THE UNIVERSITY OF THE WEST INDIES
SEISMIC RESEARCH CENTRE

STRATEGIC PLAN 2008-2013

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LIST OF ACRONYMS

CDW	Colonial Development and Welfare
CIDA	Canadian International Development Agency
COTS	Components off the Shelf
EDM	Electronic distance measurement
GIS	Geographic Information System
GPS	Geographic Positioning System
ICTA	Imperial College of Tropical Agriculture
InSAR	Interferometric Synthetic Aperture Radar
IOC	Intergovernmental Oceanic Commission
NOAA	National Oceanic and Atmospheric Administration
OAS	Organisation of American States
UNESCO	United Nations Education Scientific and Cultural Organisation
SRC	Seismic Research Centre
TWS	Tsunami Warning System
UWI	The University of the West Indies
UNFCCC	United Nations Framework Convention on Climate Change
VSAT	Very Small Aperture Terminal

INTRODUCTION

The Seismic Research Centre (SRC) of The University of the West Indies (UWI) is the agency responsible for monitoring earthquakes and volcanoes for the English-speaking islands of the Eastern Caribbean. In recent years, the SRC has played a more active role in promoting geologic hazard awareness through its education and outreach activities and it is also part of a regional effort to establish a tsunami warning system for the Caribbean and adjacent areas.

The SRC grew out of a Colonial Development and Welfare (CDW) project established in 1952 with the objective of monitoring volcanic activity in the Lesser Antilles and of providing a trained cadre of scientists in the West Indies who could react quickly to volcanic emergencies. During the first period of operation (1952-1957) the work of SRC was extended to include the monitoring of tectonic (non-volcanic) earthquakes and the non-volcanic islands of Trinidad, Tobago, Barbados and Antigua were included in the system. Jamaica joined in 1957 but withdrew in 1985 to form its own unit. The Trinidad-based Centre became part of the Imperial College of Tropical Agriculture (ICTA) in 1957 and was absorbed into The University of the West Indies in 1960, although some funding from CDW and its successor organizations remained until 1972.

The SRC is based in Trinidad and is part of the St. Augustine campus of the UWI but maintains facilities in and receives financial support from several countries of the Eastern Caribbean. The SRC also collaborates with other agencies within those countries in the provision of additional services. The SRC works closely with the National Disaster Preparedness Coordinators (or their equivalent) through whom reports to the Governments of the Region are channelled.

In recent years, the UWI has been involved in strategic planning with a view to enhancing its effectiveness and adding value to its stakeholders across the region. The SRC as an agency of the UWI has been involved in this strategic planning process and fully endorses UWI's vision, missions and key initiatives. This strategic plan, specific to the SRC, covers the period 2008-2013 and therefore embraces the UWI's strategic plan and shares its mission.

The UWI's mission is to propel the economic, social, political and cultural development of West Indian Society through teaching, research, innovation, advisory and community services and intellectual leadership. This requires the UWI to among other things:

- Conduct rigorous basic and applied research that serves to:
  (i) explore solutions to priority national and regional problems and challenges,
  (ii) create significant new knowledge,
  (iii) exploit developmental potential and comparative advantages,
  (iv) elucidate important contemporary social issues,
  (v) situate self and society in a changing world order and
  (vi) provide a sound basis for public policy formulation and decision making;
- Maintain a capacity to supply a wide range of expert technical, professional and advisory services to meet the needs of regional governments and the private sector;
- Assist the region to evaluate, assimilate, adapt and harness major new technologies in order to optimise potential benefits or limit impacts;
- Provide the population of the region with access to high quality academic programmes that are effectively delivered and that help to build strong individual, national and regional capacities in response to changing human resource needs; and
- Develop strategic alliances with other institutions to expand access to tertiary education as well as the scope of teaching and research.

These imperatives resonate with those of the SRC and its strategic plan therefore takes these components of the UWI's mission as its point of departure in developing its own strategic plan.

In 2005, the SRC began formalising its strategic plan in response to rapid changes in the field of earth sciences and disaster management. Globalisation, major advances in technology and a more demanding public have been and will continue to be the forces driving change over the next five years. To catch up and keep pace with the state-of-the art, the SRC must undergo significant transformation during the next five years. This is essential to effectively service its stakeholders at prevailing accepted levels. The 2008-2013 Strategic Plan is intended to be the roadmap guiding the organisation as it seeks to fulfil its mandate over the next five years.

The SRC has the unprecedented opportunity to build on knowledge gained from past research, create new knowledge, and use revolutionary advances in information technology to develop the means for mitigating catastrophic losses from earthquakes, volcanoes and tsunamis. This plan will assist the SRC in maintaining its position as a regional leader and to position itself to become one of the world's leading geoscience research institutions.

SITUATIONAL ANALYSIS

The Environment

The plate tectonic setting of the Caribbean region makes it susceptible to the hazardous geological events of earthquakes, volcanic eruptions and tsunamis. Earthquakes and volcanic eruptions have in the past caused significant damage and loss of life with corresponding economic cost to the region.

