

The Application of System Dynamics to Re-Engineering Career Plans

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Abstract

This paper demonstrates the use of system dynamics in the examination, evaluation and reformulation of business policy. It describes the consultancy and modelling process used to examine the recruitment and promotion systems of a large company.

The management felt that the short-term decisions they were making, particularly about how many graduates to recruit, were endangering their ability to manage the system in the longer term. They were finding that there were too many staff at middle management grades, whilst they were doubtful that they were developing the senior management of the future. They further believed that the system, as currently operated, gave them little ability to control the long-term availability of staff. It was decided to initiate a study, using system dynamics, to understand the dynamics of the manpower system and study the policy options available for controlling the system. The model enabled management to increase their understanding of the system and evaluate their current method of decision making.

The model demonstrated that the problems were indeed caused by the system, and that managers had adapted their decision making process close to the optimal, given the constraints in which they were operating. A new system of recruitment and promotion was defined, tested and implemented, which overcomes many of the problems identified in this study.

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Introduction

This model formed part of a project to study the manpower planning policies of the computing function of a large multinational company. A small study [Lane 1993] was performed on the computer programmer recruitment system in the same part of the company. It was as a result of this project that the clients wished to investigate the system further, but on this occasion they wanted to examine the entire recruitment and promotion process rather than the small part of the system previously examined [Byrne & Davis, 1991]. Managers were concerned that they had relatively little control over the system. They found that when they were faced with making recruitment decisions, the pressures they found themselves under seemed to vary from year to year although neither the long term numbers required nor the company's position in the job market changed dramatically. This suggested to the managers that there was something wrong with their current understanding of the career paths they offered, and that they had little faith in the flexibility of the system.

The current system for planning how many people they were going to recruit each year depended quite heavily on the planned levels of staff required in the future. The level of uncertainty in these totals was extremely high, they were dealing with career paths that might be up to forty years long. They could see in their current population, the results of previous assumptions that had not been fulfilled. For example, in the IT function, it had once been believed that the department's main task would be leading large design and implementation projects. As a result, a number of people had been recruited who were capable of running such projects, but not necessarily of becoming line managers. With the change in the business environment, these skills are not really required, and there were a number of surplus staff not suited to other jobs in the organisation.

The objectives of the project were not solely aimed at producing a radical improvement in performance through re-engineering the business processes [Johansson, McHugh et al, 1993] but formed part of a wider learning process [de Geus, 1988] and can be summed up as follows:

- To understand how the system in its current state will develop in the future, given expected manpower requirements;
- To understand how the different policy options available within the current system affect managers' ability to control it;
- To discover whether there is sufficient flexibility in the current system to meet changes in target numbers, or whether a more flexible system is required.

Initial Meeting

The project was started when two consultants attended a meeting of the management team. The management team consisted of around a dozen members drawn from various regional offices and the central office. They had responsibility for managing around 1,400 staff in the UK. The managers had had varying exposure to system dynamics, some had been involved in the earlier project, whereas others were entirely new to the subject. They shared a common desire to develop their staff over the long-term, enhancing their skills for more senior roles so that they grow their own future management. To achieve this they needed to understand the long term behaviour of their system, so that actions they were taking today did not undermine achievement of their overall goals in the future.

This meeting was intended as a brainstorming session within the management team, rather than as a meeting to initiate the project. However, as the issues under discussion were those that were to be modelled it seemed sensible to combine the two. At the meeting the problem was outlined as described in the introduction and different aspects were discussed. It became apparent at the meeting that the various managers all had different views as to the solution to the problem, primarily as a result of differing opinions about its causes. In order to take the project further it

was decided that we, as the consultants, would examine one of the regional offices and see what lessons could be applied elsewhere in the organisation. Thus, the second meeting was set for the regional office, by which time we would have collated our learning from the first meeting into a structured framework.

