Legislation, Information Systems and Public Health

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Abstract

The design of information systems is related to the design of organizations as expressed in legislation. A case study in public health serves as example. Suggestions are made for improving bureaucracies.

This paper introduces some ideas relating the design of information systems to the design of organizations as expressed in legislation, illustrated by a case study in the public health field. I shall assert the following. Information systems can be specified by rules which bear a strong resemblance to legislation. Legislation creates some major bureaucratic institutions which should be designed as information systems. Alternatively, if confronted by a bureaucratic system which has problems, one might begin to diagnose them by analysing the legislation. In brief: the disciplines of information systems and the law can enjoy a fertile liaison.

I became interested in legislation because of my interest in the design of information systems and this led to the LEGOL-NORMA research project. The work began in order to overcome our lack of adequate techniques for designing information systems (as opposed to computer systems). The problem clearly stemmed from our inability to describe organizations in enough precise detail, an observation which suggested the research method: the study of organizations specified by legislation. Legislation defines some of the largest organizations where computers have obvious applications, for example such departments of government as Taxation, Social Security and those dealing with licensing. Hence we formulated the goal of creating a logical language capable of expressing the kinds of complex rules one finds in legislation because we believe that this language would serve to specify organizations in general. Several versions of this Legally Oriented Language have evolved bringing valuable insights into fields such as databases and semantics as well as law and informatics. We have always sought to apply the research ideas and they proved unexpectedly valuable on encountering the case study discussed here. The research continues and anyone interested may write for a list of papers.

Legislation distributes power. From a central norm, which confers the power to make any other norms, flow powers of increasingly specific character, almost like electricity flowing through the grid and its network of transformers and switches from a generating station. If you inspect an Act of Parliament you will find that it comprises only a few kinds of norms which have rather different functions in distributing power.

Every norm says, in relation to some agent (individual or organizational), and for some purpose:
but they differ radically according to the nature of their consequents. Elsewhere I have introduced the following classification: *structure* norms, *action* norms, and *definition* norms. A structure norm leads to a string of other subordinate norms. An action norm defines what should, should not or may be done, whilst a definition norm introduces a special use of language. We only need bother with structure and action norms.

A structure norm subdivides power among agents and purposes. It may be pictured thus:

\[
A_0P_0(C_0) \rightarrow A_1P_1(C_1) \rightarrow A_2P_2(C_2) \rightarrow \ldots A_iP_i(C_i)
\]

where the \( A_i \) represent the agents and the \( P_i \), the purposes whilst the \( C_i \) represent the conditions that must be tested. When a structure norm applies it 'switches on' a list of other norms. Some or all of these, as further structure norms, could do the same thing so that a tree structure of ever more finely divided powers develops, the resulting hierarchy resembles an organizational chart but, of course, the law does not necessarily assign powers to individuals as an organization assigns them to managers, rather, it creates social contexts which require specialized patterns of behaviour. Upon this tree structure, the law hangs the action norms.

An action norm, as its name implies, determines when some action should be carried out but the actions in the consequent need further classification as:

1. Physical action.
2. Change in legal status.
3. Invocation or inhibiting of some norm structure.
4. Change to the legal structure itself.

The first kind of action norm we call a *standing order*, and only these get anything *done* outside the law itself. The second kind we call *status norms* because they change the way in which the law regards a situation. For example, whilst a standing order may have a condition such as

\[
\text{the offender shall pay £20 to the court}
\]

a status norm would say:

\[
\text{the offender shall be liable to a fine of £20,}
\]

defining the liability (a status) and leaving the ordering of payment to the discretion of the court. Standing orders generate commands to change the physical reality whilst status norms change the legal reality. The third and fourth kinds of norms deal with the exercise of powers. *Powers of legal action*, as we call the third kind of action norm, take effect upon the structure norms by invoking or inhibiting whole swathes of legal rules using expressions such as

\[
\ldots \text{shall be dealt with under Section 3 of this Act}
\]

\[
\ldots \text{the Minister may suspend the regulations . . .}
\]

Notice that the law itself does not alter, only which parts apply at the time. However a *legislative power*, the fourth kind of action norm,
confers upon some agent for some limited purpose, the power to make new rules. Thus action norms fall into four classes of increasing scope, but decreasing specificity about the changes they will bring about in the physical world.

With these kinds of norms as our building bricks, we can create an organization. What can we say about its architecture? We can distinguish three main areas needing attention:

- the system as a whole, its purpose and the resources available;
- its interior, any subsystems it should contain;
- the environment, the systems within which our system should fit.

In the context of a case study, we can look in turn at these: the system, its subsystem and its supersystems.

