

Spatially Enabling Risk for Management of Land and Property

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ABSTRACT

Recent natural disasters such as earthquakes, flood, and fire, and other issues such as asbestos, pests, and fraud all highlight the spatial nature of risk and the relationship between place and risk. These examples show that location is a major factor in determining what or where is at risk and how to manage that risk. In this paper the term risk refers to hazards and threats that exist that have the potential to damage or destroy land and property. Using this definition some examples of risks include bushfire, earthquake, sea level rise, flood, fraud, pests, asbestos, drought, tsunami, and cyclone. These risks affect different scales: some hit locally, some hit entire states, and others cross state borders to affect people on a national scale. In order to reduce the uncertainty that risks bring they need to be managed. In order to manage these risks however, accurate and timely land, property, or spatial information is required. Land administration systems currently hold this valuable land and property information but are not arranged in a way to allow for coordination and sharing across jurisdictions. This paper is based on ongoing research and uses empirical research and a case study approach to discuss the spatial nature of risk, the relationship between place and risk, and proposes a spatially enabled approach to managing risks for citizens, government, and wider society.

KEYWORDS: risk, land administration, risk management, spatial enablement

1 INTRODUCTION

As the most recent natural disasters such as fire, flood, and earthquakes demonstrate – risk is all around us, and individuals, governments, and organizations alike can be affected. What is further demonstrated by these recent events is that many of these risks are spatial and could be better managed with more detailed spatial information. Currently however, not enough use is being made of spatial technologies. Moreover, many risks relate to property, so is the valuable information held within the land administration systems being utilised?

In order to manage these risks accurate and timely land, property, or spatial information is required. This is difficult however, because many systems for managing risk have emerged in an ad hoc fashion. Moreover, approaches to spatially describing risk are often undeveloped and simplistic. The information is often fragmented, based on point datasets and is limited in its utility. In order to effectively manage these risks this information needs to be combined with and make use of land, property and spatial information. That is, the management of risk needs to be spatially enabled.

This paper intends to explore the idea of risks as spatial objects and endeavours to develop a framework to explain this way of thinking. The framework will explore the three main obstacles

that need to be addressed: the coordination of this information, the aggregation of this information, and the dissemination of this information in a way that encourages consistency and efficiency. The framework will be directed towards the three main stakeholders identified which are governments – at all levels, citizens and business.

The first section discusses the risk theory and how the theory can be applied to land and property. Risk management is discussed and the stakeholders in the risk management process are identified. The background of land administration systems in the context of risk management is then discussed. The method is then outlined, followed by the results of the research and discussion.

2 METHOD AND APPROACH

Preliminary studies into the arrangements of current information infrastructures, particularly land administration systems, and risk management stakeholders have been undertaken. The research began initially with a literature review of risks and risk management, and land administration systems. A case study of the Australian context was then carried out. The case study was qualitative in nature. From the information gathered in the case study a framework was developed incorporating the findings from the literature and the results of the case study of the Australian context. This led to the analysis of current problems, and the development of a new framework aimed at meeting the needs of stakeholders more effectively.

3 OVERVIEW OF CURRENT THEORY

Land administration exists fundamentally as a process to manage land. Management of land requires that effective risk management takes place in order to reduce effects should an event occur. In order to carry out effective risk management however, the information contained within land administration systems is required by government, business and citizens. This relationship between risk management and land administration highlights the importance of both, and the importance they represent for government, business and citizens.

3.1 Risk theory and Risk Management

A general definition of risk provided by Vaughan and Vaughan (1996) is a condition in which there is the possibility of an adverse deviation from a desired or expected outcome. More simply put this means the chance that a loss will occur. Critical to the concept of risk is the understanding of the two factors, perils and hazards, which when combined result in the chance of a loss. Peril in this instance is described as the immediate cause of a loss (Trieschmann et al., 2005; McLeman and Smit, 2006) and can be classified as either a human peril (theft, vandalism, fraud, war, terrorism) or a natural peril (earthquake, flood, storm, tsunami, bushfire). Hazard can be defined as a condition that increases the probability of a loss, the severity, or both (Athearn et al., 1989; Teale, 2008). Within the scope of this research the definition of risk is limited to pure risk – instances where there is no possibility of a gain such as fire, theft or flood where the result is either a loss is suffered, or at least no loss is suffered.