Follow Up Work

Following the meeting we identified five policy levers that could be used to influence the way that people moved through the system. We have given these our own names:

- **Move by the rules.** The personnel system lays down a series of rules about promotions. These are based on two factors, age and potential. Potential is defined as the level in the organisation that the individual is expected to achieve by the time they retire from the organisation. Through knowing the level that an individual will ultimately reach, it is possible to work out how old they should be as they reach each intermediate level in the system. This enables personnel to draw up a grid with age, potential and job level. If managers follow this system there is little discretion for them once they have recruited someone as their future career is mapped out by factors beyond manager's control - potential and age.
- **Promote from within.** This policy is simply to promote people from within the organisation as and when - and only when - a vacancy arises. The first option is people centred, when the person is ready they are promoted, the second option is more organisation centred, when the company needs a move someone is promoted.
- **Recruit from outside.** The third policy is to recruit someone from outside the organisation to fill a vacancy; either through adverts in papers or through consultants. This option is probably the simplest for the manager who has the vacancy but is likely to make a mess of the personnel system as it takes no account of developing managers from within the company and takes the means to operate development policy out of the hands of the personnel department.
- **Use fixed term contractors.** This option is very similar to recruit from outside only instead of bringing in people permanently they are given a limited contract, normally for three years. This is a useful option for bringing in the specific talent required, but is often also a means of getting around systems that restrict the number of permanent staff that can be recruited. These people perform the job of a permanent member of staff, however they do not compete for promotion at the next level.
- **Use short term contractors.** The final option is to bring in someone on a short term contract. These are contracts that are renewable monthly. They are extremely useful for filling in short term gaps in the system, however, they are an expensive option and are difficult to manage because of the short term nature of their employment.

Also resulting from the first meeting was the identification of the objectives of the system. The primary objective is to ensure that there are sufficient people to meet the required staff numbers at all levels in the system. There are also secondary objectives for the organisation as explained earlier: the desire to provide a fulfilling career path for the employees; and the desire to develop management from within the firm.

Second Meeting

Prior to the second meeting we drew up a series of influence diagrams to be the basis of discussion at the regional office. These diagrams were ultimately to form the basis of the model, the final versions are shown in figures 1, 2 and 3. The three diagrams show similar sets of logic for four of the policy levers: the promotion logic shows the structure of both 'move by the rules' and 'promote from within', which are variations on a theme; 'recruit from outside' and 'use fixed term contractors' show essentially similar logic; the final policy of using short term contractors

was not modelled at all. Following the completion of the model in the initial study we were able to assume that any shortfall in staff could be made up from the short term contract market, and any excess of these contractors could be reduced easily.

