

Integrating HAZUS (Damage & Loss Estimation Models) into MASAS (Multi-Agency Situational Awareness System)

PSTP 03-408EMSI

Rahim Othman
Galdos Systems Inc.

Murray Journey
Natural Resources Canada

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IMPORTANT INFORMATIVE STATEMENTS

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Abstract

The Earth Sciences Sector, Natural Resources Canada (ESS/NRCan), selected HAZUS as a best practice for quantitative loss estimation based on a suitability analysis of available risk assessment methods in the public domain. With a mandate from the NRCan Public Safety Geoscience Program, and support from the CRTI Risk Assessment Methods program of Centre for Security Science, Defence Research and Development Canada (DRDC), ESS is working with FEMA to develop a harmonized North American version of HAZUS that can be integrated into the evolving All-Hazard Risk Assessment Framework for Canada (AHRAF), and delivered using standards-based protocols under development by the Public Security Technical Program (PSTP) of DRDC.

Résumé

Le Secteur des sciences de la Terre de Ressources naturelles Canada (SST, RNCan) a sélectionné HAZUS comme outil de pratique exemplaire pour effectuer l'estimation quantitative des pertes en fonction d'une analyse de la pertinence des méthodes d'évaluation des risques offertes dans le domaine public. Avec le mandat confié par le programme Géoscience pour la sécurité publique de RNCan, et appuyé par le programme Méthodes d'évaluation des risques de l'IRTC du Centre des sciences pour la sécurité, Recherche et développement pour la défense Canada (RDDC), le SST collabore avec la Federal Emergency Management Agency (FEMA) (agence fédérale de la gestion des urgences) pour concevoir une version nord-américaine harmonisée de HAZUS qui pourrait être intégrée au Cadre fédéral d'évaluation tous risques (CFETR) et livrée au moyen de protocoles fondés sur des normes en cours d'élaboration par le Programme technique de sécurité publique (PTSP) de RDDC.

Executive summary

Introduction or background: HAZUS is a quantitative loss estimation method developed by the US Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). It is used to support risk-based planning activities that promote national disaster mitigation policies in the United States (National Institute of Building Sciences, 2002; FEMA, 2004; Schneider and Schauer, 2006; Bostrom et al., 2008; FEMA, 2008). The HAZUS methodology encompasses an integrated suite of analytical models, decision support tools and procedural guidelines for quantitative risk assessment of floods earthquakes and hurricanes. Models and tools are based on state-of-the art scientific and engineering knowledge and industry standards for quantitative risk assessment. Although developed for use in the United States, the HAZUS-MH toolset is robust and provides a standardized approach to loss estimation that is being adopted by organizations worldwide.

Galdos Systems Inc. has partnered with NRCan as the Federal Lead and Emergency Management officials from City of Surrey and City of Vancouver in response to the PSTP “Call 3 Request for Proposals (RFP)” to integrate HAZUS-MH model outputs into the MASAS architecture. Galdos Systems has developed, configured, and deployed the HAZUS Web-based Risk Assessment Data Management System (WRAMS) software by building a Web Registry Service (WRS), which is based on OGC and OASIS open standards such as the Catalogue Service for the Web (CSW), and the ebXML Registry Information Model profile of CSW (CSW-ebRIM). Using WRS enabled Galdos to deliver a HAZUS management capability that incorporates automated ingest and processing of HAZUS model output (HPR) files, validation of HAZUS model outputs (including automated status management, user notification, and map display), model discovery based on geographic and thematic searches, and download of model outputs from the WRAMS Service. Galdos has (and will, as part of the roadmap) further provided the ability to publish HAZUS model information from the WRAMS Service in a variety of formats such that they can be accessed through WMS, WFS, and other types of web services.

The Galdos solution ensures that the Government of Canada can distribute HAZUS-MH model outputs to any agency in Canada (or the US) with as few restrictions as possible. To meet this objective, Galdos has developed an open source WRAMS Service, which includes a documented client API that enables programmatic access to the service. This source code is owned by the Government of Canada. Galdos, however, retains all rights to and IP in the underlying Registry Service (INDICIO™), the WRAMS client application, and the plug-in for the MASAS ESRI Flex Tool (MEFT).

Galdos grants the Government of Canada a no-cost one-year subscription for the use of one copy of the underlying Registry Service (INDICIO), the WRAMS client, and the MEFT plug-in, solely for use in HAZUS-MASAS integration and test for the first year.

Results:

1. Integration of HAZUS-MH models and outputs with the MASAS framework.
2. Use of open source and open standard components in the solution.
3. Documented API to allow programmatic access to the output models.

4. Two client applications to access model outputs (the WRAMS client, and the MASAS ESRI Flex Tool plug-in).
5. High level roadmap for an improved integration of HAZUS into MASAS and with the broader Emergency Management community.

Significance:

The primary function of this project was to enable the programmatic cataloguing of HAZUS-MH outputs so that they can be discovered and utilized in the Emergency Management community. Note that such model outputs play a significant role in all phases of dealing with emergency events, from pre-event planning and mitigation, to post event response.

Additionally, the cataloguing of results/models will enable the progressive improvement of these models over time. To meet this objective, it is essential that the HAZUS-MH model outputs be distributable to both private and public agencies with as few restrictions as possible. This means using published open standards for all data models and service interfaces.

MASAS is currently based on a variety of open standards (e.g. XML, RSS/GeoRSS, and GML) and this project extends this set of open standards to include the OGC/OASIS CSW-ebRIM standard for the management of model metadata and other artifacts.

While the current project has made significant strides in the integration of HAZUS models within MASAS, full integration of HAZUS into MASAS will require a broader scope of HAZUS services than the WRAMS Services provides (adding HAZUS Model Engine, HAZUS Site Geography, HAZUS Event Descriptions, etc.) as well as a broader understanding for MASAS than the current alerting focus.

Future plans:

A Roadmap is required to lay out the development of HAZUS in this broader MASAS context.

