LINKING DSM PLANNING TO DSM PROGRAM DESIGN

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Ontario Hydro has identified certain large targets in its drive to restrain the growth of demand for electricity. A planning structure has been developed to help meet these targets and ensure that no good ideas for programs are lost.

Catalogues of program concepts have been established for all consumer sectors. This "stock" of approximately 80 concepts (with associated research requirements) was compiled in a highly collaborative effort that brought together major stakeholders within Hydro and nine consulting companies.

Once compiled, the catalogues had to be kept dynamic--constantly up-to-date and revitalized. Ensuring that good ideas are not lost in the corporate bureaucracy, and that they get a fair, timely assessment, are also crucial. Accordingly, an assessment committee was set up composed of the managers of all departments that design pro grams or carry out research to support them. Information sessions were presented to ensure that Hydro staff know about the system and feel free to submit ideas.

The system not only captures good ideas but permits more efficient structuring of program research. Uncertainties surrounding a concept can be identified and eradicated before taking a full-fledged program to the marketplace.

INTRODUCTION

There are many uncertainties in forecasting, but Ontario Hydro estimates that, by the year 2014, consumption of electricity in the province will have increased 50-100% over current levels, and consumers will expect it to be supplied as readily and consistently as possible. One solution would be a massive, continuous building program. Hydro prefers a diversified approach, a combination of various elements wedded to the principle of balance: increased supply, restrained demand.

The demand side of Hydro's 25-year Demand/Supply Plan (which calls for a peak load reduction of 3,500 MW by year 2000 and almost 5,000 MW by 2014) consists of working with customers to use electricity more efficiently. Measures already foreseen could supply an estimated 25% of projected requirements--and at no cost in terms of standard of living. Demand-side management (DSM) means doing jobs, enjoying the same home life, but using less electricity. As this limits new construction of generating stations, it contributes to a strong economy and healthy environment.

IDENTIFYING DSM OPPORTUNITIES

Ontario Hydro has developed a planning structure that will deliver solid results today as tomorrow's programs are building. This paper will discuss its conceptual bases, how it evolved and how it works. It also describes how DSM program design was developed as a planning tool and marketed.

Initial Activity

In autumn 1988, as Hydro developed its first DSM programs, it was obvious that these measures alone could not satisfy its 25-year reduction targets.

Primarily, Ontario Hydro is a wholesaler, supplying power to over 300 municipal utilities across the province. Energy Management Branch (EMB), at head office in Toronto, is responsible for designing and developing DSM programs; within EMB, Program Management Division designs and develops programs with assistance from Program Support & Services Division.

Latterly, however, DSM activity has been highly collaborative, teaming corporate specialists with consultants. In late 1988 Screening & Evaluation, a unit of Program Support & Services, was authorized to commission studies on DSM methodology and likely program candidates in three sectors: residential, commercial and industrial. Seven in number--two each for individual sectors and a coordinating overview--the studies were carried out simultaneously by nine consultants, working as a team. (Parallel work in the agricultural sector has been carried out in the interval.)

Sectoral steering committees were set up representing EMB and other major players in the corporation, such as load forecasting and the research division. An overseer committee, composed of senior officers of the players, ensured that work was carried out consistently across sectors. It also met simultaneously with all consultants at the beginning, mid point and conclusion of the studies.

In each sector, one consultant identified program concepts, performed an initial screening, and compiled a preliminary list of associated research issues. A second defined research plans to support concepts from their inception to delivery as full-fledged programs. The contractor at the overview level developed criteria and procedures for assessing concepts, prioritizing research, and screened all concepts identified in the sectors.

Study Approach

The study approach comprised the following six steps:

- identify potential DSM measures
- develop program concepts
- rank concepts by technology/market potential
- evaluate concepts economically
- select preferred concepts
- define related research projects

First, consultants identified measures that would likely be available by the mid 1990s, a "measure" being anything with a sound technological base which would reduce load. The resulting lists contained some 60-90 measures per sector. A small number were discarded (the technology was considered immature, or a similar, more efficient measure had been found) but the large majority resulted in one or more program concepts. The net list of industrial measures is shown in Table 1.

