Memo

Date: March 22, 2017

TO: Scott Freundschuh, Past Chair of COGO and
COGO Report Card Theme Experts

FROM: Earl F. Burkholder, PS, PE, F.ASCE www.globalcogo.com
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RE: Cart Before the Horse?

I wholeheartedly support development of a Second Report Card on the U.S. National Spatial Data Infrastructure. I see it as an opportunity to build on the first report by backing up a step or two and making sure the spatial data community is working with a common defensible spatial data model that accommodates 3-D digital spatial data for all disciplines worldwide. Although the current procedures given us for moving forward have precedent, I question if we might have the cart before the horse.

**My views do not represent anyone or any organization other than myself. But, I am convinced that we will be able to do a better job to the extent everyone is on the same page with respect to the definition and characteristics of an underlying geometrical model. Yes, I am advocating consideration of the 3-D global spatial data model (GSDM) – see www.globalcogo.com/gsdmdefn.pdf. Many subsequent discussions and considerations will be enhanced if we get the horse in front of the cart.**

**If such a suggestion is too "commercial or self-serving" I understand that I could be uninvited as a Theme Expert, that is OK. And, I understand that a report card is a reflection of what is instead of what could be. None-the-less, I see "establishing a vision for the future" to legitimate justification for developing a report card.**

A broad statement is that the digital revolution has had an enormous impact on many facets of civilization. Spatial data are but one part of the digital revolution but humankind all over the world experiences "place" and the importance of knowing our physical world is profound and universal. The concepts described herein are immediately applicable and deserve serious consideration. It is also acknowledged that impacts of "disruptive innovations" often extend beyond the immediate horizon. Therefore, the second COGO Report Card should accommodate immediate challenges and be sufficiently robust to remain applicable into the foreseeable future.

Gerard Mercator (1512-1594) gave us the conformal map projection (used extensively by civil engineers, surveyors, and mappers) and René Descartes (1596-1650) formalized concepts of solid geometry in his *Discourse on the Method* published in 1637. Geodesists such as Méchain (1744-1804), Delambre (1749-1822), Gauss (1777-1855), and modern contemporaries such as those employed by the National Geodetic Survey (NGS) have refined geodetic measurements and computations for the benefit of humankind worldwide. Those accomplishments and applications are legendary.

Modern measurements are collected in a 3-D environment. Efficient use of those data is enhanced by using an integrated 3-D spatial data model. The geodetic model and the map projection model for spatial data are both prefaced on horizontal and vertical datums. Horizontal is 2-D (latitude/longitude)

and vertical is 1-D (elevation). Furthermore, those models require specific manipulations of spatial data measurements to abstract mathematical surfaces (ellipsoid and mapping grid) as part of the computational process. To the extent that geometrical integrity is to be preserved, such processes can be complicated and onerous. But, use of software mitigates some of those associated challenges.

**A better spatial data model is readily available and being used in some cases. A summary is contained in a poster displayed at the 2016 AGU Fall meeting –** www.globalcogo.com/poster**. The Second COGO Report Card offers a unique opportunity for other disciplines to contribute to and to participate development of a Spatial Data Infrastructure that serves all disciplines worldwide.**

The 3-D global spatial data model (GSDM) uses the 3-D Earth-centered Earth-fixed (ECEF) rectangular coordinate system (as devised by Descartes and) formalized by the U.S. DoD for the global positioning system (GPS). The origin is at Earth's center of mass and rules of solid geometry support computations in 3-D space. Many complex reductions needed in geodesy and cartography are avoided. That means that end users can exploit characteristics of 3-D digital spatial data in a beneficial manner.
The GSDM includes a functional model of geometrical relationships used to compute 3-D positions worldwide. The GSDM also includes a stochastic model that can handle error propagation throughout the computational process. That means the end user has ready access to reliable estimates of spatial data accuracy of any derived quantity – coordinates, distances, angles, areas, volumes, and the like.

A book describing the GSDM was written by Earl F. Burkholder and published by CRC Press in 2008. More recently, a 2nd Edition has been written and is scheduled for release by CRC Press in July 2017. For more information, see www.globalcogo.com/SecEd.html. Information from the first Report Card on the U.S. National Spatial Data Infrastructure was incorporated into Chapter 2 of said 2nd Edition. For example, see www.globalcogo.com/abstracts and the information listed for Chapter 2.

Information from the original COGO Report Card was also the topic of a presentation made by Earl F. Burkholder at the New Mexico Joint Annual Conference of the American Planning Association and the American Society of Civil Engineers in Las Cruces, NM on September 24, 2015. A link to that presentation is http://www.globalcogo.com/APA-ASCE-Spatial.pdf

Recap:

- I am proud to be part of the COGO Report Card effort and will contribute as best I can.
- The views I express are mine alone and do not reflect any professional organization.
- If my participation is out of line, I can easily be uninvited.
- The GSDM can be a valuable contribution to efficient use of 3-D digital spatial data.

PS – I incorporated Global COGO, Inc. in 1996. In my case, COGO stands for Coordinate GeOmetry.