Sommaire

Introduction : HAZUS-MH est une méthode d'estimation quantitative des pertes élaborée par la FEMA et le National Institute of Building Sciences (NIBS) (Institut national des sciences de la construction). Elle soutient les activités de planification basées sur le risque qui favorisent les politiques nationales d'atténuation des catastrophes aux États-Unis (NIBS, 2002; FEMA, 2004; Schneider et Schauer, 2006; Bostrom, et al., 2008; FEMA, 2008). La méthodologie comporte un ensemble intégré de modèles analytiques, d'outils d'aide à la décision et des lignes directrices, destiné à l'évaluation quantitative des risques liés aux inondations, aux tremblements de terre et aux ouragans. Ces modèles et outils sont basés sur les connaissances actuelles des domaines scientifiques et du génie et sur les normes de l'industrie en matière d'évaluation quantitative du risque. Bien qu'elle ait été élaborée aux États-Unis, la trousse d'outils HASUZ-MH constitue un moyen robuste et normalisé d'évaluation des pertes qui est adopté par les organismes de gestion des urgences à l'échelle de la planète.

Galdos Systems Inc. a établi un partenariat avec RNCAN, à titre de représentant du gouvernement fédéral, et les responsables de la gestion des urgences des Villes de Surrey et Vancouver en réponse à l'"Appel de propositions no 3 – Demandes de proposition" du PTSP afin d'intégrer les extraits du modèle HAZUS-MH à l'architecture du Système interorganisationnel de connaissance de la situation (SICS). Galdos Systems a développé, configuré et déployé le logiciel Web-based Risk Assessment Data Management System (WRAMS) (système Web de gestion des données sur l'évaluation des risques) HASUZ en créant un service de registre Web basé sur les normes ouvertes des organismes OGC et OASIS, notamment les services de catalogue sur le Web (CSW) et le profil de modèle d'information des registres ebXML des CSW (CSW-ebRIM). L'utilisation du service de registre Web a permis à Galdos d'offrir une fonction de gestion HAZUS intégrant l'ingestion et le traitement des fichiers extraits du modèle HAZUS (HPR), la validation des extraits du modèle HAZUS (y compris la gestion automatisée des statuts, les avis aux utilisateurs et l'affichage de cartes), la découverte de modèles en fonction de recherches thématiques ou géographiques et le téléchargement d'extraits de modèle à partir du service WRAMS. Galdos a de plus offert (et offrira, dans le cadre de la feuille de route) la capacité de publier des données du modèle HAZUS tirées du service WRAMS dans de nombreux formats afin d'en assurer l'accessibilité à partir de différents types de services Web (cartographie, entités, etc.).

La solution Galdos permet de s'assurer que le gouvernement du Canada peut distribuer les extraits du modèle HAZUS-MH à tous les organismes du Canada (et des États-Unis) avec le plus petit nombre possible de restrictions. Pour atteindre cet objectif, Galdos a conçu un service WRAMS en code source libre qui inclue une interface de programmation (API) client documentée donnant un accès programmatique au service. Ce code source appartient au gouvernement du Canada. Galdos, cependant, détient tous les droits et tous les droits de propriété intellectuelle (PI) sur le service de registre sous-jacent (INDICIO), l'application client WRAMS et le plugiciel de l'outil ESRI Flex du SICS (MEFT).

Galdos accorde au gouvernement du Canada un abonnement gratuit d'un an lui permettant d'utiliser une copie du service de registre sous-jacent (INDICIO), le client WRAMS et le plugiciel MEFT, mais ce aux seules fins d'utilisation pour l'intégration et les essais SICS-HAZUS pendant la première année.

Résultats

1. Intégration des modèles et des extraits HAZUS-MH au cadre du SICS.
2. Utilisation de code source libre et d'éléments de normes ouvertes dans la solution.
3. Interface API documentée donnant un accès programmatique aux modèles d'extrait.
4. Deux applications clients pour accéder aux extraits de modèle (client WRAMS et logiciel MEFT).
5. Feuille de route générale pour une intégration améliorée de HAZUS au SICS et à l'ensemble des organismes de gestion des urgences.

Portée

La principale fonction de ce projet consiste à activer le catalogage programmatique des extraits HAZUS-MH afin qu'ils soient découverts et utilisés par l'ensemble des organismes de gestion des urgences. Veuillez noter que ces extraits de modèle jouent un rôle important dans toutes les phases de la gestion des situations d'urgence (planification préalable, atténuation, intervention après incident, etc.).

De plus, le catalogage des résultats/modèles permettra l'amélioration continue de ces modèles au fil du temps. Pour atteindre cet objectif, il est primordial que les extraits du modèle HAZUS-MH puissent être distribués aux organismes privés et publics avec le plus petit nombre possible de restrictions. Cela implique l'utilisation de normes ouvertes publiées pour tous les modèles de données et toutes les interfaces de services.

Le SICS est basé sur plusieurs normes ouvertes (XML, RSS/GeoRSS et GML) et ce projet ajoute à cet ensemble de normes afin d'y inclure la norme CSW-eBRIM des organismes OGC et OASIS pour la gestion des métadonnées de modèle et d'autres artefacts.

Si ce projet a permis de réaliser des progrès importants en matière d'intégration des modèles HAZUS au SICS, l'intégration complète de HAZUS au SICS nécessitera l'élargissement de la portée des services HAZUS par rapport à ce qui est offert par les services WRAMS (ajout de HAZUS Model Engine, HAZUS Site Geography, HAZUS Event Descriptions, etc.), de même qu'une meilleure compréhension du SICS (comparativement à l'accent actuellement mis sur les alertes).

Recherches futures

Établir une feuille de route pour développer HAZUS dans ce contexte élargi du SICS.

Table of contents

Abstract ...	i
Executive summary	ii
Sommaire.	iv
Table of contents	vi
List of figures	vii
List of tables	vii
1 Design Approach	8
1.1 WRAMS Scope	9
1.1.1 Tasks Completed.....	9
1.2 Scope – Project Objectives and Deliverables	10
1.2.1 High Level Project Timeline	11
1.2.2 What went well	11
1.2.3 Gaps and Challenges	11
2 Roadmap	13
2.1 Scope	13
2.1.1 Current Status.....	13
2.1.2 Roadmap Objectives	13
2.2 Roadmap Timeline	14
2.2.1 Assumptions Made when Developing the Roadmap	14
2.2.2 Assumptions Made about Executing the Roadmap.....	14
2.3 The Bigger Picture.....	15
2.3.1 HAZUS Services.....	15
2.3.2 Potential MASAS Services	16
2.4 WRAMS Activities	17
2.4.1 Business Activities	17
2.4.2 Infrastructure Activities	18
2.4.3 Prioritized Technical Activities.....	18
2.4.4 Non-Prioritized Technical Activities	20
2.5 Suggested WRAMS Usage Scenarios for Demonstration.....	26

