FINANCIAL ANALYSIS OF THE USE OF GIS, IMGERY AND MODELING FOR THE 2008 IOWA FLOOD
June 26, 2009

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The goal of this project was to develop a financial analysis of the use of GIS, imagery and modeling for flood response in Iowa, based on experiences with 2008 floods. This project is an outgrowth of the 2007-2008 financial analysis and business plan for the creation of the Iowa Geospatial Infrastructure (IGI), Iowa's contribution to the National Spatial Data Infrastructure (NSDI). As with the core study, IGIC received outside assistance from the Geospatial Information Technology Association (GITA) to provide expertise and education for completing the financial analysis of flood response. As with the core study, use was made of the Return on Investment (ROI) analysis methodology for multi-agency projects that GITA developed in 2006-2007 for the Federal Geographic Data Committee (FGDC). GITA also provided its single agency financial analysis methodology developed over the past five years as a major ongoing research project.

One of the findings of the core study was "Emergency response staff at the county and state level are just beginning to reap the rewards of GIS capabilities. The majority of these organizations do not currently have a means to track benefits during a natural disaster or other type of unique emergency. It will be necessary to work with them over time to devise methods for measuring the changes brought to their processes through use of geospatial technology." The flood study leverages the original work and its discovery of the need for further quantification in the area of emergency response, while taking the opportunity to learn from the experiences of Iowa's 2008 flood.

The multi-agency financial analysis incorporates spreadsheets based on details costs and benefits for six cities, nine counties, five state agencies, two educational institutions, four Federal agencies, six utilities, three consulting firms, and one private business. The 20 year analysis shows Net Present Value of $547M. Payback period falls within the first year, reflecting the emphasis of this analysis on benefits occurring within a year of the 2008 flood. Present value of costs is $194K, showing the effects of leveraging existing technology and staff for response efforts. It should be noted that the costs associated with expanding GIS capabilities to uniform standards and capabilities throughout the state are described in detail in the IGIC core financial analysis for statewide data sharing.

	2008	2009	2010	2011	2012
Cash Flows for All Participants					
Costs (Future Value)	($84,921)	($6,145)	($6,102)	($6,255)	($6,411)
Benefits (Future Value)	$171,717,881	$26,343,376	$24,294,330	$24,457,932	$24,603,570
Present Value Multiplier:	*100.0%*	*97.4%*	*94.9%*	*92.5%*	*90.1%*
Current Values					
Annual Project Costs	*($84,921)*	*($5,987)*	*($5,792)*	*($5,784)*	*($5,777)*
Cumulative Costs	*($84,921)*	*($90,908)*	*($96,701)*	*($102,485)*	*($108,262)*
Annual Project Benefits	*$171,717,881*	*$25,665,975*	*$23,060,971*	*$22,619,278*	*$22,168,865*
Cumulative Benefits	*$171,717,881*	*$197,383,855*	*$220,444,827*	*$243,064,104*	*$265,232,970*
Cumulative Net Benefits	**$171,632,959**	**$197,292,947**	**$220,348,126**	**$242,961,619**	**$265,124,708**

2013	2014	2015	2016	2017
($6,571)	($6,736)	($6,904)	($7,077)	($7,253)
$24,717,071	$24,844,397	$24,960,663	$25,078,201	$25,197,035
87.8%	*85.5%*	*83.3%*	*81.2%*	*79.1%*
($5,769)	*($5,761)*	*($5,753)*	*($5,745)*	*($5,737)*
($114,030)	*($119,791)*	*($125,544)*	*($131,290)*	*($137,027)*
$21,698,449	*$21,249,390*	*$20,799,863*	*$20,360,435*	*$19,930,879*
$286,931,418	*$308,180,808*	*$328,980,671*	*$349,341,105*	*$369,271,984*
$286,817,388	**$308,061,017**	**$328,855,126**	**$349,209,816**	**$369,134,957**

2018	2019	2020	2021	2022
($7,435)	($7,621)	($7,811)	($8,006)	($8,207)
$25,317,193	$25,438,702	$25,561,592	$25,685,891	$25,811,628
77.1%	*75.1%*	*73.2%*	*71.3%*	*69.4%*
($5,730)	*($5,722)*	*($5,714)*	*($5,706)*	*($5,699)*
($142,757)	*($148,479)*	*($154,193)*	*($159,899)*	*($165,598)*
$19,510,971	*$19,100,496*	*$18,699,238*	*$18,306,992*	*$17,923,552*
$388,782,956	*$407,883,451*	*$426,582,689*	*$444,889,681*	*$462,813,233*
$388,640,199	**$407,734,973**	**$426,428,497**	**$444,729,782**	**$462,647,635**