Risk management is defined by Standards Australia & Standards New Zealand (2009) as the policies and processes of communicating, establishing the context, identifying, analysing, evaluating, treating, monitoring, and reviewing risk. Within this framework identified in the standards, the communicating and establishing of the context sections are concerned with the necessary background information required to get an understanding of what are the potential risks. The location of land and property can be considered an important aspect in this section of the framework. The next part of the framework is centred on identifying, analysing and evaluating the risks. In terms of land and property, this section involves recognising and identifying the risks that threaten land and property, and analysing and evaluating the degree of risk each threat presents. Identification of possible hazards and perils would also occur in this section of the framework.

Once this section is completed the critical phase of treatment is next. Within this section the options of how to deal with each risk is presented. Available as choices are four options: avoidance of the risk, reduction of the risk, transference of the risk, and retention of the risk (Figure 1). To avoid the risk is the refusal to accept a risk exposure, and in terms of land and property an

example would be to refuse to live in an area that is known to be at risk – avoiding the coast to eliminate the risk of sea level rise. Reduction of a risk refers to mitigation where actions can be taken to reduce the cause of the risk or reduce elements that can contribute to the risk. An example of this would be to clear trees and dry plant matter from the immediate vicinity of a property if the risk of bushfire is known. Transference of a risk refers to the exchange of a risk from one party to another party such as taking out insurance. The final option is a result of no other option being available or no other options chosen as appropriate. When this occurs the risk is kept and no changes are made.

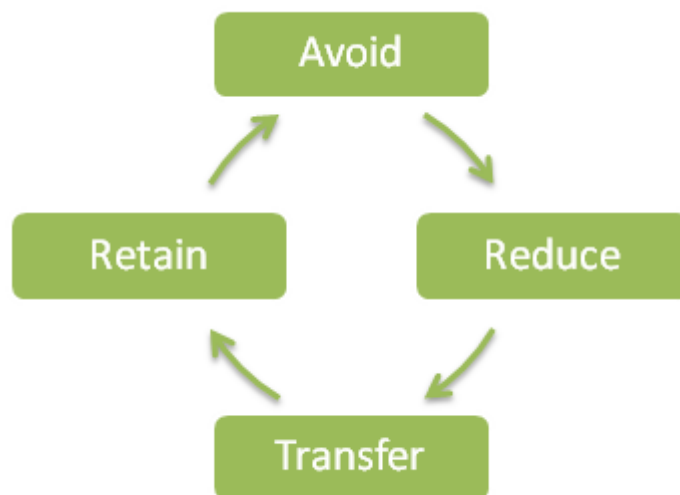


Figure 1: The risk treatment cycle

Within the risk management process three main stakeholders can be identified. They are citizens, business, and government (at all levels). Citizens are the people of a particular social, political, or national community and have a relationship with risk based on location. An understanding of the risks associated with a particular location is required in order for appropriate action to be taken to manage the risks and reduce the possibility of loss. Information about the spatial nature of the risks is required so that effective treatment of the risks can take place. Without an understanding of where each risk exists spatially, management and treatment is difficult.

Among all of the businesses that partake in risk management, insurance by far is the largest. Insurance companies have a direct relationship to risk management. They have a role to provide citizens with a means to protect the value of their property and assets. The traditional way for this to occur is for insurance companies to accept an agreed upon amount as a premium in exchange for protection from a financial cost should a risk event eventuate. In order for this exchange to happen however, insurance companies need extensive land and property information. This information needs to detail the location of the properties they insure so that types of risk that are present at a location can be understood before premiums are agreed upon.

