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The Systems Engineering Approach to the Design of Laws

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Abstract

This paper discusses the application of the methodologies of systems engineering to the design of laws of government. The systems engineering approach will bring the knowledge and expertise of investigative science and engineering to bear upon the design, operation, follow up evaluation, and optimization of laws that effectively solve societal problems. Of significance, the creation and simulation of engineering models of laws will be a multidisciplinary effort that includes experts from all relevant fields such as software engineering, law, economics, political science, sociology, and statistics. The systems engineering approach to the creation of laws promises to advance the science of laws, establish quality standards for laws and lawmaking, transform lawmaking into a knowledge industry, and improve the ability of governments to satisfy their public benefit purpose.

Key words: Multidisciplinary Design; Laws; Quality Standards; Science of Laws

1.0 Introduction

The purpose of democratic governments, such as the federal and state governments of the United States, is to secure the rights and liberty of the people [1]. To achieve that purpose, legislative assemblies create and maintain bodies of laws as the means for resolving societal problems that degrade or threaten to degrade rights and liberty. The method that governments use to create laws is the traditional method of lawmaking (i.e., the "legislative process"). However, the traditional method is seriously flawed and is incapable of creating laws that effectively solve societal problems [2]. In response to problems that are not solved by existing laws, legislative assemblies enact more laws and add them to the existing bodies of laws. The result of this process is that the bodies of laws grow in size, cost, and complexity but societal problems remain unsolved, and governments are thus unable to satisfy their public benefit purpose.

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A review of the traditional method of lawmaking reveals that it operates without reliance on scientific knowledge or engineering design methodologies for the solution of problems [2]. The opportunity thus exists to improve the performance of laws through the expansion of science and engineering to encompass laws and lawmaking [2, 3, 4, 5]. This paper discusses the systems engineering approach to the design of laws.

1.1 Traditional lawmaking

For this discussion, the term "law" refers to legislative statutes that are created by the lawmaking assemblies (e.g., legislatures, parliaments) of government. However, the law-design concepts outlined in this paper apply equally well to all other written, enforceable directives of government (e.g., regulations). Also, this discussion only pertains to democratic governments, which are obligated to secure the rights and liberty of the people, and not to authoritarian governments, which have no such obligation [2]. The parameters that define the rights and liberty of the people are human rights, living standards, and quality of life standards [2 (Appendix A)]. To create laws that solve or mitigate the societal problems that degrade or threaten to degrade rights and liberty, legislative assemblies such as the legislature of the State of California and the United States Congress use the traditional method of lawmaking [6, 7, 8]. The traditional method begins when someone comes up with an idea for a law of government. That idea is transcribed into a written petition ("bill") which is then presented to a legislative assembly. After being evaluated by the legislature and, often, modified through debate and compromise, the final version of the bill is voted upon by the legislature. If the legislature approves the bill it is added to the government's body of enforceable laws. The next bill is presented to the legislature and the lawmaking process is then repeated. The traditional method is thus a feed-forward control system that begins with an idea for a law and ends with the enactment of a new law, Fig. 1.

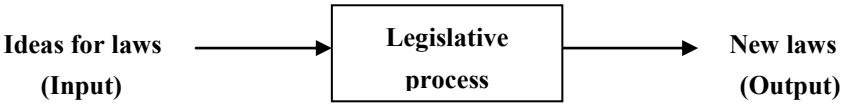

Figure 1. Traditional lawmaking. The traditional method of lawmaking is a feed forward control system that creates laws of government.