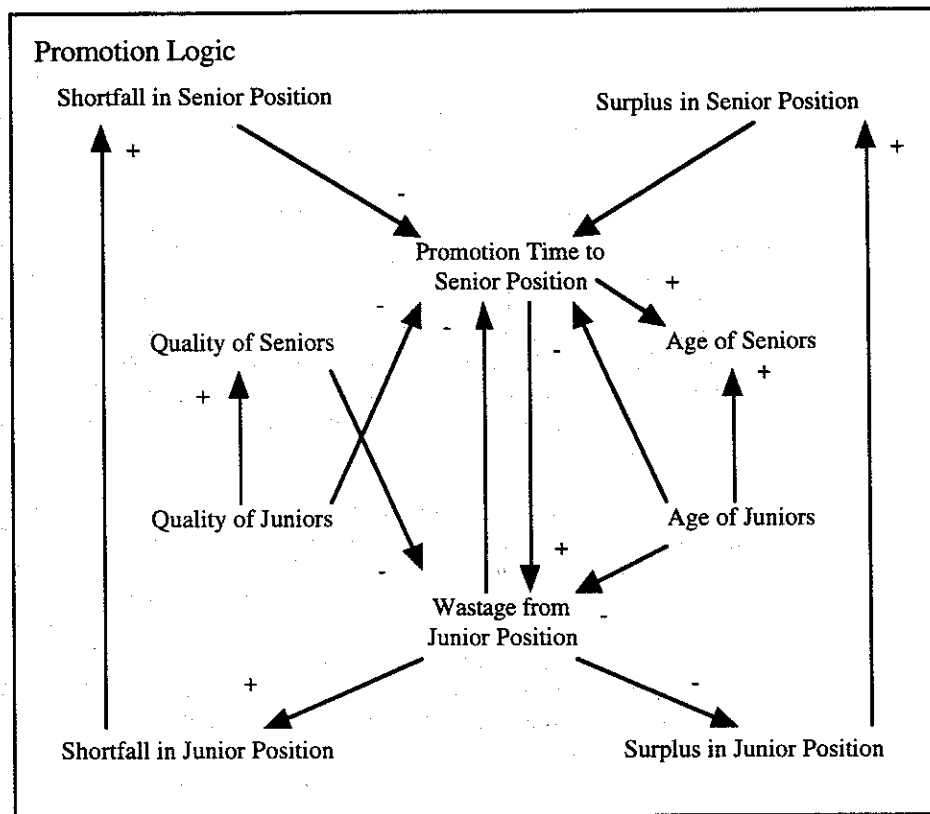


Fig 1 shows the basic logic for promoting people from within the organisation.. The explanation is as follows. Starting from a surplus in a senior position, promotion time to the senior position rises with a resultant increase in the wastage from the junior position as junior staff see promotion times rising and seek work elsewhere. Ultimately this is a balancing loop as the reduction in junior staff will feed through to senior positions. Other factors that affect promotion and wastage rates are age and potential, or quality as described in the diagrams. The logic of these is that of 'move by the rules', the older and better the junior staff are the faster they will be promoted. There are two other factors also included: higher quality senior staff are believed to reduce wastage amongst junior staff through their ability to manage staff well; young junior staff will be more likely to leave than older staff, the reason is not known for sure but it is a consistent observation.

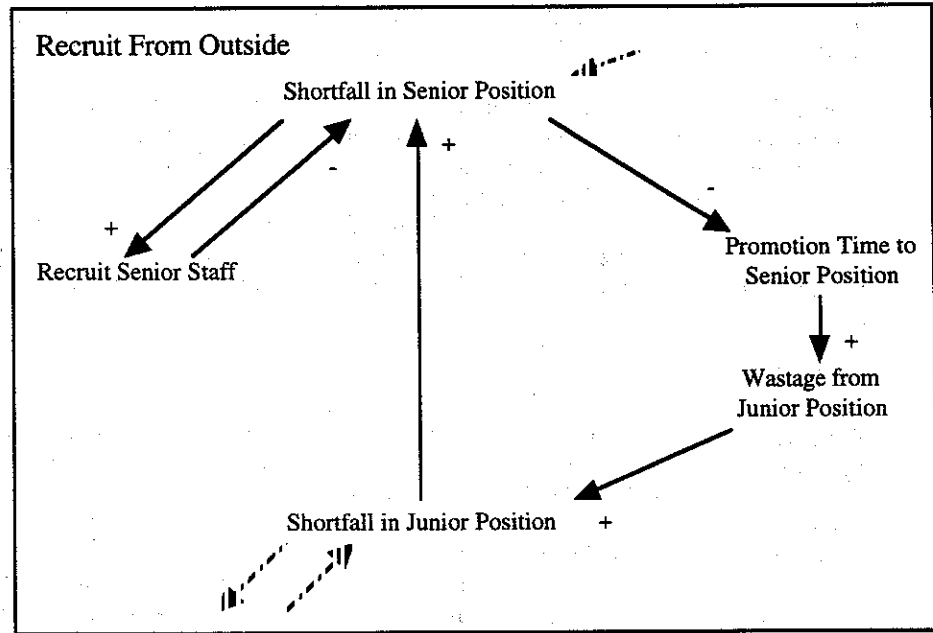


Fig 2 shows 'recruit from outside' logic. The diagram does not show a surplus, as recruiting people will not help in reducing a staff surplus. Starting from the situation of a shortfall in the senior position, managers can recruit into that position, reducing the shortfall and completing a simple balancing loop. However, the effect is to increase the promotion time and thus increase wastage in the junior position, making it harder to find a promotable junior the next time a vacancy arises. This type of behaviour has been described by Senge as 'shifting the burden to the intervener' [Senge 1990].

