THE SCIENCE OF LAWS JOURNAL

- Excellence in Governance through Science -

VOLUME 5, ISSUE 1

George T. Doran, PhD
(1939-2011)
Creator of S.M.A.R.T. goal writing

THE SCIENCE OF LAWS JOURNAL

Excellence in Governance through Science

SHOULD LAWS BE S.M.A.R.T.?

In 1981, George T. Doran's "There's a S.M.A.R.T. way to write management's goals and objectives" was published in *Management Review*. According to Dr. Doran, goals should be:

- **S**pecific – target a specific area for improvement
- **M**easurable – quantify or at least suggest an indicator of progress
- **A**ssignable – specify who will do it
- **R**ealistic – state what results can realistically be achieved, given available resources
- **T**ime-related – specify when the result(s) can be achieved.

Three decades since its first publication, Dr. Doran's S.M.A.R.T. goal writing strategy has become a widespread practice in many industries. Its popularity and use are particularly notable in the area of employee performance management where managers and employees draft S.M.A.R.T. goals together to provide the employee with clear objectives of what outcomes are expected prior to their next performance review cycle. Setting goals in this manner is popular because the process lends itself to an easy to understand and easy to validate rubric against which managers can assess whether or not the stated goals have been achieved.

I believe that Dr. Doran's S.M.A.R.T. approach to creating goals could be well-applied in the creation and evaluation of laws of government. By doing so, the laws will not only be more easily understood by the populace but the governmental organization issuing the law would also be able to definitively assess whether the law achieved its intended goals. The laws that fall short of achieving their goals could be modified or repealed whereas the laws that are successful for one governmental organization could provide the basis for a similar law elsewhere. For example, a law that proved successful in Ohio could be the foundation for a similar law in Arizona.

By implementing S.M.A.R.T. laws, both the governmental organization issuing the law and the populace tasked with abiding by it will better understand the overall objective of the law. Further, both parties will have an objective means by which to validate its success. It is my hope that Dr. Doran's approach finds its way into many governmental organizations and improves lawmaking in the same way it has spread across many industries and improved employee performance management.

–John Wood, Editor
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PROCEEDING

Accumulating Scientific Knowledge of Legislative Outcomes through Machine Learning

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Primero Systems

ABSTRACT

The accumulation and organization of scientific knowledge of laws and lawmaking and the subsequent application of that knowledge to the creation and evaluation of laws will enable law designers to craft more effective laws.

Since the body of knowledge of laws and lawmaking is scant and a single scientific repository has yet to be discovered by the Science of Laws Institute, significant research, evaluation, collection and classification of any existing published information is required.

Given that the universe of scientific articles is scattered across numerous public and private databases, the task of collection and classification is enormous.

The Science of Laws Institute is attempting to automate the database canvassing, validation of an article's scientific relevancy and subject-matter classification using machine learning tools and techniques.

This approach requires teaching the machine learning algorithms to learn the definition of "what-good-looks-like."

Our challenge is to accumulate enough "good" examples to train the algorithm and, if successful, expand the model to evaluate broader repositories of data.

This is a work-in-progress effort with the results of the machine-learning application to be determined.

INTRODUCTION

Scientific Knowledge is defined as:

"A fact that has been acquired through the scientific method. Testing is rigorous and independent, needs peer review and subsequent publication, needs a measurement of potential or actual error and must gain a degree of acceptance from the scientific community."[1]

This definition is provided by *Black's Law Dictionary* which is considered the definitive legal dictionary used by lawyers and law students from around the world.

Ironically, the application of scientific knowledge as a key component in the lawmaking industry remains conspicuously absent.

Isaac Asimov's book, *Chronology of science and discovery*, aptly chronicles how science has influenced the world, from the discovery of fire until the 20th century. [2] Through his entertaining catalog of scientific achievements, it becomes immediately apparent of the relevance of scientific discovery and the betterment of the human condition. If it was not painfully obvious beforehand, Asimov's book illuminates that it is truly not worthy to question whether the application of scientific principles is valuable when discovering approaches and solutions to the world's most challenging problems.

Why then, does the law-making industry seem to consider itself immune to the need of scientific knowledge where virtually every other industry relies on proven engineering and scientific research to support the efficacy of their products? Would you allow yourself to fly on a plane that was designed from the principle of good intent without adoption of scientific knowledge? Take medications? Enjoy food? Allow surgery?

Better designed legislation supported by scientific principles and knowledge would transform "good-intent" to measurable effectiveness. Stated more harshly, no responsible designer of any other industry would promote that they ignored published knowledge when creating a solution that affects public safety. Given that the currently-practiced method of lawmaking does not incorporate scientific knowledge in their promoted solution, one can only conclude that their design process and resultant legislative product is not professionally defensible.

Although the task may be enormous, it is well-past time to embrace improving the human condition through the application of scientific knowledge in lawmaking ... at least as one of the many necessary steps. One such initial task would be to provide law designers access to a central repository of scientific knowledge related to laws and lawmaking.

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Unfortunately, no single, organized body of knowledge exists. This lack of available knowledge denies the lawmaker the benefit of designing new legislation founded on the recorded cause and effect of similar law.

To at least partially remedy this situation, Primero Systems has teamed with the Science of Laws Institute to establish and populate a database of scientific articles related to the outcomes of legislation.

This initial effort was undertaken using UCSD interns to manually research, identify, filter and catalogue published articles from a number of scientific journals.

Their efforts and diligence, while commendable, recorded a little over a thousand peer-reviewed outcomes of legislative effects. When compared to the thousands of laws enacted **each year** collectively by U.S. state governments to say nothing about the number of annual Federal and local government legislative acts, it is apparent that relatively little knowledge is readily accessible as to the efficacy of our legislative efforts.

It also became obvious, that in order to produce a reasonably-sized repository of legislative-focused scientific knowledge, we would need to embrace a more automated means of data gathering. Although Primero Systems had been studying Artificial Intelligence (AI) components such as Machine Learning and Natural Language Processing, they had never applied these technologies for a specific project purpose.

Hence this paper chronicles the exploration and implementation Primero's AI efforts towards the goal of developing an ultimately extensive repository of legislative outcomes.

This approach would ultimately allow us to scan innumerable databases and scientific journals, extract and classify the desired information and in general, cast a much wider net while vastly accelerating the populating of results using an automated approach.

PROJECT OBJECTIVES

The Science of Laws Institute has as one of its objectives the goal of establishing a comprehensive, yet easily accessible/searchable repository of knowledge on law efficacy. The content source for this data warehouse would need to be extracted from previously published articles by scientific and/or similarly accredited journals and publications.

The current process of relying solely on human efforts for identifying, filtering and cataloguing these articles is time-consuming, labor intensive and generally inefficient.

A more automated means to produce the desired result needed to be explored. A review of supportive technologies highlighted the need to further explore Machine learning and Natural Language Processing components.

WHAT IS MACHINE LEARNING?

Machine learning (ML) is a category of algorithm that allows software applications to become more accurate in predicting outcomes without being explicitly programmed. The basic premise of machine learning is to build algorithms that can receive input data and use statistical analysis to predict an output while updating outputs as new data becomes available. [3]

WHAT IS NATURAL LANGUAGE PROCESSING?

Natural language processing (NLP) is a subfield of artificial intelligence concerned with the interactions between computers and human (natural) languages. In other words, NLP automates the translation process between computers and humans.

NLP can be used to interpret free text and make it analyzable. There is a tremendous amount of information stored in text files which are accessible via the internet. NLP allows analysts to sift through massive troves of free text to find relevant information in the files.

ML AND NLP ADOPTION & APPROACH

Given that the goal is to canvass large quantities of available text and then evaluate that data for applicability to legislative scientific knowledge, the use of both NLP and ML were logical selections.

With the support of Machine learning and Natural Language Processing, we commissioned an effort to create a Proof-of-Concept model.

PLANNING AND PROCESS

Although most ML projects are expected to vary wildly in nature, size, and scope, their general structure and process are usually similar.

Most projects require following the following process:

1. Strategy Definition/Planning.
2. Data Collection.
3. Data Preparation.
4. Algorithm Selection.
5. Hyperparameter Optimization/Tuning
6. Model Training.
7. Evaluation/Validation.
8. Deployment/Prediction.

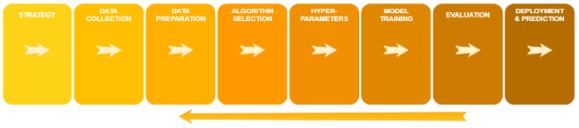

Figure 1. Machine Learning Process

Strategy Definition/Planning

The first step was to define the issue needing to be solved and gain consensus of that definition with the Science of Laws stakeholders.

In our case, the problem was clear: manually accumulating scientific articles that contain descriptions of the effects, impact or outcomes of enacted legislation and classifying them to produce a large repository of information for Science of Laws is tedious, wholly inefficient and prone to human error.

To automate the accumulating and categorization effort, we determined that there were four processes required:

1. Automate the article collection process by creating a data import and/or web page scraping tool set to gather source information from the internet or other electronic source. The tools would need to efficiently accommodate multiple presentation formats of the target data and transform that data to a consistent and desired format.
2. Run the tools against targeted websites and public databases and save the captured data into a temporal data repository.
3. Create a machine learning model that can ingest the captured data and automatically classify those articles into the initial set of target categories.
4. Update the Science of Laws central repository with the newly identified and classified articles.

Sample Data Collection

The next step was to collect enough "what does good look like" sample data which would be used to train the ML model. This sample data would be used to define a "corpus" which is required for natural language processing. In linguistics and NLP, a corpus refers to a collection of texts. For our effort, the sample data would need to include article features such as title, abstract, source, and the list of categories (one or more) to which the article belonged. For our initial machine learning effort, the categorization of articles was determined to be the primary predictive outcome for the model.

Data Preparation and Preprocessing

To create a viable corpus, data has to be imported and centralized into a single repository. Once established, an effort would need to be undertaken to ensure that the data was consistent formatted and cleaned of duplications. Additionally, the data would need to be reviewed to ensure that the required criteria was included and correct.

Further, using a visualization tool, we analyzed the distribution of the number of articles contained within a specific category. This analysis guided our efforts to select the most popular categories from which to train the machine learning model.

A critical review of the initial data set created by the UCSD interns was determined to be incomplete in terms of required criteria. Specifically, the machine learning data analysts found the collected articles contained incorrect or completely missing titles, incomplete or completely missing categories as well as other missing key fields and attributes.

As this was the only dataset available that could be used to train the machine learning model, an effort was needed by the Science of Laws principals to correct the required "corpus". To assist in this effort, the original data set was extracted into a CSV file and distributed to the Science of Laws collaborators. They manually researched and corrected the data and then returned the updated CSV to the machine learning analysts.

The analysts programmatically reviewed the CSV and eliminated duplicate articles as well as those that did not have the required data fields completed.

In addition to the data cleansing effort, the analysts programmatically analyzed the quantity of articles contained within each category and eliminated those categories that did not have a necessary minimum number of articles assigned. This threshold was determined using a combination of the number of articles available for the category and trial and error. We sorted the categories by number of articles and trimmed them until we were receiving a more acceptable accuracy. We settled at 25 articles per category as our minimum. The reason for the elimination, although harsh, is that without a sufficient quantity of articles contained within a category, the machine learning algorithm could not be trained.

Algorithm Selection

Machine learning algorithms are often categorized as supervised or unsupervised. Supervised algorithms require a data scientist or data analyst with machine learning skills to provide both input and desired output, in addition to furnishing feedback about the accuracy of predictions during algorithm training. Data scientists determine which variables, or features, the model should analyze and use to develop predictions. Once training is complete, the algorithm will apply what was learned to new data.

Unsupervised algorithms do not need to be trained with desired outcome data. Instead, they use an iterative approach to review very large datasets and arrive at conclusions. These neural networks work by combing through millions of examples of training data and automatically identifying often subtle correlations between many variables. Once trained, the algorithm can use its bank of associations to interpret new data. These algorithms have only become feasible in the age of big data, as they require massive amounts of training data.

Given the limited number of training examples available (~1,000 manually classified articles), and the fact that we had a clear target of the classification we wanted to achieve, the obvious choice was to focus on applying a supervised algorithm.

Our next effort was to identify several potentially viable supervised algorithms that would provide the highest likelihood of achieving the desired model success.

A common technique used to validate machine learning algorithms is to start with a random-generation algorithm. This algorithm should provide the worst possible predictive results since, as the name implies, the output is completely random. With "what does bad look like" understood, applying the results of the potentially viable algorithms could be compared to that baseline. If the results provided by the selected viable algorithm are not significantly improved over ones produced by the random-generator, then we can assume that the selected algorithm will unlikely produce accurate results.

This approach can efficiently eliminate incompatible options thus saving multitudes of analyst hours attempting

to unsuccessfully tune the algorithm. It also provides evidence as to which types of algorithms may be the most effective to produce the desired predictive outcome.

After determining which algorithms have the highest likelihood of success, we would exercise them using a specifically designed "test harness" to further evaluate their appropriateness. The use of a test harness provides a common means of evaluating the algorithm's effectiveness. In other words, the only variable to the testing approach would be the change of algorithm; all of the other elements of the test run would be constant.

Hyperparameters Optimization/Tuning

Hyperparameters are the initial variables and settings for a model to run. For example, they control the number of iterations of the full dataset for the training process, how the dataset should be split into smaller chunks (batches) in which the model recalculates the weights after each batch instead of finishing a full iteration of the whole dataset, and many other subtleties that can be tuned (while still using the same library, algorithm and dataset).

Initially there is no way to know the best values for hyperparameters. Oftentimes, trial-and-error or other types of "guestimates" are applied to the model based on experience and values used on previous models. These parameters are then tuned in future runs to achieve more accurate results.

