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# **UCGIS BODY OF KNOWLEDGE – PROPOSED AND UNANTICIPATED BENEFITS AND POSSIBLE FUTURE INITIATIVES**

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## **ABSTRACT**

In 2006 the First Edition of the Body of Knowledge (BoK) was published with the hope that it would help identify the breadth and depth of the knowledge that represents the domain of GIScience and Technology (GIS&T). The Editors (DiBiase, 2006) regarded this as the first of many editions that would continue to be updated and expanded to help identify the field of GIS&T. The BoK has been used by many individuals and organizations and has become a valuable asset to the academic and non-academic communities. Some of the intended uses have been realized, but many other uses are being investigated along with other formats or delivery options. This report will look at some of the applications, the future of the BoK and other initiatives that may help GIS&T.

Key words: GIS&T, GIS, Body of Knowledge, Curricula, UCGIS

## **1 Why a Body of Knowledge**

In the Introduction to the First Edition of the Body of Knowledge (BoK), David DiBiase (DiBiase, 2006) recounts the history of the effort which began with one of the University Consortium for Geographic Information Science's (UCGIS) 1997 Education Challenges to provide "a specification and assessment of curricula for a wide range of student constituencies" in GIScience. Duane Marble, who had been interested in curriculum of GIS programs and was troubled by the lack of rigor especially as it related to computer science (Marble, 1998), volunteered to lead a Task Force to create a Model Curricula for GI Science and Technology (GIS&T). The original effort was envisioned as a document that would focus on undergraduate education and not only include the BoK, but also curricular pathways based on the BoK for different individuals, suggested pedagogy and institutional implementation strategies related to GIS curriculum. Work was carried forward with a "Strawman" report in 2003 (Marble, 2003). Efforts to raise funds to continue the work were not able to be secured.

### **1.1 First Edition of BoK**

In early 2005, the Education Committee, Chaired by David DiBiase, decided to focus its efforts on the BoK part of the Model Curricula due to limited funding and time constraints. While this was a subset of the original Model Curricula project outcomes, the scope of its use was expanded to cover Knowledge Areas for all levels of education (not just undergraduate) for GIS&T. The first edition of the BoK also includes suggestions on how the BoK might be used in addition to curriculum development and review. Since its publication in early 2006, the BoK has seen many uses not specifically mentioned by its proponents. Many individuals and organizations have reviewed the BoK and have suggested ways that it can be used, have used it or have recommended ways that it might be improved. The First Edition has been translated into other languages and is serving as an initial stage of a BoK for many countries. It was the intention of the BoK Editors that the First Edition be viewed as a "work in progress" with a Second Edition

available as soon as possible (DiBiase, 2006). The Second Edition has been held up for several reasons, but it appears to be back under discussion. The Association of American Geographers (AAG), the publisher of the First Edition has requested the University Consortium for Geographic Information Science (UCGIS) undertake creation of the second edition.

## **2 Uses of the BoK**

Section II of the BoK provides a brief description of possible uses of the BoK. These include academic focused uses such as: curriculum planning, evaluation, assessment, revision, and program accreditation and articulation. Other non-academic uses are also suggested such as professional certification and employee screening. The BoK has been used for all of the above mentioned activities, but the acceptance of the user community has applied pressure to expand and update the document for use in other areas.

### **2.1 Supporting a Profession**

One unanticipated outcome has been the effect of the very existence of the document on the perception of the GIScience and Technology domain as representing a profession rather than a mere tool used in a profession. While the 14,000 plus attendees at the 2008 ESRI International User Conference in San Diego, California, may not all agree it is a profession, most of them would see it as much more than a tool. The more than 2332 people that have become GIS Professionals through the GIS Certification Institute (GISCI website July, 2008) would also likely support the premise that GIS&T is a profession. In support of the BoK, the GISCI uses the document to help qualify courses and content for points under its system to become a Certified Professional. The GISP community has also been surveyed as to the question of creating an examination as part of the certification process. While not all agreed that an exam should be required (Butler, 2007), more than 84% answering the survey believe that if an exam is required, it should be based on the core competencies identified in the BoK. This use of the BoK also supports the continued updating and revisions of the document to stay current with GIS&T professional use.

### **2.2 Other Certification Efforts**

ESRI is investigating the possibility of creating a certification program focused on the use of its software. This certification, while voluntary, would include an exam that tested the knowledge and skills needed for implementation and use of a specific software product. It is conceivable that some exam questions would require concept skills from the BoK and it would be beneficial to individuals studying for those exams to know what KA, Units or Topics might be included. It would also be useful for academic institutions interested in offering courses for individuals wishing to become certified to know what content should be included in any course offerings targeted to prepare individuals to take the certification exam.