The traditional method is prolific in the creation of new laws. For example, the legislature of the state government of California enacted an average of more than 1300 new statutes annually from 1900 to 1999 [2]. However, serious societal problems such as illiteracy, health care issues, poverty, and growing government debt have remained unresolved despite the ongoing production of large numbers of new laws. To determine the reason for the lack of problem-solving success of laws, an investigation of the traditional method of lawmaking was performed [2]. This investigation disclosed that the traditional method has the following serious flaws and omissions:

- It does not require societal problems to be defined [6,7]
- It does not assign priorities to problems for solution [6, 7]
- It does not set goals for laws in terms of measurable outcomes [6, 7, 8, 9]
- It does not require law designers to have design expertise [10, 11]
- It does not require modeling or computer simulation of law designs [6, 7]
- It does not require a full accounting of the costs of laws [10, 11]
- It does not require a full accounting of the risks and side effects of laws [10, 11, 12]
- It tolerates design defects and "intentional vagueness" in laws [10, 11, 12]
- It tolerates the inclusion of "pork barrel" and special interest provisions in laws [10, 11, 12]

- It is based upon opinions (ideology) rather than reliable knowledge [10, 11, 12]
- It does not require the citation of references [6, 7, 10, 11, 12]
- It does not require the evaluation of outcomes [6, 7, 10, 11, 12]

These flaws and omissions of the traditional method render it to be incapable of solving complex societal problems, and the laws it creates are frequently defective, vague, wasteful, unnecessary, or ineffective [10, 11]. On the occasions when it produces laws that are effective (e.g., tax laws that raise revenue), those laws are, as a generalization, unnecessarily costly and complicated [2, 10, 11, 12]. Also, since the traditional method does not evaluate the outcomes of laws, it fails to identify and repeal outmoded, ineffective, and purposeless laws, whose continued enforcement wastes government resources. As legislatures enact more laws in a continuing effort to solve societal problems with each legislative session, the size, cost, and complexity of the bodies of laws increase and governments are compelled to enforce laws selectively in violation of the rule of law. Thus, in terms of producing bodies of laws that are consistently effective, cost efficient, safe, non-intrusive, and user-friendly in the solution of societal problems, the traditional method of lawmaking is a failure [2].

1.2 The systems engineering approach to lawmaking

The serious flaws and omissions of the traditional method of lawmaking must be corrected if the bodies of laws of governments are to be successful in solving problems in the best interests of the public. To accomplish this task, it is proposed that the traditional method be upgraded to include the protocols of the systems engineering approach to the design of laws [13].

The systems engineering approach to the design of laws is to first assemble a team of experts from all applicable academic disciplines. Since societal problems and their law-solutions have, as a rule, multiple sociologic, economic, and legal dimensions, design teams must consist of individuals who collectively have knowledge and expertise in engineering design methodologies and other relevant fields such as sociology, economics, business, policy science, law, and statistics. The members of the multi-disciplinary design team will be held to high standards of systems engineering expertise and ethics.

The "customer," or intended beneficiary of the laws in a democracy, is the aggregate of the people (i.e., the citizenry) who are within the jurisdiction of the government [1, 2]. For a city government, the customer of city laws is the citizenry who are within the jurisdiction of the city government and for a state government the customer of state laws is the citizenry within the jurisdiction of the state.

The requirements of systems engineering for the design of laws constitute quality standards for lawmaking. These standards include quality design (QD), quality assurance (QA), and quality improvement (QI) standards [2, 14, 15, 16, 17]. The previously noted major flaws and omissions of the traditional method of lawmaking all relate to a lack of quality standards.

Quality design (QD) standards for a law-solution first include the identification, prioritization and analysis of a societal problem, and a statement of the law's purpose. These steps are followed by ideation of a law-solution, modeling and simulation of the law, and enactment (implementation) by the legislature.

The only valid purpose for a law is to solve a societal problem of concern to the public, and it is essential that the problem addressed by the law be defined (it is impossible to solve a problem that has not been defined). Thus the first quality design requirement is to define the problem in a simple and succinct manner that conveys the broad scope of the problem.

Every government has limited resources and it is therefore necessary for problems be addressed and solved on a priority basis. If priorities are not assigned to problems for solution, serious societal problems can be ignored by the legislature, to the detriment of the public, and resources allocated instead to non-essential or trivial matters. The priority-assignment requirement corrects a major omission of the traditional method of lawmaking and channels the resources of government towards public needs in an efficient manner.