Earthquakes arguably represent the biggest threat to the region. Population growth, urbanisation and infrastructure expansion have all served to increase the region's vulnerability to earthquakes. Some major examples include earthquakes in Jamaica (1692) and Guadeloupe (1843). Although no major earthquake has occurred in the region within the last 30 years, should one occur at this time, the impact could overwhelm the capacity to cope. Earthquakes cannot be prevented but their effects may be mitigated.

Volcanic eruptions occur less frequently than devastating earthquakes but their impact has been no less severe in the Eastern Caribbean causing substantial economic and social disruptions. Again, population growth, development pressures and expanding air traffic over volcanic regions increase risks to life and property. Some important eruptions include Mt. Pelée, Martinique (1902), Soufrière, Guadeloupe (1976), La Soufrière, St. Vincent (1902, 1971-72, 1979) and the Soufrière Hills Volcano, Montserrat (1995-present).

Tsunamis are natural phenomena that are often triggered by earthquakes, volcanic eruptions and submarine landslides. Most tsunamis are hydro-geological in origin. While tsunamis occur less frequently than earthquakes and volcanic eruptions, the hazard has been ranked fourth in the list of most pernicious of the natural phenomena to have affected the Caribbean. During the last 500 years, there have been about ten fatal events yielding an average rate of about 1-2 potentially destructive events per century. While the probability of a tsunami is relatively low, the exponential growth in population and rapid increase in coastal development have led to increased vulnerability and consequently, risk from tsunamis. High levels of poverty and unplanned or ill-conceived developments have also exacerbated the threat from tsunamis and other coastal hazards. In most cases, tsunamis strike land near their sources so the first waves arrive within minutes with insufficient time to issue effective warnings or to coordinate evacuations.

Across the globe and around the region, the fields of earthquake and volcanic monitoring, hazard preparedness and mitigation have been undergoing significant transformation. There are several drivers of change which will continue to radically impact the operating environment. The key ones among these are: globalisation, rapid technological innovation and heightened international awareness following the Sumatran Catastrophe in 2004.

A local disaster can quickly become a national one which can result in an escalation of financial loss to a scale not previously experienced. Indeed, the growing interconnectedness of the World, enabled by extensive transportation systems and modern communications, greatly expands the impacted area of a damaging earthquake or volcanic episode. Global trade, commerce, and defence may all be affected if a critical link in the communications and distribution network is taken out of service by an earthquake or a volcanic eruption.

Unprecedented advances in information technology, telecommunications and digital electronics will continue to significantly transform the operating environment. Technological advances now allow for real-time, high fidelity monitoring of seismicity across the world. As a result, earthquake parameters become available rapidly. This information is essential for categorising and properly assessing the possible impact of a significant event and issuing appropriate alerts. In the near future, it is anticipated that information technology will greatly expand the ability to map seismic hazards, including ground shaking, tsunamis and sensor and satellite-based observations of ground deformation.

The ultimate goal of seismology is the prediction of location, magnitude, date and time of damaging earthquakes. However, the current state of understanding of the nature of earthquake nucleation does not lend itself to such precise prediction. New technologies now available using advanced drilling techniques and satellite based geographic positioning systems (GPS) afford unprecedented opportunities to measure strain accumulation and physical conditions under which earthquakes occur and are being incorporated in the monitoring effort as a part of the strategy to enhance the forecasting capability by expanding the physical parameters being monitored.

Recent advances in science and technology also present opportunities to reduce risks from volcanic activity. Remote, real-time seismic monitoring of active volcanoes with expanded networks upgraded with broadband

seismometers, continuous GPS and tiltmeters, InSAR and other sensors will provide new insights into volcanic processes; GIS and database technology, numerical modelling and probabilistic assessment may be used to improve forecasting of volcanic hazards.

One of the biggest challenges in successful implementation of earthquake and volcanic risk reduction programmes has been the limited understanding of factors that motivate individuals to act on warnings. A considerable body of new knowledge in areas of social, behavioural and economic science exists that can greatly assist in decision making, risk communication and understanding the human dynamics involved in hazard mitigation. Advances in data gathering, analysis and dissemination along with the communication network available today make it possible to transmit information across the World in minutes, which was impossible a decade ago. In other words, the tools to develop an effective risk reduction program do exist. Their most effective use still needs to be maximised.

The heightened political and public awareness of natural hazards since the Sumatran event has provided a unique opportunity to influence decision-makers at the highest levels to change policies and commit the necessary resources to address the hazards to which we are exposed. In addition, the unprecedented number and impact of other recent natural disasters worldwide has renewed attention to preparedness and mitigation for natural disasters in the region and beyond. The region on the whole is now more likely to lend the support needed to implement Early Warning Systems for geological hazards, to promote long-term mitigation measures and to begin a program to educate and prepare the region for future events.