### **2.3 Student Self Assessment and Pathways**

Soon after the BoK was completed, one of the Editors (Plewe, 2006) used it to help students survey their knowledge of GIS&T. This self assessment tool, while helping students identify what they know about GIS&T based on the BoK, it also clearly identified those areas where their knowledge was weak or lacking. This tool then could help students identify what specific areas they needed to focus on in their future studies. To make this process really effective for students, courses would need to list the course content indexed to the BoK so that students could more easily pick the appropriate courses they need to complete their GIS&T pathway. In addition,

different competency requirements for specific job classifications or titles might also be keyed to the BoK so that students embarking on a career pathway could more easily identify the skill sets they needed to cover for their chosen GIS&T pathways.

## **2.4 Career Pathways and Human Resource Applications**

The BoK could become a valuable tool both for the person seeking a GIS&T related position and to the Human Resource Department trying to find an appropriately skilled GIS&T professional. If job descriptions and qualifications were linked to the BoK, it would help job applicants and Human Resource departments more easily determine if a position was a good fit for a particular applicant. It could also help Human Resource departments write better and more specific job descriptions and qualifications thus saving time and money by not interviewing unqualified applicants. Patrick Kennelly presented a study associated with a course he taught at Penn State (Kennelly, 2008). The course “Geospatial Technology Project Management” included more than 100 students from the Master of GIS Program and was scenario based with assignments leading up to a GIS Project Plan for different organizations. Relevant to this paper, Kennelly, looked at the competencies used by the students and linked them to the Knowledge Areas in the BoK. He found that most of the projects focused on only five of the KA (Geospatial Data, Design Aspects, GIS&T & Society, Organization & Institutional Aspects and Analytical Methods). This study would suggest that GIS Managers active in Project Management should have a strong background in those five KA’s. This information might be useful for students wishing to go into this field as well as HR departments looking to evaluate prospective GIS Project Managers.

## **2.5 Accreditation and Building a Geospatial Intelligence Analyst Pathway**

One of the first uses of the BoK for Accreditation was by the United States Geospatial Intelligence Foundation (USGIF). The USGIF is made up of entities interested in the many disciplines and fields where geospatial intelligence is vital. This rapidly expanding field needs highly skilled workers in the tradecraft of geospatial intelligence. The ability to expand the field has been hampered by the lack of graduates with the specific skill sets required for this specialty. The USGIF decided to set up guidelines and create a program to accredit certificate programs for geospatial intelligence analysts (Kalweit, 2006). The first task was to identify those competencies needed in GIS, Remote Sensing and other related technologies and general business skills. The Education Committee, lead by Susan Kalweit, created a survey listing the possible competencies that might be needed and set them to working professions to have them validated. The committee found it was very easy to use the BoK to select those competencies for GIS portion of the survey. It was much more difficult to select competencies in other areas without a document like the BoK. This, while not specifically a pathway as defined by the Model Curricula and BoK, does support the idea that a program can be designed for a specific career or workforce domain using the BoK.

## **3 Issues and Possible Next Steps**

The original 1997 Challenge was to develop “specifications” for and “assessment” of curricula. In order to develop specifications, it is necessary to define those specifications in a form and structure that can be understood and used by those needing to develop or assess GIS&T curriculum. The BoK has tried to logically cover the depth and breadth of GIS&T domain of knowledge. It is in a format and structure that is easily understood by academics at the university level. The terminology used to define the Knowledge Areas, Units and Topics are appropriate for use in higher education, but may not be easily understood and used by the workforce or secondary or two year college programs (Sullivan, 2008). Some specifications are missing or not

adequately covered, but this was anticipated by the Editors with the expectation that deficiencies would be remedied by subsequent editions and updates made in this dynamic field.

