information Infrastructure'. *The Information Society Journal,* 1/ 3: 167-190.

Canadian Government (1986). *Management of Government: Major Surveys, A Study Team Report to the Task Force on Program Review, July 31, 1985.* Canadian Government Publishing Centre, Ottawa K1A OS9, Canada.

CEC. European Community Commission (1989). *Guidelines for improving the synergy between the public and private sectors in the information market,* Office for Official Publications of the European Communities, 1989.

Coopers and Lybrand (1996). *Economic Aspects of the Collection, Dissemination, and Integration of Government's Geospatial Information.* A report arising from work carried out for the Ordnance Survey. Published by The Ordnance Survey, Southampton SO9 4GH, UK.

Department of the Environment (1987). *Handling Geographic Information, Report of the Committee of Enquiry chaired by Lord Chorley.* London, Her Majesty's Stationery Office.

EC (1998). *Public sector information: A key resource for Europe.* Green Paper on public sector information in the information society. Office for official publications of the European Communities, 1999. http://www.echo.lu/legal/en/access.html.

Executive Order 12906 (1994). *Coordinating geographic data acquisition and access to the National Spatial Data Infrastructure.* President Clinton, Federal Register 59, 17671-17674.

Frank Robert H,.(1997), *Microeconomics and Behavior.* McGraw-Hill, 3 rd Edition.

Groot R. (1998), *Spatial Data Infrastructure (SDI) for sustainable land management.* ITC Journal 19997- 3/ 4 pp. 287- 294.

Groot R.and McLaughlin J. D. (*Eds*) (2000). *Geospatial Data Infrastructure: Concepts,Cases and Good Practice.* Oxford University Press (in preparation)

Kerf M., Gray R. David, Irwin Timothy, Lévesque Céline, Taylor Robert R. (1998). *Concessions for infrastructure: A guide to their design and award.* World Bank Technical Paper No. 399, Washington D.C.

Mapping Sciences Committee. (1990). *Spatial Data Needs: The Future of the National Mapping Programme.* National Research Council, National Academic Press, Washington D.C.

Mapping Sciences Committee. (1993). *Towards a Coordinated Spatial Data Infrastructure for the Nation.* Report of the Mapping Sciences Committee, Board on Earth Sciences and Resources, Commission on Geosciences, Environment and Resources, National Research Council, National Academy Press, Washington, DC, USA.

Posner, Richard A. (1969). *Natural monopoly and its regulation.* Stanford Law Review, Vol. 21: pp 548- 643.

Price Waterhouse (1995). *Australian land and geographic information infrastructure benefits study*, Canberra, Australia Government Publishing Service.

Rhind, D., (2000). Funding a National Geospatial Data Infrastructure, in Groot R.and McLaughlin J. D. (Eds.), *Geospatial Data Infrastructure: Concepts, cases and good practise.* Oxford University Press pp. 48- 51

Smith and Rhind (1999). "Characteristics and sources of framework data" chapter 47, p. 655, in Longley P., Maguire D., Goodchild M., and Rhind D. W.(eds), *Geographcal Information Systems: Principles, techniques, management, and applications.*

Train, Kenneth, (1991). *Optimal regulation: The economic theory of natural monopoly.* MIT Press, Cambridge, Mass.

Talero, Eduardo, (1996). *National Information Infrastructure in Developing Economies.* Conference on National and International Initiatives for Information Infrastructure, Harvard, Boston, January 25-27, 1996.

The role of a geospatial data service centre

(For example for the environment and physical planning domain)