The ultimate goal of this optimization process is to find the hyperparameters that have the potential to provide the desired outcome using the selected ML algorithm for your target data.

Model Training

Once the data is cleaned and preprocessed, the preferred algorithm is selected and the hyperparameter settings are determined, it is time for the model to start the training. This effort requires no human input but a lot of CPU (or GPU if you have it) power!

Evaluation/Validation

As part of the run, the model will self-check for accuracy using parameters within the model's code that control the distribution of the source data. Specifically, the parameters determine the percentage of the source data that will be used for model training, and the remainder that is withheld to compare the training results with known results.

As an additional model parameter, we included coding to print the articles (ID, Title, Abstract and manually assigned categories), as well as the categories that the model assigned. We use that output to visually compare not only if the model selected the appropriate categories, but also to allow us to determine which category it assigned or failed to assign.

Comparing the model predictions with the withheld outputs allows us to compute a performance measure for the model. This provides an estimate of the skill of the algorithm to make predictions on unseen data.

This process is iterative until the desired acceptable accuracy is achieved.

Deployment/Prediction

Once we are satisfied that the model is predicting results accurately, we can deploy the model on new data.

The model is oftentimes deployed as an Application Protocol Interface (API) thus rendering it available for other people or other programs.

WORK-IN-PROCESS

As of this writing, the modeling efforts are continuing to be exercised. We expect to have additional information available for the presentation.

NEXT STEPS

For this initial model training phase, we intentionally restricted the categories to be as broad as possible. As our initial dataset is very limited, this approach allowed us to maximize the number of articles available with which to develop the model.

Once we are satisfied with the model performance, we will apply it to additionally obtained articles from the previously defined data sources (i.e. webpage scrapping and public databases).

Further category refinement is expected once the model has a much greater dataset.

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[1] *Black's Law Dictionary*, 2nd Edition
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[3] TechTarget|SearchEnterpriseAI

Gary founded Primero Systems in 1994 with the belief that software's limitless capabilities can be used to help businesses realize their goals – and that every company's potential can be improved through the power of software. Under his leadership, Primero has become a trusted software development company with a loyal and varied customer base – from national retail chains to Fortune 1000 companies. Gary has been managing and developing complex systems for more than 30 years; he regularly draws upon that experience to guide Primero forward and ensure the successful completion of mission-critical software projects. As CEO, Gary shapes Primero's unique culture and drives home the customer-centric mantra of only when a client succeeds does Primero succeed. Integrity, relationships, competence, dedication and quality are all principles that drive Gary and influence Primero's way of doing business.

Prior to founding Primero, Gary spent 11 years with the U.S. Navy's submarine force, which was instrumental in shaping his leadership vision. It was there that he saw first-hand the value of teamwork, camaraderie, mutual respect and accountability – attributes Gary carries with him to this day. After his service in the Navy, Gary further honed his craft at Litton Industries (now part of Northrop Grumman), where he successfully developed and implemented numerous complex software solutions for multi-billion dollar companies. Gary is a Certified Scrum Master and a strong advocate of Agile Software development methodologies.

PROCEEDING

Laws and Regulations: How Much Is Too Much? A More Scientific Approach to Evaluating Impacts

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ABSTRACT

Laws and their associated regulations are usually put in place to curb corporate excesses, ensure safety and privacy, and achieve other governmental goals. However, how much regulation is too much? How can an enterprise assess the impacts of new regulations on their core business areas? How can an enterprise quickly analyze the scope of new regulations, assess their impact, and logically organize either an enterprise wide acceptance of the new challenge or a considered response as to why these regulations unnecessarily hamper the enterprise's core businesses? We propose a method of using a standardized set of "scaffoldings" or templates that can be "stacked" to address strategic, operational, and infrastructure concerns in separate layers. We employ techniques adopted from enterprise architecture to "normalize" the elements of each layer so that like objects are stacked on like objects. This allows the enterprise to see where the impacts of the new regulations fall, decide what new enterprise approaches are necessary for compliance, and assess costs and consequences. If the enterprise finds the new regulations are excessively burdensome, the enterprise can provide reasoned, logical arguments against these regulations instead generally opposing the concept of regulations.

INTRODUCTION

In this paper, we introduce a set of techniques and "thought tools" that provide a logical/rational analysis of the impact of proposed laws/regulation on a specific enterprise/business. These tools and techniques can be used to determine if protests about new regulations have a legitimate basis rather than being complaints just because the regulations require change. The results of the impact analysis can be used to judge whether the impact on affected businesses is justified by the stated public benefits of the laws and regulations. (See Rao, Reedy and Bellman, 2017).

PROBLEM DEFINITION

How can we quickly and logically assess the impact of new regulations on types of enterprises to determine if these regulations unnecessarily hamper the enterprise's core business or if the costs of compliance are balanced in terms of benefits to the public? Here is our three step approach:

- Identify impacts on current specific architecture for any given enterprise or more generally, on a generic abstract enterprise of a given type
- Use the impacts to identify potential compliance responses that enterprises might use at any stage of the law or rulemaking process
- Assign probabilities and costs categories to these responses to estimate impact in terms of quantifiable measures

How can we achieve these results using techniques that provide streamlined and systematic methods and can be applied quickly?

SCAFFOLDING AND LAYERING TECHNIQUES

An *enterprise* is a collection of resources and performers performing complex activities directed towards a common purpose. An enterprise by definition is complex, risky, involves a lot of moving parts and can range in scale from specific projects to large enterprises such as the Federal Government or a large commercial enterprise. An enterprise can also cross multiple organizations, such as the Nuclear Reactor Industry.

Enterprise Architecture is the identification of the structural components and behavior of an enterprise, their relationships both within the enterprise and to elements

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outside the enterprise, and the evolution of structure and behavior over time. Enterprise architecture, more correctly defined as architecture description, is a representation of these elements.

Just as the study and narrative representations of law have been codified and standardized over the years, architecture frameworks, standardized vocabulary and unified methodologies have brought disparate architecture descriptions built for multiple stakeholders with multiple viewpoints into common formats that provide architecture-based analysis using aggregation, integration and comparison capabilities across architectures.

For representing the structure and behavior of an enterprise/company in a standard format, we propose a *scaffolding* approach that we have described in our paper presented at the 2016 ISPIM conference and elsewhere (Rao, Reedy and Bellman, 2016). This same format can be used for documenting the viewpoints of internal levels within the enterprise. The scaffold is a conceptual structure that is based on the six Aristotelian interrogatives and more recently, described by John Zachman (c.f. Zachman, 1987, and Rao, Reedy and Bellman, 2018). The six interrogatives (WHAT, HOW, WHERE, WHO, WHEN and WHY) are mutually exclusive and cover all aspects of an enterprise from a single viewpoint.

- WHAT - Elements of products, services, materials or information
- HOW - Elements of activities, functions, or processes
- WHERE - Elements of locations, equipment and tools
- WHO - Elements of roles and responsibilities
- WHEN - Elements of time periods, events and cycles
- WHY - Elements of purpose, rationale and drivers

Stacking is a method of representing existing layers of the enterprise, each documented in the scaffolding format, to investigate the impacts of laws and regulations at each level of the enterprise or company. Using the scaffolding technique "normalizes" the elements of a specific layer so that like objects are stacked on like objects. By developing the stack of analyzed enterprise layers, we can then view the impacts throughout the enterprise, its readiness to embrace the necessary changes, or its level of resistance to the changes. Layers represent viewpoints of various stakeholders or "tribes" within the enterprise. Example layers include:

- Strategic Layer: concerns of the Chief Executive Officer, Top Executives and the Board
- Operational Layer: concerns of the Chief Operating Officer, Company Management, Plant Operators, and worker groups
- Technology: concerns of the Chief Technology Officer
- Infrastructure: concerns of managers responsible for networking, supply chain, IT operations, automation, and other elements, including the concerns of Chief Information Officers

Some types of enterprises may require additional layers, such as a Standards layer, which is needed for the nuclear power industry. Another layer may represent the concerns of the Chief Financial Officer and represent elements of investment, asset and expense categories for example.

EXAMPLE CONTEXT AND APPROACH

The regulations we use for an example are the recent EPA regulations (EPA, 2018) on coal ash. What is coal ash? Coal ash a by-product of coal fired electric power plants and comes in several forms, principally fly ash, which is recovered from the stack scrubbers that remove pollutants from the smoke stacks of the power plants, and bottom ash, which is the residue of the burned coal from the bottom of the plant furnaces. Coal fired power plants exist in almost every state across the lower 48 usually sited near water sources, since this form of electric power production is water intensive.

There is good reason to regulate coal ash. Coal ash is a toxic material that contains heavy metals, such as arsenic, lead, and mercury, and is dangerous to both people and the environment. (The exact contaminates in coal ash depends on the source of the coal.) As of 2000, the electric power industry was the largest source of toxic pollutants (from both coal ash and coal sludge from coal mining) in the U.S. Currently, about 40% of fly ash is recycled in the form of cinder block or other building materials, but the remaining 60% is stored in containment areas, usually close by the power plants. These containment areas may involve impoundment ponds (fly ash mixed with water) or pits (dried residue of impoundment ponds). Recently (2008 to present) there have been multiple incidents of rivers, lakes, and other sources of drinking water being contaminated by leakage from coal ash containments. Examples of this type of incident include:

- 2008: TVA Kingston Fossil Plant – This spill released 1.1B US gallons of fly ash slurry (coal fly ash and water), which covered 300 acres of land with up to six feet of sludge, including residential areas and polluted the Clinch and Emory Rivers (Tennessee River tributaries) and other nearby waterways. The spill was caused by the rupture of a containment wall (Wikipedia).
- 2014 Dan River Steam Station (ceased operations in 2012) – This spill released 39K tons of coal ash into the Dan River, which provides drinking water for North Carolina and Virginia communities. Increased levels of arsenic and selenium were recorded. The spill was caused by a burst storm drain pipe near a coal ash containment pond and leakage continued for almost a week (Wikipedia).
- 2018 L V Sutton Power Plant (previously closed) – This spill released 2K cubic yards of ash into the Cape Fear River near Wilmington, N.C. The spill was caused by collapse of a containment wall due to heavy rain from Hurricane Florence (The News&Observer 10/03/2018).

This type of incident has driven the development of Federal regulations for coal ash storage. Even so, coal ash is still not categorized as hazardous and was not regulated prior to 2015. Current coal ash storage regulations attempt

to cover coal ash containments cradle to grave (post-closure). However, they do not cover coal ash containments that stopped receiving deposits of ash prior to the implementation of the regulations.

The focus of our example is power generation companies (which may or may not be Public Utilities) that operate coal fired power plants. In some cases, the power generation company is owned by a holding company that specializes in power related products and services. In this case, the holding company may own multiple other types of power generation companies and power grid companies and any individual coal-fired power generation company owned will probably not be able to add additional power plants with other types of power generation (such as solar, wind, or nuclear). Some Public Utilities do not generate their own power but buy it from power generation companies. (An example is Puget Sound Energy, See Michael Lewis *The Fifth Risk* (2018) for a discussion regarding reluctance of power generation companies to invest in technology research).

Our example uses the following methodology:

1. The example is limited to two layers: Strategic and Operational
2. A scaffolding is developed for each layer for an abstracted coal fired power company prior to regulations with impacts of the regulations identified.
3. After the scaffolding is developed, an analysis is developed by:
   a. Identifying potential approaches for the company in addressing the impacts
   b. Estimating probability and cost rating for each approach
4. After analysis, the set of the company's logical options can be identified and the overall impact of regulations on the company's core business evaluated.

"Back-office" operations such as billing, collections, HR, and payroll, are ignored in this example.

EXAMPLE

Figure 1 provides an overview of the scaffold, potential impacts, and probability/cost analysis for the Strategic Layer for a coal fired power generation company. Figure 2 provides the same overview for the Operational Layer. A quick examination of these figures shows that the major continuing costs of compliance with the regulations comes on the operational side of the company, while the costs on the strategic side tend to be one-time costs. The regulations certainly increase the costs for the power company but don't otherwise hinder their core business. Despite the costs of compliance, there will may be only a relatively short-term decrease in profits for the company. Whether the company is directly a Public Utility or simply a power generation company, the increased costs of complying with the regulations will be eventually be passed on to the electric power consumers. The company may also institute a policy that slows down compliance and spreads out the cost increases over time.

