



SysScience of Laws

***TWO ESSENTIAL
SOURCES to enable
APPLICATION OF
SYSTEMS ENGINEERING
TO A SCIENCE OF LAWS***

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... this paper, this talk...2 of 4 msgs...

***1st Sci & the Law Institute: discover, enable
sci knowledge/methods to improve LL&PP***

***2nd Learn from past attempt of science
advising law at the highest level - OTA***

***3rd Intro to a rich new systems science,
Systems Processes Theory & Sys Pathology***

***4th Go beyond science to systems science →
as a foundation for SE → LL&PP***

...only time for msg 2, “reviewers;” handouts for # 3 & 4

CURRENT STATUS AND PERSPECTIVE

- **Initially “Science and Public Policy” → different meaning**
 - ✓ Science concerned mostly legislation that funded major scientific institutions and enterprises of \$140 B/yr (NIH ~\$30 B, NSF ~\$7 B/yr)
 - ✓ Executive branch had high level expert advice since Truman (PSAC)
 - ✓ Balance of Powers issue; how could Congress match Executive expertise to evaluate science proposals; new technologies???
- **Today’s > focus use science to directly influence LL&PP**
- **113th Congress (2013-14) has 3 scientists for 535~0.5%**
 - ✓ 2 physicists and 1 microbiologist (all in the House)
 - ✓ 6 are engineers; 19 are M.D.’s; are MD’s scientists? are engineers scientists? -- technical issues go far beyond medical
 - ✓ But can 5% of Members advise all 535? On all issues, problems, tech
- **SO Who advises Government about technical issues?**
 - ✓ Mostly vested interests, corporations, lobbying groups

CONGRESS BECOMES AWARE OF NEED

- **Dilemma: Good Policy Needs vs Competing Powers Needs**
 - ✓ Congress acting on many new technologies without knowledge
 - ✓ Absence of deep directed research & evaluation of social problems
 - ✓ Congress need to balance Exec support agencies power & info
 - In new issues; ABM, EPA or not, pipelines, supersonic transport, & more (Nixon)
 - Response to newly created agencies: OMB, OST→ OSTP, CEQ of '69, etc.
 - ✓ Comm Chairs wanted to retain & regain power: so advice must be “closely aligned with Congr needs” “match language & policy context” “authoritative”
- **Need key info direct to Congress beyond similar from NRC**
 - ✓ Identify Impacts, +&-, of New Tech's existing & projected
 - ✓ “Early warning” function needed (Weisner-Kennedy)
 - ✓ U.S. massive innovation engine; anticipate range of consequences
 - ✓ Study national level problems (most are complex/hybrid systems based)
 - ✓ But popular politics not informed on these complex systems
 - ✓ Need to go beyond even conventional interdisciplinary science

• National Public Debate: Origins go back to 60's

- ✓ 1958 House created Comm on SRD; a 1st; '57 Sputnik shock
- ✓ House '63 named Daddario (D-Conn) Chair, House Subcomm on SRD
 - At first, only authorization funding NSF; then hearings '64 on gov't-sci relations; Yaeger coined term TA;
 - Proposed TAB '66; ID potentials, transfer, ID undesirable results; → 3 studies LOC, NAS, NAE; recs "detached & neutral" "insulated from policy-making" "reflect both public/private interests"
 - '69 hearings refined TAB to legislative, not executive branch; included 7 members of public, & Dir support organiz, no action on amendment
 - My paper, 1968; Feature Article in *Science*; ghostwritten for Daddario (D-Conn);
 - Wrote all but title; Graduate science student effecting national LL&PP? Stealth SS
- ✓ Senate; Bartlett (D-AL) proposed Congress Office of Science and Technology (S&T); like executive, died in committee; important to analyze why never out of committee
- ✓ Success came through bicameral bi-partison legislation: Daddario led in House; Kennedy in Senate



OTA AS CASE STUDY: SUCCESSFUL LEGISLATION A DIFFERENT ERA?

