needs to be screened, developed, and tested before being implemented, so will go through a number of stages similar to some of those in Figure 6.3. In addition, ideas need not all be large scale. A celebrated exponent of widespread innovation is the Toyota car company whose process is reckoned to have generated over a million ideas since the 1970s, over 80 % of which have been implemented.[4]

ASSET LIFE STAGES

Equipment and other fixed assets constitute another class of resource that may move through recognizable stages. Management of physical assets is a somewhat neglected issue in strategy, even in operations management. Yet for many companies, the value involved is considerable—a typical utility company, for example, could have tangible assets worth five times the company's annual turnover or more. For such organizations, the renewal and maintenance of physical assets is a dominant component of its business strategy. This is not simply due to the sheer scale of financial value and expenditure involved; the consequences of success or failure on the issue reaches out into the market, through the impact on customers' experience and hence on the company's reputation. A company that manages the issue well may also achieve superior performance overall, enabling it to develop both organically and by acquiring others.

Chapter 5 discussed how physical assets deteriorate, often by becoming increasingly unreliable. It treated any particular type of asset as a single population, and averaged out its reliability across all units. Chapter 5 also pointed out that the *distribution* of asset quality has important implications for asset management strategy, whether quality is rather uniform across all units, or heavily skewed by a few particularly poor units.

The distribution of asset quality does not arise by chance but instead reflects the history of their acquisition and aging. This can lead to recognizable stages in the life of an individual unit, for example:

- Whilst new units are "bedding in," even small problems in their manufacture can give rise to undesirable failure rates, despite suppliers' best efforts to ensure this does not arise.
- Units may then enter a long period when they are highly reliable, provided they are properly maintained. For motor vehicles, this period of high reliability may last many years, depending on mileage, whilst for many industrial items, 10–20 years of reliable life is common.

- Maintenance staff or users may then notice an increasing occurrence of failures—not sufficient to make the product unusable, but inconvenient and costly nevertheless. Regular maintenance is not sufficient to prevent this higher failure rate of older units. The unit may be described as "degrading." For cars and industrial assets this stage may last several more years.
- Finally, the unit becomes so unreliable that it is frequently breaking down, often seriously so, causing considerable inconvenience and cost.

Although industrial cases provide the clearest examples of this aging chain, with the important impact on reliability that arises from the process, similar stages can be observed with buildings and with key assets in other industries, such as refrigeration equipment in data centers, vehicles in logistics firms, food preparation equipment in catering and the quality of fittings in restaurants, hotels, and leisure outlets. To use the following framework in other cases, it is only necessary to review and define the life-stages appropriate to the particular situation of concern, and identify how many units reside in each stage.

Note that certain intangible "assets" also degrade over time. Information technology systems (as distinct from the hardware on which they run) effectively become less useful, even though the code of which they consist remains the same or even improves, because the business needs that the systems serve are moving forward. Similar decline applies to business processes and technologies.

Strategic management of an asset base includes a number of policy options—for example, how frequently to undertake routine maintenance, when to replace a unit completely, and when to refurbish a unit. Refurbishment involves taking the unit out of service, replacing worn-out parts and effectively restoring it to an as-new state. Depending on the asset involved, this may be possible only with units that are not too seriously dilapidated, and may only restore the unit to a partial state of as-new health.[5]

Table 6.2 shows an illustrative population of equipment units in a regulated power-supply firm, distributed amongst the four states defined above, with the number of years a unit stays in each state and the corresponding failure rate.[6]

Given this initial mix of assets and reliability, total failures occur at the rate of 900 per year (0.9 per 100 assets per year), each such event costing $20 000 in repair effort and related costs. The company receives a fee for each unit of power it supplies to customers in its region, but a penalty charge is deducted from this fee for any failures in its system that inconvenience its customers. (This situation reflects a particular regulatory regime, which may differ between countries.)