The Act which established a Water Supply and Sewerage Board, has been roughly analyzed in the Appendix. Of course, this contains only a sketch of the whole Act which fills 20 pages. Most of the detail takes the form of action rules which hang, like leaves, upon this tree which springs from its root purpose ‘The rapid development and proper regulation of water supplies and sewerage in M’, which falls within the jurisdiction of the Board. At the level of analysis shown, the only agent below the State is the Board so the structure norms in the diagram only mention the purposes governing their dependent action norms. The Appendix should contain enough detail adequately to illustrate the key ideas in this paper.

The case arose in practice during some work advising the newly created Board under great pressure of time. The analytical methods, applied even in a rough-and-ready manner to the legislation which established it, helped to reveal a multitude of organisational problems more easily than expected.

A new organization, like a new building, has a purpose and a budget; the architect needs to know both these as precisely as possible. Similar conflicts arise over generality, which gives the architect freedom to work out an optimal solution, and specificity, which imposes the client’s detailed wishes. But organizations differ from buildings; they can act in these matters for themselves. The legislation gives the organization the status of an agent:

3. (2) The Board shall be a body corporate, having perpetual succession and a common seal, with powers, subject to the provisions of the Act to acquire, hold or dispose of property, both moveable and immovable, and to contract, and may sue or be sued by its corporate name aforesaid,

and gives it some standing orders. At this level, the standing orders lay down tasks of wide scope. e.g.,

14. The duties and functions of the Board shall be as follows, namely,

(a) to prepare, execute, promote and finance the schemes for the supply of water and for sewerage and sewage disposal,
(b) to render all necessary services in regard to water supply and sewerage to the State Government and local bodies and on request to private institutions or individuals also,

through a list of more specific duties to the catchall,

(m) to perform and discharge other such duties and functions as are allotted to the Board under the provisions of this Act or as may be entrusted to it by the State Government.
These standing orders define the outputs of the system but it cannot produce these without adequate inputs. In the case of the Water Supply and Sewerage Board very general provisions head a list of more specific powers which provide the needed inputs, mostly income and information:

15 (1) The Board shall, subject to the other provisions of the Act, have power to do anything which may be necessary or expedient for performing its duties and discharging its functions under this Act.

(2) Without prejudice to the generality of the foregoing provisions, such powers shall include the power . . .
(a) to inspect . . .
(b) to obtain . . . information . . .
(c) . . . (d) . . .
(e) to lay down the schedule of fees
(f) . . . (g) . . .
(h) to approve tariffs for water supply and sewerage . . .
(i) . . . (j) . . .
(k) to acquire, possess and hold lands and other property . . .
(l) to abstract water . . .
(m) to raise . . . money . . .
(n) to receive grants . . .
(o) . . . (s) . . .

All these appear in the Appendix, section F.

So the legislation does deal with the whole system, its purpose and resources but at a level of generality which needs supplementing. Here we find the seeds of organizational problems; where the details begin, so begins the design work proper. Great generality does provide flexibility in the design but the draftsman can only purchase it at the expense of problems of interpretation, some of which the next paragraph will address. Notice, that the legistations must strike a balance between precision and generality that will produce the desired structure without tying the hands of the information system designer.

The quotations above allow me to draw attention to an important point concerning the use of powers of legal action. The phrase ‘subject to the . . . provisions of . . .’ indicates where some agent may have the power to invoke or inhibit the relevant norms, e.g., both 3 (2) and 15 (1), above. Rightly enough, the legal draftsman inserts this phrase quite liberally to underline that one should interpret the Act as a whole, but it needs careful implementation as a control feature of an information system.

In the example considered here, the Act drastically limits the powers of the Board by requiring budgets to receive State Government approval in advance:

34. (1) The Board shall, before the commencement of . . . a financial year, prepare a statement . . . of the programme of its activities . . . as well as a financial estimate . . . and the same shall be submitted to the State Government . . .

A simpler information system would have resulted from the State retaining only a power to intervene retrospectively on the basis of accounts of activities completed, plus some other, relatively informal powers of supervision. The unwillingness to transfer relatively untrammeled responsibility to the Board will incur a high cost in bureaucratic machinery. So we glimpse some potentially large consequences of
provisions inserted in the Act for reasons of legal and political caution.