The regional and international community is also being proactive about hazard reduction and mitigation and in particular, the increased vulnerability to Tsunamis globally. Possible funding sources include: the United States Agency for International Development, the United Nations Development Programme, the Commonwealth Secretariat, the Canadian International Development Agency (CIDA), the Organisation of American States (OAS), the Caribbean Development Bank and the World Bank. In particular, the clear mandate of the Intergovernmental Oceanic Commission (IOC), a commission of UNESCO, is to coordinate the establishment of Tsunami Warning Systems in regions at risk around the world. The Caribbean and SRC in particular, has been actively involved in the process of establishing a TWS for the region. This TWS is proving to

be the catalyst advancing the realisation of a seismic network with extensive real time capability.

The focus of climate change on the global agenda also brings with it opportunities for the region. In particular, discussions are now centred on the nexus between climate change and disaster preparedness particularly for small island developing states. These issues were prominently featured on the discussions that took place at the 2007 Commonwealth Heads of Government Meeting in Uganda. More importantly, the United National Framework Convention on Climate Change (UNFCCC) began negotiations in Bali in December 2007 with the aim of reaching global consensus in 2009 in Copenhagen. The global focus on these issues will serve to significantly heighten awareness and channel resources into projects such as establishment of early warning systems as well as education and outreach programmes.

The Organisation

The SRC operates an Eastern Caribbean Seismograph Network which has been in operation since 1952. It is the agency responsible for monitoring and studying earthquake and volcanic activities in the English-speaking Lesser Antilles. Prior to 1998 the seismic network comprised an array of 32 narrow-band vertical sensors that were linked in real-time to the SRC in St. Augustine, Trinidad via a combination of leased telephone circuits and/or several radio links. While the network composition and configuration provided real-time detection coverage of geologic events, high telecommunication costs for data transmission inhibited the routine, systematic deployment of sensors at the level necessary for detailed analysis of geologic events. During periods of elevated activity, the local network in the affected area was strengthened by rapid deployment of additional stations at the level necessary for investigating the episode. This approach is clearly not the most effective since possibly crucial initial information may be lost.

During the period from 1998 to 2003 data acquisition was decentralized. Instead of all data being transmitted directly to the PC-based system in Trinidad, the network was subdivided and 13 such systems were deployed throughout the Eastern Caribbean. This distributed data acquisition and monitoring provided a shorter, more direct and cost effective link to the recording systems, which improved data quality while preserving accuracy and allowing increased surveillance coverage of seismic activity within the subdivisions. The SRC

communicated with each system via the public switched telephone network and the Internet. An important drawback of this approach is the loss of real-time data collection at SRC and the consequent loss of real-time data processing and reporting capability. A network upgrade of instrumentation, layout and communications, currently underway will overcome this constraint and introduce the rapid event processing essential for an effective Tsunami Warning System along with features that enhance the monitoring of and reporting on earthquakes and volcanoes.

The SRC is well poised to take advantage of advances in technology, the heightened interest among regional and international policy makers and the opportunity provided to the SRC to assist in the development of an early warning system for tsunamis to enhance its effectiveness and add greater value to its stakeholders.

S.W.O.T. ANALYSIS

Strengths

The SRC can potentially capitalise on a number of strengths as it attempts to re-position itself and enhance its effectiveness. Among these strengths are the following:

1. A well established regional seismic network is currently in place which forms the backbone of the monitoring system. It is robust and has the flexibility to assess both earthquake and volcanic activity - it is an integrated network.
2. The SRC's status as a Centre of the UWI provides a degree of autonomy that facilitates the rapid decision-making that is often necessary in executing its core functions.
3. The SRC can take advantage of existing UWI mechanisms (e.g. the UWI Distinguished Open Lecture Series; training workshops; sabbatical visits) to encourage external researchers to collaborate on joint projects with the SRC.
4. The SRC is considered an authority in its field.
5. The SRC generally has a cadre of technically competent, highly skilled, self-motivated and well experienced staff.
6. Significant experience has been gained in the execution of Education and Outreach (E&O) programs in the Eastern Caribbean.
7. The SRC has a unique library collection composed of several hundred texts, journals, articles, and other printed and electronic material.
8. The SRC possesses a significantly large seismic database that is readily accessible and available to undertake research.
9. The SRC has the capability to host research students and engage in collaborative research projects with external agencies (e.g. NOAA, University of East Anglia, University College London and Bristol University).
10. Apart from seismic monitoring, other volcano monitoring programs have been developed and are developing including ground deformation (mainly GPS, tilt and EDM) and geothermal monitoring.
11. Extensive expertise and knowledge in the Earth Sciences has allowed for revenue generation through consultancy work.
12. The SRC has analytical capacity for undertaking geochemical analysis of volcanic gases and condensates; it is the only such facility in the English-speaking Eastern Caribbean
13. The SRC has the capability to be one of the key champions in developing a Tsunami Warning System for the Caribbean.