The second step was to transform measures into concepts for potential programs (ie. channels to deliver measures to the marketplace). Between 10-20 concepts were developed in each sector; the list of industrial concepts is shown below.

- lighting efficiency improvements
- motive power optimization
- "conflict management" strategies
- optimization of production/distribution of compressed air
- reduced uncertainty in technology performance and cost
- group load-management cooperatives
- innovative DSM financing
- equipment/building efficiency standards
- "capability/accountability building" among Hydro retailers
- cogeneration/parallel generation opportunities
- private sector ESCO service firms/Hydro ESCO spin-off
- coincidentalized metering
- decision-making processes/criteria

Third, program concepts were screened and ranked according to marketing and technological criteria. Technical criteria included: maturity of the technology in the early to mid 1990s; economic attractiveness (to be interpreted as total resource test); persistence (equipment life net of "snapback"); and dispatchability (Hydro's ability to control load).

Table 1. Energy Conservation Measures Industrial Sector

Lighting Efficiency Improvements
60W incandescent to 22W fluorescent and controls
150W incandescent to 35W high pressure sodium and controls
96W fluorescent to electronic ballast and controls
82W fluorescent to electronic ballast and controls
Convert mercury vapour to high pressure sodium and controls
Convert mercury vapour to metal halide and controls
Lighting controls
Optimization of Compressed Air Production/Distribution
Compressed air leak reduction
Compressed air nozzles medium savings
Compressed air reduce operating pressure
Compressed air outside air intake
Compressor controller
Reduce operating pressure, engine nozzles, leak reduction
Trim pump impeller
Downsized pump (10 to 5HP)
Pump variable speed drive
Flow restricting nozzles
Oversized piping
Refrigeration condenser pressure - existing control
Refrigeration condenser pressure - reset switch
Refrigeration condenser pressure - auto control
Refrigeration suction pressure - manual/controller
Refrigeration screw compressor full load
Refrigeration reduce air infiltration
Efficient motor 1.0-5HP from standard motor/rewind
Efficient motor 5.1-20HP from standard motor/rewind
Efficient motor 21-50HP from standard motor/rewind
Efficient motor 51-125HP from standard motor/rewind
Efficient motor >125HP from standard motor/rewind
Economizer on air conditioning system
Insulate steam pipes

Market criteria were: potential impact, penetration rate, lost opportunities and "free riders". Weights were assigned to the criteria to reflect the importance of particular factors relative to the group. In the marketing perspective, potential impact was critical; for the technology, maturity.

Next, DSStrategist--a model developed by a well known American consultant--was deployed, applying the five cost-benefit tests of California Standard Practice to each concept in turn. In this way, between 6-13 preferred concepts were identified in each sector.

The sectoral steering committees reviewed these lists, reducing them to eight items or less each for the residential, commercial and industrial sectors. Among the preferred industrial concepts was *motive power optimization*. Motive power accounts for about 80% of the electricity used by industrial customers and, in individual subsectors, may reach 95% of end-use share. Table 2 illustrates the process of ranking optimization as a program concept.

The key to reducing demand in this instance is to view motive power from an overall or integrated perspective rather than that of discrete applications. This approach, beginning with factors of machine design, such as optimal motor-to-equipment size, runs the gamut of functions "between shaft and load", not neglecting policies on maintenance. An approved program might include energy-efficient motors, adjustable speed drives, power factor corrections. Incentives might be offered both for measures singly and (topped-up) for a package.

Finally, to resolve uncertainties in preferred concepts, rigorous and far-ranging investigation was prescribed. Since each program concept requires some investigation before a program design can be finalized, an extensive agenda of research projects was proposed to be completed over the next three years. By case, such research might deal with technical requirements, database development, product and consumer research, the role of Hydro's trade allies, or the feasibility of technical demonstrations, pilot projects and field trials. With unlimited resources, all these projects could be undertaken; since constraints are likely, it is necessary to choose among them, to prioritize to achieve an effective research program. The criteria to be applied, with related weights and scoring system, are outlined below.