We have already started to look at the subsystems, the interior structure of the organization, as determined by the legislation. To see it more clearly, the Appendix will help; section D outlines the duties and functions of the Board, amplifying the output specification. The Act defines in remarkable detail some operational tasks. The engineering of new schemes, however, receive only a mention in a subparagraph, quite out of proportion to its organizational importance (section D, level 2, branch 3: “Prepare, execute, promote & finance ....”) More implied organizational structure appears in those parts of the Act which detail the Board’s powers—section E of the Appendix. These correspond to the input side of the system. The level of detail varies less than in the specification of duties but other problems should be mentioned. These problems looked at in information systems terms concern the perturbations with which the system must contend; as far as concerns the Board, they will arise from the activities of other bodies involved in water supply projects, such as irrigation and industrial development authorities. Here the legislation fails to deal with a major source of conflict between the government’s own agencies, an omission that an information systems study of the draft legislation would have picked up. Finally, we should turn to section C of the Appendix to see some explicit structuring of the Board. The Act also specifies the membership of the Board (in the sections mentioned at the bottom of section A of the Appendix) and how to make and terminate appointments but this does not affect the subsystems. Taken as a whole, the Act has many implications for internal organizational structure in its provisions for duties, powers and constitution, but these stand apart from one another with no attempt to correlate them, whereas an information systems approach would require each subsystem to have defined inputs and outputs.

Now we turn to the super systems or principal systems surrounding the Board. To understand this view consider an engineering system such as one for satellite communications. The basic system does the communicating, having messages and perturbations as inputs and noisy messages as outputs. But to put the basic system satisfactorily in operation, and to keep it there and eventually remove it, requires several related collateral systems. We have systems to design and construct the satellites and ground stations, to launch the satellite into orbit, and commission the ground stations, to maintain or monitor and repair (if possible) the basic system and to supply it, and others to stand by in case of malfunction and to recover normal operations, to evolve the system as demands upon it change, and ultimately a systematic termination of the basic system is required. Every system requires the support of similar collateral systems although their relative importance varies, they provide a useful basis for analysis, as I shall now explain.

An organization such as the Water Supply and Sewerage Board requires collateral systems to support it and the legislation creating the Board should specify so much of these as necessary. They differ greatly in importance. The design system prepares the legislation (this paper suggests that we could improve the design system by including an information systems study at the drafting stage). The construction system (see section B of the Appendix) assembles the property and the people required by the Board; in this example the resources come from
existing State and local Government bodies. The launching system, as it appears in the Act, simply deals with the commencement of the Act and some small matter of retaining temporary power to make regulations (very bottom of section B of the Appendix). The Board has to rectify its own defects, by and large, but the Act does specify ways of monitoring performance to maintain standards. A self-organizing system can deal with its own standby arrangements, its repair and recovery, can procure its own supplies and evolve its own machinery, provided it has the necessary powers. The Act incorporates these powers in addition to those required for day-to-day operations (the basic system), as you will find in sections C and E of the Appendix. Of course, to terminate the Board remains a function of the Government; its omission from the Act does not seriously matter. So we see the role which a consideration of collateral systems should play in the formulation of the Act.

The Act does deal with these matters indicated above, but not in a thoroughly systematic way; let me draw attention to some typical problems. To start with, the Act does not provide for the costs of constructing the Board, only with the vesting of property and the transfer of employees. Also affecting the same collateral system, the Act provides for vesting local government property (such as water works and distribution systems) in the Board but fails to cover the transfer of the staff involved, thus inviting industrial relations problems to infect the new organization on its inception. Yet another difficulty surfaces when one looks at the cost of acquiring assets; the Act stipulates that the Board must pay local authorities for them but says nothing about the source of funds and even seems to rule out other solutions such as giving the surrendering authority a financial interest in the Board. A systematic study of the construction system whilst drafting the Act would have removed these problems.

Further problems with collateral systems arise because this particular Act introduces probably too many expensive ways of monitoring what the Board does. For example (section A of the Appendix), it introduces many external controls, so that regulations, bye-laws and new funds all require prior approval by the State Government. Effectively, therefore, the Act claws back to the Government responsibilities ostensibly conferred upon the Board in the wide ranging section 15, already quoted. Alternatively the Act could have reserved formal powers of intervention to the Government based on actual performance. Such an alternative strategy would tend to reduce the need for formal, bureaucratic machinery whilst encouraging informal consultation with no significant loss of control. Generally speaking, collateral systems can operate with more informality than the basic system. Thus we have a second example of the importance of analysing collateral systems in the preparation of legislation.

I have tried to indicate how drafting legislation from an information system viewpoint might help us to specify better organizations. Let me now summarize the main ideas. Legislation and systems specifications resemble one another quite closely. Therefore the structures which one finds in information systems should have their counterparts in any legislation, especially Acts of Parliament which create organizations, such as a Water Supply and Sewerage Board illustrated here. Three main levels of structuring stand out:

1. The basic system (the Board performing its normal duties (output)
with the allocated resources and dealing with routine problems (input).