As providing insurance is largely a maths game, the concept of pooling underpins the entire insurance sector. In order to effectively carry out pooling, where risks of similar nature are grouped together to pay for the losses that some might incur, adequate information about land and properties and the potential risks that affect these locations is absolutely critical. The ability to be able to use the laws of large numbers to determine the chance and likelihood of a risk occurring, the average cost of damages, and then spreading this cost over a large number of people allows for society today to operate smoothly and function effectively. However, without understanding the nature of each risk, offering insurance of any type would be too great a risk for an insurance company. Only with adequate information are insurance companies able to carry out calculations which determine the likelihood of a risk occurring, and the cost required in premiums to cover the cost of the risk event occurring. The better the information available, the easier it is to offer protection in the case of loss (Palmer, 1998). Not having access to this critical land and property information causes considerable problems for insurance companies. It means that they either issue

insurance without knowing the full extent or likelihood of a risk occurring, or don't offer insurance at all simply because the unknown present too much risk.

Without the existence of insurance the risk of owning any asset that has the potential to be destroyed, damaged or lost is too high and the benefits of owning it are far outweighed. If this critical spatial information, which supports decisions made by the insurance sector, is not available, which may be as a result of a variety of reasons such as political, institutional, technological, or legal, then society as a whole suffers.

Governments at all levels have a role in managing risk. As the overarching authority in society they have a role to protect citizens and maintain basic security and public order. As a part of this role, the government manages the use of land and property. Making decisions regarding what can be built and where it can be built is largely up to governments. As such they need to be well informed and able to take into account all relevant factors such as risks. The decisions made by government in terms of land and property are recorded in land administration systems, however access to this information for other parties is not always permitted. Allowing access to this critical information is necessary for the management of risks and governments should take action to allow dissemination of this important information to the public.

3.2 Land Administration Systems

Most risks have a relationship to land. The location and nature of the land determines what and where will be at risk, and people develop connections to land based on these factors. This is because land is not just the earth that people walk on; it is fundamentally the way people think about place. Human life depends on having land on which to live and work. It represents territory, opportunity, wealth and prosperity, and can be an essential element for survival. This fundamental and crucial function that land holds in society has led to the development of rules dictating how land should be managed over time. As time progresses the complexity of the relationships between people and land evolves and a system is required to explain the workings of the arrangements and to provide an understanding of the relationships. The discipline of land administration is the key. Land administration is the growing and evolving discipline about land administration systems (LAS) and is the process of administering the complex rights, restrictions, responsibilities, and (increasingly) risks related to land and its use. A land administration system provides a country with the infrastructure to implement land-related policies and land management strategies (Williamson *et al.*, 2010).

A commonly used tool within the land administration discipline is the land management paradigm which defines the different elements, their relationship, and their role within a land administration system (Figure 2).

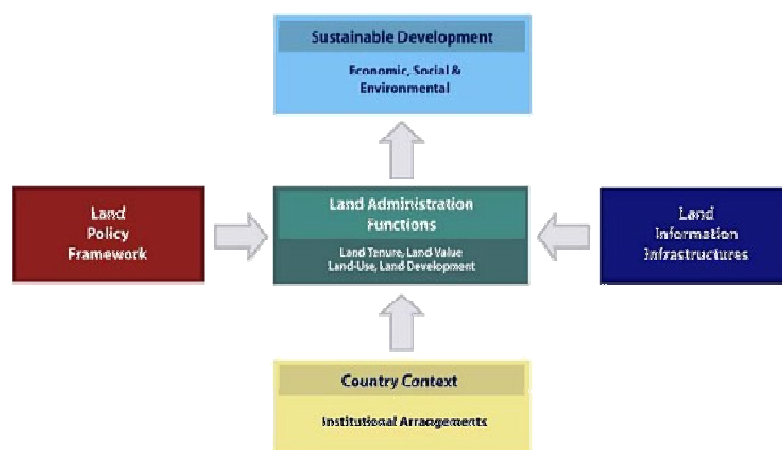


Figure 2: The land management paradigm (Enemark et al., 2005)

The land management paradigm incorporates the country context, land policy framework, land information infrastructures, and the land administration functions in support for sustainable development. At the centre of the paradigm, embedded within the land administration functions, are the components land tenure, land value, land use, and land development. These components,

when implemented effectively lead to efficient land markets and effective land use management which in turn contributes to economic, social, and environmental harmony.