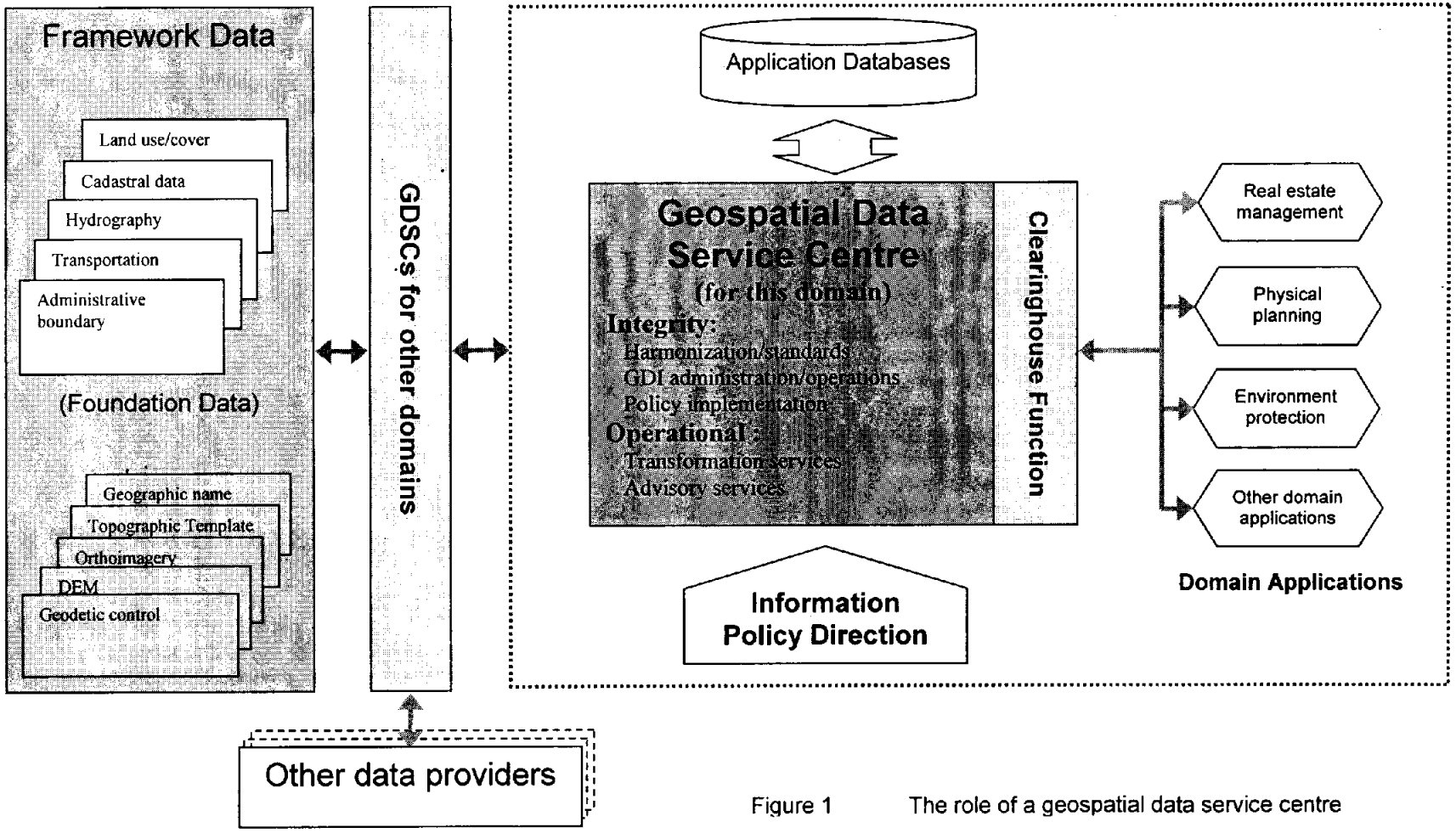
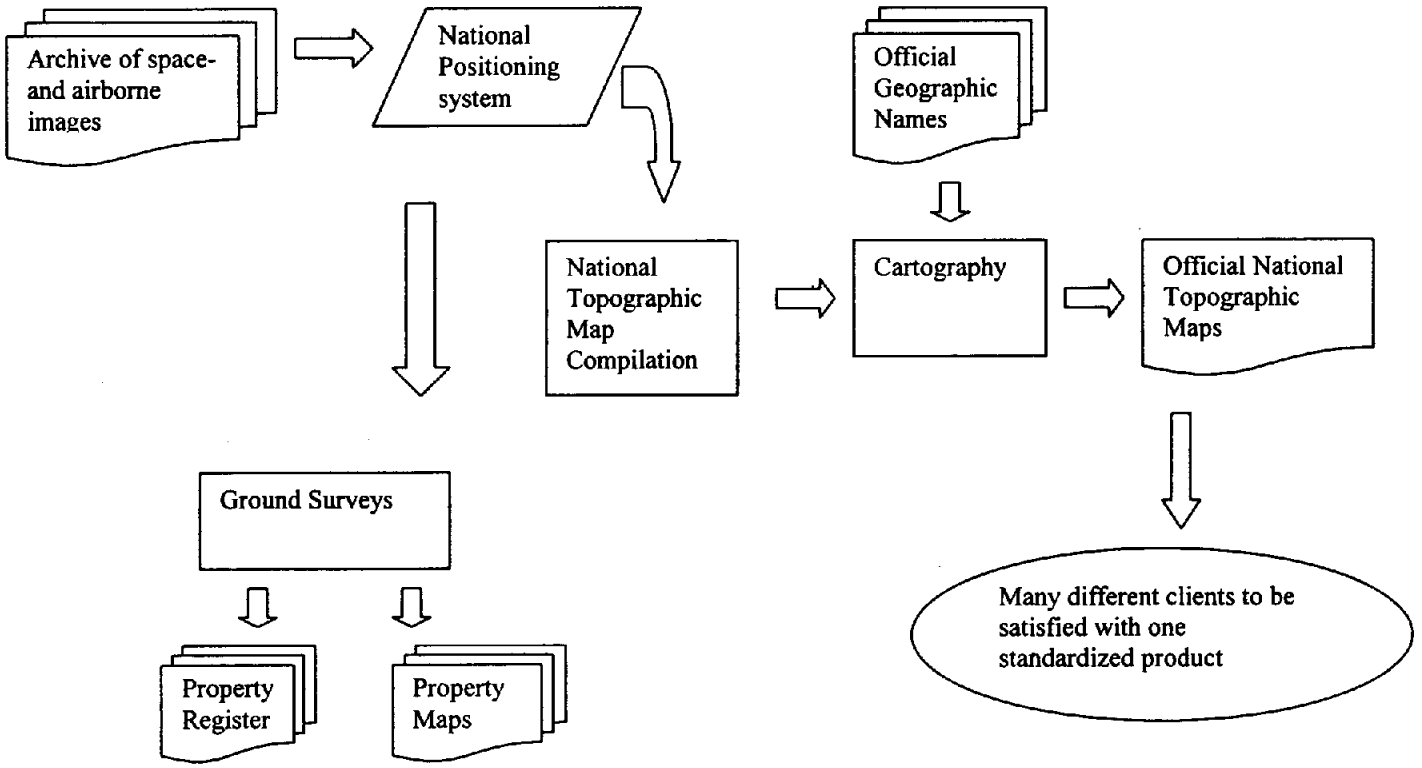