- **Public Law 92-484, signed by President Nixon in 1972**
 - ✓ Rep Davis (D-GA) Chair, SRD re-intro'd with refinements via debate
 - Streamlined; stand alone legislation; eliminated Presidential Appointments; removed outside input (public; other Dir's); limited TA requests to Congressional Committee Chairs; TAB Chair/VC bicameral, alternating House and Senate;
 - ✓ Harvey Brooks, chair NAS Study'68 called for; he wrote > bill
 - ✓ 1st new legislative branch agency since GAO in '21; unique features
- **New OTA: Administration, Resources, Roles**
 - ✓ Annual budget of \$21.9 M; Daddario 1st Dir; >half staff were Ph.D.'s
 - ✓ At peak in 80's, 143 full-time core staff; w temp staff → >200 at peak
 - ✓ 12-member governing Board; 6 Dem's, 6 Repl's; 3 ea House/Senate
 - ✓ TAB job was (appt Dir) (choose proj's) (approve budget) (approv-deliver reports)
 - ✓ TAAC job was external sci-citizen advisory; designed as substantive
 - ✓ Characterizing phrases: "tuned carefully to language & context of Congr"
"no recommendation of specific policies" "stakeholder bias minimized"

- **Changes from Legislative Intent to Actual Performance**
 - ✓ Both TAB members and their staffs became highly involved
 - ✓ Function migrated from policy recommendations (1st rpt Drugs) → including a range of positive and negative alternative policies
 - ✓ TAAC became marginalized; external science advice ~lost; no vote
 - ✓ Early warning function lost also;
 - ✓ Much pre-study of scope of each effort due to limited resources
- **General Elements of each Assessment**
 - ✓ Comprehensive advisory panel tech experts; stakeholders; core OTA team; individual projector directors; contracts for major analytical tasks; in-house specifically assigned research teams;
 - ✓ Workshops; extensive external peer review; redo draft; dissemin'tn
- **Internal OTA organization → job of OTA Director**
 - ✓ Evolved to 9 Program Areas in 3 Divisions
 - ✓ Each headed by an Assistant Director

OTA ACTIVITIES: MEASURES OF PRODUCTIVITY

- **24 years of studies; 1972 to 1995**
- **Trend: Annual Reports increased steadily across history**
 - ✓ Six-fold from 10/year to 60/yr from 1975 to 1995 (see chart)
 - ✓ Aver 32 rprts annually; doubled average in 1st two decades
 - ✓ Also uncounted #'s summ, interim, special rprts; background papers
 - ✓ Also >many 2-pg briefs jokingly (internally) called “senator-sized”
- **Completed >755 studies/reports; very wide range of topics; significant public issues, then and today**
 - ✓ Acid rain; energy; health; global climate change; polygraphs; space; defense; info tech; environment; textile industry; nuclear; weapons of mass destruct; biopest control; global telecomm; etc.
 - ✓ Some massive: one 12 vol's; another 3 vol's; another 2 vol's
 - ✓ Av. Time = 18 months; av. Cost = \$½ M; “staying power” of reports
- **Compare value added: \$20M/yr (OTA) to \$3.2B (Congr) ~½ %**

OTA ACTIVITIES: MEASURES OF INFLUENCE

- **TAB was a big part of the OTA Influence & Effectiveness**
 - ✓ Predicted: would become “disinterested” “dysfunctional” never did
 - ✓ Met every six weeks in session; more often as workload increased
 - ✓ Very well-known/senior Congr members part’d vigorously; shared staff
 - ✓ Ex’s Informing Debate: ICBM; Drug costs; explosive taggants
 - ✓ Sometimes same report, same info used by BOTH opposing sides
 - ✓ Otherwise respected but just one of several inputs analytical vs rhetorical
- **Union of Concerned Scientists Assessment of Impacts**
 - ✓ Ex1: 1985 OTA warned about huge oil spills, lack of preparedness
 - ✓ Ex2: Missile defense sys opposed by sci’s fund’d @ \$9B for corp
 - ✓ Ex3: DHS used defective radiation detection sys for 3 yrs (\$B’s)
 - ✓ Ex4: saved >>\$\$\$ causing distribution of gov’t docs via e-publishing
 - ✓ UCS Conclusion: OTA saved vast amounts of taxpayers money; and contributed to better economic well-being, safety & health of Am’s