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Costs fell into the categories of imagery acquisition and processing, outsourced analysis, staff time spent on flood analysis, and local survey crew time. Analysis of benefits was the most time consuming and challenging portion of this project. The GITA resource formally interviewed 69 individuals representing 36 organizations and created spreadsheets with applicable cost and benefit information. The Iowa Department of Natural Resources provided additional interviews, as well as conducting and attending many meetings and outreach discussions with potential participating organizations in Iowa.

General categories of benefits include:

- staff time saved during emergency response
- staff time saved doing routine emergency preparedness work
- citizen time saved
- citizen cost for surveying saved
- mileage saved
- additional damage reimbursements provided
- materials saved (sandbags)
- building damage avoided
- ability to bill private entities for unneeded prevention (sandbagging)
- cost avoidance of unnecessary relocation activity

Analysis of strategic benefits shows many areas which may become quantifiable as they are studied over time. These include:

- faster information flow gets area economic activity back up and running sooner
- better and faster information gets presidential disaster declaration sooner

- debris removal facilitated
- better communication with helping agencies to assist citizens better and faster
- better road closure information to the public saves time and increases safety
- maps and data used as communication tool for briefings
- use by Emergency Operations Center as situation awareness tool
- maps provide time lapse record of the stages of the flood, which will be useful for hazard mitigation planning for the next flood
- better resource allocation during response
- modeling aided decision to drain basin naturally rather than paying to bring in big pumps
- estimation of amount of damaged material going to landfill

Observations:

FIRMS were not available for the entire state at the time of the 2008 flood. They were created statewide as needed as part of the recovery process and having this information available will be useful going forward for design of structures and planning, even though this work product cannot be considered an official FIRM for insurance rating purposes.

In some flooding areas, little GIS work was done because the Emergency Operations Center and data servers were affected by the flood. Many of these areas are making plans to move their emergency response centers to higher ground.

Areas experiencing 500-year flood levels did not have a plan in place for dealing with this amount of water. Many of these communities will be modifying their emergency planning and building permitting processes as a result of the 2008 flood.

Many areas with relatively sophisticated GIS capabilities did not have LiDAR elevation data available and would have used it to provide greater modeling accuracy or to avoid having to make field measurements during the flood.

Many counties were able to keep road closings updated on web-enabled maps provided to the public. This is likely to have provided considerable savings to the public, as well as providing a public face for GIS activities. Many counties commented that they need to get procedures in place for this type of communication before the next emergency. Counties need to have preplanned analysis routines available for use in an emergency.

Some areas shared data well and others did not. These issues need to be addressed before the next emergency.

A number of counties suggested that it would be helpful if FEMA provided HAZUS support.

Many counties did not have GIS departments well integrated with emergency response operations and could benefit from establishing procedures to coordinate efforts in advance of the next emergency. Likewise, counties may have had modeling results or imagery available for use but been unaware of this during the emergency.

There is a strong need for flexible real-time flood inundation mapping capabilities for the state. Refer to Iowa State pilot using student labor.

Notes on Methodology:

Methodology was the same as for the 2006-2007 project, using GITA's financial analysis approach.

A unique feature of this study was the approach we took to weather risk, in order to extend benefits experienced following the 2008 flood over the 20 years of the study. A number of approaches to weather risk were examined. We determined to align our approach with the plans of Iowa Homeland Security as it prepares to estimate flood risk for the 2010 Mitigation Plan. We used metrics from statewide 500-year HAZUS runs. We took the value of Total Direct Economic Building Loss for Johnson County, which provided the majority of the city and county benefits from its experience with a 500-year flood, and used this to scale up to statewide non-agricultural property at risk. The scaling factor is 0.07249 which = (Johnson County Total Direct Economic Building Loss of $573,684,000 / Statewide Total Direct Economic Building Loss of $8,317,441,000) X .002 annual risk of experiencing a 500-year flood. The 20-year extension presents a conservative estimate of benefits, noting that use of 100-year HAZUS metrics would result in a scaling factor approximately 50% greater.