TABLE 6.2: CHARACTERISTICS OF ASSETS IN EACH LIFE STAGE OF AN ILLUSTRATIVE COMPANY

	Bedding-in	Reliable	Degenerating	Unreliable
Number of assets (000) initially in each stage	5	60	30	5
Time in this stage (with normal maintenance)	1 year	20 years	10 years	Until replaced
Failures per year per 100 assets	1.0	0.5	1.0	5.0

Even with perfect maintenance, this population of assets inevitably flows towards the unreliable state, so unreliable assets must be replaced with new, at a cost of $50 000 each. Degenerating units can be taken out of service and refurbished, making them as-new at a cost of $20 000 each. Maintenance spend ensures that reliable and degenerating units remain in those states for the longest possible time. Any shortfall in this optimum maintenance spend shortens each unit's life, resulting in an increasingly unreliable network.

Figure 6.4 shows a long time horizon for the company's assets. The business starts with a relatively poor asset base that continues to deteriorate for the first five years:

- maintenance spending on reliable assets is not sufficient to keep this number at its initial level
- maintenance and refurbishment of degenerating units are not sufficient in total to prevent a rapid flow of units into the unreliable state
- spend on new equipment is insufficient to prevent the number of unreliable units growing quickly
- the total rate of failures is growing, driven especially by the rising number of unreliable units, and price penalties are reducing the company's revenue
- falling revenue and rising operating costs are causing a rapid decline in the company's net cash flow.

The management of this degrading asset base can be explored with the **my**strategy model *asset life cycle.msf*, available at www.strategydynamics.com/smd6.

The strategic question here is where to intervene with changed spending rates, and how those spending rates should change as time passes, so as to both reestablish and sustain an acceptably low failure rate whilst at the same time producing acceptable and sustainable cash flow. The strategy depicted is as follows:

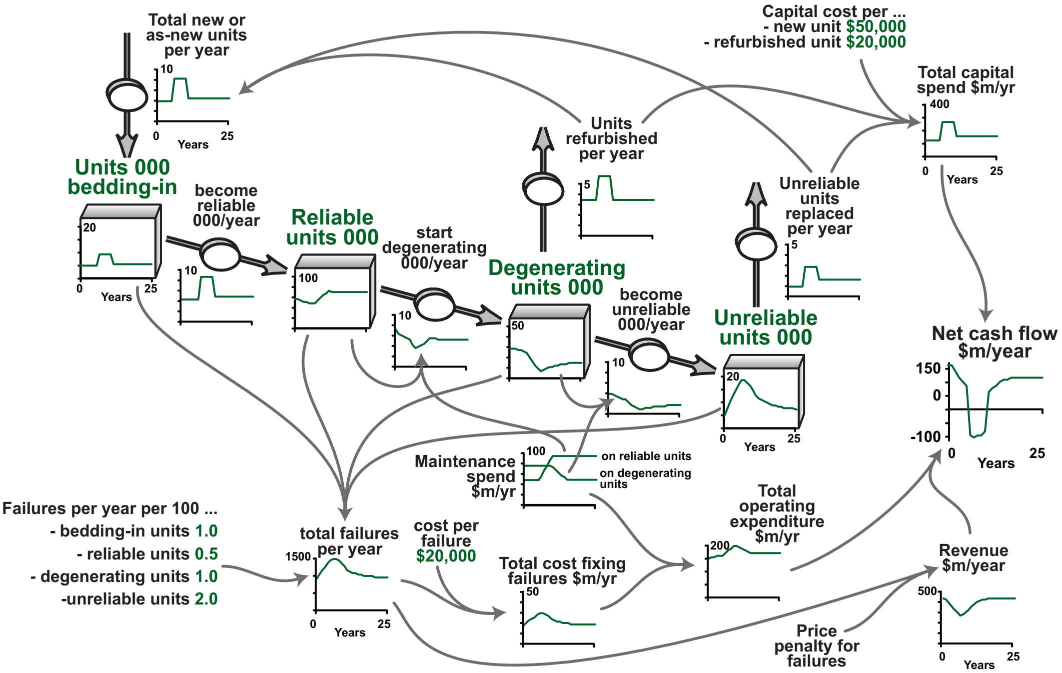

Figure 6.4: **Recovery strategy for a deteriorating asset base in a power supply firm.**