OTA DISSOLUTION: HISTORY & ISSUES

- **OTA funding stopped in 104th C; not dissolved, defunded**
 - ✓ During “Contract w Am.” period; N. Gingrich; Republicans in power
 - ✓ Gain of 8 S seats; 54 H seats; zero sum game mentality;
 - ✓ Others on block: CRS (servs all members); CBO (budget); GAO (audit/mgmt)
 - ✓ Put forward as “symbol of congressional budget austerity;” close of entire Federal agency (brownie points); >symbolic; amazing close maneuvering
- **WHY?? Most Issues of a Political Nature: Reactions**
 - ✓ Not due to imperfection of research; rather due to political realities
 - ✓ “Lack of mission fully integrated with a well-est’d congr process”
 - ✓ Daddario favored liberal legislators; staff had bias; Kennedy dom’d
 - ✓ Also decried as a tool for Kennedy & Dems to attack Nixon admin
 - ✓ G. Brown (D-Ca) “shameful” “defense against dumb” other agencies could not sub
 - ✓ Houghton (R-) opposed move “we are cutting off one of the most important arms of Congress when we cut of unbiased knowledge about science and technology.” Others said “politics overriding science”

OTA DISSOLUTION: CONSEQUENCES & PROSPECTS FOR INCOSE

- **With OTA dissolution.....**

- ✓ **CRS expected to fill the gap; didn't; SO IN EFFECT...**
- ✓ **...Congress relied more on experts with stake in outcomes**
- ✓ **...More centralization of power in House of Representatives**
- ✓ **...Less influence of expertise from other government agencies**
- ✓ **...Autonomy of Comm. Chairs lessened; Speaker power increased**
- ✓ **...Policy set by party leaders more than ever before**
- ✓ **...Diminished incentives for inclusiveness overall (→ today's stagnation?)**
- ✓ **...Support agencies < motivated to see perspectives of both parties**
- ✓ **Still need "to anticipate policy debate several yrs in advance"**
- ✓ **Still need timely accurate info for legis while analysis in progress**
- ✓ **In 2001 Congress asked GAO to experiment with TA; continues**
- ✓ **But no TAB to establish priorities and no Topic targeted funding**
- ✓ **Ironically, OTA was used as "model" for new European TA efforts but never as strong or direct in Europe; parliamentarianism diff't**

RE-ESTABLISH OTA? PLAYERS & ODDS OF SUCCESS



WHO ADVISES NOW?



• Roles of Pre-Existing Congressional Support Agencies

- ✓ Congressional Budget Office (CBO); Congressional Res Serv (CRS) (in LOC); Gov't Accountability Office (GAO) has TA unit (modest pilot);
- ✓ Overall GAO closest to subbing but only 1 rppt/yr (too few staff; too narrow range of studies; not connected to Congr; no TAB; overwhelmed by auditing focus; short-lived; & different style reports)

• External Science Advisors

- ✓ Nat'l Research Council (NRC); research arm of NAS, NAE, Inst Med
 - Doubled to 59/yr from m=22 yr after OTA closed; dropped back in 1yr; >Exec brch
 - Quite diff't from OTA; aim to reach consensus; > independent; >purely technical
- ✓ OTA staffers founded ITA; (too little funding, no direct connect to C, folded)

• Re-establishment called for by Some Pols & Think Tanks

- ✓ Hillary Clinton (in Pres campaign stated would restore OTA); Ralph Nader
- ✓ Union of Concerned Sci's (backed by 100 citizen, technical, academic groups)
- ✓ Woodrow Wilson Int'l Ctr report /or/ Science Cheerleader Blog for
- ✓ ECAST network (Expert & Citizen Ass't of Sci&Tech) in favor

OTA + HISTORY ANY LESSONS LEARNED?