Program impact (MW)	0.4
Anticipated benefits of the research:	
• Better estimate of load impact	0.1
• Better estimate of program cost	0.1
• More effective program delivery	0.1
• Resolution of technical issues	0.1
• Lower consequences of failure	0.2
TOTAL	1.0

Table 3 represents the application of these criteria to uncertainties in the concept of motive power optimization.

PUTTING CONCEPTS TO WORK

Concept Catalogues

Refining and consolidating the consultants' work, Screening & Evaluation compiled a set of three program concept catalogues, including related research agendas. (In the interval a fourth catalogue, covering the agricultural sector, has been produced.)

As a "stock" of concepts that might be developed, the catalogues extend Hydro's reach and grasp in DSM planning. They provide a compact group of comparable but clearly differentiated activities that rewards investigation, assessment and prioritization with results of greater precision.

For example, impact can be reassessed discretely over time, summed with less fear of double-counting, and aggregate impact pegged more accurately. Concepts individually are highlighted and compared, allowing faster and more pointed prioritization. Based on prioritization, appropriate budgets and emphasis can be awarded to particular activities.

Identifying/Assessing New Concepts

However, capitalizing on these catalogues demands renewal of the concept stock, and Hydro has developed a dynamic process to generate new DSM concepts.

Where do concepts come from? Most ideas appear in an ocean of unknowns, demanding to be researched. Optimistically, as it's investigated, an idea's value as a potential DSM activity solidifies, evolving towards a program concept. Proven, the concept undergoes detailed program design to emerge, a full-fledged activity, in the field transmitting abundant data for evaluation.

It is important to give every measure a hearing, to ensure that it is not lost in the corporate bureaucracy. An assaying system, based on the Study Approach above (and shown diagrammatically in Figure 1), now assures the new idea specific and just consideration.

Table 2. Scoring Matrix (Motive Power Optimization Program)

<table>
<tr><th rowspan="3">FACTORS</th><th rowspan="3">CRITERIA</th><th rowspan="3"></th><th colspan="3">SCORING WEIGHTS*</th></tr>
<tr><th>HIGH</th><th>MODEST</th><th>LOW</th></tr>
<tr><th>(3)</th><th>(2)</th><th>(1)</th></tr>
<tr><td>Technical (0.50)</td><td>• Maturity of technology/concepts</td><td>0.417</td><td colspan="2">x</td><td></td></tr>
<tr><td></td><td>• Economic attractiveness to Hydro</td><td>0.250</td><td></td><td>x</td><td></td></tr>
<tr><td></td><td>• Persistence of load reduction/savings</td><td>0.250</td><td>x</td><td></td><td></td></tr>
<tr><td></td><td>• Dispatchability</td><td>0.083</td><td></td><td></td><td>x</td></tr>
<tr><td></td><td></td><td>1,000</td><td></td><td></td><td></td></tr>
<tr><td>Market (0.50)</td><td>• Potential impact</td><td>0.750</td><td>x</td><td></td><td></td></tr>
<tr><td></td><td>• Penetration rate</td><td>0.083</td><td colspan="2">x</td><td></td></tr>
<tr><td></td><td>• Lost opportunity</td><td>0.083</td><td>x</td><td></td><td></td></tr>
<tr><td></td><td>• Free riders</td><td>0.083</td><td></td><td>x</td><td></td></tr>
<tr><td></td><td></td><td>0.999</td><td></td><td></td><td></td></tr>
</table>

RAW SCORE: 2.62

NORMALIZED SCORE $\frac{RS}{3}$ x 100: 87.5

* Assigned by the steering committee, weights are subjective, not absolute.

Ideas from whatever source are channeled to Screening & Evaluation. Each idea is assigned a "champion", or advocate, and is subjected to two modes of close investigation (analysis, screening) to assay its feasibility and potential.

Analysis, since it depends on sources readily available, moves quickly. Still rudimentary in form, the idea circulates among EMB managers to determine its fit with current or planned activities, its potential in the market. If a likely niche is seen, enabling technology, share of market, and ultimate impact on demand are projected. (The bases of projections are clearly identified, including lacunae.) The idea is then deemed a concept ready for screening.