- From years 5–10, the company undertakes a major investment program to replace many of its unreliable units.
- Over the same period, most of the degenerating units are refurbished. This not only reduces their contribution to the overall failure rate, but also cuts drastically the pool of degenerating units that subsequently become unreliable. The number of unreliable units therefore continues to decline even after the replacement program is cut back from year 10.
- To prevent the number of degenerating units rising too quickly once again, maintenance of reliable units is progressively increased—a switch of spending away from the declining number of degenerating units. The rate of reliable units starting to degenerate does rise, simply because of the greater number of reliable units in existence, but not sufficiently to allow much increase in the population of degenerating units.
- Over the later years, the continuing fall in unreliable units allows a slight reduction in overall failure rates, though this is partly countered by a small increase in degenerating units.

- After the replacement and refurbishment programs are ended, and maintenance is reallocated onto reliable units, falling failure rates reduce the price penalty on the company, allowing net cash flow to recover to a healthy and sustainable rate. (Note that this illustration does not include the cost of capital. Over the five-year period of higher replacement and refurbishment, the company invests over $500 m more than it would have done, had its original investment rate continued. The interest cost of this additional investment would reduce the ultimate improvement in cash flow, but the result is still preferable to the original performance.)

In practice, the asset base for such a company would be made up of a variety of asset-types—switches, transformers, cables, etc. Each of these asset types would have its own characteristics of aging rate, maintenance requirement and contribution to failures, and each require its own strategy for reaching and sustaining an adequately reliable performance level. The aging chain in Figure 6.4 would thus need to be repeated across each type of asset, and the resulting performance added up across all the types of asset involved.

Doing it right: resources in development must be "MECE"

The resource development chains in this section each encompass the entire population of the resources involved.

The law-firm chain includes all lawyers in the firm, partners and others, the product chain covers all products undergoing development, and the utility firm model includes all of the firm's units of equipment. This illustrates an important principle that is essential to making sure the performance outcomes are numerically accurate—the stages in the chain must be "MECE," mutually exclusive and collectively exhaustive; that is, each unit of resource must be in one of the chain's stages and *only* one.

- The lawyers in Figure 6.1 are either regular lawyers in the lower stock or partners, but not both.
- The products in Figure 6.3 are either in unscreened ideas *or* in technical development *or* in commercial development *or* in final development.
- The utility firm's assets are either bedding-in *or* reliable *or* degenerating *or* unreliable.

This principle can require some care. It is important to label each state carefully to avoid any uncertainty as to the state in which any resource unit resides. It may also be necessary to clarify any exclusions—for example, the product development chain stops when products are actually launched, and therefore excludes products that were previously developed.

There can be complications when a resource unit is participating in two or more development processes. As noted above, firms sometimes try to compress the product development cycle by working in parallel on technical development and commercial evaluation. Depending on the complexity of the situation and the potential impact of specific decisions, it may thus be necessary to construct linked development models. As far as one department is concerned, products have either not started development, are in the initial technical development stage, or are in final development. But the commercial department needs a chain taking a different view, with products either being not yet in commercial development or actively being worked on. These two separate chains must still conform to the MECE rule.

FURTHER IMPLICATIONS OF RESOURCE DEVELOPMENT

ATTRIBUTES CARRIED FROM STATE TO STATE

Chapter 5 explained how resources carry attributes with them when won by, or lost from an organization. Resources also carry attributes with them as they develop from stage to stage. A common case concerns staff experience, which for simplicity can be measured in years. Figure 6.5 shows a three-level staff structure, with junior staff being hired with no experience. Thereafter, three distinct mechanisms raise or lower experience:

- junior staff add one year of experience for each year they remain in that grade
- each junior person lost reduces the total experience of the group by taking with them the number of years' experience they have
- each junior person promoted also reduces the total experience of the group by taking with them the number of years' experience they have, but this is added to the experience of the middle management group.

Note, as explained in Chapter 5, that the stock of *total juniors' experience* is expressed in person-years, so the average person's experience is given by dividing this total by the actual number of *juniors*.