Role of a Model
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The following item was written for a different audience – mostly for those skeptical of benefits available from adopting and using the global spatial data model (GSDM). Of course, *Benchmarks* readers might also be skeptical. But I am convinced that *Benchmarks* readers might be more easily persuaded than others. That is because surveyors stand to realize immediate benefits on an operational level while benefits for policy makers and administrators might be more abstract – such as standardizing workflow, avoiding duplication of effort, or preserving the value of existing spatial data holdings.

Models are used to enhance human understanding of abstract concepts. A well-formulated model contains rules and guidelines which serve to eliminate ambiguity and support concise communication between various users of the model. Of many models that might be available for a given circumstance, the best model is one that is, at the same time, both adequate and simple. A model is adequate to the extent it accommodates and describes what is needed (e.g., geometry and observed phenomenon). The advantage of a simple model is that it can be more readily understood by those using it.

Of many definitions for a model that could be cited, the definition given above is self-fulfilling in that it is intended to be both adequate and simple. Of course, there is a trade-off. An inadequate model can often be improved by increasing the level of complexity expressed in the model. But that tends to make the model more difficult to use. In some rare cases the adequacy of a model can be enhanced while simultaneously increasing the simplicity (rather than complexity) of the model – a win/win case.

The 3-D global spatial data model (GSDM) is an example of such a win/win case and is the subject of on-going research. Spatial data are used to express the geometry of location. A characteristic and consequence of the digital revolution is that spatial data are digital and three-dimensional (3-D), 4-D when time is included to express changes in location. A point of clarification is that spatial data are generic while geospatial data are those referenced to the Earth. A question not yet settled is, “Are spatial data a subcategory of geospatial data or are geospatial data a subcategory of spatial data?” In practice, the words are often used interchangeably.

Some of the models used by scientists and geodesists for spatial data are rather complex. However, as spatial data applications continue to expand, a simpler concise spatial data model that is adequate for the needs of the spatial data user community is urgently needed. Following is a list of reference resources currently being included in developing justification for implementing the GSDM. Others will be added as appropriate.

A. Data Analysis Techniques for Physical Scientists – Pruneau (2017).
   Written by a high-energy (CERN) physicist for a high-level audience. Ch 1 explains the scientific method.
B. A Crack in Creation: Gene Editing and the Unthinkable Power to Control Creation – Doudna/Sternberg (2017).
   Describes development of CRISPR gene editing process. Understanding the use of a model is critical.

C. Tunnel Visons: The Rise and Fall of the Superconducting Super Collider – Riordan/Hoddeson/Kolb 2015.
   Account of attempting to understand the high-energy standard model. Oh, what might have been!
D. Sapians–Harari (2015), Homo Deus–Harari (2017), and 21 Lessons for the 21st Century–Harari (2018).
   Series of 3 well-written books that cover entire span of humanity – what model deserves most credibility?
E. Who Discovered America? – Menzies/Hudson (2013).
   Along with Harari (above), this book challenges traditional view of the history we've learned (what model?).
F. Longitude – Sobel (2005) Hint: Google "Utube Longitude" and watch the 3-hr PBS video version.
   Story of Harrison chronometer and the triumph of his model. This is fascinating story with many parallels.
G. The Book Nobody Read: Chasing the Revolutions of Nicolaus Copernicus – Gingerich (2004).
   Copernicus published the heliocentric model in 1543 – at the end of his life. Acceptance was not immediate.
H. Mercator, the Man Who Mapped the Planet – Crane 2002.
   Summary of life/work of Mercator and his 1569 conformal map. Are conformal criteria still relevant?
I. Measuring America: How the U.S. Was Shaped by the Greatest Land Sale in History – Linklater (2002).
   Summary of philosophy of land ownership and land surveying in the U.S.A. What is the "model"?
J. Temperament - the idea that solved music's greatest riddle – Isacoff 2001.
   Perfect pitch in traditional piano tuning is not possible – a model provides a workable compromise.
K. Night Comes to the Cretaceous – Powell (1998).
   Challenges previous models & develops solid proof of demise of dinosaurs 65 million years ago.
L. Statistics for Spatial Data – Cressie (1993).
   Describes high-level concepts and tools for handling traditional geospatial data.
M. The God Particle: If the Universe is the Answer, What is the Question? – Lederman/Teresi (1993).
   Retired Director of Fermi Lab writes an understandable summary of the "standard model."
N. The Structure of Scientific Revolutions -Kuhn (1962, 1970, 1996), MUST READ! Also READ.
   Description of how scientific advances are really made – and not made. Very insightful/applicable!