Weaknesses

The SRC must take into account several weaknesses that, if left unaddressed can seriously impact its competitiveness and effectiveness. These include:

1. The current building/facility is inadequate, unsuitable and structurally deficient as well as aesthetically unappealing.
2. There is some level of complacency and inflexibility amongst long-serving staff.
3. For some staff positions there seems to be an absence of clearly defined job descriptions, roles and responsibilities which sometimes leads to confusion and conflict.
4. There exists several miscellaneous tasks that do not fall within the core responsibilities of staff members that are not being undertaken efficiently.
5. There are no written policies and procedures for Human Resources, Information Technology, Finance and Communications.
6. The Education and Outreach function is not clearly defined, seriously understaffed and does not have a budget for activities.
7. Some seismic stations in the monitoring network have long downtimes.
8. There is a lack of 'real-time' capacity in the monitoring network in its current configuration.
9. The SRC's current budget limits the amount of maintenance that can be done on the network.
10. The monitoring network lacks redundancy and some aspects of the communications links between remote stations and the SRC are weak.
11. There is a lack of, or minimal, on-site support personnel in the islands.
12. There is a lack of awareness by local support personnel of the urgency to keep the network operational.
13. Urgent modification in the seismic data processing software remains to be done.
14. There is a lack of a set of written protocols or procedures outlining how staff members should respond during periods of Emergency/Crisis (e.g. media interaction, field deployment, and maintenance).
15. There are not enough GPS stations for quantitative modelling of ground deformation.
16. There is insufficient use of alternative techniques to monitor ground deformation such as EDM and precise levelling ('dry tilt').
17. The time gap between re-occupation of the GPS stations may result in the deformation episode being completely missed.
18. The geothermal monitoring program has a similar gap in data collection and a smaller number of monitoring sites.

19. The seismic dataset is not continuous in a machine- readable form and some segments may therefore not be readily accessible.
20. There are insufficient continuous GPS stations in operation by the SRC.
21. The magnitudes of earthquakes determined prior to 1980 are inconsistent.
22. There is a lack of sufficient financial resources for undertaking research; SRC's budget caters for routine monitoring only and does not readily support research work.
23. Research in the past has been predominantly volcano-related at the expense of other areas.
24. The research activity/agenda is largely done in response to specific volcanic or seismic episodes rather than focused on general/overall processes.

Opportunities

The drivers of change in the environment provide the SRC with real opportunities for institutional growth and development. The most significant of these are:

1. Recent and unprecedented advances in information technology, telecommunications and digital electronics now allow for upgrade to real-time seismic monitoring and reporting of ground motion intensities.
2. New technology including GPS will allow for monitoring and measurement of strain accumulation and the physical conditions under which earthquakes occur.
3. Availability of a considerable body of knowledge in the areas of social sciences, risk communication and decision making as well as decision sciences and earthquake safety can provide greater insight into human dynamics involved in hazard mitigation.
4. Increased awareness of disasters as a result of major world disasters and the momentum created by these disasters to focus on mitigation.
5. Strong economic growth in the region, particularly among highest contributing countries.
6. Trinidad and Tobago is host of the 5th Summit of the Americas in 2009 and Commonwealth Heads of Government Meeting in 2009. Climate change and disaster preparedness are among themes being considered.
7. Heightened interest in and promotion of a strategy for Comprehensive Disaster Management (CDM) across the region.
8. Research partnerships available at leading institutes around the globe.
9. Opportunities exist to forge strategic partnerships and deepen collaboration with institutions within and outside the region.

10. The SRC can exploit alternative funding sources such as assistance from international development agencies like the United States Agency for International Development, the Organisation of American States (OAS), CIDA and the World Bank to the region.

Threats

The SRC faces several serious threats that must be acknowledged and addressed in order to achieve its vision. Some of these are listed below:

1. The hazards posed by the state of the building used for its operational base. There is serious potential for damage/destruction due to fires, earthquake and other hazards.
2. Attempts to decrease the autonomy of the SRC by integration into other UWI departments or national institutions (e.g. merger with the Physics Dept; integration into the University of Trinidad and Tobago).
3. Expansion by regional organisations with similar interests to cover geographical areas and field of operations that is currently within the ambit of the SRC.
4. The development and execution of similar E&O programs by other agencies in the region which compete for similar audiences and resources as the SRC.
5. Political and public misconceptions about the SRC's role and responsibility in the region.
6. Competitors producing higher quality products and services.
7. Late payment or non-payment of contributions by islands that contribute to the recurrent budget of the SRC.

VISION, MISSION, CORE VALUES

Vision

To be the leading agency in the Eastern Caribbean for earthquake, volcano and tsunami monitoring and for the dissemination of information to reduce risk, deaths, injuries, property damage and economic loss

Mission

To monitor and study earthquakes, volcanoes and tsunamis in the Eastern Caribbean and provide advice and information for emergency response, public safety and loss mitigation

Core Values

The SRC cherishes and is determined to preserve its core value system which has been developed over the over fifty years of existence. This value system is characterised by the following ideals:

- Commitment to excellence
- Independent thought and inquiry
- Commitment to precision and accuracy
- Keen sense of individual and social responsibility
- Respect for the rule of law
- Culture of innovation
- Ability to adapt easily

STRATEGIC FOCUS - THE NEXT FIVE YEARS

Exposure to the potentially hazardous effects of earthquakes, volcanoes and tsunamis are a fundamental reality of life in the Eastern Caribbean. The degree to which future losses of life and property in the region can be mitigated depends on the collective understanding of these geological hazards and on the implementation of a comprehensive disaster management strategy to cope with the existence of these threats.