List of figures

Figure 1: Solution Architecture	8
Figure 2: Project Timeline.....	11
Figure 3: High Level Timeline for Roadmap	15
Figure 4: Future HAZUS Architecture.....	16

List of tables

Table 1 List of Deliverables	10
Table 2: Improved HAZUS Services.....	15
Table 3: Potential MASAS Services	16
Table 4: Business Activities	17
Table 5: Infrastructure Activities.....	18
Table 6: Quarter 1 - Activities Prioritized by NRCan	19
Table 7: Quarter 2 – Notification and Language Support Activities.....	20
Table 8: Quarter 3 – Upload Activities	20
Table 9: Quarter 4 – Search Activities	22
Table 10: Quarter 5 – Modeling Activities.....	22
Table 11: Quarter 6 – Output and Accessibility Activities.....	23
Table 12: Quarter 7 – Presentation Activities	24
Table 13: Quarter 8 – Optimization and Error Handling.....	26

1 Design Approach

This study focused on the development of the Web-based Risk Assessment Management System (WRAMS). This is a web-based application for managing damage and loss estimation models created by HAZUS 2.1. Only earthquake models were considered in this project, however, future support for flood and hurricane models is included as part of the roadmap.

The general intention of the WRAMS is to enable online creation, management, and publication of repositories containing HAZUS 2.1 model outputs. An installation of WRAMS would enable HAZUS 2.1 users to upload, store, discover, and download model outputs.

WRAMS enables hazard modeling specialists to effectively communicate the results of their work to front line emergency management personnel. Simulation model results are filed automatically and can then be searched, retrieved and displayed over the Internet, using impact based criteria understood by the emergency management community.

The study also focused on the integration of the WRAMS with the Multi-Agency Situational Awareness System (MASAS). The focus was on the mechanisms required to integrate the outputs of quantitative natural hazard risk assessments into the broader open architecture of the MASAS framework to address the needs and operational requirements for pre-event planning, disaster mitigation, and emergency management operations across Canada.

The WRAMS was built on the Open Geospatial Consortium (OGC) CSW-ebRIM standard for metadata/artefact management. CSW-ebRIM provides an existing, easily extensible metadata model (ebRIM) for capturing the information required for the discovery of HAZUS models (e.g. metadata, indicators, etc.). Using an open standard such as CSW-ebRIM means that the model created for the project can be easily extended in the future, allowing the WRAMS to store and manage additional artifacts.

The Galdos INdicio Web Registry Service was used as it already implements the CSW-ebRIM standard. This ensured that open standards were used and that project resources were directed at key development issues. The following diagram illustrates a high-level architecture of the system.

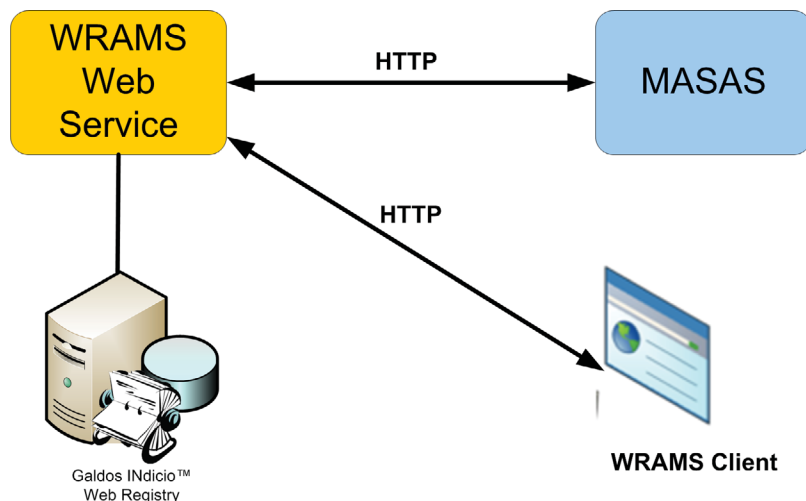


Figure 1: Solution Architecture

1.1 WRAMS Scope

The main WRAMS functions are:

1. Upload: enables HAZUS 2.1 risk assessments to be identified on a local computer (that is HPR project files), and ingest selected model outputs (i.e. indicators) into WRAMS. Uploading is a role-based function that is available to authorized users.
2. Validate: enables viewing of an uploaded risk assessment analysis, as a map and as a table, to validate model outputs. Validation enables a user to accept or reject the risk assessment. Upload permissions are required for validation.
3. Share: enables sharing of validated outputs of risk assessment with a community. Requires upload permissions.
4. Discover: enables browsing and searching the WRAMS. Browsing options include: (1) map-based, where the geographic extents of the outputs are displayed over a base map, and (2) thematically, where users can query thematically on output model attributes. Discovery is role-based such that users can only find data they are permitted to view.
5. Download: extracts a model output from the WRAMS and stores it in a user-specified file on a local computer. Downloaded formats may include: HAZUS 2.1 HPR file (i.e. same as the uploaded file), and OGC KML/KMZ file. This function requires download permissions, which might differ from discovery permissions.
6. Publish: provides notifications. Notifications are triggered by the sharing of data (i.e. after a user decides to share model). Notification requires download permissions. Notifications are sent only to registered users.

1.1.1 Tasks Completed

In order to achieve the WRAMS intended functions, the following tasks were completed:

1. Design of the model outputs (i.e. indicator definition, formula, etc.).
2. Creation of an ebRIM model (i.e. extension package) for the HAZUS 2.1 model outputs. NB: Note that such a model is portable to all CSW-ebRIM compliant registries.
3. Mapping of HPR file to ebRIM model.
4. Creation of a harvest component for ingesting and processing HAZUS HPR files. This component opens a given HPR file, and extracts specific data (MS Access, MS SQL Server, ESRI) for inclusion into the ebRIM model.
5. Definition of styling rules for model outputs (e.g. symbols, line color, etc.).
6. Development of transformation components to generate specific output data formats, including HAZUS HPR (i.e. same as the imported file) and OGC (KML/KMZ).
7. Development of an ATOM notification component for the integration with MASAS.