Strategic Layer	Potential Impacts	Probability/Cost Analysis
WHAT: Electrical Power, Cost, Profit, Policy	Changes in Cost, Profit, and Policy	Probability of Changes: High; Probability of Resistance: High Moderate to High Cost Increase Overall; Short Term Decrease in Profit; Moderate Cost of Policy Change
HOW: Generate & Distribute Power; Manage Costs; Maximize Profit	Additional high-level business functions	Probability of New Business Functions: Moderate Moderate Cost
WHERE: Plant Installations; Headquarters & Business Offices	Acquisition of additional land; modifications to existing installations	Probability of New Land Acquisition: Moderate; Probability of Modifications: High Moderate to High Costs
WHO: Upper Management & Executives; Planners; Business Units/Divisions	New Business Units; new management responsibilities; new management skills/expertise	Probability: High Low to Moderate Costs
WHEN: Business Lifecycle, Production Lifecycle, External Events	Changes in business & production lifecycles; additional cycles & events	Probability: High Costs included in establishing new business functions
WHY: Profits; Public Utility Services; Safety; Compliance	New regulation compliance	Probability: High Costs include costs of overall changes

Figure 1. Strategic Layer a Coal Fired Power Generation Company

Operational Layer	Potential Impacts	Probability/Cost Analysis
WHAT: Electrical Power, Coal, Water, By-products	Restrictions on type of coal used; reduction in power output	Probability: Low High Costs
HOW: Operate & Maintain Coal-fired Power Plant; Manage Coal Supply/Storage; Manage By-product Storage; Maintain Grid Connections	Move & line/seal ash ponds/pits; additional water pollution monitoring; transport of coal ash; recycling of coal ash	Probability: High High Costs; but potential new revenue stream
WHERE: Power Plant Installation	New locations for coal ash ponds/pits; transport roads; new monitoring sites	Probability: High High one-time costs
WHO: Plant Managers; Operations/Maintenance Engineers & Crews	New/additional crews, engineers, and managers for coal ash transport and pond/pit sealing, maintenance, and monitoring	Probability: High Moderate to High Costs
WHEN: Operations & Maintenance Schedules; External Events	New schedules for coal ash pond/pit development, maintenance, & monitoring; additional emergency responses	Probability: High Costs included in establishing new business functions
WHY: Public Utility Requirements; Profit; Grid Cooperation Agreements; Safety; Compliance	New safety concerns; new compliance concerns	Probability: High Costs include total costs of compliance plus additional safety costs for new business processes

Figure 2. Operational Layer for a Coal Fired Power Generation Company

In addition, the costs of compliance can be partially offset by a new revenue stream from selling coal ash for recycling into building materials, such as cinder block, or fill. Gaining other new revenue streams from branching out into additional forms of power generation (that don't involve coal ash by-products) is more problematical and depends on the exact ownership structure of the company. Independently held Public Utilities or power companies have the option of phasing out the now more expensive coal fired plants and phasing in other forms of power generation. However, power companies that are held by holding companies may not have this option. If the holding company already holds other companies in these other forms of power generation, then the coal fired power generation company may be forced to remain in its current business and becoming non-competitive with other forms of power generation.

The Trump administration has proposed rolling back some of the current regulations. These roll-backs primarily impact the ground water monitoring aspects of the regulations. Included are lowering the number of heavy metals checked for, weakening the standards for drinking water, and allowing state officials to terminate ground water monitoring altogether. Other regulatory areas proposed for change include allowing leaking storage ponds to continue to operate for longer periods of time and

allowing state officials to judge if the rules are being followed instead of licensed engineers.

SUMMARY AND ADDITIONAL RESEARCH

Laws and regulations can impact an enterprise in multiple ways: requiring specific roles; requiring or constraining activities; constraining or requiring response/cycle times or other aspects of timeliness. Enterprises tend to resist change and respond to proposed new laws and regulations with protest. The potential impact of a law or regulation on an enterprise can be analyzed using a 6-dimensional scaffolding applied in layers that can then be "stacked" to see where the impacts on the enterprise fall. Probabilities and costs can be assigned to potential impacts and reasonable or alternative approaches to the impacts can be investigated. This analysis can provide a cross check on how legitimate the protest against the new law is. Since the scaffolding technique provides separation of concerns, the analysis can be performed by multiple groups independently and then merged. If this analysis is done prior to regulation finalization, then the results of the analysis can be used to provide sound, logical feedback to the law-making process. Once done, the analysis can also be used to assess the change in impacts caused by roll-back of parts of the regulations.

Future research in this area should include integrating these techniques into the law-making process.

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Quality Standards for Laws

PROCEEDING

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ABSTRACT

Laws of government (legislative statutes) are the useful problem-solving means, or tools, by which the ends of government are attained. Since laws have a direct impact on human rights, living standards, and quality of life, it is critically important that they are designed and maintained to solve societal problems in a just and efficacious manner. However, there are currently no uniform quality standards for the design and evaluation of laws, and the public is placed at risk from poorly designed laws. This paper discusses quality standards for legislative statutes. Quality standards, such as globally-recognized ISO 9000 standards, have proven to be effective in improving the performance, cost-efficiency, and safety of useful products and procedures. The application of similar quality standards to laws holds the promise of improving the performance of laws, hence governments, for the benefit of the public and will accelerate the development of the science and engineering disciplines of laws.

INTRODUCTION

The purpose of government, as stated in the Declaration of Independence of the United States of America, is to secure the inalienable rights and liberty of the citizenry of the government [1]. (Note: This discussion is focused on the various governments of the United States of America, but the principles of governance and lawmaking can apply to all governments.) To achieve this purpose under the directives of the Constitution of the United States, federal, state, and regional governments are obligated to solve (solve, mitigate, or prevent), by means of laws and to the extent that is practicable, the problems that degrade or threaten to degrade the rights and liberty of the people. The parameters that define rights and liberty are human rights, living standards, and quality of life standards [2]. Governments are thus challenged to create and manage bodies of laws (the "rule of law") that solve societal problems and thereby satisfy governments' obligation to secure the rights and liberty of the people.

The measure of the effectiveness of a government is the extent to which its rule of law is efficacious in the solution of societal problems. If a government's laws are mediocre or ineffective, the government will be mediocre or ineffective; if laws are successful, the government will be successful. The key to the success of a government, therefore, is in the quality of its body of laws. The purpose of this report is to present the findings of an investigation of the bill drafting stage of law-design used by governments. The conclusion of this report is that the bill drafting process lacks quality design standards and that governments will benefit from the adoption of quality design standards for the creation of laws. The discussion includes a review of the problem-solving method, lawmaking, methods and materials, results, discussion, conclusion, and recommendations.

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PROBLEM SOLUTION

Problem Solving Method

The formal, reliable method by which devices and processes are designed to solve complex problems is the Problem-Solving Method (PSM). The generic PSM consists of the following steps [2]:

1. Problem definition and analysis
2. Prioritization of problems for solution
3. Statement of solution goal (purpose statement)
4. Search for / selection of promising solution
5. Cost / risk analyses of proposed solution
6. Testing and acceptance or rejection of solution
7. Citation of references
8. Signature of designer(s)
9. Follow up evaluation of outcomes and validation of solution

The steps of the PSM are explained in the following subsections.

Problem Definition and Analysis

A statement of the definition of the problem is an absolute requirement for problem solution; it is impossible to solve a problem that has not been defined. Also, the size and nature of the problem need to be analyzed and recorded so that an appropriate solution can be formulated.

Prioritization of Problems for Solution

Resources are always limited; it is essential that priority is given to the most serious problems for solution.

Purpose Statement

A statement of the purpose of problem solution in terms of a measurable goal is an essential requirement of problem solution. It informs all involved parties of the intended outcome and thus minimizes the possibility of efforts that do not contribute to the outcome. Also, it is impossible to

evaluate the performance of a problem-solving effort if the goal is not defined.

Search for Solutions

A solution is the forcing mechanism or process that accomplishes the stated problem-solving goal. The simplest path to finding an appropriate solution is to use a solution that has already been successfully applied to similar problems. Alternatively, the individuals involved in the problem-solving effort may engage in innovative "brainstorming" sessions to evoke ideas for new solutions. After the most promising existing or new solution has been identified, its applicability and appropriateness are evaluated.

Cost / Risk Analyses

For any problem-solving activity to be acceptable, its benefit (problem solution) must be greater than the sum of its costs and side effects/risks. Costs include factors such as research and development, operations and maintenance, quality assurance, and end of cycle expenditures. The operation of any useful device involves an element of risk and the generation of unwanted and potentially harmful side effects. An essential requirement for projects that affect the public is an "environmental impact statement," which assures the public that the risk and anticipated side effects of the project are within acceptable limits.

Testing and Validation

For the solution of complex problems, the creation and testing of a model of the proposed solution is essential [3]. Models allow designers to evaluate all internal and external conditions and boundaries that are relevant to the design of the solution. All variables and assumptions are expressed in mathematical terms (which may initially require "educated guesses") so that the model can be analyzed with computer simulation. Mathematical models enable designers to make and test changes to optimize designs and make accurate predictions of future performance. The goal is to identify the solution parameters that predict the greatest net benefit (maximum performance). Once the design is complete, the solution is implemented.

Citation of References

The citation of all data bases, methods, and sources is an absolute requirement for complex problem-solving projects. The citation of references confirms that the problem analysis and design process used only relevant and reliable knowledge bases and procedures. If a problem-solving process fails in its purpose or produces unacceptable side effects, a review of the cited references may help to determine the cause of failure, e.g., from the use of inaccurate or incomplete data bases in the design process.

Signature of Designer(s)

It is important that the designer(s) of any complex device or process, especially one that has an impact on the public wellbeing (e.g., nuclear reactor, transport aircraft, pharmaceutical, law of government…), apply their signature to the final design documents. Signatures acknowledge that the designers are qualified and competent for the design effort and that they take credit and responsibility for the new product.

Follow up Evaluation and Reporting

A follow up evaluation (quality assurance – QA) of the performance of each solution is required to confirm its problem-solving efficacy. Evaluation of outcomes completes the problem-solving process because it confirms or refutes the ability of the solution to reach its goal.

The results (both successes and failures) of the evaluation are recorded and serve as a reference base and guide for future design projects. Innovative problem-solving efforts may involve the development or discovery of new methodologies, processes and devices, which are then reported in the scientific literature. QA programs are applied periodically to identify and enhance (through quality improvement programs – QI) the performance of successful solutions and to discontinue failed programs and outmoded solutions [4].

The PSM is the only reliable method by which solutions to complex problems can be designed. There are no real-world problems that it cannot address, and it blocks attempts to solve problems that do not exist. If a complex problem cannot be solved by the problem-solving method, that problem cannot be solved with existing technologies.

LAWMAKING

The legislative process, by which governments create new laws to solve societal problems, is depicted in Exhibit 1. It begins with an idea for a law, which can originate from virtually anyone such as individual citizens, legislators, lobbyists, or government agencies. The idea is then presented to a legislator (legislative sponsor) for acceptance as the basis of a new or amended law of government. If the legislator agrees to sponsor the idea, it is forwarded to the government's Office of Legislative Counsel where it is drafted into a bill. The Office of Legislative Counsel is responsible for assuring that the bill meets legislative design standards, has proper style and syntax, and has no constitutional or other legal conflicts [5]. The legislative sponsor then submits the completed bill to the legislature for consideration as a new law of government (see Figure 1).

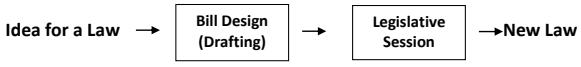

Figure 1. The Legislative Process. The creation of a law involves two principal steps: Bill Drafting and Legislative Sessions.

Despite good intentions, governments have been less than successful in meeting their obligations to solve societal problems by means of laws. Tens of thousands of laws are annually created by the federal and state governments of the United States [6], for example, but there has been little proportional improvement, over time,

in the abatement of societal problems such as poverty and homelessness [7]. (Note: During the first decade of the 21st century the State of California enacted 8,879 legislative statutes.) The results of a previous study on the general lack of success of laws indicated that the lawmaking process of government is deficient in quality design standards [6]. The present report is of a follow-on study that evaluated the official bill drafting manuals of State Governments and of the House of Representative of the United States for their content of quality standards for the design of bills.

METHODS AND MATERIALS

The key step in the design of a law (as a problem-solving instrument of government) is the bill drafting stage (Figure 1), in which an idea for a law is transcribed into a written document (bill) that meets the design requirements of a potential new law of government. For the federal and state governments of the United States, the drafting of ideas into bills is undertaken by the office of legislative counsel of each government. In the present study, the published bill drafting manuals of the office of legislative counsel of the federal and 32 state governments [8] were analyzed for their content of the following elements of the problem-solving method, which comprise quality design standards:

- Definition and analysis of the problem that the bill addresses
- Assignment of priority to the problem for solution
- Purpose statement (intent / goal) of the bill
- Selection method for sanction (enforcement mechanism) of the bill
- Evaluation of legality of the bill and its interaction with related laws
- Estimated total costs of the bill
- Estimated risks and side effects of the bill
- Testing and evaluation of the bill
- Citation of references to data bases, methods and procedures
- Name, credentials, and affiliation of bill designer
- Follow up evaluation and validation

RESULTS

The results of the analysis of bill drafting manuals are listed in Figure 2. The following subsections provide an explanation of the results.

Problem Definition

None of the manuals requires a definition of the problem under consideration for solution by means of a law. Although many manuals stated that it was important for the drafters of bills to understand the problem to be solved, a definition of the problem is optional, as noted ("should" not "must"):

"…the drafter should consider … What is the problem the sponsor seeks to remedy?" [8.p., p.13]

"A drafter should understand the problem being addressed before drafting its solution." [8.r., p.3]

PSM QUALITY DESIGN STANDARDS FOR PROPOSED NEW LAWS (BILLS)	NUMBER OF MANUALS THAT REQUIRE QUALITY DESIGN STANDARDS (33 MANUALS)
Definition of Problem	0
Analysis of Problem	0
Priority of Problem	0
Purpose Statement (Goal)	0
Structured Selection Process for Sanctions	0
Interaction with Other Laws / Legality	33*
Full Cost Analysis of Solution	0
Risk Analysis of Solution	0
Performance Prediction (Benefit / Cost - Risk)	0
Citation of References, Methods, Data Bases	0*
Signature of Law Designer	0
Follow Up Evaluation Measures	0

Figure 2. Summary results of the requirement of problem-solving method elements (quality standards) in federal and 32 state bill drafting manuals (*Existing laws that interact with the proposed new law are cited.)

Problem Analysis

None of the manuals required an analysis of the size and nature of problems submitted for solution by means of a law.

Priority Assignment

None of the manuals required an assignment of priority to problems for solution.