The SRC will leverage its organisational strengths and take advantage of the opportunities in the external environment to re-position the organisation as the leader in seismic and volcanic research and monitoring and in the development of early warning systems for tsunamis. The SRC will strengthen the institution by analysing its weaknesses and mitigating the threats in the operating environment.

In order to achieve the vision and mission outlined above, the SRC will focus on the following five strategic objectives during the plan period.

1. **Enhance monitoring operations to better assess and forecast the onset of a volcanic, earthquake or tsunami event.**
2. **Re-position the research function to improve the understanding of earthquakes, volcanoes and tsunamis and to produce a cadre of trained geoscientists.**
3. **Promote education, outreach and impact mitigation.**
4. **Strengthen the financial condition of the organisation.**
5. **Enhance capability through human resource development.**

In this first strategic plan for the period 2008-2013, a number of key initiatives or strategies to achieve each of the strategic objectives are identified. In addition, in order to facilitate implementation, it is imperative that performance be measured and progress tracked. Indeed, without appropriate monitoring and measurement, the plan may not be very meaningful. Nonetheless, setting targets and measuring progress towards the achievement of these targets require the availability of appropriate and robust indicators and a system to monitor these indicators over time. In this first plan, key performance indicators are proposed. As the plan is being rolled out, and the planning process becomes institutionalised, indicators will be refined and the SRC will be able to measure its progress in a more scientific manner as well as benchmark itself with other similar institutions.

STRATEGIC OBJECTIVES

STRATEGIC OBJECTIVE 1

Enhance monitoring operations to better assess and forecast the onset of a volcanic, earthquake or tsunami event.

Background

A modern regional earthquake monitoring and reporting system is fundamental to obtaining timely and accurate seismic information, the core of an effective earthquake response and mitigation strategy for the region. An integrated seismograph network will organise and manage the collection and distribution of seismic data and develop and provide new products and services. The thrust of this initiative is to return to real time monitoring of earthquakes. At the present time, the SRC uses the internet and regular telephone lines which introduce a delay in the transmission of data from remote stations to the SRC headquarters in St. Augustine, Trinidad.

Usually volcanic eruptions are preceded by measurable changes in seismicity, ground deformation and other geophysical and geochemical parameters. Vigilant, sustained monitoring of these signals provides the data needed to detect the initial stages of volcanic unrest, forecast eruptions and improve scientific understanding of the volcanic processes. While the SRC conducts a continuous study of active volcanoes in the Lesser Antilles by both geological and geophysical methods, several shortcomings have been identified.

While there are over twenty seismological organisations in the Caribbean and adjacent areas, very few resources have been traditionally assigned to the study and mitigation of tsunamis. The SRC is at the present time developing a programme to address the hazards that a tsunami can pose to the region. This is being done in collaboration with partner agencies within the Caribbean and adjacent areas. A well instrumented, highly efficient seismic network is the first line of defence in a TWS. A seismic monitoring network that is designed to meet the specific demands of a TWS (instrumentation, layout and communications) will invariably incorporate features that are common to monitoring other geological hazards. The SRC will build on the common features that have been established in earthquake and volcanic monitoring and upgrade missing features.

Key Initiatives and Strategies

- Upgrade fourteen remote digital seismic stations operating in the Eastern Caribbean.
  - Ensure the availability of backup power
  - Provide access to a robust internet service
  - Construct vaults for sites that host broadband sensors
  - Increase technical support where required
- Extend the seismograph network with an additional three stations to be located on Tobago, Aves Island and Montserrat.
- Utilize a range of software products to log and automate the processing of data from these upgraded installations thereby reducing the time it currently takes to recognize and report potentially threatening events (volcanic, seismic and tsunamigenic).
- Build a robust communications infrastructure with Very Small Aperture Terminal (VSAT) links as the primary carrier and use of other carriers to ensure redundancy.
- Collaborate with international (e.g. the United States Geological Survey & the Institut de Physique du Globe de Paris) and regional (e.g. the Puerto Rico Seismograph Network) institutions in the establishment of real-time, high-quality, broadband and continuous GPS stations in the Eastern Caribbean.
- Develop sustainable networks for monitoring ground deformation on all potentially active volcanoes in the English-speaking Eastern Caribbean.
- Continue routine monitoring of potential ground deformation using Global Position System (GPS).
- Implement systems to ensure automated data retrieval and data processing.
- Integrate the various streams of data collected by the SRC to formalise multi-parameter monitoring of volcanoes.
- Collaborate with other agencies and actively source funding to increase the number of continuous GPS stations operational in the Eastern Caribbean.
- Install and utilise digital cameras to monitor activity at all volcanoes considered most likely to erupt in the near future.
- Monitor data regarding geothermal activity at volcanoes.
- Build a geochemical database that provides baseline data on activity at volcanic systems in the region as well as on health impacts associated with volcanic activity.
- Develop the seismic component of a Tsunami Early Warning System in collaboration with partner agencies in the Caribbean and adjacent areas.
- Develop automated solutions for earthquakes.