8. Definition of access control rules to support security requirements.
9. Development of a WRAMS client to support all WRAMS functions.
10. Loading of sample HAZUS models to support the demonstration.

1.2 Scope – Project Objectives and Deliverables

The primary focus of this study was to integrate HAZUS-MH (version 2.1) into the evolving MASAS architecture. The study focused on the mechanisms by which the outputs of quantitative hazard risk assessments for earthquake threats could be incorporated into the MASAS framework (version 2). The goal was to address the needs and operational requirements for pre-event planning, disaster mitigation, and emergency management operations across Canada.

The final outcome of the project is the integration of HAZUS with MASAS supported by the creation and deployment of a demonstration system available to key project stakeholders and partners to test and evaluate the benefits of the integration.

The project deliverables are summarized in the table below:

Table 1 List of Deliverables

No.	Deliverable Item	Deliverable Description
1.	Project Charter	
2.	Quarterly Progress Report	SOR report, progress status and updated project schedule
3.	Interim Progress Report & Strategic Advisory Note	Design Document and deployment of WRAMS at Galdos
4.	Final Version of Strategic Advisory Note	WRAMS SW & API, WRAMS User Guide and on-site installation of WRAMS
5.	Final Report & Demo	HAZUS-MASAS Integration Road Map and final demonstration

1.2.1 High Level Project Timeline

Galdos was awarded the contract in March 2011; however, the contract was not generated and signed until October 2011. Below is a high level timeline of the project highlighting the milestones:

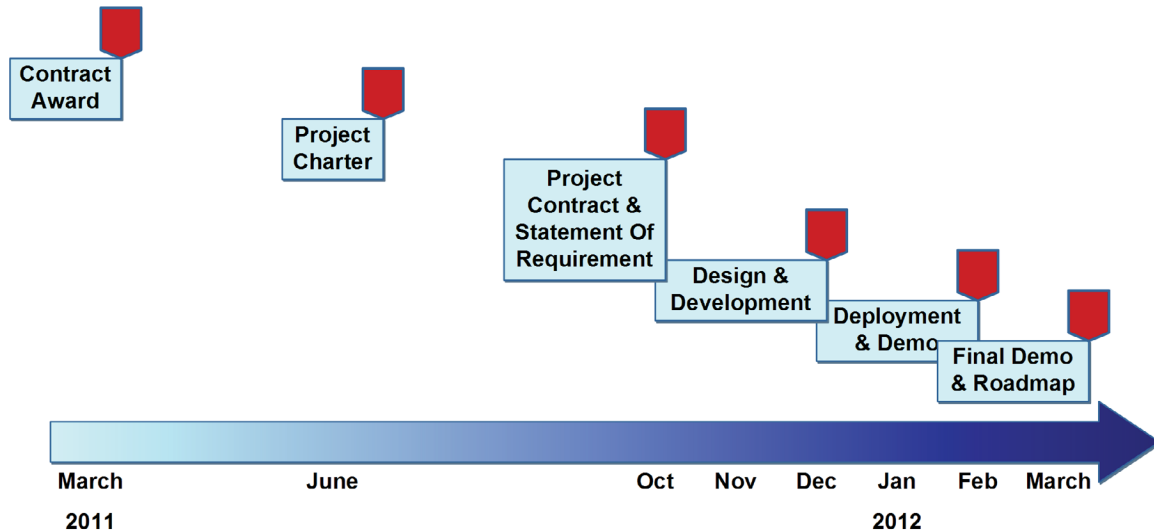


Figure 2: Project Timeline

1.2.2 What went well

- 1- The project Charter was finalized at an early stage of the project.
- 2- The development of a Statement of Requirement helped to further define the deliverables and detail the requirements.
- 3- The cooperation and close working style adopted by NRCan and Galdos was useful to ensure a common understanding of the project, especially in light of the tight time schedule.
- 4- The support provided by the Project Manager from NRCan, Murray Journeay, the Portfolio Manager, Jack Pagotto, and the MASAS team, led by Ken Marshal, was an important factor for the success of the project.
- 5- Involving key stakeholders (City of Vancouver and City of Surrey) from the beginning of the project allowed them to provide valuable input and feedback to the vision and design of the solution.
- 6- Despite the delay in getting the contract generated and signed, the project team managed to complete the project by the initially set deadline of March 2012.

1.2.3 Gaps and Challenges

- 1- The contract signature was delayed by about 6 months.

- 2- Due to the shorten timeline, not all functions and features could be accommodated for the demo; however, they were included in the roadmap.
- 3- There was an intention to include more project partners so that the project can have more input and feedback from more different perspectives; however, due to the delay in the project start, this was not possible.

2 Roadmap

To ensure the complete success of this study, a roadmap was developed for the WRAMS. This roadmap identifies key business/technical capabilities and issues that need to be addressed in the short and long term in order to maximize the outcomes of the current study.

This roadmap was supported by feedback and requirements provided by the study partners, as well as the lead Federal organization for the study, NRCan.

2.1 Scope

2.1.1 Current Status

As part of this study, the following items were developed and demonstrated:

- The WRAMS Service version 1.0 was developed and demonstrated to NRCan, City of Vancouver – EMO, City of Surrey – Fire Department, and other stakeholders. The source code for the WRAMS Service was provided to the Government of Canada.
- The WRAMS Service API, included in the WRAMS Service, was documented, and the documentation was provided to the Government of Canada.
- A WRAMS client was developed to demonstrate the main functionalities of the WRAMS Service.
- The WRAMS Service was integrated with MASAS version 2. The integration primarily consists of ATOM notifications sent from the WRAMS Service to a MASAS Hub. The notifications alert the MASAS users to:
 - ♦ The availability of newly shared output models.
 - ♦ The withdrawal of previously shared output models.
- The MASAS ESRI Flex Tool (MEFT) was extended to support WRAMS-specific notification and display.

2.1.2 Roadmap Objectives

The WRAMS roadmap is intended to support the following primary objectives:

- To identify activities that will improve and strengthen the integration of WRAMS with the MASAS framework (e.g. security, user management).
- To identify technical items that will enhance the functionalities provided by the WRAMS Service and the clients developed during this study (e.g. advanced search capabilities, etc.).
- To identify activities that will allow the WRAMS Service to have a broader integration with other national and international systems and frameworks (e.g. additional output formats).