After the problem has been defined in general terms and assigned a priority for solution, its size and nature must be thoroughly and accurately analyzed by the design team. The problem analysis step is needed so that an effective solution can be formulated. The analysis is also important because it may disclose that the problem cannot be solved by means of a law or that it should be solved by another level of government or that its priority should be reassigned. The analysis of the problem must also include an evaluation of the reasons for the failure of existing laws to solve the problem (failed laws will be referred to the quality assurance program for laws). The traditional method does not require an analysis of problems or of the reasons for the failure of existing laws, and this requirement for problem analysis corrects a significant omission of the traditional method of lawmaking.

If a law lacks a statement of purpose, the people who administer, enforce, interpret, and comply with the law must formulate their own opinions as to the intent of the law. Since these opinions can vary significantly, the results of enforcement of the law will be spurious. Also, it is impossible to evaluate the results of a law that has no stated purpose. For these reasons, a statement of the purpose of the law in terms of a measureable problem-solving outcome is required. The purpose statement must be simple, succinct, and clear.

After the decision has been made to proceed with the creation of a law to accomplish its problem-solving purpose, the design team members engage in ideation, or "brainstorming" sessions, in which ideas for a law are presented and evaluated. Ideation is the first step of the traditional method of lawmaking; it is the fifth step of engineering design protocols. For the solution of complex societal problems, the proposed law may contain multiple components and subsystems, each of which may have alternative design options. To determine the best combination of design pathways that were proposed through ideation, it is necessary to create and simulate models of the proposed law designs.

The design team next creates models (knowledge-based, systemized descriptions) of one or more of the law-solution ideas. Models incorporate the relevant and reliable data that were derived from problem analyses, and also include all data of the external (e.g., constitutionality) and internal (e.g., costs) boundaries and requirements that pertain to the law [18, 19]. For example, the law must not violate human rights and, to be useful to the public, the sum of its costs, restrictions, side effects, and other burdens must not exceed its problem-solving benefit [2]. Of note, the high standards of expertise and ethics required of design teams and the optimization of problem-solving performance of models will preclude the incorporation of political agendas, “pork barrel,” and other special interest provisions into law. The task of modeling a proposed new law requires that all parameters and cause and effect mechanisms of the law be expressed in mathematical terms. When the structure and variables of the law-solution are expressed mathematically, the model of the law can then be evaluated by a high speed computer. Computer models have the advantage that they can be repeatedly tested and their parameters adjusted to determine the most efficacious pathways to the stated goal of the law. The use of models and high speed computers will improve the competency and predictability of law-designs by orders of magnitude as compared with the traditional method of lawmaking (e.g., the traditional method evaluates several variables in the design of a law at a rate of ten to twenty calculations per hour; computer models will contain 1000’s to 1,000,000’s of variables that are evaluated at the rate of trillions of calculations per second). When the final design of the law is approved and enacted by the legislature, the subsequent results of law enforcement will be compared to the outcomes that were predicted by the model. The degree of accuracy of the model can then be assessed and its design improved, for future law-creation purposes, on the basis of feedback measurements and analyses.

References to all of the data bases, methodologies, assumptions, and findings in the analyses and design phases of the law must be cited and appended to the law. This documentation will create a “paper trail” for retrospective analyses of the model, will expand the knowledge base of law-design processes for future design projects, and accelerate the transformation of lawmaking into a knowledge industry. The written text of the law must also contain statements of the definition of the problem being addressed, the priority ranking of the problem, the purpose of the law, the names of the designers, and a title that

accurately reflects the intent of the law. These statements will enable all users of the law to know the history and intent of the law.

When the design process is completed, the proposed new law is submitted to the legislature for a vote of approval or rejection. If approved (enacted), the new law is added to the government's body of laws for enforcement.