Screening is collaborative, including designers in Program Management and researchers in Program Support and other parts of Hydro. Their assessment goes to a committee of the seven divisional managers, which ensures that investigations are thorough and timely, and which decides to develop, reject or defer the concept. Accepted, it proceeds either to program review or research review--parallel activities leading to program design.

Table 3. Risk-Reducing Benefits of Enabling Research - Program Concept: Motive Power Optimization

RISK-REDUCING BENEFITS OF ENABLING RESEARCH

PROGRAM CONCEPT: MOTIVE POWER OPTIMIZATION

SOURCES OF RISK & UNCERTAINTY	DEGREE OF UNCERTAINTY NOW PRESENT	IMPACT OF RISK ON PROGRAM SUCCESS	LIKELY SUCCESS OF ENABLING RESEARCH IN REDUCING RISK IF UNDERTAKEN	SINGLE MOST CRITICAL ISSUE TO BE ADDRESSED
Size of available technical market potential	2	1	4	Realistic savings contribution of adjustable speed drives, given equipment sizing, duty cycle and line balancing constraints.
Optimal mix of incentive information and other program features	3	3	3	Combining persuasive justification for integrated approach with "can't ignore" financial inducements without "giving the store away".
Ultimate level of market acceptance	3	4	3	Logisitical feasibility and customer appeal of an encompassing (and expensive) A-Z efficiency program.
Optimal program delivery strategy	2	2	4	Best use of factory/process design, architects and engineers, vendors and equipment manufacturers, in the implementation process.
Total cost of program deployment	1	1	3	Minimize rebates and incentive payment outlays so as to contain cost without losing marginal applications.

KEY

DEGREE* or *IMPACT: *(1)* Little or none *(2)* Some *(3)* Significant *(4)* Extreme

RESEARCH SUCCESS: *(1)* Of speculative value *(2)* Reduce risk somewhat *(3))* Reduce risk significantly *(4)* Virtually eliminate risk