- To identify business activities and recommendations to continue the advocacy of the WRAMS within the Canadian Emergency Management community (e.g. demonstrations and trainings).

2.2 Roadmap Timeline

The roadmap activities detailed in 2.4 cover a period of 2 years. For planning purposes, the technical activities (sections 0 and 2.4.4) have been grouped by quarters.

The roadmap is much more than a collection of activities compressed into a schedule. It is meant to deliver and demonstrate tangible benefits to the WRAMS users at regular intervals by means of pilot projects and training sessions.

2.2.1 Assumptions Made when Developing the Roadmap

The following assumptions were made in developing the roadmap timeline.

- The Galdos INDICIO open standard based registry service will be used in order to ensure continuity and minimize development and integration cost due to changes in the backend service.

2.2.2 Assumptions Made about Executing the Roadmap

The following assumptions were made about the execution of the roadmap:

- The evolving MASAS architecture will be documented and communicated with the WRAMS team, and any critical changes will be shared immediately. An extension to the MASAS API recommended by the WRAMS team will be strongly considered as part of a collaboration strategy.
- A MASAS team will be available to answer questions in a timely and effective manner.
- A MASAS Hub will be available for integration and testing.
- An NRCan team will be available to lead all business activities.
- An NRCan team will be available to meet, answer questions, provide comments, make recommendations, and supervise all technical activities.
- Training materials and demonstrations will be needed to support the early and late adopters of the WRAMS.

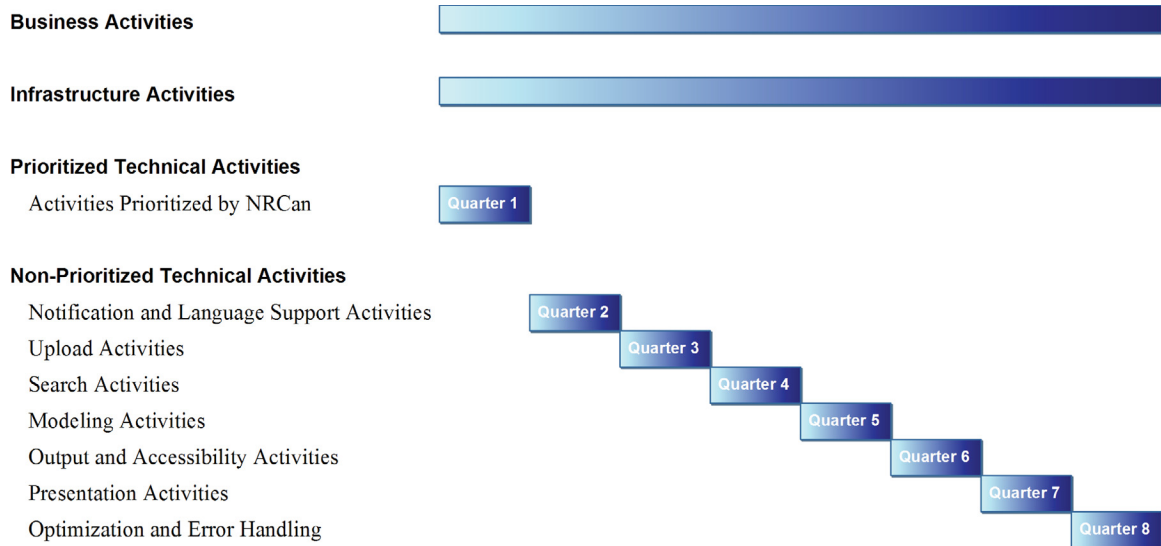


Figure 3: High Level Timeline for Roadmap

2.3 The Bigger Picture

2.3.1 HAZUS Services

In order to complement the WRAMS activities detailed in section 2.4, a number of activities can be executed to automate the creation of HAZUS model outputs. The activities are out of the scope of the WRAMS Service but would greatly enhance the overall use of event model simulation in Canada.

Table 2: Improved HAZUS Services

Service	Function
Hazard Model Engine	Automatically generates hazard models for specified events given site geography, event description, asset inventory, etc. For example, this engine would allow running a model simulation as soon as an earthquake occurs without any human interaction.
Asset Inventory Service	Maintains/provides shared asset inventories (e.g. soil maps, geology, rivers, etc.)
Hazard Model Management Service (WRAMS)	Manages hazard models; runs outputs from the Hazard Model Engine.

Rows highlighted in orange represent output of the current pilot study.

The figure below illustrates a broader HAZUS architecture:

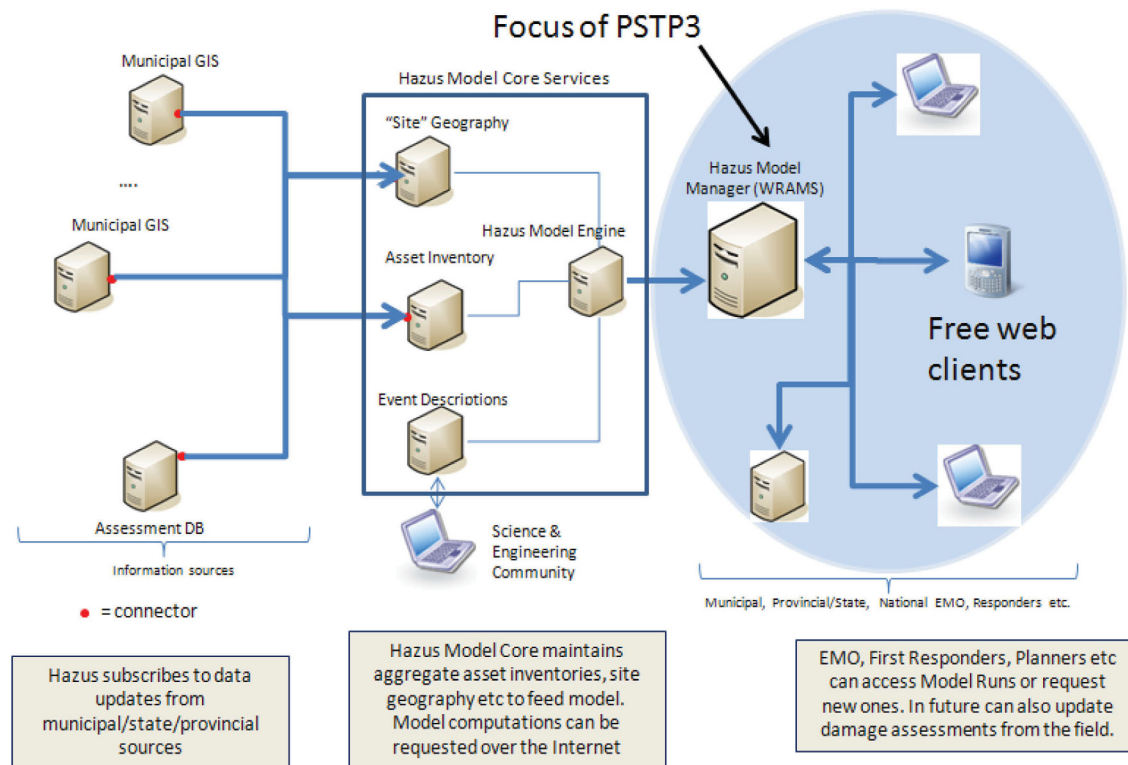


Figure 4: Future HAZUS Architecture

2.3.2 Potential MASAS Services

In addition to redefining the use of HAZUS models, a review of the current MASAS scope should be made. The current MASAS Hubs are used to publish and share alert events; however, Galdos believes that, in order to benefit the Canadian Emergency Management community, the scope of MASAS should be broader, to include HAZUS and WRAMS and to support the additional services listed in the table below.

Table 3: Potential MASAS Services

Service	Function
Event Description Service (Current MASAS?)	Describes specific events (e.g. earthquake), including the state of the event.
Alert Service	Accepts, validates, and publishes alerts to subscribers.
Resource Service	Provides resource information such as number of burn beds in a hospital, sand bags, etc., to requestors. (using a standard such as EDXL-RM)

Service	Function
Hazard Model Engine	Automatically generates hazard models for specified events given site geography, event description, asset inventory, etc. For example, this engine would allow running a model simulation as soon as an earthquake occurs without any human interaction.
Asset Inventory Service	Maintains/provides shared asset inventories (e.g. soil maps, geology, rivers, etc.)
Hazard Model Management Service (WRAMS)	Manages hazard models; runs outputs from the Hazard Model Engine.

Rows highlighted in orange represent services provided by a broader HAZUS architecture.

2.4 WRAMS Activities

This section contains the list of activities identified in the WRAMS roadmap.

2.4.1 Business Activities

The following table contains a list of business activities that can be executed in parallel to the technical activities described in section 0 and 2.4.4. Business activities will help in promoting and demonstrating the functionalities of the WRAMS service.

Table 4: Business Activities

Item	Description
Governance	<ul style="list-style-type: none"> • Encourage participation of local, regional, provincial/territorial, and federal agencies. • Ensure governance fits into a national interoperable plan. • Encourage a governance model that includes: executive leadership, technical committee, communication and outreach committee, architecture and business committee.
Demos	Provide demos to promote WRAMS at the local, regional, provincial/territorial, federal, and international level. Cf. section 2.5 for potential demo usage scenarios.

Item	Description
Training	<p>Training should be supported by online training programs (and resources) as well as on-site training programs.</p> <ul style="list-style-type: none"> • Executive Training: Why WRAMS/HAZUS? Governance? Funding and resource? Lessons learned? • Manager Training: same as Executive + What is an HPR file? What are indicators? • System Architect Training: What is the WRAMS architecture? How can WRAMS be integrated with your existing systems? • Implementer Training: Introduction to WRAMS API? How it can be used?

2.4.2 Infrastructure Activities

The following table contains a list of activities that can be executed in order to provide a better infrastructure for sharing information related to the models.

Table 5: Infrastructure Activities

Item	Description
Risk Map Atlas	National library of risk maps (e.g. theme maps, custom maps based on selected indicators) generated from WRAMS outputs. Currently, maps can be generated and saved on the user's local drive; a Risk Map Atlas would provide a mean for users to generate maps and share them with other users and systems. The service should provide secure and public access.
Models Clearinghouse	National library of HAZUS models that provides governments and industries with a central repository for HPR files. The service should provide secure and public access.
Integration with Canadian Framework	The integration with MASAS was part of this project. As part of future projects, we will need to investigate the benefits of WRAMS outputs to Canadian Geospatial Data Infrastructure (CGDI ~ compatible interface standards such as CSW, WMS, WCS, WPS, WFS, and other OGC standards), Emergency Management System Interoperability Framework (EMSIF), etc.

2.4.3 Prioritized Technical Activities

The following table contains the list of activities that have been prioritized by NRCan.

Table 6: Quarter 1 - Activities Prioritized by NRCan

Id	Priority	Item	Description	WRAMS Service/Client?
HM-1	1	Support for flood indicators	In addition to earthquake models, HAZUS allows modeling event scenarios for floods. Flood uses cases were mentioned during the first meeting with the partners.	Service/Client
HM-2	2	User creation API	<p>Add an API to allow WRAMS administrator users to create new users, assign roles, etc., and extend the WRAMS client UI provided for integration and testing in the pilot project.</p> <p>In the current pilot environment, only 6 users are available.</p>	Service/Client
HM-3	3	Improve styling	The styling of some indicators can be improved (icons size, colors, etc). This activity will be driven mainly by the feedback provided by the partners.	Service
HM-4	4	Multi-lingual support	Support for specifying the language type (e.g. French, one of the many native languages such as Inuktitut) through the API (e.g. creation, query, etc.). The INdicio registry service already supports multiple languages for specific properties such as name and description. Additional work needs to be done for other metadata properties.	Service/Client
HM-5	5	Additional export format	Additional output formats such as GML, a format requested by NRCan, can be supported to represent indicators and assets. Currently only ebRIM XML and KML are supported.	Service/Client
HM-6	6	Clients improvements	Based on feedback from partners during the demonstration.	Client

2.4.4 Non-Prioritized Technical Activities

The following table contains the list of activities that have not yet been prioritized.