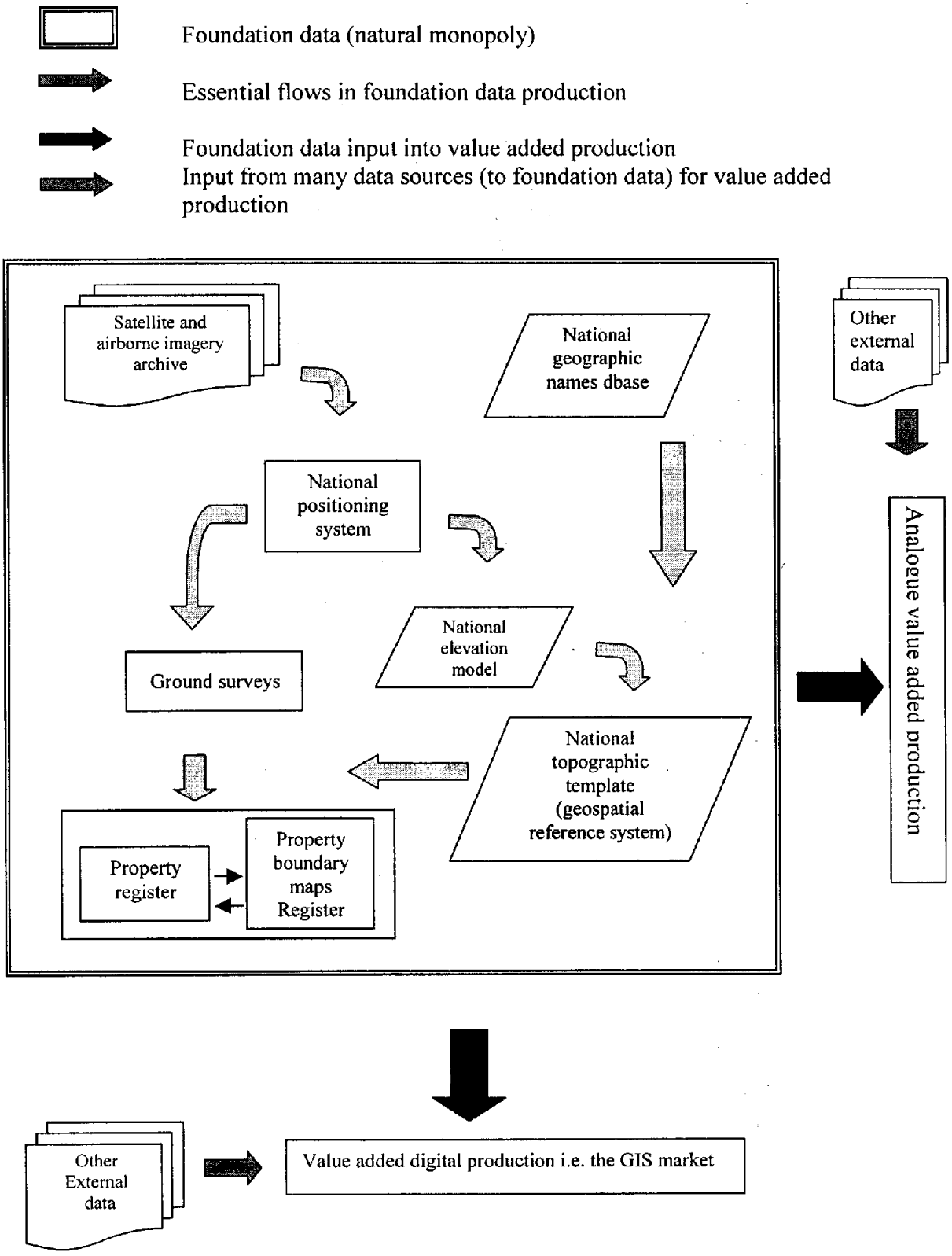