Purpose Statement (Goal)

A statement of the law's goal, or purpose, defines the law's ultimate objective so that all responsible, involved parties can work towards that end. Also, the defined, measurable objective enables a quality assurance (QA) program to evaluate the law's performance. The value of a QA program is that it can determine if a law should be continued in force, amended, or repealed. The bill drafting manuals of the offices of legislative counsel do not require a statement of purpose in the law and discourage the use of purpose statements:

"The regular inclusion of a findings and purpose section in all bills is not advisable." [8.i., p.6]

However, when bill drafters exercise the option of including a purpose statement, the manuals recommend that it should describe the force that the law applies rather than the goal or outcome that is desired. Two examples of the typical terminology of purpose statements include the following:

"A purpose paragraph consists of descriptive clauses separated by semicolons, using the "ing" form of a verb (e.g., "altering," "authorizing," "requiring," "exempting," "establishing," "prohibiting")." [8.p., p.38]

"The primary purpose of these phrases (of the subject matter of the bill) is to satisfy the requirements of Joint Rule 2.01 that the title of a bill "briefly state its purpose." The following words are examples of some of the more

common words that begin these phrases: "changing" "adding" "modifying" "authorizing" "regulating" "abolishing" "providing" …" [8.r., p.13]

These statements reveal confusion between means and ends. The "means" of a law is the enforcement mechanism that is applied to achieve the "end" of the law, which is its problem-solving objective. When legislatures regard the purpose of a law as the force that is applied rather than the end-condition that is sought, they circumvent the problem-solving objective, and merely create laws. Legislatures can then declare that 100% of their laws satisfied their purpose simply because they were enforced. By substituting means for ends, it is possible for a legislature to create an entire body of "successful" laws that never solves one problem. Thus, the purpose statement, as described in bill drafting manuals, is misleading (to the public and the government) and defeats the purpose of government as stated in the Declaration of Independence.

Another misstatement of the purpose of laws is as follows:

"Generally, the purpose of legislation is to direct behavior." [8aa, p.2]

For a government dedicated to the safety and wellbeing of the public (i.e., securing rights and liberty), this statement is incorrect. A government that believes its purpose is to direct (control) human behavior is at risk of becoming an authoritarian government, to the detriment of the public. The purpose of representative government, as defined in the opening paragraphs of this report, is to control problems, not people.

Selection of Sanction

There is no requirement for an effective method of selection of the sanction (enforcing mechanism) of the law. The legislative sponsor may have chosen the sanction (fine, incarceration, subsidy, …) before the bill came to the bill drafter's desk. Alternatively, the bill drafter decides (makes an "educated guess") to select a sanction as the forcing mechanism of the law:

"In many bills, this part is the largest portion of the bill as it sets forth the rights, powers, duties, immunities, and jurisdiction of those persons or entities that are the subject matter of the bill. It is also the most difficult portion to draft, as it is the portion of the bill that requires the drafter to make a decision between specific requirements or general prohibitions to facilitate the client's (e.g., legislative sponsor's) policy." [8.g., p.18]

"Fines provide a virtually unlimited source of variation. … The type and range of penalty are virtually unlimited." [8.m., p.16]

Interaction with Other Laws / Legality

All of the bill drafting manuals require bill drafters to review the bill's interaction and possible conflict with laws that address the same subject matter and to confirm the legality and constitutionality of the bill. Of significance, the purpose for the review of existing laws is not to determine the reason why these laws were less than effective in dealing with the problem they address but rather to assure that the new law will not interfere with the existing law.

"Read all relevant laws, including uncodified law where appropriate, to determine what must be enacted, amended, or repealed in order for the proposed law to be implemented smoothly." [8.n., p. 1-10]

Cost Analysis

The bill drafting manuals do not require a comprehensive analysis of the cost of the proposed law. For example, the cost of research and development of the bill, the legislative process, promulgation, enforcement, burden on the courts, compliance, and quality assurance are not included in the cost analysis requirements of the bill drafting manuals. The manuals of five states do require an accounting of the estimated effect of the law on the general fund (treasury) account of the state, as in this example:

"…a fiscal note is required if the bill will have a negative or positive effect on state revenue, appropriations or allocations or require a local unit of government to expand or modify its activities…" [8.o., p. 25]

In several states, the fiscal impact of the bill is not evaluated in the bill drafting stage. Instead, the fiscal impact is considered by the legislature in the second (legislative session) stage of law-design:

"All bills are reviewed by Controller General's Office for fiscal impact after the bill has been introduced. The CGO office determines if a fiscal note is necessary." [8.g., p. 44]

The result of inadequate cost analyses of bills is that legislators are placed in the untenable position of deciding to vote for or against a bill without having complete information of the total estimated costs of the law.

Risks

There is no requirement for the evaluation of risks to the government or the public (equivalent to an "environmental impact statement") by the law.

Performance

There is no requirement of an estimation of the predicted performance of the law (i.e., no requirement for modeling and simulation of the mechanics and outcome of the bill).

Citation of References

There is no requirement for a citation of references to scientific literature, data bases, methodologies, or procedures; bills can be designed and submitted to the legislature without a demonstrable basis in knowledge. As noted in the previous section on "Interaction with other laws," the existing laws that are affected by the proposed new law are cited.

Signature of Designer

There is no requirement for the bill designer(s) to attach a signature to the final design of the law. The affiliations, qualifications, and competency of bill designers is thus unknown to the government and the public, and there is no individual accountability for the quality of the final bill-

product. By default, the legislator-sponsor of the bill is usually listed as its "author."

Follow up Evaluation and Validation

There is no requirement for a quality assurance (QA) evaluation and validation of the bill after it has been enacted into law. If a law is ineffective, conflicts with other laws, or is harmful to the public, it is not identified and remains in force until repealed or superseded by future laws.

DISCUSSION

The results of the study demonstrate the deficiency or absence of a requirement for PSM elements (quality design standards) in the bill drafting manuals that guide the creation of legislative bills. In the absence of quality standards, it is now possible for a bill to be presented to a legislature and enacted into a law without the following:

1. Definition of the problem to be solved
2. Statement of the law's purpose in terms of a measurable outcome
3. Cost / risk analyses of the law
4. Basis in knowledge
5. Provisions for follow up evaluation and validation of the law

In the absence of quality standards, governments cannot, through their legislative process and rule of law, consistently satisfy their problem-solving (i.e., public benefit) obligations to the people. In fact, governments continuously place the public at risk from the production of laws that have omissions and harmful defects related to the lack of design standards, and from persistent societal problems that poorly designed laws are unable to solve. The lack of quality design standards for bills is a serious problem but it also offers an opportunity for governments to improve their performance. By simply adopting the same quality design standards that are routinely observed by other major productive industries and by international standards organizations such as the International Organization for Standardization (ISO) [9], governments can significantly improve the problem-solving efficacy of their bodies of laws.

RECOMMENDATOIN

Based upon the findings of this report, it is recommended that governments adopt quality design standards for the creation of laws of government. As a first step, a bill-design manual, based on the PSM, should be created. Logically, the science / engineering community, which successfully applies the PSM in the creation of problem-solving tools, should oversee the creation of the manual. The manual could then be adopted for use by government offices of legislative counsel as an adjunct to current bill drafting manuals for the creation of bills.

Quality design standards require follow up evaluation and validation of bills after they have been enacted into law, and a separate set of quality assurance standards, based on the PSM, should be created, also by the science / engineering community, and used as a feedback mechanism to maintain peak performance of the body of laws. The advantage of these quality standards is that they will foster the development of the science of laws [10] and bring, for the first time, the full resources of science and engineering to bear upon the solution of societal problem by means of laws.

PREDICTION

The adoption, by governments, of quality standards for laws will significantly improve the performance of governments and the rule of law.

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q. Massachusetts:https://malegislature.gov/Content/Documents/General/LegislativeDraftingManual.pdf
r. Minnesota: https://www.revisor.mn.gov/static/office/2013-Revisor-Manual.pdf
s. Missouri: http://www.moga.mo.gov/rsmopdfs/BillDraftManual2011.pdf
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w. North Dakota: http://www.legis.nd.gov/legislative-drafting-manual
x. Ohio: http://www.lsc.state.oh.us/rules/rdm06_06.pdf
y. Oregon: https://www.oregonlegislature.gov/lc/PDFs/draftingmanual.pdf
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aa. Tennessee: http://www.capitol.tn.gov/Archives/joint/staff/legal/2018%20Drafting%20Guide.pdf
bb. Texas: http://www.tlc.state.tx.us/docs/legref/draftingmanual.pdf
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Can we create a sustainable government using the INCOSE Systems Engineering Measurement Primer?

PROCEEDING

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The Science of Laws Institute

ABSTRACT

Recent reports in the United States show a growing gap between societal needs and available budget. This paper posits one possible path to reconcile the situation is through the tailoring and adoption of the concepts detailed in the INCOSE *Systems Engineering Measurement Primer*. In order to illustrate the viability of this approach, the author examines the stated purpose and uses of a measurement system, as defined by INCOSE, and then identifies lawmaking examples where those same concepts could be applied. Next, the author walks through the steps suggested by INCOSE for implementing a measurement system and identifies the predicted level of difficulty and the items that would be critical for that step's success. Then, the author provides concluding thoughts and recommended next steps.

BACKGROUND

In its current form, the U.S. government is financially unsustainable. According to a March 2018 report in Business Insider, the US national debt is rising 36% faster than the economy. Further, the current amount of the national debt already exceeds $21 trillion [1]. The goal of this paper is to explore one manner in which the U.S. government might reconcile differences in societal needs and available budget: by applying the same practical approach to measurement that is used by systems engineers in a multitude of other industries, including aerospace and defense.

As discussed in Schrunk (2015), there is a theoretical optimum in the number of laws. Laws added beyond that optimum diminish the usefulness of the collective body of laws (see Figure 1) [2]. Another characteristic of laws, beyond their usefulness, is the cost associated with monitoring and enforcing that law (see Figure 2). Combining these concepts, it stands to reason that by eliminating laws that detract from the usefulness of the collective body of laws, a government could simultaneously gain efficiency in the remaining laws and save money in the monitoring and controlling of all laws (see Figure 3). The challenge, then, facing the government is in identifying the laws that should be eliminated. The author of this paper posits that one method of identifying laws for elimination is through the adoption of a measurement system such as those described in the INCOSE *Systems Engineering Measurement Primer* [3].

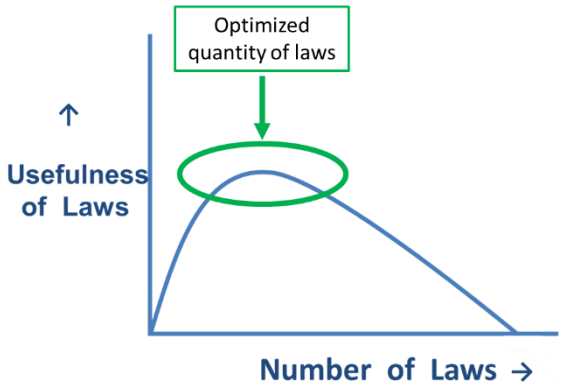

Figure 1. Optimum number of laws as discussed in Schrunk (2015) [2]

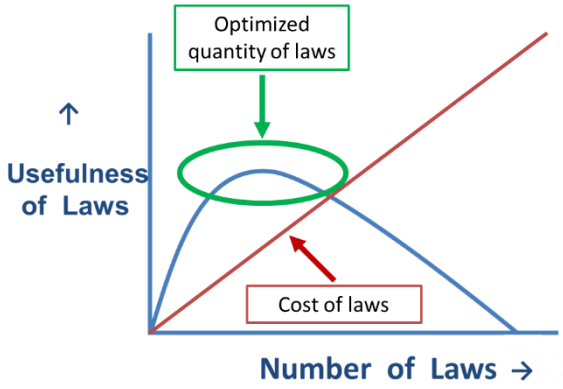

Figure 2. Cost associated with monitoring and enforcing laws

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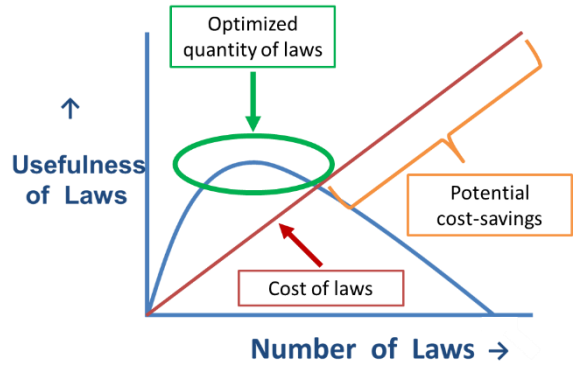

Figure 3. Potential cost-savings through elimination of non-productive laws

According to the SE Measurement Primer, measures offer the insight needed for planning, controlling, managing, and improving many aspects of projects and products including:

- Adequacy of performance
- Resources and cost
- Growth and stability
- Effectiveness
- Customer satisfaction

This is accomplished by using measurement as a feedback control system as illustrated in Figure 4.

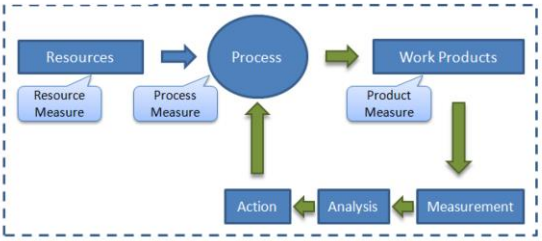

Figure 4. Measurement as a Feedback Control System (from INCOSE Systems Engineering Measurement Primer [3])

HYPOTHESIS

The main hypothesis needing to be explored is whether or not the U.S. government can reconcile differences in societal needs and available budget through the tailoring and adoption of the concepts detailed in the *Systems Engineering Measurement Primer* [3]. This measurement system would enable a feedback control system for lawmaking, allow for the introduction of a quality assurance program, and lead to the modification or elimination of non-productive laws. While there are many aspects of this hypothesis that can and should be tested, the aim of this paper is to evaluate the sub-hypothesis of whether or not the *Systems Engineering Measurement Primer* could be applicable to lawmaking [3].