As mentioned earlier, a primary focus of land administration involves administering the complex right, restrictions, responsibilities and risks related to land and land use. The first three elements (rights, restrictions, responsibilities) are considered traditional to property and are linked to the land. These elements are able to be identified due to their nature which requires that they are regulated by law. The fourth element risk is a new consideration for land administration. Unlike the traditional rights, restrictions, and responsibilities which are well defined, risks remain largely unknown and thus can exist with a relationship to land without this relationship ever being revealed. Only recently has the importance for understanding and identifying risks to property received attention. Land administration systems that are based on 19th century models are in charge of managing land and property, consideration for 21st century issues such as social, economic, and environmental risks have not been taken into account.

4 RESULTS – A NEW APPROACH

Analysis of the Australian context revealed the stakeholders involved and the infrastructures available for managing risks to land and property. The variety of risks that affect land and property has been shown. The arrangements and interactions between these components in the Australian context are discussed here.

4.1 Case Study of the Australian Context

Increasingly in Australia there are risks that are of national significance. Examples of these risks are flooding, bushfire, sea level rise, drought, asbestos, and insulation. Events that are a result of these risks are becoming more frequent. We are seeing more frequent storm events which results in flood damage to many properties, the worst bushfire events in the history of the country causing severe damage to property and loss of life, and asbestos concerns as a result of bad management in the past.

In order to manage these risks, spatial information and spatial technologies as well as land administration systems need to be taken advantage of. The accurate and timely land and property information that is kept within the land administration systems underpin risk management decisions made by governments, business, and citizens, however is not accessible by these stakeholders because of a variety of institutional, technical, political and economic reasons. The limited sharing and aggregation of this fundamental land and property information between jurisdictions and organisations is impacting on the ability of stakeholders to make effective risk management decisions and threatens financial stability.

An example that demonstrates this is the current lack of comprehensive insurance available in Australia. Most notably, flood insurance against riverine flooding is not generally available despite an estimated 160 000 Australian homes being at risk of a 1 in 100 year flood. Insurance companies as a major stakeholder in the risk management process have a role to provide individuals with a means to protect the value of their property and assets, however, current insurance arrangements mean that consumers who are aware of the flood risk and want to manage the risk are unlikely to be able to obtain insurance at all, or at an affordable premium. The Insurance Council of Australia wish to resolve the problem and achieve greater market availability of flood cover for the majority of households, but in order to do so they require access to fundamental land and property information such as floodplain information (Insurance Council of Australia, 2006). This information for a variety of institutional, technical and economic reasons is not available in Australia for use by insurance companies, and prevents citizens and business from being able to manage their risk.

The reality of this problem has been highlighted with the recent Queensland flood events. Hundreds of properties were inundated by the water that overflowed from the swollen Brisbane River which resulted in houses being severely damaged. Insurance for these victims is limited for this type of event, and reconstruction of the damaged properties and the replacement of damaged contents in many cases will be left as the responsibility of each individual owner.

Another example that demonstrates the limited sharing and aggregation of land and property information between jurisdictions, and the effect that this has on effective risk management decisions is climate change. In Australia recent predictions have indicated sea level rise will be a result of climate change. These predictions have labelled some coastal areas vulnerable to inundation and consequently, as areas that are unfit for development. Decisions that are made regarding development are the responsibility of the local council. Of late however, some of these decisions made by the local councils have been overturned by a higher planning authority who claim councils are ignoring the risks of predicted sea level rise to developments in the area. As a result councils are confused and argue that the level of information and guidance by governments for councils isn't complete and doesn't indicate how sea level rise and climate change ought to be dealt with by councils. This information is critical for effective risk management decisions to be made and must be made available so that the risks associated with climate change can be understood by decision makers to ensure the safety of Australians living in these vulnerable areas.

