THE ROLE OF REMOTE SENSING IN THE GEOECONOMY

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ABSTRACT: The authors have argued that we are in a new economy driven by and dependent upon geospatial information. Remote sensing has both contributed to and benefited from this new economy. Not only is the major source for much of that information remote sensing, imagery is increasingly being used to organize or serve as a backdrop for other information.

The linkages between remote sensing and this new economy are explored through several prisms in this paper. These include:

- The history of remote sensing and its recent popularization (through the first Iraq war and more recently through Google);
- The role of data policy and importance of spatial data infrastructures;
- Recognition of the value of the field in business and government;
- Development of new applications that feed on past success in business and government;
- The impact of the field, including broader support for science; and
- The need for a national remote sensing policy and strategy for a country to maintain its status as a highly developed nation.

The paper concludes with recommendations in light of current plans and future prospects within competing programs elsewhere in the world.

1. INTRODUCTION

The GeoEconomy has been defined and explained in Ryerson and Aronoff (2010). Simply defined the term recognizes that we are in a new economic order that is both driven by and dependent on geo-information, including that derived from remote sensing. There are historic links to the past when human survival depended on an individual's understanding of local geography. As societies developed, such understanding became the responsibility of specialist map-makers, and later geographers, geodesists and others. With the advent of the Internet and broad access to geographic information facilitated by the likes of Google, access to such information has once again been made possible for the individual. Now the individual can replace geo-luck (the good luck of being in the right place at the right time) with geo-awareness (knowing what place to be in at what time to reap location-specific benefits) to gain "geo-advantage" (an advantage from knowing more about the geography of an area or the location of an opportunity). We have suggested that the GeoEconomy began in 1999 with the United Nations adopting a resolution that underlined the importance of geo-information as part of a national infrastructure (UNISPACE, 1999). The resolution also underlined the importance of earth observation data. It should be of interest that the resolution was developed with the input of colleagues from Asia, North America, Africa, and Europe.

Remote sensing has both contributed to and benefited from this new economy. Not only is the major source for much of that geo-information remote sensing, imagery is increasingly being used to organize or serve as a backdrop for other information. In the balance of this paper the linkages between remote sensing and this new economy are explored through several prisms. These include the history of remote sensing in Canada, its use in Thailand, its recent popularization, and the role of data policy and importance of spatial data infrastructures. The paper also addresses its value in business and government, the development of new applications, the impact of the field and the need for a national remote sensing policy and strategy for a country to either maintain its status as a highly developed nation, or achieve such status.

2. LINKING REMOTE SENSING TO THE GEO-ECONOMY

2.1. Some Relevant lessons from Canada

Canada got into remote sensing for several reasons, the most important one being the simple fact that our strong and economically dominant neighbour to the south was developing remote sensing satellites. To protect our sovereignty Canada believed that it was important to know at least as much about our country and its resources as the Americans

did. The development of Radarsat was an extension of that. By monitoring our northern regions on a daily basis we could argue that we were engaged in their management and exerting sovereignty.

While there was a fast start in Canada's Federal Government and broad interest in provincial agencies, constitutional arrangements prevented the Federal Government from becoming directly involved in universities. An arrangement whereby the national remote sensing agency would develop an "ITC-like" training institute was not supported by several provinces. For that reason there was a relatively slow and un-coordinated start in academe. While there was a fast start in many provinces, some of the provincial activity dampened industry development since these provincial agencies competed with the nascent remote sensing industry. Early on remote sensing in Canada was similar to what was happening elsewhere – it was a solution looking for a problem…any problem. This was often accompanied by overselling.

In spite of these early set-backs and difficulties a truly national and successful program emerged along with the birth of an export industry. Significant international success was enjoyed by the likes of MDA, PCI, Intera/Intermap, and others. With Landsat TM and SPOT came wider application and high visibility with growing popular interest. Some might mark this period, after 1986, as the era in which Radarsat was born, but this would be wrong, the concept of a radar satellite began in 1974 and its goal was to fill a policy need – both for the sovereignty issue and a need for information about ice in northern waters where oil exploration was beginning.