2. The subsystems (water supply, sewerage, new schemes, policy formulation, research and so on).

3. The collateral systems (especially construction, launching, maintenance, supply and evolution of the basic system).

This structuring applies recursively so that every subsystem and collateral system has its own sub- and collateral systems. Finally, I made the point that this should not result in a proliferation of bureaucracy but, instead, a deliberate encouragement of appropriate informal systems. Thus we should have no difficulty in relating the legislation to some of the main 'architectural' features of the organization.

The legislation serves as the blueprint for the organization in legal terms but in order to build a modern organization making effective use of information technology, we also need a system specification. Can we reconcile these? A concrete affirmative answer is given by our formal languages, LEGOL and NORMA, which serve to specify both information systems and legislation, thus providing a unified treatment of the human and computer parts of the system. The Appendix, in an informal way, follows this plan and serves to present the key material from the Act in a reasonably understandable form. So I hope that the reader can see how we can merge the techniques of the legal draftsman and of the systems designer to the benefit of each.

Let us improve the bureaucracies we create. Although we tend to disparage them, bureaucracies serve us well in many fields, not least in the field of public health where probably more people benefit from simple measures such as water supply and sanitation, than from more sophisticated medicine. Simple measures, on a vast, national scale depend on bureaucratic information systems. Let us therefore have better bureaucracies, and let us begin at the beginning, with the legislation that creates them.

Let us recognize bureaucracies as the dominant machines of our age and set about improving them. First let us engineer them better using our new information technology and secondly, and as importantly, let us 'landscape' them so that we human beings find them agreeable to visit and inhabit. These improvements will depend on extending our knowledge of complex information systems and how, in particular, the formal structures needed for technology can merge into the informal structures needed by people. We can begin by making more interdisciplinary studies of law and informatics.

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Appendix

The MWSSB Act arranged as a tree structure

A. Rapid Development and Proper Regulation of Water Supplies and Sewerage in M

- ACT Ch 48, 1976
  - Title extent and commencement
  - Definitions (Ch I)
  - Transfer of resources* of Board (Appendix, section B)
    - Directions for coordination between B and head body 22
    - Visit of assets etc.
      - When 18 (1), 20
      - May be given 90 (1)
    - Directions from State G.
      - State G. has discretion on what relevant 60 (2)
    - Approve funds 26 (21)
    - Approval of regulations 66 (1)
    - Approval of bye-laws 67 (1)
    - Appointment of auditor 34 (3)
    - B has duty to report (64)
    - Grants (28)
    - Establishment of posts to be sanctioned by State G. 8 (1)
      - Appointment of Government servants 8 (2)
    - Establishment and constitution of B (3, 4)
      - Effective membership of B (5, 6 and part of 7)
    - Organisation
      - Structure (explicit in the legislation)* (Appendix, section C)
      - Duties and functions (implying structure)* (Appendix, section D)
      - Powers (implying structure)* (Appendix, section E)

- Acts not (13) invalidated

- External controls (CH IX)
  - Annualy both previous activities and plans 61 (1)
  - Ad hoc as required by State G. 61 (2)

- Formation of MWSSB

* Continued in subsequent sections

B = Board
B. Transfer of Resources to Board
(Continued from Appendix, section A)

- Property and assets 18 (1) (a)
- Rights, liabilities and obligations 18 (1) (b)
- Suits and legal proceedings 18 (2)

Gov’t to determine what is vested in B.

- Taking over WS and S Services
  - Plant and materials 20 (1) (a)
  - Subsoil 20 (1) (b)
  - Rights etc. income and 70 (1) (c) expenditure 21

B shall pay local body for assets taken over 23 (4)

B requires State Gov’t approval 20 (1)

Gov’t to select persons and times 23 (1)

- Rights of staff preserved
  - Permanent or temporary nature of post retained 23 (2)
  - Tenure, remuneration conditions not to be 23 (3) changed to disadvantage of staff

- Pension and other funds transferred 23 (4)
- No rights generated under Industrial Disputes Act 1947 by this change of employment 23 (5)

- Permanent Gov’t staff may retire 23 (6) (a)
- Temp. staff take notice or pay in lieu 23 (6) (b)
- Employee still liable 23 (7) (a)
- B competent 23 (7) (b)

Gov’t retains power to make regulations until B takes over 25 (1)
Legislation, information systems and public health

C. Structure
(Continued from Appendix, section A)

Explicitly identified units and roles

Chief Executive 8 (3)
Member-Secretary

Facility to review and appraise technical, financial, economic and other pertinent aspects of every water supply and sewerage scheme in the State 34 (4)

Financial organisation

Keep accounts 3 + (2)
Furnish balance sheets

Funds

Record Fund 95
Loan Fund 26 (1)
Other Funds 26 (2)

Require approval of State G.