4.2 Development of a Risk Framework

The issues raised in the case study and in the previous study of current literature all conclude with the same message: that accurate and timely spatial information and land and property risk information is fundamental for effective risk management. However, currently in Australia there is no infrastructure that facilitates the coordination, sharing, aggregation and dissemination of consistent information on risk. As a consequence the ability of government, business and citizens to manage risk to land and property is limited. Figure 3 below demonstrates the current arrangement of land and property information, risk information and stakeholders in Australia.

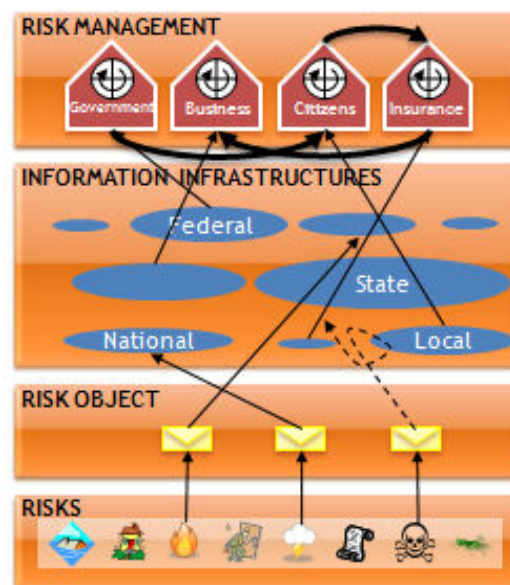


Figure 3: The current situation – Australian context

The framework above (Figure 3) was developed to give an overarching view of the current arrangements of all stakeholders, information infrastructures and risks in Australia currently. Within the Australian context the problems associated with the coordination, sharing, aggregation and dissemination of information is exacerbated by the out of date administrative arrangements that exist. Australia as a federated country is made up of six states and two territories – all with their own land administration systems. On top of these arrangements exists the three levels of government which includes federal government, state government – one for each of the eight jurisdictions, and local governments, which sit within each separately defined area in a state or territory.

Within the figure sits four separate layers, each representing a different element in the complex problem. The first layer from the bottom is the risk layer which represents the risks that

are present in society today that affect property. Examples of these risks are flooding, earthquakes, bushfire, fraud, storms, rights restrictions and responsibilities, asbestos, and pests. The second layer of the diagram represents the risk object. The risk object represents a relationship between a person and a risk. A risk object is created when a person that is affected by a risk (has a relationship with the risk) recognises that relationship. The risk object reflects this recognition because without an understanding of the risk or acknowledgement of the existence of the risk the risk is unable to be managed. Managing a risk is an active choice so the creation of the object is necessary before the stage of risk management can take place. The third layer of the diagram represents the information infrastructures that exist. These infrastructures are present in all levels of government – federal, state and local, as well as in businesses – national, state and local, and range from authoritative land administration systems, to other infrastructures which hold important land and property information. The final layer of the diagram is the risk management layer. This layer represents all the stakeholders that are involved in the risk management process. These stakeholders are able to carry out risk management by making choices about how to deal with risk that is relevant to them. As a part of this process the stakeholders are able to transfer the risk – one treatment option, to each other. For example the citizen might transfer the risk to an insurance company, which the insurance company may then transfer to another business to reinsure the risk.

5 DISCUSSION

Results from research in the areas of risk management, risk information and land administration system all argue that good information is required for the risk management process to be effective. The necessity of making this information available is also strongly put forth. This message is relevant for all major stakeholders, whether they are government, business or citizens.

The information that is required when making risk management decisions is ‘where’ is the risk. If where the risk exists can be understood, then it can be more effectively managed. Moreover, understanding ‘where’ the risk exists allows for an understanding of ‘who’ is affected by the risk to be discovered. With this information smart risk management choices can be made by stakeholders.

