METROLOGY FOR THE SOCIAL, BEHAVIORAL, AND ECONOMIC SCIENCES

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Abstract

A metrological infrastructure for the social, behavioral, and economic sciences has foundational and transformative potentials relating to education, health care, human and natural resource management, organizational performance assessment, and the economy at large. The traceability of universally uniform metrics to reference standard metrics is a taken-for-granted essential component of the infrastructure of the natural sciences and engineering. Advanced measurement methods and models capable of supporting similar metrics, standards, and traceability for intangible forms of capital have been available for decades but have yet to be implemented in ways that take full advantage of their capacities. The economy, education, health care reform, and the environment are all now top national priorities. There is nothing more essential to succeeding in these efforts than the quality of the measures we develop and deploy. Even so, few, if any, of these efforts are taking systematic advantage of longstanding, proven measurement technologies that may be crucial to the scientific and economic successes we seek. Bringing these technologies to the attention of the academic and business communities for use, further testing, and development in new directions is an area of critical national need.

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The Technologies To Be Developed

Science underwrites the value of tangible forms of economic capital by ensuring that measures of commodities from minutes to kilowatts to barrels are universally verifiable and comparable. Increasing interest in the economic value of the intangible forms of human and social capital studied in the social and behavioral sciences raises the question as to whether the quality of measurement in these areas might one day approximate the scientific rigor and practical convenience of measures in the natural sciences. Over 80 years of research strongly suggests that the answer to this question is yes (Fisher, 2009; Stenner, Burdick, Sanford, & Burdick, 2006).

There are two phases in the development of universally uniform metric systems. The first determines whether something exists in a persistent, stable and measurable state independent of the sample measured, the equipment and operator measuring, time, and space. In this first phase, things themselves act as agents compelling agreement among observers as to their separate and real status as objective phenomena in the world.

The second phase in the process of establishing metrological uniformity transforms this agent of agreement into a product of agreement. Now, given a measurable phenomenon, research technicians collaborate on the unit size and range, nomenclature, and terminology by which its quantitative and qualitative features will be communicated. Systems for calibrating instruments in the standard metric, and checking their traceability to it, are devised and implemented.

The first phase in the process of establishing metrological uniformity for intangible forms of capital measured via ability tests, surveys, assessments, and ratings has effectively been underway for at least 50 years, since the work of Rasch in the 1950s, and for more than 80 if Thurstone's pioneering work from the 1920s is included. Though virtually unknown outside psychometric circles, the facts of additive, independent, transitive, linear, ratio, and separable parameters for constructs measured in the human and social sciences are not controversial.

Much of this work has been conducted by researchers trained in the natural sciences who turned their attention to the social sciences, such as Thurstone (an electrical engineer), Rasch (a mathematician), and Wright (a physicist who worked as an assistant to Nobelists Townes and Mulliken before taking up psychometrics). A number of reviews of this work are available (for instance, Bezruzcko, 2005).

There are, however, few signs of any research programs, funding, or practical demands targeting the second phase in the work required for universally available metrologic uniformity in the measurement of intangible forms of capital. The viability of such a goal is suggested repeatedly with every calibration of an instrument producing data that meets demands for separable, independent model parameters. New instrument calibrations are published every day, providing evidence of another construct that is a possible candidate for a standardized metric.

A critical national need exists for a widespread awareness of the viability and desirability of reference standard metrics for human, social, and natural capital. Barriers include

- the huge cost of developing and deploying these metrics;
- a general lack of awareness of the decades of research proving the viability and special advantages of reference standards in the behavioral sciences;
- an underdeveloped public appreciation for both the high returns provided by investments in

metrology and the vital role played by metrology in the history of science and capitalism;

- institutional orientations better able to serve the needs of existing paradigms than the emergence of new ones; and
- deeply rooted cultural presuppositions about the nature of number and the alleged limits of psychosocial measurement.

Over 80 years of research successfully refutes the assumption that measurement in the social sciences is epistemologically inferior to that of the natural sciences. We need research exploring possibilities for more rigorously defined metrics and the benefits that could be obtained from them. The primary results that could be obtained in an economic context informed by universally uniform, linear and ratio metrics for intangible forms of capital follow from the oft-repeated saying, "You manage what you measure." Most of the metrics currently used in the management of human, social, and natural capital are nonlinear and ordinal scores, ratings, and percentages. Because their unit magnitudes are dependent on locally variable score distributions, these alleged "metrics" are often uninformative, confusing, or deceptive. The incommensurability of these so-called measures effectively locks up human, social, and natural capital markets by making individual information transactions so expensive that decisions are made with no information, or with the wrong information.

Though advanced measurement applications have demonstrated highly desirable advantages and capabilities for decades, they have not become the mainstream paradigm. This may in part be due to the opinion held by many that improved measurement is an academic nicety, an end in itself, or is an expression of particular researchers' special theoretical investments.

Despite these opinions, and though we rarely stop to think about it, we all know that fair measures are essential to efficient markets. When different instruments measure in different units, market transactions are encumbered by the additional steps that must be taken to determine the value of what is being bought and sold. Health care and education are now so hobbled by myriad varieties of measures that common product definitions for the outcomes of these industries seem beyond reach.