### **3.1 National Geospatial Technology Center of Excellence**

In 2005 a meeting was held at the ESRI Education Users Conference to discuss possible national coordination efforts to help community colleges interested in geospatial technology education. This discussion was continued with a Roundtable dialogue at the National Science Foundation (NSF) meeting for Advanced Technology Education. The consensus of the meetings was that colleges needed some assistance in dealing with program support and it could be best met through some form of nationwide program (Sullivan, 2008). A grant to study this need was funded in 2007 and focused on ten issues important to two year programs. A copy of the report is available from [www.marinetech.org/workforce/geospatial](http://www.marinetech.org/workforce/geospatial). The year long study included several surveys of educators on the issues and brought them together with government and industry at a national forum. An outcome of that study was the funding by NSF of a National Geospatial Technology Center of Excellence (GeoTech Center) in 2008. The GeoTech Center, hosted by Del Mar College, Corpus Christi, Texas, with seven other colleges, two universities and one industry partner, will provide support and a unified voice for two year programs. One of the most important issues to be addressed by the GeoTech Center is closely linked to the BoK – that is, identifying the core competencies for two year geospatial technology programs. This effort will be led by David DiBiase from Penn State University and includes the outcome from previous efforts to define the skills, competencies, roles and tasks needed by GIS&T professionals. This will include the outcomes from DACUMS (Developing A CURriculum, San Diego Mesa College, <http://geoinfo.sdsu.edu/hightech/dacum.htm>), US Department of Labor (GITA and AAG, <http://www.giwis.org>) and a NASA funded study for Workforce Development (Gaudet, 2008), as well as new DACUMS, studies and activities to be conducted by regional partners and vetted by industry.

## **4 The Future**

A report to the UCGIS entitled “Next Steps for the GIS&T Body of Knowledge and Model Curricula Initiative” (DiBiase, 2008) summarizes the results of a survey David DiBiase conducted during a session at the ESRI Education User Conference in San Diego in 2008. The survey included questions specific to the structure of the BoK as well as to its uses. One question asked participants to rank the top 3 uses of the BoK. While “Curriculum Planning” was the most often cited in the top 3, DiBiase found that “Defining the GIS&T field” had the highest ranking with “Program evaluation” third. The survey results also suggest that the current organization of the GIS&T “knowledge areas” in the first edition of the GIS&T BoK is preferable to other formats. Comments by participants included adding missing units or topics, validating the content by professionals, and otherwise improving the content breadth of the BoK. When asked what should be future priorities, many options were selected including creating self assessment instruments, creating accreditation standards and curriculum pathways, but the most selected priority was to produce a 2<sup>nd</sup> Edition of the BoK. Many of the participants of the survey wanted to participate or contribute to a 2<sup>nd</sup> Edition. Other notable findings were that participants felt that the current structure and format should be retained, a digit excerpt should be available and that the next Edition should be undertaken (DiBiase, 2008).

### **4.1 UCGIS and GI Science Knowledge Web**

The University Consortium of Geographic Information Science (UCGIS) Officers, Board of Directors and Committee Chairs (UCGIS, 2008) have been reviewing the needs of the academic community in light of outputs from several UCGIS Research and Education initiatives including

the BoK. The preliminary summary suggests that there are needs for the UCGIS community of researchers and educators to more closely communicate and build a virtual community around GIScience within a knowledge base. The format, structure, methodology and platform, while under discussion, have been suggested to be by a scaleable approach “through sustainable synergy using a cyberinfrastructure to minimize constraints of interaction in space and time.” This consortium activity would be to provide a Geographic Information Science Knowledge Web (GISKW). While many within UCGIS are currently working on projects funded by many sources to help advance GIScience in many different areas of research, this new initiative would try to create connections between research, education and workforce so that knowledge can be accessed, shared, linked and built upon. This would be a virtual community of interdisciplinary research and education scientists which would derive an underlying ontology for the GISKW from the BoK. Thus, a future edition of the BoK should be undertaken to provide this underlying base for a broader GISKW.

## 5 Conclusions

The first edition of the BoK has, at the very least, brought together people from industry, government and academia to discuss the knowledge areas important to individuals engaged in GIScience and Technology. The BoK has also helped foster a professional identity to the practitioners of GIScience in many workforce domains. It has served as a guide to the GIS Certification Institute and helped the USGIF create guidelines for GIS knowledge areas needed for an accreditation program for Geospatial Intelligence Analysts. It is helping educational institutions develop and update their curriculum, provide students with a basis on which to evaluate their GIS&T educational needs and Human Resources a tool in defining GIS related positions and applicant qualifications. It has also been recognized that the first edition needs to be updated and a second edition produced that has the same structure as the original BoK. It has also been suggested that a digital excerpt needs to be included or created to help users make the best use of the BoK for their particular needs. It has also been recognized that there needs to be more ways to build a GIScience Knowledge base and that new initiatives need to be started to investigate the structure and format for such a GIS Knowledge Web.

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