Spatially enabling the information about risk to property is a possible solution. Spatial enablement of this type of information would allow access to the information in a simpler and easier way based on a specific location. The capability to retrieve information about potential risks to land or property based on the location of that land or property enhances a stakeholder’s ability to make smarter, safer choices about risk and to more effectively manage risks. A model showing how spatially enabled information would operate is depicted in Figure 4.

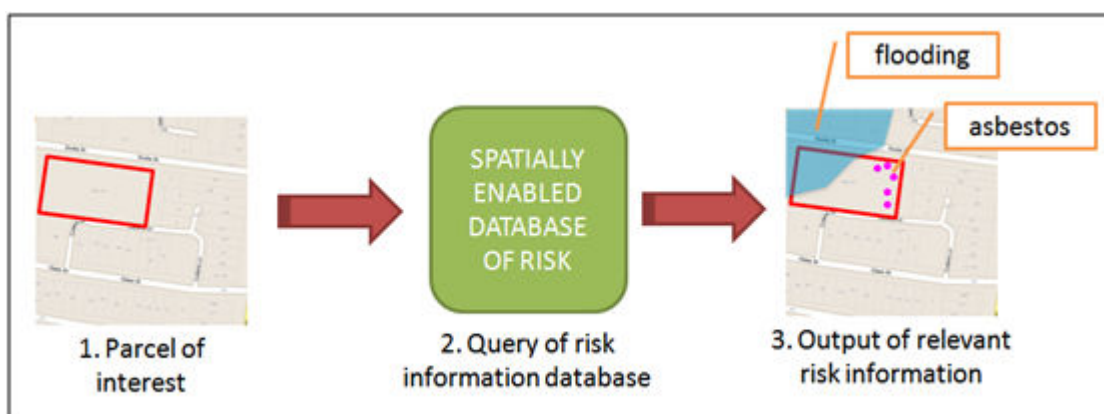


Figure 4: Spatial enablement of risk information

Spatially enabling the information makes it easily accessible and interpretable for stakeholders. They can visualize how different disasters or risks affect them specifically based on location.

From the preliminary research carried out which aimed to develop a framework to explore the idea of risks as spatial objects Figure 3 was developed. Within this framework the risk object concept was expanded on and the relationship between the risks, the information infrastructures

and the stakeholders was explored. The problems associated with the current model are discussed further below.

- **Risks**

The risks layer represents the risks and the information available describing the nature of each risk. This information is needed by government, business, citizens and insurance companies for effective risk management to be carried out. In order for this risk information to make its way to the risk management level, it needs to pass through an information infrastructure situated in the middle layer. The problem is that in Australia many different information infrastructures currently exist, so when the risk information is passed into the information infrastructure it may end up in one of many infrastructures, or it may end up in no infrastructure at all. Because there is currently no aggregated system each information infrastructure is operating in an ad-hoc and uncoordinated fashion which contributes to existing problems associated with obtaining important information about risks related to land and property.

- **Risk Object**

The risk object represents the recognition of a particular risk by the person who has a connection or relationship to that particular risk. Problems arise when a risk object is created for a certain risk; however the information about this risk does not belong anywhere or is not recorded in a way that the stakeholders can access this information. An example of this might be asbestos – where location information about the risk might not be known and therefore may not be recorded. Challenges such as this need to be addressed to ensure information about all relevant risks can be made available for stakeholder use.

- **Information Infrastructures**

The information infrastructures layer represents all of the locations where information about land and property is stored. This includes information about rights, restrictions, responsibilities and risks. This information is critical to all stakeholders, especially the citizens who in most cases seek out this type of information to help them make decisions about property they intend to purchase and/or live in. For a citizen this type of investment is a big deal and could result in financial ruin if smart decisions are not made. As a result of the potential consequences citizens require as much information about the land and property as possible. The ability to be able to access this information quickly and easily would be of great benefit to citizens and also to other stakeholders however, information of this type is not always centrally located or easily accessible due to the current arrangements of the information infrastructures. When information describing risks is passed into the information infrastructures situations arise where the risk information may end up in one of the many infrastructures, or it may end up in no infrastructure at all. Attempts by stakeholders to find this information then become futile, because where to look is not known, nor whether it even exists.