- Develop data sharing protocols amongst seismological organisations to enable integration into a regional TWS.
- Identify both tsunami hazard zones and the region's vulnerability.

Key Performance Indicators

- Establishment of a VSAT network of stations
- Real time acquisition of data
- Reduction in time for issuance of earthquake solution
- Increase in the number of sites used for ground deformation and geothermal monitoring
- Health impact studies on exposure to background volcanic emissions
- Increase in the number of continuous GPS stations in operation in each island
- Number of volcanoes for which information supports public safety decisions
- Real time flow of critical data during evolving volcanic activity
- Number of hazardous volcanoes with published hazard assessments
- Creation of data sharing protocols
- Health impact studies on exposure to background volcanic gas emissions

STRATEGIC OBJECTIVE 2

Re-position the research function to improve the understanding of earthquakes, volcanoes and tsunamis and to produce a cadre of trained geoscientists.

Background

This strategic objective represents one of the core functions of the SRC – research. An important feature of the SRC is the co-existence of operations and research. However, from the foregoing analysis of the internal environment, research seems to be affected by the limited budget of the organisation. In addition, the research agenda appears to be biased towards volcano research. Further, while a number of individuals have been trained at the centre, producing geoscientists has not been the focus of the institution.

Since research is critical for both monitoring and mitigation, this function will have to be re-positioned for greater visibility and effectiveness. In addition, as an agency of The University of the West Indies, the SRC should be upgraded to have the capacity to supply a wide range of expert technical, professional and advisory services to meet the needs of regional governments and the private sector in Seismology and Volcanology.

Consequently, the SRC will actively engage in and support research into the processes by which earthquakes, tsunamis and volcanoes occur. Research will also be conducted to better appreciate the social and economic implications of earthquakes and volcanoes. This latter area will serve to advance the understanding of the social and economic impacts of earthquakes and volcanoes, determine levels of risks deemed acceptable by various groups in society, and reduce the social, economic and political barriers to effective earthquake risk reduction. Further, there will be a concerted effort to increase the supply of trained professionals to serve the needs of the region.

Key Initiatives/Strategies

- Target high school students to study geosciences through education and outreach programmes at career fairs, career guidance seminars etc.
- Lobby for a quota of national scholarships to be allocated to the study of Earth Sciences/Geosciences.

- Source scholarships from the private sector, international organisations and international civil society organisations.
- Partner with leading world research institutions for internship programmes.
- Introduce a graduate internship programme at the SRC.
- Introduce graduate course in Volcanology and Seismology at the SRC.
- Increase the number of graduate students conducting research at the SRC.
- Maintain an easily accessible archive of earthquake data including waveform data and derived products to stimulate engineering applications and further the seismological understanding of the locations and causes of future earthquakes throughout the region.
- Research effective means to communicate real-time warnings to various intended recipients so that appropriate responses are elicited. Incorporate research results into the development of earthquake early notification systems.
- Advance social science research to overcome social inertia to change and hazard loss estimation. Focus on the following areas:
  - Human and societal impacts
  - Loss estimation and quantification of economic impacts
  - Effective fiscal instruments and cost containment methodologies
  - Emergency response and recovery
  - Decision making, policy making and land use planning
  - Risk perception, risk management and risk communication
  - Public health consequences of earthquakes
  - Direct and indirect economic losses occurring as a consequence of earthquakes
- Advance research in understanding earthquake hazards in the following areas:
  - Physics-based earthquake models
  - Predictive models of seismic hazards
  - Seismic hazard mapping for performance-based seismic engineering
- Research tsunami hazard mitigation strategies including modelling and computational simulation, geographical information and communication systems, social sciences and planning.
- Research into risk communication, cost-effective mitigation and integration of tsunami mitigation into multidisciplinary coastal zone management.
- Develop collaborative projects with UWI departments, external institutions that focus on mutual areas of interest for the SRC and that are guided by clear protocols (MOUs, data license, etc.).
- Develop a Research Agenda that is used to guide research at the SRC with a provision for annual review and revision.
- Homogenise the seismic database.

- Conduct research into the impact and response of built structures to strong ground motion.
- Conduct vulnerability assessments of historic and public buildings.
- Incorporate existing research projects into the future research programme for the SRC. These include but are not limited to the following projects:
  - T-phase signals observed from recent Dominica earthquake sequence and Kick 'em Jenny volcanic eruption
  - Deep earthquakes that occur off the east coast of Trinidad that suggest a deeper origin than the crust
  - Bathymetry of the Gulf of Paria and its impact on the extent of tsunami run-up
  - 1979 Soufriere St. Vincent volcanic eruption-related earthquake sequence and the pre-1995 Montserrat earthquake sequence
  - The communication risk and hazard information on hazardous geological phenomena
  - Strong Motion Studies in Trinidad and Tobago
  - Experimental Study of magma rheology and flow
  - Geology and physics of pyroclastic density currents in the Lesser Antilles
  - Vulnerability and risk assessment of volcanic islands
  - Multi-disciplinary modelling of the activity at Boiling Lake, Dominica

Key Performance Indicators

- Increase in graduate student enrolment at the SRC
- Increase in the number of students undertaking research at, or in association with the SRC
- Number of students enrolled in post graduate courses run by the SRC
- Number and percentage of research projects in areas identified
- Number of strategic partnerships with research institutions & UWI departments/units
- Number of publications in peer-reviewed journals
- Research expenditure per full-time academic staff member
- Research expenditure as percentage of recurrent budget
- Number of research grants awarded

STRATEGIC OBJECTIVE 3

Promote education, outreach and impact mitigation.