A common theme throughout the development of remote sensing in Canada has been the attention paid to the needs of government and policy makers. That is as true today as it was forty years ago. This is a useful lesson for all countries everywhere, both those contemplating increasing their activities in remote sensing and those considering ill-conceived reductions in remote sensing.

2.2. Remote Sensing: Coming of Age?

The contention in this paper is that remote sensing is important in the new economy. A question that immediately arises concerns the level of maturity of remote sensing: has remote sensing come of age? We can begin to answer this question by exploring several factors and by assessing what it is that remote sensing actually provides. There are three fundamental factors that play into the response. First, location is a way to integrate information. Second, we are a visual species. Third, today there are new tools & business models, leading to both lower cost and wider access to remote sensing imagery. What remote sensing provides is location information in a highly visual form and this plays to our natural human instincts and capabilities. In addition, remote sensing provides a base layer upon which to place and study information. Lastly, from remote sensing imagery one can derive thematic information linked to economic variables.

Returning to our question, has RS finally come of age? While it has become widely recognized that remote sensing produces useful information about resources, we contend here that it has yet to truly come of age. There are two factors that have negatively influenced the development of remote sensing.

The first negative influence comes from data policy. Far too many countries have embraced what appears to be a high-cost and low-use data policy. This leads to lower returns to society than would be possible under a low-cost high-use policy. After all, the benefits derived from remote sensing (be it in resource management or environmental studies) appear to be far greater from its use than from its sale. These policies are changing – as can be seen from the Group on Earth Observation's activities aimed at data sharing. And while there will be more data use in the future, policies must be changed. These changes do not necessarily remove private sector companies from the equation, but they do place a greater onus on governments to develop appropriate policies, as has been the case in Thailand (see Section 3.1 below) and as Canada appears to be doing with its Radarsat Constellation.

The second negative influence issue that seems to receive less attention than is required involves spatial data infrastructures (SDIs). While remote sensing is seen as a useful base layer in an SDI, and while it is possible to store and make accessible vast amounts of data, the full value of remote sensing imagery is seldom realized. All too often it is seen as something "pretty," and rarely are the full image capabilities stored. Google Earth is a case in point: the imagery cannot be processed using traditional image processing tools. Simply stated, we must develop a wider recognition and understanding among a broader audience of the value of remote sensing as a source of information. Part of this requires us to develop more issues-driven applications and make processing tools more accessible (see

the Open Dragon Project - http://www.open-dragon.org/) while making these applications more user-friendly. All this must be done while avoiding overselling.

In business there is broad understanding of the value of remote sensing in the resource industries. Indeed, that understanding has been for up to four decades, depending on the sector. For remote sensing to truly come of age it must move beyond the resource sector. That is now beginning to happen: there is now growing interest among banks, retailers, real estate, insurance companies, etc. We have even worked with investment bankers who want to use remote sensing as a tool to help them make the right investment.

As in the private sector, the awareness of the value and usefulness of imagery has taken hold in the resource sectors, but, surprisingly, somewhat slower in traditional mapping and land survey. Furthermore, remote sensing is largely invisible in central agencies such as ministries of finance or those setting government policies and priorities. We believe that as environmental concerns and sovereignty issues grow, this will change. It will also change as the image-aware-generation enters these agencies

2.3. Building on Past Success

Much of the success in remote sensing has been, as noted above, in the resource sector – both in finding exploitable resources and in their management. Topics like change detection, land cover, land use, topography, and assessment of areas affected by cataclysmic changes – floods, fire, etc. have dominated work in the field of remote sensing. Areas where it has been used, but to a lesser extent, is to identify locations at which to take samples, as legal proof of something, and the like.