As has been pointed out in a wide variety of works over the last several decades, we need to broaden the focus of business management beyond investments, factories, equipment, property, and labor. Instead of the traditional three forms of capital (land, labor, and manufactured equipment), we actually employ four (natural, human, manufactured equipment, and social). Land and labor are far more complex than a mere piece of ground and the functionality of a job description. These complexities are captured by the multifaceted concepts of natural and human capital, which have to include diverse and distinct dimensions of the resources brought to bear. And social capital is of such vital importance that capitalism itself could not have gotten off the ground without it.

In order to make capitalism live up to its own accounting principles, we need better measures fit into an accounting framework that redefines profit so that it is less a matter of liquidated capital, and more a matter of removing wasted resources from within a closed system of limited capacities. In order to learn how to reduce the waste and increase the stocks of human potential, community trust, and natural resources, we must better learn the truth of the maxim, we manage what we measure.

Calibrated instruments traceable to reference standards express value in universally uniform metrics that function as common currencies. New efficiencies for human, social, and natural capital markets come from the reduced friction in transactions, which are made meaningful and comparable via metrological networks not much different from the one connecting all the clocks. The intangibles of health care, education, social services, and human/natural resource management may not be forever doomed to locally dependent product definitions that defy pricing.

What we need are ways of extending the basic capitalist ethos into the domain of the intangibles. How can we set up markets so that the invisible hand efficiently promotes social and environmental ends unintended by individuals maximizing their own gains? How might we extend the free play of self-interest into more comprehensively determined returns for the global dividend? Better measurement will inevitably be of central concern in answering these questions.

In this context, the existence of an actual market of shared uniform information would coordinate the collective decisions of purchasers and providers to match supply and demand far more efficiently than could ever be the case in the current system of high-friction, ordinal, and locally dependent “metrics.”

Innovation is increasingly seen as best conceived as a group effort. The wisdom of crowds phenomenon makes it possible for actors coordinated by shared information to accomplish in short order tasks that either could not be done by independent individuals at all, or only by using much more time and resources. The profit motive is an energy source of incredible power and potential. Creating an economic and social context in which innovation on the broadest scale could be brought to bear on issues of human, organizational, and environmental performance and management would be productively disruptive and transformative on the highest levels.

Justification for NSF SBE Attention

The societal challenges associated with the development and deployment of a metrological infrastructure for human, social, and natural capital are of a magnitude that prevent even the largest corporations or research institutes from undertaking the task alone. And piecemeal efforts often are not just inadequate to the task, they actually make things worse as uncoordinated and mutually contradicting efforts compete for attention and resources. We need broad efforts undertaken by society as a whole, with everyone's interests represented. No individual, small business, major corporation, or nonprofit foundation could ever hope to succeed alone in a task of this scale and scope.

Likely proposers to a funding competition in this area would include commercial agencies already making use of the available advanced measurement techniques. In education, these include the Northwest Evaluation Association; MetaMetrics, Inc.; Educational Testing Service; ACT; Pearson; and many others. State departments of education with longstanding expertise in this area include those in Oregon, Michigan, Illinois, Vermont, and in many other states. In health care, research groups with relevant expertise include QualityMetric, FOTO, Inc., the Rehabilitation Institute of Chicago, PeaceHealth, and others.

Academic departments of psychology, education, sociology, public health, health systems management, and others conducting research and teaching in this area would also likely propose projects for funding. Academic departments with particularly high profiles in this area can be found at the University of California, Berkeley; University of Illinois, Chicago; Johns Hopkins University; University of Toledo (Ohio); Emory University; Northwestern University; Boston College; University of Denver; University of Michigan; the Chicago Medical School; and elsewhere around the world.

The societal challenges related to the improved measurement of human, social, and natural capital are not being addressed for a number of reasons. First, despite the longstanding existence of data, instruments, and theory to the contrary, it is widely and mistakenly believed that the fundamental measurement of constructs measured by way of ordinal observations is impossible. Second, it is also widely and mistakenly believed that all numbers are inherently and always effectively quantitative, or that supposed differences in kinds of numbers are purely academic and of no practical consequence.

Third, the metrological infrastructure is almost completely invisible to and taken for granted by the public, meaning that local efforts aimed at expanding it into a new domain are virtually meaningless and inevitably futile. Fourth, the existing system of incentives and rewards makes it very difficult, if not impossible, for individual researchers and teachers to have an impact on the behaviors and decisions of their clients and students, as these are culturally rooted in the familiar, albeit misunderstood and misapplied, ordinal and local systems. Fifth, even when an individual or organization does grasp the significance of the new measurement technologies, these very few isolated and uncoordinated instances depend too heavily on local leadership, and eventually starve for lack of sustenance from a larger networked metrological culture.

The sum meaning of these five conditions is that research and development of metrological infrastructure for intangible capital will not proceed at all without leadership at the national level and without public funding. But the nation's scientific frontiers and commercial frontiers would potentially be greatly stimulated simply by publicly introducing the idea that such an infrastructure could be possible, and by suggesting that considerable benefits relative to existing goals for improving education, health care reform, and environmental management could accrue from it.

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