Background

While the SRC's core mandate has historically revolved around research and monitoring, these activities are not an end in themselves. As already alluded to, research activities may facilitate monitoring and vice-versa. However, the wealth of information produced should inform a strong outreach function for the SRC. The SRC is well poised to perform this role as it is viewed as an authority in the areas of Volcanology and Seismology. The education and outreach function clearly needs to be strengthened. With only one dedicated staff member and no specific budgetary allocation for this function, the education and outreach activities have been limited.

While the SRC will work with other agencies – key among them being the disaster management offices – the incredible opportunity the SRC has for increasing public awareness and education, informing planning and facilitating disaster mitigation cannot be overemphasised. Indeed, this is where real value is added to the region and the SRC will be appreciated as providing a real service to the people of the region. The objective of this thrust is to help people modify their behaviour or their response to hazards. The SRC will translate the information on hazards to help mitigation. The SRC will partner with disaster management personnel, planners, engineers and other stakeholder in this regard.

Key Initiatives/Strategies

- Inform citizens about geologic hazards and risks
  - Identify a hazards awareness champion
  - Develop a higher profile in the media and a good rapport with media professionals
  - Install permanent displays in museums, libraries, public buildings, community centres
  - Offer technically qualified and interesting public speakers to speakers' fora
  - Solicit support from key private and public organisations

  - Create public service announcements, multi-media presentations on hazards which can be displayed at public waiting areas as well as on national television
  - Develop mobile displays for malls, libraries, airports
  - Promote an annual hazards awareness week (e.g. Earthquake Awareness Week)
  - Have press releases prepared in advance to take advantage of a window of opportunity such as a high visibility geologic events overseas or a moderate earthquake in T&T
  - Develop a policy to guide all interactions with the media
- Increase awareness among students
  - Incorporate hazards education in school curricula
  - Incorporate the study of earth science, natural and human history, math, geography, physics, computer science in an age appropriate manner
  - Sponsor, support and encourage hazards drills and safety exercises in all schools.
  - Develop modules for a multi-level curriculum for hazard education in all schools.
  - Conduct lectures at schools
  - Lobby for national scholarships to be awarded for the study of Seismology and Volcanology.
  - Develop resource materials for use in primary and secondary schools.
- Develop programmes targeted to business – guides and training for earthquake preparedness in the workplace for managers and employees, techniques to reduce losses and resume operations quickly after a disaster.
- Develop a state of the art resource centre at SRC with interactive features.
- Organise national and regional workshops, seminars and conferences.
- Inform regional development and physical planning.
- Develop Earthquake, Volcano and Tsunami Hazard Mitigation Programmes.
- Establish and maintain a highly visible profile for the SRC.
- Establish reliable warning and alert and notification systems.
- Maintain and strengthen working relationships with the emergency planning and response community.
- Develop realistic scenarios for emergency response exercises.
- Maintain high capacity website that can be easily accessed by professionals and the public alike, to provide data, information products and educational materials.
- Ensure that design professionals and building officials are kept current on relevant geosciences information by convening periodic meetings of

geoscientists, engineers, and building officials to discuss the implications of geo science information to building safety.
- Develop codes, guidelines, demonstration projects and training in the use of new design and retrofit procedures.
- Perform geologic-hazards investigations for critical public facilities.
- Improve plan review procedures on new construction to ensure that buildings are being designed in accordance with current seismic code requirements, particularly public buildings like schools, hospitals and emergency response facilities
- Undertake scenario planning and foresighting exercises to better manage a disaster.
- Formalise and reinforce existing emergency response protocols

Key Performance Indicators

- Formulation of Education and Outreach Plan
- Percent of recurrent budget allocated to Education and Outreach
- Number of seminars, workshops and conferences held
- Positive press per month/quarter
- Number of visits on website
- Awareness surveys among general and targeted population
- Number of requests for information disaggregated by student, professionals, media, government, and general population
- Number of emergency professionals trained
- Number of schools receiving materials
- Number of businesses accessing resources
- Materials produced to guide safe and economical earthquake resistant design of new buildings
- Implementation of emergency response protocols
- Number of sessions for design professionals
- Number of organisations hosted
- Number of visits to library facilities
- Number of persons accessing virtual library and help desk
- Number of positive relationships as weighed by bi-annual surveys.
- Preparation of an Emergency Communications Plan and Media Policy
- Number of educational tools developed

STRATEGIC OBJECTIVE 4

Strengthen the financial condition of the organisation.