- **1. Opposite Purposes: Politicians (Pols) vs. Scientists**
 - ✓ Pols seek results that agree with their positions and needs, not facts
- **2. Where Power Resides**
 - ✓ Advisors think power lies in facts; Pols know they have the power
- **3. Personal contact more influential than written reports**
 - ✓ OTA showed face-to-face interchange was the most effective
- **4. Subjectivity over Objectivity; Winning beats Neutrality**
 - ✓ Experts use neutral study to discover fact; Pols gather “facts” to win
- **6. Consensus elusive even counterproductive**
 - ✓ Pols & Public misunderstand self-correcting role of sci method
- **7. Key political problems < solvable by scientific method**
- **8. Critical Importance: ability to establish priority listings**
- **9. Pre-Issue Ideology causes Anti-science behaviors (?)**

- **10. Must emphasize Alternatives over Conclusions**
 - ✓ Congress wants a range of options, not fact constraints on options
- **11. Science controls variables; Pols consider all variables**
 - ✓ Congress must raise economic, opinion, special interests issues
- **12. Congress Members keep power to themselves**
 - ✓ They want experts “on tap, not on top” note balance of powers
- **13. Be sensitive to both Branches needing science advice**
- **14. Do not forget other key assess factors than sci & tech**
 - ✓ Just as imp! Trade-off; budget priority; value judge; public opinion
- **15. Critical importance - function of “early warning”**
 - ✓ Gov’t should be much more proactive, not always just reactive
- **16. Must find antidote to today’s anti-science attitude**
 - ✓ Consider current inflexibilities on climate change, evol, repro bio...

- **17. Need for tight coupling with Congress (> just TAB)**
- **18. Eliminate long time delays in arrival of Tech Assess**
- **19. Keep and expand proven *sine qua non* features:**
 - ✓ Do studies only relevant & adapted to needs, concerns of Congress
 - ✓ Prove authoritative, independent, neutral in experts & methods both
 - ✓ Communicate in direct, simple, clear language & personal relations
- **20. Key need today is to go beyond conventional science**
 - ✓ Often complex, hybrid systems beyond reach of conv science
 - ✓ Especially important to us sugg'g use of SysSci & SysEngineering
 - ✓ Some humility & awareness of limits needed here
- **21. Need to bridge chasm tween nat sci & social science**
- **22. Bridge linear and non-linear causation in systems**
- **23. Advise State as well as Federal Gov't (recent AG scandal)**

HANDOUT TEASER: A RIGOROUS SCIENCE OF SYSTEMS AS A GUIDELINE?



What SE & SS could provide BEYOND science so BEYOND OTA/others ...assumes a consensus SysSci exists or evidence-based SE

- **Note LL&PP IS design/building of SYSTEMS; more than any other branch, congress specifies new key social sys**
 - ✓ ...BUT classical LL&PP guided by past law precedents, tradition
 - ✓ ...Lawyers never have studied how to build sustainable sys
 - ✓ ...Desperate need: more than “seat of pants” haphazard design
- **Science, esp. SS & SE, can help design key new social sys**
 - ✓ ...apply universal principles of how sys work & don’t work to LL&PP
 - ✓ ...apply same to crisis societal problems (montage)
- **Where find these “universal principles”?**
 - ✓ Systems Processes Theory (SPT) (INCOSE-SSWG) descriptive to prescriptive
 - ✓ 104 universal, isomorphic systems processes (how systems work)
 - ✓ Many Linkage Propositions capture how systems dynamicswork
 - ✓ Taxonomy of Systems Pathologies (how systems don’t work)

APPENDICES IN PAPER

BIBLIOG OF 7 BOOKS;

5 ARTICLES

5 SYSSCI ARTICLES

HANDOUTS

LIST OF ACRONYMS

DADDARIO SCI PAPER

MINI-POSTERS ON SYSSCI