Table 7: Quarter 2 – Notification and Language Support Activities

Id	Item	Description	WRAMS Service/Client?
HM-7	Improve notification	In order to extend the scope of the WRAMS, the notification mechanism must be extended. Systems other than MASAS can also be notified (e.g. US systems for improved cross-border information exchange, users with mobile phones, etc.). The following functionalities can be added to the WRAMS: <ul style="list-style-type: none">• Additional notification type: SMS and GeoRSS.• Notification retry mechanism	Service
HM-8	Subscription creation API	Add an API to allow users to subscribe to events based on user defined criteria (e.g. notification type, area of interest, etc.).	Service/Client
HM-9	Additional ATOM elements	Improve MASAS and allow specifying additional ATOM elements such as: contributor, subtitle, etc. These would be useful fields that can be used to send additional information to MASAS.	Service/Client
HM-10	Support for French	Provide client interface in both official languages by translating the current UI.	Client

Table 8: Quarter 3 – Upload Activities

Id	Item	Description	WRAMS Service/Client?
HM-11	Support for hurricane indicators	In addition to earthquake and flood models, HAZUS allows modeling event scenarios for hurricanes.	Service/Client

Id	Item	Description	WRAMS Service/Client?
HM-12	Upload models that failed to load	<p>A new API can be added to allow users to upload an HPR file that initially failed to load. Note that not all uploading errors can be recovered (e.g. invalid HPR files, unsupported HAZUS version, etc.) - examples of errors that can be recovered includes database connectivity, virtual memory exception, etc. Additional things to consider:</p> <ul style="list-style-type: none"> Do we need to remove all indicators created for a model before the failure (currently not done, created objects are only removed when the model is deleted). <p>Additional warning messages are also generated during the upload process (e.g. invalid geometry). This information needs to be communicated back to the user.</p>	Service/Client
HM-13	Mixed feature classes	Allow different geometry types (e.g. point, polygon) to be used for indicators that are based on the same ESRI feature class (e.g. Hazard Potential).	Service
HM-14	Proportional Symbols	<p>Currently, different icon sizes can be assigned to indicators (e.g. if a value is between 0 and 1, icon size = 0.5; if a value is between 1 and 2, icon size = 0.8; etc.); however, the symbols cannot be scaled according to the size of the view extent on the client. This feature would allow adjusting the size of the symbols according to the scale of the map.</p> <p>This would also require support for mixed feature classes.</p>	Service/Client
HM-15	Selective upload	When uploading an HPR file, allow the user to select the indicators he wishes to upload (currently everything is loaded).	Service/Client
HM-16	Complex balloon content	Allow a low level indicator to display the indicator values of other low level indicators in the KML balloon. This will help reduce the number of indicators that need to be generated.	Service

Id	Item	Description	WRAMS Service/Client?
HM-17	Complex chart syntax	Allow more complex chart syntax such as 'piechart SUM ind1, ind2, etc.' where specific indicators to be included in a chart can be selected. Currently only child indicator values can be used in a chart.	Service

Table 9: Quarter 4 – Search Activities

Id	Item	Description	WRAMS Service/Client?
HM-18	Gazetteer search	Allow a user to search for uploaded models using city, community or place names. This capability would allow a user to enter a place name (e.g. address or landmark) and have the nearest outputs displayed in a table or on a map.	Service/Client
HM-19	Search for indicators by name	Indicator list needs "name" filter; enter char's to filter based on 'name'; only show matching entries.	Client
HM-20	Additional search capabilities	<ul style="list-style-type: none"> • Allow for additional text search based on sources, subjects, description, etc. • Allow temporal search (e.g. by upload date). 	Client
HM-21	Selection of child indicators	Some indicators are not root level indicators. We need to allow the user to select a parent and automatically select all children.	Client
HM-22	Area specific outputs	Allow generating indicators and charts for a selected study region, set of tracts, or set of blocks.	Service/Client

Table 10: Quarter 5 – Modeling Activities

Id	Item	Description	WRAMS Service/Client?
HM-23	Code list values	Some indicators are based on code list values (e.g. soil types: A, B, etc.). It would be more effective and flexible to store the values and the associated names/definitions using an ebRIM classification scheme. Provide translation in both official languages.	Service/Client

Id	Item	Description	WRAMS Service/Client?
HM-24	Validity date	Allow a user to set a validity duration or expiration date for a model. When a model expires, the WRAMS service would automatically withdraw the model and change the model status to WITHDRAWN.	Service/Client
HM-25	User profile	<p>Allow the storage of a user profile. The profile of a user could contain:</p> <ul style="list-style-type: none"> • Predefined theme maps: a user can create any theme map they like and request to apply it to a given HPR file. • Preferred styling rules: a user can create their own styling rules that they wish to apply for specific indicators. Currently KMZ files are generated on ingest; if a style is modified, an HPR file needs to be reloaded in order to re-generate all the indicators. • Predefined chart formulas: a user can choose the indicators they wish to display in a given chart. • Preferred notification and/or subscription parameters: a user can specify a preferred notification mechanism (e.g. email) and a preferred subscription filter (e.g. only models in Vancouver). <p>Custom rules/maps created by a user might be shareable: at the organization level (predefine a style for all maps generated by a user that is related to NRCan), etc.</p>	Service/Client
HM-26	OAuth support	Support User/Security integration with MASAS (OAuth ~ MASAS is not ready for this).	Service/Client

Table 11: Quarter 6 – Output and Accessibility Activities

Id	Item	Description	WRAMS Service/Client?
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Id	Item	Description	WRAMS Service/Client?
HM-27	Geospatial web service interface	<p>Support for Open Geospatial Consortium (OGC) standard interfaces such as the Web Feature Service (WFS), Web Map Service (WMS), and Table Joining Service (TJS).</p> <p>Strongly consider standards defined in the Treasury Board of Canada Secretariat (TBS) Standard on Geospatial Data, http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=16553&section=text which are ISO 19115 and ISO 19128 (OGC WMS 1.3).</p>	Service/Client
HM-28	Additional output formats	Support for additional output formats such as shape files, GML (via WFS?), etc. The list of formats should be based on actual requirements from the community. Additional output formats will be essential for better integration of the WRAMS service with exiting systems (e.g. GIS, EM systems, etc.). Currently the output formats are: ebRIM XML and KML/KMZ.	Service/Client
HM-29	Layer Download	<ul style="list-style-type: none"> • Allow user to download indicators and assets separately ~ currently indicators and assets are downloaded as part of the same KMZ file. • Allow user to select and save layers without viewing them. 	Client
HM-30	Web Accessibility	Follow guidance provided by TBS on implementing the standard for Web Accessibility using standards such as Common Look and Feel (CLF), Web Content Accessibility Guidelines (WCAG): http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?evttoo=X&id=23844&section=text	Client