ANALYSIS APPROACH

The *Systems Engineering Measurement Primer* [3] is structured as follows:

1. Introduction
2. Business Value of Measurement
3. Measurement Process
4. Application Guidance and Lessons Learned
5. Example Measures
6. Summary
7. References
8. Key Measurement Terms
9. Feedback Form

The analysis detailed within this paper is focused on two portions of Section 2 Business Value of Measurement, specifically Section 2.2 Purpose of Measurement and Section 2.3 Uses of Measurement, plus Section 3 Measurement Process. First, the author evaluates if the concepts described in Purpose of Measurement and Uses of Measurement are applicable to lawmaking by identifying lawmaking examples where those concepts could be applied. Next, the author, applies his judgment to estimate level of difficulty to implement a measurement system within lawmaking as described in Measurement Process.

PURPOSE OF MEASUREMENT

According to the Primer [3], the purpose of measurement is to:

- Communicate effectively throughout the project organization
- Identify and correct problems early
- Make key tradeoffs
- Track specific project objectives
- Defend and justify decisions

The following subsections will elaborate on these concepts as well as examples that illustrate how those measurement concepts could be applied within lawmaking.

Communicate effectively throughout the project organization

Per the primer [3], a measurement system helps stakeholders communicate effectively throughout the project organization. Specifically, a measurement system can:

- Provide quantified information related to process, progress, and/or product
- Increases awareness
- Reduce uncertainty and ambiguity
- Support risk analysis
- Introduce unique terminology for all concepts, activities, tasks, and entities

Within lawmaking, stakeholders could benefit from common terminology and data from a measurement system when discussing:

- Lawmaking process
- Concepts and mechanisms for new laws
- Proposed changes to existing laws

Identify and correct problems early

Per the primer [3], a measurement system can be used to identify and correct problems early. Specifically, a measurement system can be used to:

- Identify problems
- Take action to limit impact
- Manage risks before they become issues
- Identify root cause to determine appropriate corrective and preventive actions

Within lawmaking, a measurement system could be used to identify and correct:

- Risks related to laws
- Ineffective laws
- Unanticipated consequences related to laws

Make key tradeoffs

Per the primer [3], a measurement system can be helpful in support of decision making related key tradeoffs. Specifically, a measurement system can be used to:

- Quantify different aspects (e.g., maintainability, design cost, reuse) of each alternative
- Base decisions on credible facts rather than subjective opinions

Within lawmaking, a measurement system could be used to support tradeoff decisions, such as:

- Selecting between differing approaches to solving same societal problem
- Choosing which laws to enact and/or retire while remaining within budget

Track specific project objectives

Per the primer [3], a measurement system can be used to track specific objectives. Specifically, a measurement system can aid in:

- Understanding current progress towards objectives
- Deciding whether to continue with current plans or make revisions

Within lawmaking, a measurement system could be used to:

- Understand the current state of the lawmaking process
- Understand current progress towards the objective(s) of a particular law

Defend and justify decisions

Per the primer [3], a measurement system can be used to defend and justify decisions. For example, a measurement system can:

- Support informed decision making
- Be used to defend or justify decisions previously made based on data obtained through the measurement system

Within lawmaking, a measurement system could be used to defend and justify decisions such as:

- Keeping or removing laws based on its effectiveness
- Keeping or removing laws based on its burden versus its benefit

Summary of Findings related to Purpose of Measurement

As summarized in Table 1, each of the stated purposes of measurement have been shown to be applicable to lawmaking based upon the author's ability to identify relevant examples in lawmaking.

Table 1. Summary of Findings related to Purpose of Measurement

Measurement Purpose	Applicable?
Monitor the progress and performance of activities	Yes ✓
Communicate effectively throughout the project organization	Yes ✓
Identify and correct problems early	Yes ✓
Make key tradeoffs	Yes ✓
Track specific project objectives	Yes ✓
Defend and justify decision	Yes ✓

USES OF MEASUREMENT

According to the primer [3], the uses of measurement are to:

- Characterize: Gain Understanding of Products and Processes
- Improve: Identifying and Evaluating Improvement Opportunities
- Predict: Facilitating Projections and Planning
- Evaluate: Providing Feedback and Status

The following subsections will elaborate on these concepts as well as examples that illustrate how those measurement concepts could be applied within lawmaking.

Characterize

Per the primer [3], stakeholders can use a measurement system to characterize system performance, including:

- Process performance
- Technical performance

Within lawmaking, stakeholders could characterize:

- Process performance (e.g., duration from problem identification to enacted law)
- Technical performance (e.g., intended and unintended effects of laws)

Improve

Per the primer [3], stakeholders can use a measurement system to drive improvement activities including:

- Identifying variance
- Quantifying improvements made
- Enabling quantitative process management
- Establishing goals for performance of processes
- Collecting and analyzing the measures of process performance
- Making adjustments to maintain process performance within acceptable limits

Within lawmaking, stakeholders could use a measurement system to drive improvement activities including identifying and evaluating improvement opportunities related to:

- Efficiencies in lawmaking process
- Effectiveness of laws

- Reduction of side effects of laws
- Reduction of the financial burden of laws

Predict

Per the primer [3], stakeholders can use a measurement system to drive prediction activities including:

- Improving predictions and planning through use of historical data
- Formulating statistical and causal models for predictions
- Aiding in the budgeting, scheduling, and planning new projects

Within lawmaking, stakeholders could use a measurement system to aid prediction activities including:

- Predicting effectivity of laws
- Predicting time required to observe positive effect of law
- Predicting financial burden of law
- Predicting needs and costs of supporting infrastructure (e.g., permitting office to review building codes)

Evaluate

Per the primer [3], stakeholders can use a measurement system to evaluate system performance, including:

- Customer satisfaction
- Product penetration
- Team effectiveness

Within lawmaking, stakeholders could use a measurement system to evaluate:

- Citizen satisfaction
- Penetration of law within citizenry
- Penetration of law within enforcement agencies
- Effectiveness of law-design team

Summary of Findings related to Uses of Measurement Systems

As summarized in Table 2, each of the stated uses of measurement have been shown to be applicable to lawmaking based upon the author's ability to identify relevant examples in lawmaking.

Table 2. Summary of Findings related to Uses of Measurement Systems

Measurement Use	Applicable?
Characterize: Gain Understanding of Products and Processes	Yes ✓
Improve: Identifying and Evaluating Improvement Opportunities	Yes ✓
Predict: Facilitating Projections and Planning	Yes ✓
Evaluate: Providing Feedback and Status	Yes ✓

MEASUREMENT PROCESS

According to the primer [3], the measurement process consists of the following steps:

Establish Commitment
Plan
Perform
Evaluate

The following subsections will elaborate on these concepts as well as discuss the author's opinion or the level of difficulty related to implementing the process step within lawmaking and what critical needs are required to implement that step.

Establish Commitment

According to the primer [3], establishing commitment to implement a measurement system requires:

- Changing the organizational culture and infrastructure
- Defining the focus and scope of the measurement program
- Providing funding, resources, and training

In the author's opinion, the difficulty related to implementing a measurement system within lawmaking is high, mainly due to the need to change the organization's culture (which is typically difficult). The author believes that, in addition to changing the culture, the following items would be critical to this step's success:

- Measurement tools and techniques specific to laws and lawmaking
- A specialized training curriculum related to measurement systems within lawmaking

Plan

According to the primer [3], the planning related to implementing a measurement system includes:

- Aligning measurement activities with organizational needs
- Identifying and prioritizing information needs
- Specifying measures that satisfy information needs
- Defining data collection, analysis, storage, and reporting
- Defining criteria for evaluating the measurement plan
- Allocating resources to measurement
- Preparing activities to help guide and manage cultural and organizational change
- Acquiring and deploying supporting technologies

In the author's opinion, the difficulty related to planning for a measurement system is medium with the most challenging aspect being the need to come to agreement on measures related to the effectiveness of laws. The author believes the following items would be critical to this step's success:

- Agreement on measures related to the effectiveness of laws
- Agreement on measures related to the financial burden of laws
- Measurement tools and techniques
- An information technology infrastructure to support measurement activities

Perform

According to the primer [3], the performing of a measurement system includes:

- Integrating measurement into relevant project processes
- Collecting, processing, storing, and verifying measurement data
- Analyzing data and developing information products
- Documenting, making recommendations, and communicating results to measurement users

In the author's opinion, the level difficulty related to performing (i.e., executing) a measurement system within lawmaking is low. The author believes the following items would be critical to this step's success:

- Collecting performance data on laws and lawmaking
- An established network for reporting performance data
- Analysts skilled at interpreting and making recommendations based upon the lawmaking data

Evaluate

According to the primer [3], the evaluating of a measurement system includes:

- Measuring performance of measurement process
- Evaluating feedback from measurement users

In the author's opinion, the level difficulty related to evaluating a measurement system within lawmaking is low. The author believes the following item would be critical to this step's success:

- Tailoring of existing measurement system evaluation tools and techniques for use in lawmaking

Summary of Estimated of Levels Difficulty Related to The Measurement Process

Table 3 below provides a summary view of the level of difficulty estimated for performing each step of the measurement process within the context of lawmaking.

Table 3. Summary of Estimated of Levels Difficulty Related to The Measurement Process

Measurement Process	Level of difficulty?
Establish commitment	High
Plan	Medium
Perform*	Low
Evaluate	Low

*Note: Perform in this context relates to measuring lawmaking factors and creating information products to support decision making. It does not include the actual decision making.

CONCLUSIONS AND NEXT STEPS

Based upon the lawmaking examples provided, the purpose and uses of measurement as described within the *Systems Engineering Measurement Primer* are applicable to lawmaking; however, there are several critical needs identified [3].

Based upon the findings documented within this paper, it appears plausible that a measurement system could be employed for lawmaking. Such a system could be used to identify poor performing laws (based on empirical evidence rather than conjecture). Those laws could then be targeted for modification or repeal; thus, leveraging the measurement system as a feedback control mechanism as portrayed in Figures 4 and 5. Through the continued use of the measurement system, those involved in lawmaking would gain understanding of how laws operate and how to consistently create high performing laws. Over time, as the number of poor performing laws is diminished and the overall quality of laws is improved, the body of laws can be optimized for the given constraints, including available budget. This would then lead to significant cost savings and, potentially, financially sustainability as shown previously in Figure 3.

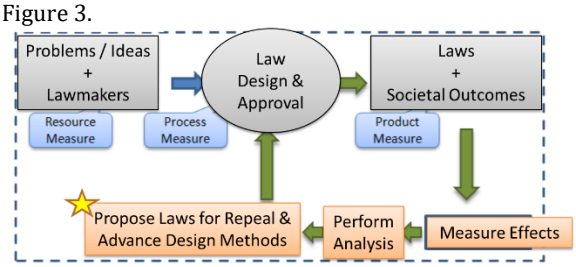

Figure 5. Lawmaking Measurement as a Feedback Control System (based on INCOSE *Systems Engineering Measurement Primer*[3])

In order to further validate and quantify the benefits of a measurement system for lawmaking, the author recommends identifying a lawmaking body interested in employing measurement and then following the general sequence laid out in Section 3 of the *Systems Engineering Measurement Primer* [3] (i.e., Establish commitment; Plan the system; Perform measurement, analysis, and decision support; and Evaluate the measurement system). The stakeholders involved in these activities should document and publish their findings as they execute each step so that other lawmaking bodies may be able to learn from those activities and be inspired to pursue similar efforts within their lawmaking system.

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John Wood, Ph.D. has spent his career pursuing a penchant for perfection in areas where less-than-perfect performance can be deadly. During more than two decades in military service, civilian sector innovation, and academia, he has applied his systems engineering expertise to advance high-profile programs in healthcare delivery, aviation prognostics, nuclear weapon infrastructure, and more.

Currently, Dr. Wood serves as a director at The Science of Laws Institute and the Editor-in-Chief of *The Science of Laws Journal*. Dr. Wood holds a Bachelor of Science in electrical engineering from the U.S. Naval Academy and a Ph.D. in systems engineering from the George Washington University.

PROCEEDING

Science of Laws for Humanity's Futures on Earth and in Space

Bob Krone*
Kepler Space Institute

ABSTRACT

Humanity's improvement and survival, both on Earth and in Space, will require the involvement of work in all the hard and soft sciences, the arts, and the spiritual disciplines in new ways unprecedented in humanity's history. It will need the will of Earth's national and international leadership. Failure to do so will result in too high a risk for human tragedy. This paper suggests ways that the Science of Laws Institute and the Kepler Space Institute could merge their strengths to contribute to a breakthrough vision for humanity's next epoch. It recommends that the Policy Sciences legacy of Professor Yehezkel Dror, and his *Singularity* concept for humanity's improvement and survival be fundamental to the research.

Keywords: Law of Space Abundance; Humanity's needs; Justice for humanity; Leadership; Governance and decision-virtues; Law and enforcement; Policy Sciences; The Yehezkel Dror Singularity Concept for Anthroporegenesis – the study for the emerging phase leap of the human species.