Our past experience, detailed elsewhere (Ryerson and Aronoff 2010) suggests that broader and easier access leads to new ideas and new applications. It is a case of marrying real information needs with imagery interpretation capabilities in a practical, repeatable manner that meets a client's needs…leading to gaining a "geo-advantage." Arriving at a simple application is not necessarily what the remote sensing scientist wants to deliver.

3. IMPACT OF REMOTE SENSING IN THE GEO-ECONOMY

3.1. Some Experience from Thailand

In a previous paper (Ryerson and Peanvijarnpong 2007) it was noted that a wide range of policy areas of importance to Thailand had benefited from that country's policy of providing low cost imagery to government agencies. A sampling of these applications is given in the following table from that paper.

• Forest inventory • Forest change detection • Forest fire • Human impacts • Mapping and monitoring fishing activities (freshwater, coastal, marine) • Aquaculture monitoring • Coastal shrimp • Vessel detection and monitoring • Environmental feasibility studies • Security • Municipal/local area tax mapping • Mineral resource mapping • Field work planning	• Land use at various scales • Crop type mapping (12 major crops) • Crop area & crop statistics • Statistical sampling frame development • Land cover • Flood zone mapping • Landslide mapping • Disaster and risk management and reduction • Soil mapping • Route selection and corridor planning and terrain suitability studies • Base mapping (topographic) • Water management

It can be concluded that Thailand has benefited in a significant fashion from its intelligent and comprehensive application of remote sensing. Every country should be aiming to apply remote sensing to these topics or at least to

those of importance to the country concerned. To do so will require attention to data policy and the factors outlined here and in the materials in the references.

3.2. Major Application Areas

In Ryerson and Aronoff (2010) we show how remote sensing has been applied to virtually all of the major policy areas important to all national governments. In some cases remote sensing (or forerunner technologies such as aerial photography) has been applied for almost a century – as in security. In others such as climate change, remote sensing has only been used much more recently. The following table provides a quick summary of the major policy areas where remote sensing has been routinely applied in at least some jurisdictions.

• Emergency Response - Flooding	• Security	• Resource Management
• Emergency Response – Earthquake	• Sovereignty	• Change monitoring
• Environmental Monitoring	• Climate Change	• Government Transparency
• International development	• Economic Security	• Health and safety

3.3. Societal Impacts

Imagery has been widely seen by almost everyone and, thanks to Google and Microsoft, today people EXPECT imagery to be available everywhere. Imagery has also become an important data source and can provide irrefutable proof of certain things – it can help provide the all-important geo-advantage, replacing geo-luck. Furthermore, by its pedigree – high tech and space – it contributes to a broader interest in science. It is reasonable to conclude that imagery can contribute to many important policy files…in fact, as noted in the tables above, it can contribute to almost EVERY important policy file. Indeed, remote sensing has clearly helped to transform what we expect in our infrastructure.

In transforming society's infrastructure, capabilities, and expectations, remote sensing has, one can argue, transformed society itself. We have changed the way people think, what they perceive to be possible, and what actions they choose to take. Furthermore, access to and control of geospatial data and technologies shifts the distribution of power. This fact has impeded or in some cases delayed access to data in some countries.

4. CONCLUSION

This paper has focused on the impact and importance of remote sensing and its role in a modern economy. We can conclude that developing countries with limited remote sensing and geospatial activities have the potential to realize proportionately greater benefits from the data and technology. It is also clear that Google Earth has promoted global access to data. Such global access promotes global use and, by extension, global competition.

We conclude that remote sensing is required to address key policy and business issues which are now, more obviously than ever, global in nature. Furthermore, remote sensing has had, and will continue to have, important societal impacts and as such is a critical component of the evolving GeoEconomy. In the GeoEconomy we believe that success requires access to and effective use of geospatial information and technology, especially including remote sensing.

Failure to invest in remote sensing data, technologies, infrastructure and applications will lead to a significant competitive disadvantage. In our experience, and as is demonstrated here and in the references provided, data policy is a major consideration – poor policy stifles use, limits benefits, and renders other investments far less useful.

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