Table 12: Quarter 7 – Presentation Activities

Id	Item	Description	WRAMS Service/Client?
HM-31	Order indicators in KMZ file	Control order of layers in .KMZ file (if possible) for display purposes. The objective is to follow the order expressed in the Indicator C-Scheme.	Service

Id	Item	Description	WRAMS Service/Client?
HM-32	Dynamic chart	Allow the creation of dynamic charts. Dynamic charts represent charts that are generated based on user inputs. Currently, charts are generated when models are uploaded.	Service/Client
HM-33	Report/maps	Allow users to print maps, generate reports that would include maps, charts, etc.	Service/Client
HM-34	Load existing KMZ file	Allow the client to load a KMZ file directly from the local file-system.	Client
HM-35	Load existing WFS/WMS layers	Allow client to display data from existing WFS or WMS; this will facilitate integration with systems such as the Canadian Geospatial Data Infrastructure (CGDI).	Client
HM-36	Automated spell check	Provide automated spell check (multi-lingual) so that same words are entered (color vs. colour) to facilitate the search of HPR files.	Client
HM-37	Layer vs. Asset	Add distinction on the client between layers and assets ~ currently they are all in the same tree (but may be different colors).	Client
HM-38	Theme maps	Provide support for theme maps.	Client (MASAS)
HM-39	Shared styling rules	In order to improve the styling definitions at the national level, a common registry containing the styling information (icons, line colors, etc.) could be used by both MASAS and WRAMS.	Service/Client
HM-40	MASAS Java Script tool	Extend the existing MASAS Java script tool and integrate it with WRAMS: <ul style="list-style-type: none"> • Allow tool to read notification created by WRAMS • Allow tool to access WRAMS 	Client

Table 13: Quarter 8 – Optimization and Error Handling

Id	Item	Description	WRAMS Service/Client?
HM-41	Optimize polygon handling	Find a way to minimize the use of repetitive polygon in KML. Possible to create one time, then refer back to single set of them.	Service/Client
HM-42	Cleanup on startup	For various reasons (e.g. power outage), the upload of an HPR file could have been interrupted; however, when the system is restarted, the status of the HPR file will still be set to SUBMITTED. Possible action when the WRAMS service is restarted may be: <ul style="list-style-type: none"> • Change the status of all SUBMITTED HPR to FAILED • Restart the processing of all SUBMITTED HPR files 	Service
HM-43	Upload a remote HPR file	Allow the WRAMS service to upload an HPR file that is stored in a remote accessible location. Currently the HPR files must be loaded and sent to the WRAMS service. With this capability the WRAMS service would retrieve the file from a remote location. This will help client applications to reduce the memory footprint when loading HPR files. The location of the file would be specified in the metadata content when uploading a new HPR file.	Service/Client

2.5 Suggested WRAMS Usage Scenarios for Demonstration

This list contains some potential scenarios that may help promote and demonstrate the activities detailed in the above sections. Mounting these demonstrations may require some additional development work.

- The following pilot projects/scenarios can be executed in order to demonstrate the sharing of WRAMS outputs:
 - ♦ Cross-border: If an earthquake occurs in Vancouver, what are the consequences for US cities close to the border? How can we notify US systems? etc.
 - ♦ Cross-domain: Show how a shared model would help responders in Law Enforcement (e.g. social disruption), Emergency Management (e.g. area burned), Health Care (e.g. # of injuries), Transportation (e.g. damaged bridges), etc.?
 - ♦ Cross-jurisdiction: Show how a shared model would help the provinces of Ontario and Quebec if a flood occurs due to water rise in the Saint Lawrence River?

- ♦ Cross-platform: Show how WRAMS outputs are interoperable and can be integrated with applications running on different platforms such as Windows, Unix, etc.
- ♦ Use of multiple application vendors: Show how WRAMS outputs are interoperable and can be integrated with applications provided by different vendors (e.g. Google Earth, ESRI, etc.)
- ♦ Multilingual: Show how a model created in French by the city of Hull (QC) can help the city of Ottawa (ON)
- The following additional scenarios demonstrate the broad use of WRAMS outputs:
 - ♦ Display of KMZ files on mobile phones, tablets, etc. (currently the Google Earth application on iPhone doesn't support the structure of the KMZ file)
 - ♦ Offline use of WRAMS outputs: Show how the HAZUS -MH application can be used offline, if installed. Is there such a thing as a KML viewer that does not require GE or G/Maps? Use of Google Earth Portable?
 - ♦ Federated WRAMS model (Adding local registry for each EC for geographic redundancy and availability).
 - ♦ Show the difference between current HAZUS sharing process and new process with WRAMS.

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13. ABSTRACT The Earth Sciences Sector, Natural Resources Canada (ESS/NRCan), selected HAZUS as a best practice for quantitative loss estimation based on a suitability analysis of available risk assessment methods in the public domain. With a mandate from the NRCan Public Safety Geoscience Program, and support from the CRTI Risk Assessment Methods program of Centre for Security Science, Defence Research and Development Canada (DRDC), ESS is working with FEMA to develop a harmonized North American version of HAZUS that can be integrated into		

the evolving All-Hazard Risk Assessment Framework for Canada (AHRAF), and delivered using standards-based protocols under development by the Public Security Technical Program (PSTP) of DRDC.

Le Secteur des sciences de la Terre de Ressources naturelles Canada (SST, RNCa) a sélectionné HAZUS comme outil de pratique exemplaire pour effectuer l'estimation quantitative des pertes en fonction d'une analyse de la pertinence des méthodes d'évaluation des risques offertes dans le domaine public. Avec le mandat confié par le programme Géoscience pour la sécurité publique de RNCa, et appuyé par le programme Méthodes d'évaluation des risques de l'IRTC du Centre des sciences pour la sécurité, Recherche et développement pour la défense Canada (RDDC), le SST collabore avec la Federal Emergency Management Agency (FEMA) (agence fédérale de la gestion des urgences) pour concevoir une version nord-américaine harmonisée de HAZUS qui pourrait être intégrée au Cadre fédéral d'évaluation tous risques (CFETR) et livrée au moyen de protocoles fondés sur des normes en cours d'élaboration par le Programme technique de sécurité publique (PTSP) de RDDC.

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