HUMANITY'S NEEDS

Humanity's needs have occupied philosophers, historians, scholars, and authors for millennia. A search of Amazon.com in July 2018 for "humanity" found over 60,000 books, for "world futures" over 30,000 books, and for "humanity's needs" over 1,000 books. During the 20th century, many organizations researching global resources and humanity's needs began ongoing research—like the Lifeboat Foundation, dedicated to the prevention of global catastrophe risk, the World Future Society, Jerome Glenn's Millennium Project, and the Stockholm International Peace Research Institute. The hope for harmony and peace throughout humanity has always existed in most religions, and there are United Nations organizations dedicated to their pursuit. But humanity's perceived needs, and diverse values systems, have also been the cause of much hate, intolerance, violence, greed, wars, and genocide throughout history. There is now increasing investigation into the dilemma of science and technology both serving and impacting humanity's good, while at the same time there are moral failures and the incapacity to control the risks to humanity from some of the advances in science and technology. [1]

Yehezkel Dror has advanced his focus for improved policymaking from national to international, then to humanity—primarily in the 21st Century—for reasons he describes and defends after detailed research and diagnosis within the following publications:

- *For Rulers*
- *Avant-Garde Politician: Leaders for a New Epoch*
- *The Capacity to Govern: A Report to the Club of Rome*
- *Journal of Space Philosophy*, Special Issue, Vol. 7, No. 2, devoted exclusively to Dror's unique legacy and his Singularity concept

DREAMS AND NIGHTMARES

The following section, written by Yehezkel Dror, on "Dreams and Nightmares," summarizes his conclusions in 2018 for readers, and it is republished from the *Journal of Space Philosophy*, Vol. 7, No. 2, (Summer 2018)

The Dream and Its Nightmares

The dream of science and technology is obvious and largely realistic. Science and technology are at present the main "driver" of the future of humanity, largely for the better. Hunger is being eliminated, life expectancy is prolonged, human drudgery is reduced, lifelong learning for all is becoming a reality, distance is becoming less of a factor dividing humanity. True, disparities continue and in some respects become worse, but the average quality of life and level of development of humanity is rising, and the worst off are also doing better than before. Given time, so the optimistic narrative goes on, science and technology will radically upgrade the situation of humanity as a whole, and it will also provide unprecedented opportunities to improve the very nature of humanity thanks to biotechnologies, while giving humanity the stars.

All this is potentially true and justified in utilitarian terms. Values of freedom and the moral significance of gaining a better understanding of the universe and of humanity itself provide further, and in some sense deeper,

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grounding to the conclusion that the scientific and technological endeavor should be free to unfold.

However, the nightmare side of scientific and technological progress must be recognized. Some of the apprehensions, such as on humanity displacing itself by its artifacts, seem groundless [2]. Others, such as on cloning and genetic rewiring of the human brain, may be no more than understandable but unjustified fears of the inconceivable – which may very well be most desirable. However, the possible and likely uses of knowledge and instruments supplied by science and technology for mass killing and perhaps enforced collective suicide require very grave attention and determined action.

In short, the clear and obvious danger – though one strangely neglected till the September 11 trauma – is one of devilish uses of the knowledge and instruments supplied by science and technology for mass killing, genocide, and doomsday initiation by actors beyond control by presently available norms, structures and tools.

Radical Novelty

Mass killings and genocide happened in the past, without the benefit of the most recent advances in science and technology. But, since the Second World War something radically novel has happened: humanity has got from science and technology as a gift the power of self-destruction [3]. And, in the foreseeable future, this gift will be put at the disposal of underdeveloped states and also nonstate actors, including small groups and perhaps also individuals.

The facts are too clear to require elaboration. Leaving aside the ambiguous findings on greenhouse effects, the potentials in nuclear engineering and biotechnology to make instruments of mass killing and doomsday available to an increasing range of actors are obvious, up to the specter of an individual "mad" scientist producing in his home laboratory a virus likely to wipe out most of humanity. This power of humanity to destroy itself is radically new, and it requires no less radical innovative countermeasures.

Self-Containment Will Not Work

As against this pessimistic view, there are opinions claiming that self-containment makes radical countermeasures superfluous. The relatively strongest version of this view asserts that science and technology will eliminate the causes of evil by eradicating deprivation, help with solving conflicts by transforming them into win-win situations, and making all of humanity much too satiated to engage in self-destruction.

Regretfully, such hopeful views of the "end of history" have no basis whatsoever in human history or in what we know on the human mind. To limit myself here to the most fundamental of all counterarguments, "true believers" are an inherent, though small, part of humanity that is essential for human advancement [4]. But some of them are sure to be committed to "evil values," which entitle and indeed obligate them to kill others, up to the possibility of believing that collective enforced suicide is the way to salvation.

No material or educational advancement of humanity will eliminate this phenomenon, which has accompanied human history from its beginnings. But the difference is that now and even more so in the foreseeable future, such highly committed and in their view extremely moral individuals and groups are equipped with gifts of science and technology, enabling them to realize their destructive values on increasingly larger scales, up to humanity as a whole.

The crucial problem is not "rogue states" threatening to use mass-killing instruments for limited purposes, which are relatively easy to deter. Rather, it is "true believer" rulers, groups, and individuals committed to mass killing and increasingly able to realize their norms effectively that pose the really fateful problem. The paradigmatic model is one of a suicide killer well equipped with mass killing devices who believes with his whole heart and soul that his way to heaven, and often that of the sacrificed masses too, is by killing and being killed – the more the better morally [5].

Growing Incapacity-to-Govern Deficit [6]

Put into a larger context, the problem is one of a growing incapacity-to-govern deficit. This deficit is less the result of the actual decrease in capacities to govern, as caused inter alia by the effects of mass media on politics, but it stems in the main from the increase in the minimum required qualities to govern essential for coping with crucial issues. The challenges posed to national and global governance by globalization illustrate this point. However, the main challenge to capacities to govern is posed by the potential and likely misuses of the products of science and technology for the worse, up to the absolutely evil.

Science and technology must be free to evolve, as a value in itself and as an essential condition for their flourishing and bringing benefits to humanity. But science and technology and their uses must be controlled to prevent the emergence of fatal knowledge that cannot be supervised, preclude access to potentially dangerous knowledge by persons and groups likely to use it for the worse, and inhibit and destroy those gearing to misuse the fruits of science and technology for mass killings. These contradictory requirements overtax by far present capacities to govern – thus posing a life-or-death requirement for redesigning governance.

Towards a Global Leviathan

Exploration of the required restructuring of governance, including moral and cognitive core capacities, structure, and staffing, will lead to formation processes and subjection to societal control – this should be a main concern for informed discourse, sorely lacking at present. Most of the books on governance miss the main issue, concentrating on deepening democracy instead of the needed phase jump in capacities to govern.

In contrast, real needs, as I see them, are put starkly by my proposal to move towards a "Platonic Global Leviathan" as essential for coping with the fateful problem of armed evil prophets [7].

In short, thanks to the gifts of science and technology we are moving into an epoch in which assurance of life and safety against mass-killing fanatics requires a strong global regime that takes stern measures against the diffusion of dangerous knowledge and instruments and capacitates and destroys potentially true believer mass killers well before they can act [8]. By-bye to national sovereignty, the fiction of the equality of states, global decision making by a majority of states, "power to the people" at global assemblies, etc. Instead, in matters concerning the advancement of science and technology and the diffusion and use of its results, authoritative global decisions and their enforcement by an oligopoly of main powers is becoming increasingly a must. It may take another major mass killing or two for the necessary steps to be taken. But the progress of science and technology together with the permanence of true believers, some of whom are sure to be "evil," will make a mutation in human governance towards a Global Leviathan inevitable.

It depends on us, humans, who will be first.

THE YEHEZKEL DROR SINGULARITY CONCEPT AND SOCIAL TRANSFORMATION

Throughout history on Earth, war and violent revolution have been among the main drivers of social transformations. This was the case through the 20th century, and it is likely to continue in the 21st century and beyond. But Dror is not recommending war to improve coping with the Singularity; rather, he poses the need for a global decision and enforcement regime designed to prevent dangerous missuses of Singularity knowledge and tools, whether on purpose or accidentally. He prescribes a Platonic Global Leviathan. This will involve a sociopolitical paradigm shift. It will require the kind of avant-garde political leadership and rulers that he designs in his book publications, as essential for humanity's improvement and survival.

But this involves difficult long-term efforts. In the meantime, space exploration and the beginning of space settlement can provide safeguards for the survival of humanity in case of devastating catastrophes on Earth, and with time, they may stimulate essential changes in human values and institutions, in part thanks to innovate social structures in human societies beyond Earth.

YEHEZKEL DROR'S LEGACY: IMPROVING HUMANITY'S PROSPECTS

The following sections are abstracted from the *Journal of Space Philosophy*, Vol. 7, No. 2, Summer 2018, "Yehezkel Dror's Legacy: Improving Humanity's Prospects"

1. While I endorse and use in this chapter the term "Singularity," personally, I prefer a more professional term that better expresses the contents of the emerging human phase leap, namely *Anthroporegenesis*. This is all the more necessary because the term Singularity and its associates, such as *Transhumanity* and *Posthumanity*, are increasingly becoming a flag of convenience for baseless speculations. But there is also a growing body of serious work using these terms, so I adopt them subject to this warning.

2. Though rudimentary, lacking elaboration, and without academic references, this draft presents the main features, issues, problems, options, and choices related to the Singularity hypothesis, as conceptualized by me. It can also be regarded as an outline exploration of a radically novel and, indeed, revolutionary paradigm presenting the new epoch into which the human species is cascading, however unprepared.

"Thinking as usual" while undergoing a metamorphosis is a widely used speedway leading humankind to avoidable catastrophes.

3. **Not a Technological Singularity**. As best presented by Ray Kurzweil in his books, the term Singularity in the present context (as distinct from mathematics and astrophysics) refers to the scientific and technological quantum leap that pushes the human species into a radically novel mode of being. But what is usually meant, and sometime explicated, is a technological Singularity. The following partly overlapping emerging technologies constitute the main relatively realistic dimensions of the (technological) Singularity (leaving for the long-term future esoteric possibilities such as downloading human minds into computers and thus making them nearly eternal):

A. Artificial general intelligence leading to intelligent and super-intelligent robots and perhaps spiritual machines, increasing or surpassing the mental abilities of human beings, however enhanced. Included are the possibility of human-machine combinations, and also an escalating chain of intelligent robots designing and producing super-intelligent ones, which in turn design and produce super-super- intelligent robots, and so on into an inconceivable future with radical implications for human beings, such as cohabitation, being marginally tolerated, and elimination.

B. Nanotechnologies, enabling production of nanomachines, including nanorobots that can act within human bodies, prolonging life and enhancing various abilities, or acting as invincible mass killing machines; and surpassing the ambitions of alchemists by transmuting materials and thus eliminating scarcities and rehabilitating the environment, but also creating havoc, such as by reducing the value of gold to that of lead that is cheaply transformable into pure gold.

C. Genetic engineering enhancing human bodies and minds, prolonging life expectancy, enabling human cloning, making it easy to transmute and synthesize viruses, and much more.

D. Human-machine interfaces and combinations multiplying human abilities while compensating for

bodily and mental deficiencies, up to transforming humans into cyborgs.

E. Cheap and non-polluting energy that can be easily stored, changing totally all energy- based technologies and tools.

F. Accelerated and large-scale space exploration, thanks to enhanced human bodies, intelligent robots, and new space traveling technologies (leaving aside long-term possibilities to reach exoplanets and perhaps to expand humanity beyond the Solar System).

There are different opinions on the likely timeline of progress in developing the various Singularity technologies, ranging between a couple of decades and one or two centuries. I personally think that the more critical and radical Singularity innovations require scientific knowledge and technologies far beyond our present reach. Thus, to achieve superintelligence, its currently unknown nature has first to be clarified.

Therefore, I recommend a good measure of skepticism on predictions that most of the Singularity is around the corner.

My assessment is that it will take at least one or two centuries before salient Singularity technologies become mature, even if not slowed down by civilizational catastrophes or on purpose. And full-scale superintelligence may take even longer, if at all achievable.

Nevertheless, it is very likely that by the end of the 21st century some of the technologies will be mature enough to significantly impact on humanity, providing many blessings accompanied by explosive disruptions and harsh moral and political quandaries.

Thus, within this century, artificial generally intelligent (but not superintelligent) robots are likely to reduce radically labor done by humans, creating mass unemployment. Human enhancement is likely to result in harsh biological inequality between the few who can pay for expensive enhancements, such as significant increases in life expectancy, and the many who will not be able to benefit from such technologies before they become affordable by all – which at best will take a long time. And berserk fanatics are likely to produce mass killing viruses and to use them for extortion and genocide.

The contrasting uses of emerging Singularity technologies for better and worse, as differently defined by the beliefs of diverse parts of humanity, will pose harsh choices requiring unprecedented measures. While most existential risks associated with the Singularity are widely recognized, and countermeasures are analyzed at various academic and policy units, in my view, much more is needed to reduce serious risks to humanity. And achieving the benefit of the Singularity may not be much easier.

The Real Singularity

Technology is not an agency, being rather a set of tools based largely on science and hands-on creativity. Technology produces the emerging Singularity, is its landmark, and instantiates it. But the real ontology of the Singularity is different:

The real Singularity is the growing ability of the human species to shape its future evolution as a species, the salient features of the evolution of the biosphere of earth, and its physical surface characteristics.

The human species has influenced its evolution and that of some animal and plant life since its beginnings. Hunting, fire, mating patterns, selective breeding, seed selection, medical knowledge, biopolitics, changing eating patterns – these and related behavior have increasingly impacted on the dynamics of human evolution and parts of its environment, all the more so after the industrial revolution, as recognized by the novel term for our epoch "Anthropocene." It includes nuclear fusion, the first steps into space, and human-caused global climate changes that constitute the dawn of the Singularity, the core of which is what I call Anthroporegenesis, in the sense of the human species acquiring the technologies that enable it to bring about a new genesis, transforming the human species and its living world radically.