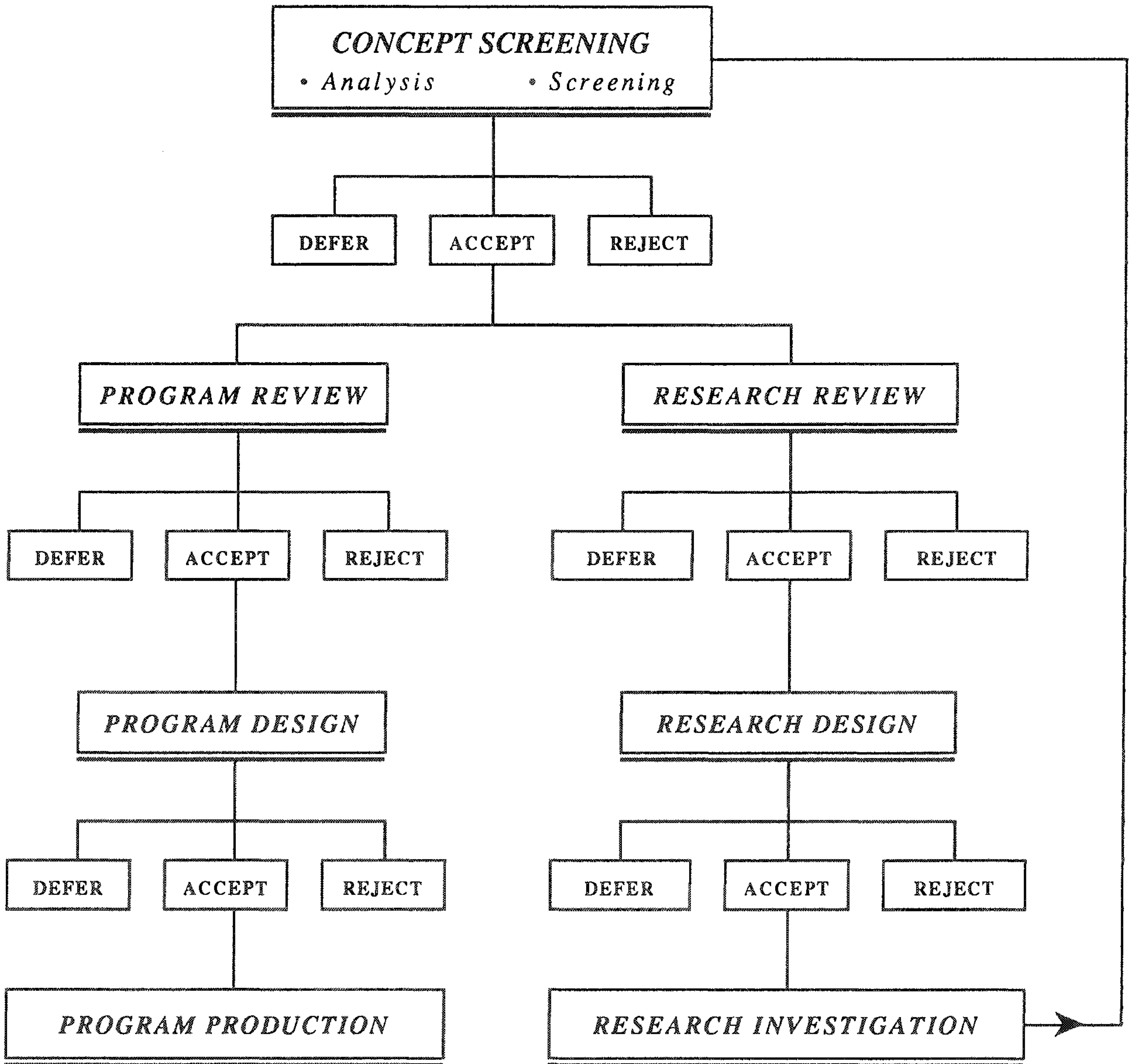

Figure 1. Concept Screening

Developing The Program

Review. A program developer is assigned and, initially, the concept is subjected to thorough scrutiny, resulting in preliminary estimates of program requirements, opportunities (including risks), and benefits. Gaps in the basic data are filled and new ones identified, all in the perspective of DSStrategist requirements--for it is here the model is first deployed. The program is "flown by" players within and outside Hydro, ensuring *inter alia* that it is integrated with other DSM activities. In a report summarizing the review, highlights are the projected annual operating results for Years I-V and estimated costs of additional research. On this basis, it is decided whether to advance the program to design, to defer or to cancel it.

Design. At this stage, the thrust is to identify and describe the components of production, and order them as a valid plan (or plans) of action. Technical and market research are performed in detail, eradicating holdout gaps in the data; task objectives and criteria are finalized. DSStrategist generates a final report indicating cost/benefit ratios over the program's life. Hard cost estimates, including incentive costs; a work outline setting production budget and milestones; a comprehensive plan of market impact measurement: all take their place, with supporting documentation, in a detailed program design. On this basis, it is decided whether to produce the program, to defer or to abandon it.

Production. The design approved, the program developer is authorized to spend funds on production. Work begins with the execution of components such as monitoring, pre launch market measurement, and a feedback structure ensuring program support. Production streams are constantly coordinated to bring the required human and material resources on site, and costs carefully registered as work proceeds. As a final step, the program is launched, the product delivered to target customers.

Evaluation. Post launch, all programs are subjected to process and impact evaluation, during which DSStrategist is used to produce updated cost-benefit ratios. Given the audit trail laid down, this will lead to improved forecasting of program impacts.

CONCLUSIONS

In bringing a program to completion, numerous assumptions must be made. The process described above has the advantages of identifying the sources of assumptions; disseminating assumptions to a wide circle of experts; highlighting the truly important assumptions; and depositing a good audit trail. It ensures that validation, if achieved, is based on state-of-the-art research and moved from a variety of perspectives, with constant crosschecking. Ultimately, it tells why assumptions were made--in case of failure, distancing inherent fault from bad judgement.

The *sine qua non* of the process is data, historical data, fresh data, particularly from active (pilot or full-fledged) programs tailored to specific problems. Hydro's activity is also influenced by its own, extensive surveys of other utilities' experience, ongoing NORDAX reportage, and intensive work on load shifting. Evaluation is increasingly reinforced by data from Hydro programs--which, it is expected, will eventually prove an assaying tool second to none.

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