Next, a rigorous quality assurance (QA) program will be performed by the design team (the "QA Commission") to review the efficacy of every enforced law. Unless a government measures the outcomes of its laws, it is "flying blind." That is, a government cannot know if it has accomplished anything of value for the public unless it utilizes an accurate and reliable system for assessing the outcomes of laws. Therefore each law must undergo a periodic (e.g., every ten years) quality assurance (QA) evaluation to confirm that it is "necessary and proper." The QA program (which does not currently exist) will employ empirical (i.e., scientific) methodologies to measure, analyze, and document the outcome of each law, including its costs, burdens, and impact upon the human rights, living standards, and quality of life of the public. Every law whose net benefit (the net benefit is the difference between the problem-solving benefit of the law and the sum of its costs, risks, restrictions, and other burdens) to the public is demonstrated to be positive by the QA commission will be referred to the legislature for affirmation and continued enforcement. All other laws will be recommended by the QA commission for repeal by the legislature. By leading to the repeal of non-productive laws (e.g., outmoded, ineffective, conflicting, duplicative, harmful, and unenforced laws) the QA program will pay for itself [15] while improving the performance of government. Of significance, the process of measuring and analyzing the outcomes of laws will produce and accumulate reliable knowledge of the cause and effect mechanisms of laws and of knowledge-gathering technologies, thus advancing the science of laws [2, 3, 4, 5, 20].

Every law that is not repealed as a result of the QA program will be referred to the design team for review and possible amendments by a quality improvement (QI) program. The goal of QI, which observes previously described quality design (QD) standards, is to correct defects and improve the effectiveness, cost-efficiency, clarity, safety, and user-friendliness of laws so that they approximate the characteristics of the "ideal law" [21]. The incorporation of quality programs (QD, QA, and QI) will improve and transform the traditional lawmaking process from an input-driven feed forward control system that creates more laws (see Fig. 1) to an output-driven feedback control system that solves problems in the best interests of the public as required of democratic governments, see Fig. 2.

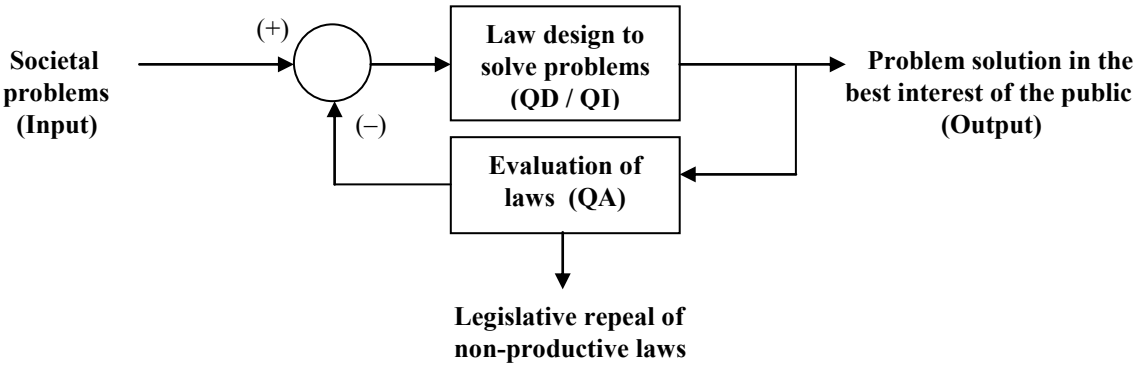

Figure 2. The systems engineering feedback control system of lawmaking. The quality programs (QD, QA, and QI) that are an inherent property of systems engineering will transform the lawmaking process into a problem-solving feedback control system under the direction of the legislature. This system will be self-correcting in the direction of optimum outcomes of laws in terms of the best interests of the people as a whole, thus satisfying the public benefit purpose of government (compare to Fig. 1).

1.3 Discussion

The systems engineering approach to lawmaking will create a division of labor between 1) legislatures, who set policies through open discussions and debate of societal issues of concern, and 2) engineering design groups, who are contracted by legislatures to design and optimize laws that carry out legislative policies. By this division of labor, the role of legislators will change from that of "lawmakers" to "trustees," whose task is to assure that the body of laws always and optimally serves the best interests of the people. The promise of this approach to lawmaking is that it will bring the full resources and expertise of science and engineering to bear upon the solution of societal problems. For this reason, further evaluation – and eventual implementation – of this lawmaking concept by governments is recommended as a highly important undertaking in the public interest.

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