To put the core ontology of the Singularity clearly:

Humanity as a composite agency is taking charge of critical features of its future evolution as a species, partly displacing natural evolution. It does so thanks to tools provided by leaping science and technology – but the decisions on using these tools are made by humankind.

The future of our species will continue to depend at least in part on natural events, such as objects from outer space hitting Earth and mega-volcanoes. But the human species is developing technologies it can use to change its biology and minds, to reshape Earth radically, perhaps to settle other planets, and also to terminate the existence of the human species with or without other humanity-generated forms of life taking over.

Let me recapitulate the critical reformulation of the nature of the emerging Singularity, which is not recognized in current uses of the term but is critical for handling the Singularity, to reduce negative effects and to increase positive ones:

The Singularity is not constituted by technological evolution partly displacing natural evolution, even if phenomenologically this is happening. It is the human species, which acquires the knowledge and tools increasingly enabling it to impact on its future evolution, using

Pondering Singularity scenarios and what to do about them requires a total shift in human perspective:

We have primarily to think, invent, and act in terms of evolutionary processes shaping the future of humanity and the increasing role of human choices in steering them. Therefore, while the welfare of humans now and in the near future continues to be very important, assuring a long-term future for the human species has top priority (unless future generations decide differently, such as letting a super-superior species take over).

Parts of humanity have faced many critical choices in the past, whether they recognized them as such or not. These have ranged from individual existential choices to collective ones on regimes, economic systems, moral norms, wars or peace, and so on. But few such choices shaped the deeper levels of our long-term history, and none impacted significantly on our nature and evolution as a biological species. All this is changing with the emerging Singularity.

For the first time in the history of life on Earth, a species has the capacity to shape deliberately its future evolution and, consequently, it has to make decisions, explicitly or by default, on the meta- Hamletian question "to be, what to be, or not to be." And, on a higher order level, humanity has to decide, explicitly or by default, who should make such decisions and shape significantly its evolutionary future, and how to implement such choices effectively.

Some of these issues receive attention, such as discourse on avoiding catastrophes. Also, somewhat elaborated are decision criteria. But most emerging decision forks, including critical ones, are ignored or badly considered – including the meta-issues of who should decide on interventions with human evolution and how to implement such decisions.

Historic processes are by their very nature dynamic, non-linear mixtures between necessity and chance. This is true, in various proportions, from the macro-level of cosmic processes to the nano- level of atomic and subatomic events; and also, with adjustments taking into account the important role of "choice," the life history of individuals. However, totally novel is the increasing importance of human choice in shaping the processes determining the future of the human species:

The future of the human species is increasingly shaped by human choice interacting with necessity and chance. Therefore, application of existential philosophy to humanity as an agency and developing the nature of humankind as a collective deliberative agency are at the core of upgrading human impacts on the future of humanity as a species.

This sounds great, but it may be catastrophic unless human future-impacting choices are of optimal quality. However even optimal choices have results that depend in part on necessity and chance beyond human control. This is all the more so the case in the face of prevailing deep uncertainty. Therefore:

Even optimal human future-shaping choices are inherently and unavoidably "fuzzy gambles, often for high and also fateful stakes"—because the future is in deep uncertainty, reaching wild uncertainty and also inconceivability. This is increasingly the case as we move into the Singularity with its unprecedented phase leaps into the largely unknowable.

If this is the nature also of optimal choices, then all the more so suboptimal choices carry multiplying risks. Taking into account the usually low quality of human choice on complex quandaries, it is far from assured that the increasing power of humanity to shape its future will work for the better. It is no less likely (to put it relatively optimistically) to result in catastrophes and even collective unintended species suicide.

Please do not be misled by the fact that humanity is today overall better off by material criteria than ever before. This is true, largely thanks to evolving science and technology, which till recently was in the main very beneficial for humanity without catastrophic risks for the future of the species. Also beneficial have been some governmental policies and social self-regulating processes such as relatively autonomous global markets and mild regimes, such as democracy. But if we take a close look at the actual choices of governments on global issues rather than pious declarations, such as on climate change, then the nakedness of the princes in charge of increasingly critical and perhaps fatal choices is fully revealed.

A tentative, frightening conclusion is unavoidable:

Choices significantly impacting on the future of humankind suffer from a growing and increasingly dangerous hiatus between the growing magnitude of impacts and the low quality of fuzzy gambling choices by main global decision-makers. This quality deficit is sure to produce global catastrophes. Therefore, radical improvement of critical choices is imperative, together with awareness of unavoidable risks stemming from more powerful technologies, however beneficial they may be if well used.

The assessment above is at the core of this chapter. Therefore, it is explored further in the following sections. Fuller though still partial treatment is provided in other writings by the author [9].

Decision Criteria

Given the insights suggested above, it is necessary to consider decision criteria fitting important choices posed by advancing towards the Singularity. Widely accepted, at least verbally, is the precautionary principle, formulated with variations more or less as follows:

The precautionary principle: If the consequences of an action are unknown but judged by some scientists to have even a small risk of being profoundly negative, it is better to not carry out the action than to risk negative consequences.

This decision criterion follows the minimax game theoretical rule, aiming at minimizing the possible loss for a worst case. Thus, it does not balance potential risks and benefits. Also, it is very vague on the number and quality of pessimistic scientists who have a veto on novel technologies. Little wonder that the precautionary principle is usually not acted upon; and the few cases when it was applied, such as the exclusion of mutated seeds by the European Union, are in error, even if they are supported by true Green believers.

However, this criterion does not really take into account deep uncertainty on the short- and long- term possible and likely consequences, for better or worse according to disputable values. Even less so does it consider such choices as fuzzy gambles on critical and sometimes fateful stakes. And this criterion and similar ones completely ignore actual choice criteria of high-level decision- makers, such as public support or opposition, political and material profits and losses, short- termism and so on – all further aggravated by multiple biases, including depth psychological ones in addition to simpler ones explored by experimental psychology.

Also usually ignored are cultural impacts; value diversity sensitivity maps, decision delay options combined with structured learning, the legitimate role of pattern-recognizing intuition, and more. Even more amazing is lack of giving due weight to the historic fact than nearly all technologies are not only error-prone, but they are also earlier or later used for the worse, such as tribal slaughters and damaging greed.

In short, decision frames fitting real-life high-stake fuzzy gambles within their internal and external contexts are sorely underdeveloped. And second- and third-best criteria, which are available as illustrated above and are much better than nothing, are hardly applied as required – because of short-sighted vested interests and policy inertia. This is clearly demonstrated in the relatively clear-cut case of global climate change.

Ethics theory distinguishes between rule-based ethics, utilitarian ethics, and virtue ethics. In addition to upgraded decision criteria, I propose a similar approach to Singularity choices, including requiring from high-level decision-makers "fuzzy gambling decision virtues," such as deep uncertainty sophistication, global grand-strategic perspectives, and long-term pondering horizons – within future human evolution frames when Singularity issues are at stake. This leads to the crucial issue who should be the decision makers on major Singularity choices.

Global Future-Shaping Super-Elite

It is essential to recognize, however politically incorrect and in many respects disturbing, that unavoidably (until humanity perhaps becomes super-human) a miniscule part of humanity, however constrained, dominates nearly all important future-impacting decisions. To put it into guesstimated orders of magnitude, no more than, say, a maximum of ten thousand humans make or meaningfully influence 90 percent of significant future-impacting choices.

In other words, for every 750 thousand humans there is one significant global future shaper. Even if I am wrong by one order of magnitude and there are 100 thousand humans who belong to the global future-impacting super-elite, which is for sure a large exaggeration, still it is one person per 75 thousand humans.

But in fact, the number of major impactors on the future in relation to the Singularity (and other critical choices) is surely much less than ten thousand, leaving us with a striking though not really surprising conclusion:

Improving the decision virtues of, say, one thousand carefully selected persons can significantly upgrade critical Singularity choices. And doing so is not absolutely impossible.

Not less important are social institutions and processes, such as the free market and social media. However, despite being cybernetic and self-regulative, they can be redirected by the global future- impacting super-elite, even though they in turn are partly shaped by the social institutions and processes, and changing them may require radical or even revolutionary measures. Therefore, for our purposes, it is correct to focus mainly on the global future-shaping super-elite.

Let me refine the somewhat rough analysis. The global decision-making super-elite is composed of transformative thinkers, the senior staff of international organizations, powerful economic actors, innovative scientists and technologies, a few civic leaders, some military commanders, select mass media moguls, and single outstanding and senior politicians. But not all parts of this super-elite are of equal importance for coping with Singularity issues. Adopting the distinction by David Priestland between societies dominated by merchants, soldiers, and sages, with the addition of politicians, decisions related to the Singularity are in most societies dominated by merchants (in a broad sense of that term) [10]. In a few societies, military R&D elites dominate Singularity-relevant choices, but they too are subject to economic considerations. Scientists and technologists, who can be viewed as knowledge sages, are critical in laying the foundations of the Singularity. But, alas, they depend for resources on merchants or soldiers.

Nominally, politicians are in overall charge, having ultimate formal decision authority over all Singularity-related choices, subject to more or less constitutional limitations. They are also the only part of the global future-impacting super-elite which is value-wise legitimized to make authoritative future-shaping choices. Therefore:

The decision vices and virtues of political leaders are of potentially dominant importance in shaping the future of the species.

In fact, many politicians abandon this task, despite its outstanding importance (or because of it) to other decision-makers as long as no storms erupt. This bodes ill for the future unless rectified, because many other parts of the global future-impacting super-elite and most of the more powerful social processes do not fit the requirements of optimal future-shaping choices. Thus, market processes and merchants are driven by the profit motive, which often degenerates into greed; public opinions suffer from an abundance of tribalism compounded by ignorance on the Singularity; soldiers serve mainly tribal images and interests; scientists-technologists are seeking knowledge and status, and they are dominated by merchants and soldiers who control the needed resources. Worst of all, the vast majority of politicians are infected by power considerations, ignorant about science and technology, short-sighted, and subject to social demands and values that do not serve the future, but which most politicians are unwilling to confront or do not know how to overcome or redirect.

The diagnosis above is somewhat one-sided. There are individual exceptions, such as globally minded political leaders, socially responsible merchants, and some scientist-statesman/women. But they are constrained by widespread tribalism and profit seeking, as well as ignorant and capricious publics misdirected by the amusement industry, even in highly developed societies. The dreams of the Enlightenment are further away from reality than ever, despite mass education.

Typical in some important respects is the belated awakening of President Barack Obama, potentially a nearly optimal Singularity decision-maker, to the world as it is. As clearly put in the memoir of one of his senior advisors:

> Ambitious legislative activity was out of the question. Abroad, the forces of tribalism and nationalism were building, like tremors before an earthquake…. After years of … growing tribalism at home and abroad, he had priced in the shortcomings of the world as it is, picking the issues and moments when he could press for the world that ought to be [11].

On a deeper level, the real question is who is entitled to make future evolution-shaping choices on behalf of humankind as a collective

I cannot overestimate the broad and deep significance of this conclusion, on the level of both political philosophy and political institutions and practice. It makes havoc of assuming that a democratically elected global parliament has the right to take decisions shaping the future of human evolution. Such legitimacy can only stem from merit: having the qualities required for optimally steering the future evolution of humanity as increasingly (though surely not completely) possible. Therefore:

The theory and practice of democracy and other political regimes have to be reformulated so as to move towards merit regimes, in particular but not only so in respect to significant future human evolution-shaping choices.

However, I will not further develop this radical conclusion in this paper, moving instead to the required merit taking the form of fitting decision virtues, as especially required from political leaders steering the future evolution of the human species in the context of the Singularity

Required Decision-Virtues

The compelling conclusion is demanding:

Senior global future-impactors, and in particular political leaders, require personal decision virtues and supportive environments very different from the prevailing ones.

As noted, at this stage it is necessary to specify the qualities needed by future-shaping political leaders (and, with adjustments, by other members of the future-shaping super-elite), to enable them to approximate optimal fuzzy gambles on Singularity issues. But in view of the limits of this chapter and the two books I have written on that subject, I limit myself here to a list of twelve representative qualities, in no particular order [12]:

(1) commitment to the long-term future of the human species as a priority task, together with efforts to facilitate the thriving of contemporary humans; (2) pondering in terms of the evolutionary processes shaping the human future, as transformed by the Singularity; (3) globalism overriding tribalism, combined with political skills, making doing so feasible; (4) good science and technology literacy, with emphasis on Singularity-related domains; (5) multicultural insights; (6) intense innovation-friendliness; (7) a strong "inner citadel," combined with the Kantian rule *saper aude* (dare to rely on your own potential abilities); (8) uncertainty-sophistication; (9) pronounced reasoning abilities combined with open-ended intuition on Singularity-related issues;

(10) seeking advice from Singularity and human evolution professionals, including especially Singularity policy scientists, subject to careful screening; (11) crisis coping skills, with emphasis on utilizing them to implement Singularity-coping ideas that cannot be realized without conservatism-disrupting and mentality-shocking events; (12) Constant learning and critical self- reflectivity related to major Singularity challenges.

No human being, even with soft enhancement, can be outstanding in all these decision virtues. And, in the foreseeable future reliance on super-intelligent robots to take care of humanity will not become practical; and if and when it becomes available, it will usurp human authority and nullify human moral responsibility for existential choices, while also endangering the future of humanity. But there are enough examples of political leaders, however scarce, who have clearly demonstrated the potential to become adequately qualified to make good future-shaping decisions, without being outstanding in all respects and always arriving at optimal choices.