- **Stakeholders**

The stakeholder layer represents the parties involved that have an interest in risk management. Within this layer the stakeholders gather information required for them to make risk management decisions and to carry out their chosen risk management treatments. The information they require about risks affecting their land and property is contained within the information infrastructures. A problem that arises from this scenario is that the relationship between the stakeholders and the individual information infrastructures determines what information is available and to which stakeholders the information is available to. Not all information is available to all stakeholders, however all available risk information is needed for effective risk management. Access to this information is critical because the risk management cycle relies on timely and accurate information about the nature of property risks and who they apply to. The current information infrastructure arrangements prevent this from happening.

5.1 Proposed System

Responding to the problems raised regarding the current arrangements, a framework addressing these problems has been developed. The framework (Figure 5) takes into account the current situation as shown in Figure 3 and transforms the information infrastructures layer of the diagram into a one connected infrastructure that uses a land administration system as the platform.

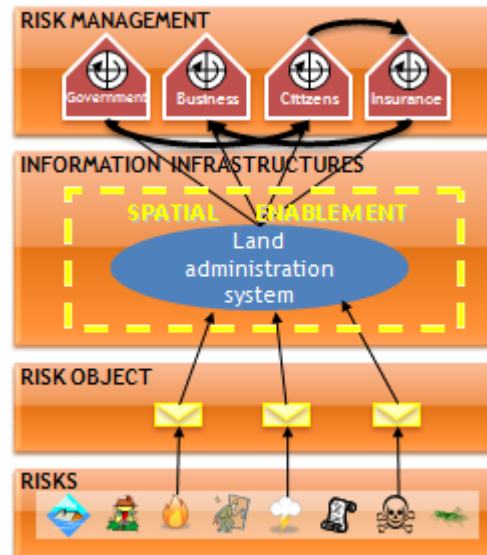


Figure 5: The proposed framework for aggregating and disseminating consistent information about risk to all stakeholders.

For this proposed model a land administration system was selected as the platform because it is shown to be an effective infrastructure for managing and integrating land information (Williamson and Wallace, 2007). Already land administration systems have the capability to manage rights, restrictions and responsibilities relating to land, so extending the role of these systems towards managing risks is a logical progression. The proposed framework demonstrates an infrastructure that is able to coordinate all of the current information infrastructures to allow for timely, accurate, and aggregated information about risks that relate to land and property to be facilitated.

To address the problems highlighted, further spatial enablement of the information within the land administration system has been included in the proposed framework also. The aggregation of the information infrastructures would allow for the information to be searched across one platform, and spatial enablement of the information would greatly enhance the effectiveness of the system for the stakeholders attempting to gather information. A search queried into the platform would return all of the relevant information based on the spatial located searched. Further research into the specific architecture of this framework is required.

6 CONCLUSION AND FUTURE DIRECTION

This research has given an overview of the current understanding of the way that risks to land and property and the information that describes these risks relate to stakeholders and information infrastructures. The framework developed provides an understanding of the wider context and uses Australia as a case example; however the framework requires further empirical testing. How the situation can be improved needs to be explored further.

Two case studies are planned with the intention of gathering an understanding of the problem in more detail. The first case study will be aimed at investigating and understanding each different layer of the diagram (Figure 3) to gain an understanding of how each layer operates and how the different layers interact with each other. The second case study will look specifically at land administration systems with the aim to understand how land and property information is

managed in each different land administration system that already exists and to investigate the capability for these systems to expand their operations to be able to manage risk information. The information from both these case studies will be brought together and will provide further insight into the issues, as described in this paper, and will highlight possible solutions to resolve issues surrounding this problem.

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