Power to form committees and delegate powers except those under 34.66.67 (11)

Establishment requires approval of State G 8 (1)

Recruitment 8 (1)
Allocation of duties 8 (1)

Making of regulations

Appointment of State servants requires Govt. approval 8 (2)

for recruitment 8 (1)

conditions of service 8 (1)

B. may invite advisors from Govt. 10

Defining functions, duties & committees

To manage its affairs 15 (1)

To provide training 15 (k)
D. Duties and Functions
(Continued from Appendix, section A)

- Render all necessary services to state and local bodies 14 (b)
  - on request to p. institutions and individuals
- Assess manpower and training 14 (j)
- Carry out applied research 15 (k)
- Prepare draft State plans for WSS and drainage on directions of State G.
  14 (c)
- Review and advise on tariff, taxes, fees and charges for WSS in the areas of the B and local bodies
  in agreement 14 (d)
- Establish standards for WSS 14 (f)
- Review annually for WSS for B and local bodies in agreement

Duties and functions

- General
  - Technical
  - Financial
  - Economic
  - Other aspects

Policy formation

- Assess manpower and trainig
  - Carry out applied research
  - Prepare draft State plans for WSS and drainage on directions of State G.
  - Review and advise on tariff, taxes, fees and charges for WSS in the areas of the B and local bodies
    in agreement
  - Establish standards for WSS
  - Review annually for WSS for B and local bodies in agreement

Prepare, execute, promote and finance schemes for WS and S 14 (a)

Use of sewers

- With permission
  - In writing 46 (a)
  - In compliance with bye-laws 46 (b)
- On direction if premises and 50 m away 47
- Illegal otherwise 48

Building activities related to S

- Permit required from B 49
- B may erect ventilation 50

Sewerage

- Testing private facilities

  - (a) obstructing construction
  - (b) causing damage
  - (c) altering flows
  - (d) obstructing operations

- Prohibitions 52

Operation and regulation of systems

- Non-domestic uses of water supply

  - Definition 40
  - Illegal without permission 41
  - Tariffs (?)

- Control of WS connections

  - Waste illegal 43 (1)
  - On written notice 43 (2)
  - Repairs
  - B’s action 43 (3) consumer pays
  - Licensed plumbers 42 (1)
  - only non-trivial work
  - Illegal work may be dismantled 43 (7)

- Cutting off supply 44
  - (1) (a)
  - (1) (b)
  - (1) (c)
  - (1) (d)
  - (1) (e)
  - (1) (f)
  - (1) (g)

- Consumer’s liabilities unaffected 44 (2)
- Reconnection charge 44 (3)

Water supply

- Prohibition of interference 45
  - (1) (a) to (e) apparatus working inspection
  - (2) consumer may close stop cock if
    owners affected agree

Penalties (Ch VIII)
Legislation, information systems and public health

E. Powers

(Continued from Appendix, section A)

Do anything necessary or expedient (15 (1))

General

- Exercise other powers conferred by Act (15 (2) (5))
- Enter into contracts 15 (2) (1)
- Acquire, hold, possess property etc. 15 (2) (k)
- Limited liability for acts in good faith 61

Financial action

Provided no losses incurred 27.

General

- Approval rec’d
- Statement to State Govt. 34 (1)
- Previous year’s limits apply if approv. delayed
- Adopt its own budget 15 (1) (g)

Fix fees for all kinds of services 15 (2) (e)

Powers

Adopt budget 15 (2) (g)

Management of investment fund

- Raise money

Repay 15 (2) (e)

Receive grants 15 (2) (m)

Loan 15 (2) (m)

- Subject to State approval 31 (1)

Operational

- Advance 15 (2) (p) 31 (2)
- Record 33.
- State guarantee 35

- Incurred expenditures 15 (2) (r)
- Approv. tariffs 15 (2) (b)
- Pay compensation 63

Technical Action

(For specific duties)

- Prepare 15 (2) (a)
- Carry out
- Abstract 15 (2) (1)
- Dispose

- Direction of local bodies
- Subject to arbitration by State Gov’t 16 (2)
- Emergency measures 15 (2) (j)

Information gathering

- Inspection of any WS and S facilities 15 (2) (a)
- Reports from local bodies or operating agencies 15 (2) (b)
- Any relevant return statement; stats 16 (3)
- From local body, other body, individual

- From local bodies 62.
- with state Govt. help.

Organisational

- Provide training 15 (2) (a)

- Manage its affairs 15 (2) (b)