Background

While the SRC has managed its resources well and has been able to fulfil its core functions with some success, it has been constrained in undertaking additional projects including investing in new technologies to improve its functions to transition to real time monitoring. In addition, funding constraints have among other things led to the degradation of the physical plant. Research efforts have also been stymied because of funding constraints. The SRC must therefore strive to become more financially independent. It can perhaps diversify its funding sources by developing a culture of entrepreneurship and exploring alternative funding mechanisms. At the current time, the SRC is funded by the governments of the region as detailed in Table 1 below.

Table 1: Contributing Countries.

Country	Monitoring	Percentage[1]
Trinidad & Tobago	Earthquake	50.0
Barbados	Earthquake	21.3
Grenada	Volcanic and Earthquake	4.3
St. Vincent & the Grenadines	Volcanic and Earthquake	4.3
Saint Lucia	Volcanic and Earthquake	4.3
Dominica	Volcanic and Earthquake	4.3
Saint Kitts/Nevis	Volcanic and Earthquake	4.3
Antigua and Barbuda	Earthquake	4.3
Montserrat	Earthquake	2.9

Key Initiatives/Strategies

- Explore additional income sources through business operations, full fee academic programmes, institutional consultancies, technical services, intellectual property income, partnership agreements, and publications.
- Establish quantifiable performance indicators for increased effectiveness.

[1] Percentages of the recurrent budget of the SRC provided by each country.

- Invest in technology to promote greater efficiency in monitoring and data management activities.
- Pursue improved cost effectiveness in procurement management. Establish clear performance standards for outsourced services and improve the effectiveness of monitoring mechanisms.
- Target specific areas for efficiency gains.
- Source corporate sponsors.
- Partner with state agencies with similar mandates.
- Enhance resource mobilisation mechanisms such as access to development and endowment funds.
- Explore opportunities for increased funding from government's capital development programmes such as the Public Sector Investment Programme (PSIP) by formulating robust proposals for submission to Central Government.
- Review the existing policies and practices relating to own-account academic consultancies.
- Forge linkages with various regional and international development organisations to funds. These include the Caribbean Development Bank, the Organisation of American States, the Commonwealth Secretariat, the Inter-American Development Bank, the World Bank, and the International Organisation for Migration.

Key Performance Indicators

- Increase in capital budget
- Increase in recurrent budget
- Increase in number and value of grants
- Increase in consultancies
- Reduction in non-essential expenditure
- Number of corporate sponsors
- Access to technical cooperation
- Increase in revenue from publications, provision of technical advice, seminars

STRATEGIC OBJECTIVE 5

Enhance capability through human resource development.

Background

The SRC currently has twenty staff members. However, there is no dedicated human resources position. Day to day human resource management concerns are addressed by supervisors and the Head of the SRC. This, coupled with the absence of an HR policy, staff development plans and succession planning has led to some degree of complacency, demotivation and retention issues among some staff members. An HR function will assist the organisation in developing its human capital – the asset of the SRC by instituting best practices in human resource planning and development.

Given the strategies outlined, in particular the expanded function of outreach and new areas of monitoring and research, the current staff complement, will need to be re-visited. In addition, there is need for an organisational structure to reflect the strategic objectives of the SRC and to provide for greater upward mobility and staff retention.

Key Initiatives/Strategies

- Promote a work environment that is conducive to high performance, job satisfaction and the general well being of staff.
- Radically improve the physical work environment by constructing a state of the art facility which will allow the SRC to effectively fulfil its core objectives.
- Create a learning environment.
- Create an organisational structure that is more flexible and allows for upward mobility and retention of skilled and experienced staff.
- Develop a succession plan.
- Create a human resource post to position the HR function in a more strategic manner.
- Provide opportunities for learning and growth within the organisation.
- Prepare a professional development programme for each member of staff.
- Establish a performance management system with an effective incentive system that recognises excellent performance.

- Create opportunities for greater sharing of information, experiences and skills among all staff members.
- Create a more cohesive team.
- Ensure the highest standards of health and safety for staff at all times.

Key Performance Indicators

- Completion rate of new facility
- Number of human resources positions
- Development and implementation of human resource management plan
- Length of time to recruit
- Quality of recruitment decisions
- Performance measurement and management
- Creation of training plan for staff
- Dollars spent on training per employee.
- Implementation of "lunch and learn" programme
- Introduction of new performance appraisal system
- Number of training days per employee per year
- Employees engaged in training for upward mobility
- Retention rates
- Level of employee engagement
- Level of employee satisfaction
- Implementation of OSHA

ACTION PLAN

In the plan period, the SRC will attempt to deepen the planning process by developing an action plan with a fairly comprehensive set of activities, targeted outcomes, resource requirements and timelines. Once there is agreement on the strategic objectives and key initiatives, there should be some preliminary work on selecting the appropriate performance indicators and getting baseline data and benchmarks for the organisation.

This action plan indicates an explicit commitment to the discipline of performance measurement and will facilitate monitoring and evaluation, resource planning and should contribute significantly to the attainment of the strategic objectives established by the organisation.