Furthermore, a well-designed global leadership seminary can help carefully selected participants to develop adequate decision virtues. This brings us to the institutional requirements of composing and implementing

well-crafted future-impacting choices, which are far beyond the capacities of contemporary global regimes – but not in the realm of the impossible, given the likelihood of crises breaking the tyranny of the status quo.

Enforcement Regimes

Preventing dangerous misuses of Singularity knowledge and tools, whether on purpose or accidentally, is impossible without a radically novel global regime accompanied by painful value transformations, which will be strenuously resisted. Thus, an adequate enforcement regime must be global in scope, overriding state sovereignty, breaking through tribalism, and having forceful instruments to impose its authority when necessary.

Furthermore, it may have to impose personal duties in addition to human rights, regulate and sometimes limit research freedom and technology marketing, engage selectively in intrusive intelligence collection, and be entitled to impose, after due process, harsh punishments. Some property rights, ownership of mass killing weapons, and promotion of hate ideologies will also have to be inhibited. And conflicts that may escalate to catastrophic levels will have to be resolved, with imposed measures and dictated "agreements" as may be necessary.

Taking care of human welfare and fairness will remain the task of national governments and the United Nations with its agencies, subject to quite some reforms. But containing dangers posed by the Singularity on lines illustrated above requires some kind of "Platonic Global Leviathan," subject to controls and maximum reliance on the subsidiarity principle – but with a preponderance of global enforcement tools.

The concept of global leviathan is clear enough for the limited purposes of this chapter for all who are familiar with relevant writings by Thomas Hobbes, though the proposed authority will be less autocratic and more circumscribed than the absolute ruler proposed by Hobbes. But the term "Platonic" needs some explanation.

Taking into account that the quality of an organization depends primarily on the quality of its senior leaders and staff, it is essential that outstanding politicians supported by excellent professionals constitute its human dimension. This returns me to Plato's *Republic*, which proposed rule by philosophers. Leaving aside the lifestyles dictated by Plato to the rulers, which are both impossible to realize and not fully necessary, the concept of philosopher that was probably in the mind of Plato (though never explicated in his surviving writings) was one of constant seekers of truth in a comprehensive meaning of that term. If we add the ideas of Michel Foucault on truth and power, we have a good basis for conceptualizing the requirements of the heads of the Platonic Global Leviathan, which add to and go beyond and above the qualities required for being a decision-virtuous future impactor, as already discussed. Thus, deep understanding of human evolution, a fusion between idealism and realism, total exclusion of personal considerations in making important fuzzy-gambling decisions, complete disconnection from tribal identity, psychoanalytic measures to reduce mind-distorting depth processes, proven outstanding pattern- recognizing intuition, and some features of a warrior combined with compassion – these illustrate the extra qualities required for heading and running the proposed global authority.

Complementarity of the leaders of the Platonic Global Leviathan can help to achieve emergent synergetic qualities meeting more or less such demanding requirements, which surpass individual potentials. Carefully dosed mind enhancement may also be of much help.

To illustrate the counter-conventional features of the senior global authority leadership further, it may well be advisable to fill many positions by coadoption, so as to strengthen independence. But it is too early to go into such details, which need consideration by outstanding teams rather than by me thinking alone.

I think enough has been said to provide readers with a sense of what is absolutely needed, but also completely impossible given the world as it is. There is only one way out of this aporia if we want to be realistic as required:

The only way to establish an adequate global authority approximating the features of a Platonic Global Leviathan, which are essential for containing the risks of the Singularity, is to have good designs ready and to prepare needed knowledge and appropriate political leadership and professionals to utilize global major crises for realizing in stages what is essential but impossible without painful creative destruction.

What Is to be Done Now

Main suggestions for action now, to utilize coming crises for the better and perhaps also to reduce their costs, include for instance, with overlaps:

- Setting up a global think tank network, based on existing centers studying catastrophic dangers as well as select individuals, to work part time and full time in multidisciplinary teams on major Singularity decision issues and composing humanity-craft (a term I derive from statecraft applied to the human species) options.
- Establishing, as mentioned, a global public leadership seminary, dedicated to developing political leaders and professionals with the necessary decision virtues.
- Activating a global scientific council headed by select Nobel laurates and limited to, say, 150 scientists, philosophers, free-floating intellectuals etc., to serve as a kind of scientific senate, and when necessary, science court, as several times proposed, discussing major Singularity dangers, elaborating and applying codes of ethics for Singularity scientists and technologies, and more.
- Building an intranet for open and closed discussion of main Singularity choices by carefully screened participants reflecting different backgrounds, with canvassing of ideas from interested publics at large.
- Bringing together a small group of highly qualified persons, including also former senior political leaders,

to work out alternative designs of the needed global authority or adequate alternatives.
- Strengthening informal colleges of concerned social activists and a variety of leaders together with scientists, philosophers, technologists, etc. – to mobilize broad public support for needed measures including an adequate global regime.

There is quite some activity in such directions, but much more is needed and can and should be done urgently, beyond my limited creativity and the constrained scope of this paper. But one dimension of urgent action which is in multiple ways an important facet of preparing for the Singularity and, even more so, an integral central part of the Singularity, is large-scale and long-distance space exploration.

(Note: This ends the Yehezkel Dror abstract from the *Journal of Space Philosophy*, Vol. 7, No. 2, Summer 2018, "Yehezkel Dror's Legacy: Improving Humanity's Prospects")

WHY DOES THE FUTURE SPACE EPOCH OFFER NEW THINKING ?

Space exploration, and ultimately settlement, can contribute a lot to the emerging Singularity Epoch. A valuable contribution to understanding the fundamental differences between Earth and Space are the writings of Frank White on *The Overview Effect*. His Overview Institute has 3,000 followers. His insights came from his personal interviews with astronauts, and he describes a cognitive shift in awareness from their experiences from Earth orbit or the lunar surface. In the perspective from Space, national boundaries vanish, the conflicts that divide people become less important, and the need to create a planetary society with the united will to protect this "pale blue dot" becomes obvious.

All the resources humans will ever need are waiting in Space. The Law of Space Abundance, which states that space has abundant resources to meet human needs, has been proven valid [13]. Scarce resources have caused conflicts and catastrophes throughout history. Space will not be the only source of solutions for Earth's problems, but it will open new doors to resolving those problems.

There is a huge spectrum of subjects to be investigated, documented, discovered, and researched– then applied – if humankind is to overcome the problems, mistakes, and pathologies of its history on Earth, and to steer its future evolution beneficially. Science, technology, and education continue to give us some of the necessary tools and hope for the future. Our Earth cradle has brought us nearer to maturity, but we are far from there. But science and technology have also given humanity the tools for its own extermination. All the more so, innovative values and understanding, augmented tools, redesigned institutions and positive political as well as spiritual-moral leadership are urgently needed.

Yehezkel Dror's unique scholarly-praxis career provides us with (1) realistic historic analysis, (2) evidence of the increasing risks to humanity in the 20th and 21st centuries, (3) the Policy Sciences to improve the capacity to steer the future, (4) his Singularity Contour for humanity, and (5) A Mirror for Rulers to guide the urgently needed novel genre of political leaders.

"This dream can become a future reality if the critical mass of moral leadership and effective governance can be created. Without this unprecedented leadership and international collaboration ... the movement of humanity into Space will remain a dream or, even worse, it may take the form of nightmares becoming dismal realities for Earth's people."
--Yehezkel Dror

CONCLUSIONS

Thinking and acting on human Space settlements requires a much longer timescale than current discourse. This will require quite a shift in the short-term thinking dominating much of politics and business.

Throughout history, war and violent revolution have been among the main drivers of social transformations. This was the case through the 20th century, and it is likely to continue in the 21st century and beyond. But Dror is not recommending war to improve coping with the Singularity; rather, he poses the need for a global decision and enforcement regime designed to prevent dangerous missuses of Singularity knowledge and tools, whether on purpose or accidentally. He prescribes a "Platonic Global Leviathan." This will involve a sociopolitical paradigm shift. It will require the kind of avant-garde political leadership and rulers that he designs in his latest two books, shown above, as essential for humanity's improvement and survival. But this involves difficult long-term efforts. In the meantime, Space exploration and the beginning of Space settlement can provide safeguards for the survival of humanity in case of devastating catastrophes on Earth, and with time, they may stimulate essential changes in human values and institutions, in part thanks to innovate social structures in human societies beyond Earth.

Ongoing global transformations need guidance to avoid very negative looming consequences and to realize very positive potentials. Markets, civil society, etc., however important, cannot be relied upon to provide the needed guidance; normatively and realistically, only governance can do so. However, to fulfill crucial future-building tasks adequately, politics must be revitalized, democracy must be refocused, and governance must be radically redesigned.

My personal feelings are that Yehezkel Dror's wisdom is a blessing for global rulers and for humanity.

PLANNING FOR SCIENCE OF LAWS INSTITUTE AND KEPLER SPACE INSTITUTE CONTRIBUTIONS

Reaching the decision for the Science of Laws Institute and the Kepler Space Institute to collaborate on this huge challenge may take time for our two Boards of Directors.

Only a few scholars, and no governments, have made serious research attempts to address the complexities, the unknowns, the barriers and the political infeasibilities of such an unprecedented task.

However, there seems no more noble vision than the improvement and survival of humanity. Time is not on humankind's side. Leaving the future to machines is not a preferable strategy.

END NOTES AND REFERENCES

[1] The most recent best seller is Yuval Noah Harari, *Homo Deus: A Brief History of Tomorrow*, (New York: Harper Perennial, 2017), 449. It is a brilliant historical work. But, as the book title indicates, humanity's destiny may be that machines replace humans as they exist today, and humans convert to technological gods. The Yehezkel Dror Singularity concept included in this paper is broader, and it results from his being the cofounder and leading scholar of the Policy Sciences.

[2] As postulated in B. Joy, "Why the Future Doesn't Need Us," Wired, April 2000, 238-62.

[3] In the sense of Carl R. Hausman, *A Discourse on Novelty and Creation*, 2nd ed. (Albany: State University of New York Press, 1984). The growing literature on the Singularity and proliferating publications on catastrophic risks follow up on Joy's pioneering essay.

[4] As discussed in Eric Hoffer, *The True Believer* (New York: Harper & Row, 1951).

[5] For a theory of such behavior, developed during my two years with the RAND Corporation, see my book *Crazy States: A Counterconventional Strategic Problem*, updated ed. (Millwood, NY: Kraus Reprints, 1980).

[6] This subject is extensively discussed in my recent book *The Capacity to Govern: A Report to the Club of Rome* (London: Frank Cass, 2001).

[7] As first put forth in my book *The Capacity to Govern*, passim.

[8] My debt to Thomas Hobbes's *Leviathan*, published in April 1651, is obvious. A recent edition is by Richard Tuck (Cambridge: Cambridge University Press, 1991).

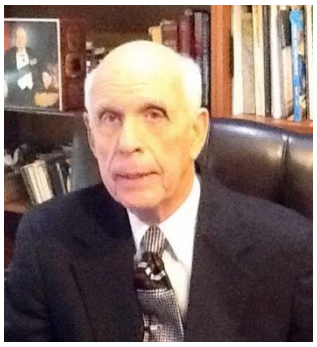
[9] See my short book *For Rulers: Priming Political Leaders for Saving Humanity from Itself* (Washington, DC: Westphalia Press, 2017).

[10] David Priestland, *Merchant, Soldier, Sage: A New History of Power* (London: Penguin, 2012).

[11] Ben Rhodes, *The World as It Is: A Memoir of the Obama White House* (New York: Random House, 2017), Kindle Edition, 142-43 and 298.

[12] *For Rulers*, as mentioned; and Avant-Garde Politician.

[13] The Leadership of the Kepler Space Institute formulated the Law of Space Abundance in 2009. It is not a legislated law. It reflects the extensive research on Space resources to date. Current and new findings will continue to validate it over time.



Dr. Bob Krone is a global educator, author, and consultant in Advanced Management theory and practice. He is President of the Kepler Space Institute (www.keplerspaceinstitute.com); An Emeritus Professor of the University of Southern California (USC) in Los Angeles, U.S.A. (1975-1993);was a Distinguished Visiting Professor in the School of Business at La Sierra University in Riverside, California, U.S.A.(1992-2007); and an Adjunct Professor for Doctoral Programs in the International Graduate School of Business at the University of South Australia (1995-present). He authored or co-authored twelve books and 90 professional journal articles. He was the Founder and been the Editor-in-Chief of the Journal of Space Philosophy since 2012.

Bob graduated from the Naval War College Command and Staff College in 1962. He is a Fellow Member of the American Society for Quality (www.ASQ711.org) with an academic specialty in the Quality Sciences; Board Member of the National Board of the Distinguished Flying Cross Society (www.dfcsociety.org); Past Member Board of Directors of the Veterans Museum and Memorial Center, San Diego, California (www.veteranmuseum.org) and Emeritus Member Board of Directors of Idyllwild Arts (www.idyllwildarts.org).

Bob stayed in touch with Aerospace after his 1952-1975 career retirement from the United States Air Force, where he flew fighter jets and was decorated with the Silver Star, four Distinguished Flying Crosses, Bronze Star and eleven Air Medals for combat flying in Vietnam, by being a member of the NASA sponsored Aerospace Technology Working Group (ATWG), the Space Development Committee and Kepler Space University. His important space publication was editing *BEYOND EARTH: THE FUTURE OF HUMANS IN SPACE* (Apogee Space Press, 2006). That book was on the Universe Today list of "Best Space Books in 2006" and was influential as a foundation document for the founding of the Kepler Space University.

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  - Members

If you are able to volunteer, please provide your contact information and a brief description of available services at: ***www.scienceoflaws.org/contact.aspx***.