Figure 1 The role of a geospatial data service centre


Archive of space- and airborne images
National Positioning system
Official Geographic Names
National Topographic Map Compilation
Cartography
Official National Topographic Maps
Ground Surveys
Property Register
Property Maps
Many different clients to be satisfied with one standardized product


Foundation data (natural monopoly)
Essential flows in foundation data production
Foundation data input into value added production
Input from many data sources (to foundation data) for value added production
Satellite and airborne imagery archive
National geographic names dbase
Other external data
National positioning system
Ground surveys
National elevation model
National topographic template (geospatial reference system)
Property register
Property boundary maps Register
Analogue value added production
Other External data
Value added digital production i.e. the GIS market

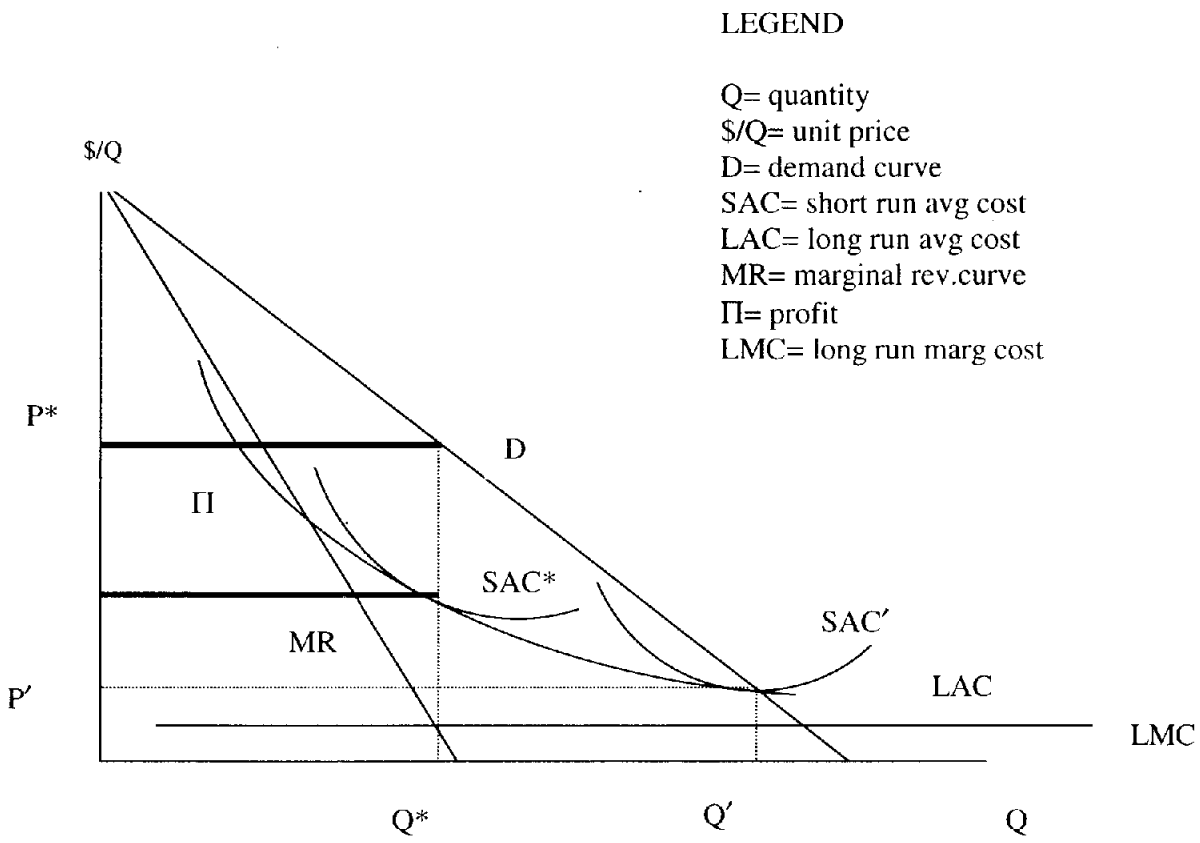


Fig. 4- Output-Maximizing Monopolist

Source: Frank, R. (1997) pp.401.