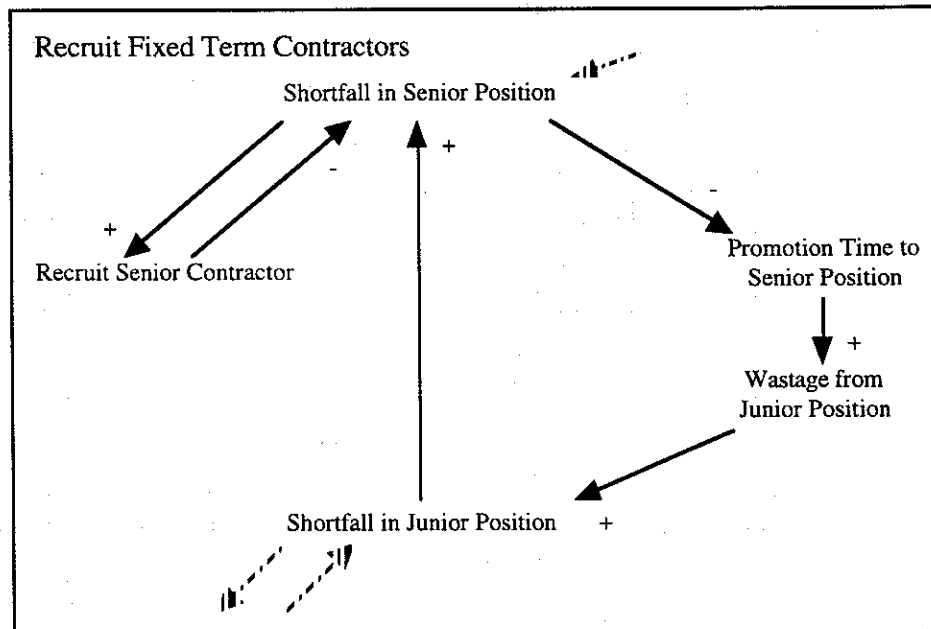


Fig 3 shows the logic of 'recruiting fixed term contractors'. It is exactly the same as recruiting people from outside except in the duration of the effect, which in this case is only temporary.

Formulating these diagrams was a particular challenge because all the policies interact with one another, as can be seen from the common factors in the diagrams. In addition, the diagrams

themselves need to be stacked one on top of the other to get the true picture. Thus, the clients (and indeed the consultants) were dealing with only a very small part of the total picture at once.

The second meeting took place over a full day at the client site, with members of the client team entering and leaving as their time commitments allowed. This was not an ideal process. However, the time spent in preparation of the diagrams proved to have been invaluable as they were easy and quick to explain and were used to bring returning participants up to date rapidly with the flow of the meeting. The diagrams were finalised in this meeting, with agreement from all the client team. At this stage one member of the client team was selected to work particularly closely with the consultants in the collection of data and the conversion of the causal loop diagrams into the model itself.

Model Building

Following the production of the causal loop diagrams the team began to work on a system dynamics model [Forrester 1985] using the package Stella from High Performance Systems [Richmond et al, 1987]. The basic structure of the model is a series of repeating units made up of those elements shown in figures 1 to 3. There are two sets of flows, one modelling the staff numbers, the other modelling staff quality. The fact that the company grades staff according to their potential enabled us to model staff quality in a co-flow so that it was possible to model all the influences in the causal loop diagrams. Figure 4 gives a diagrammatic representation of the structure of the model. There is the main flow of staff, rising through the hierarchy at a rate determined by the company's policies, the target staff levels and the quality of staff available.

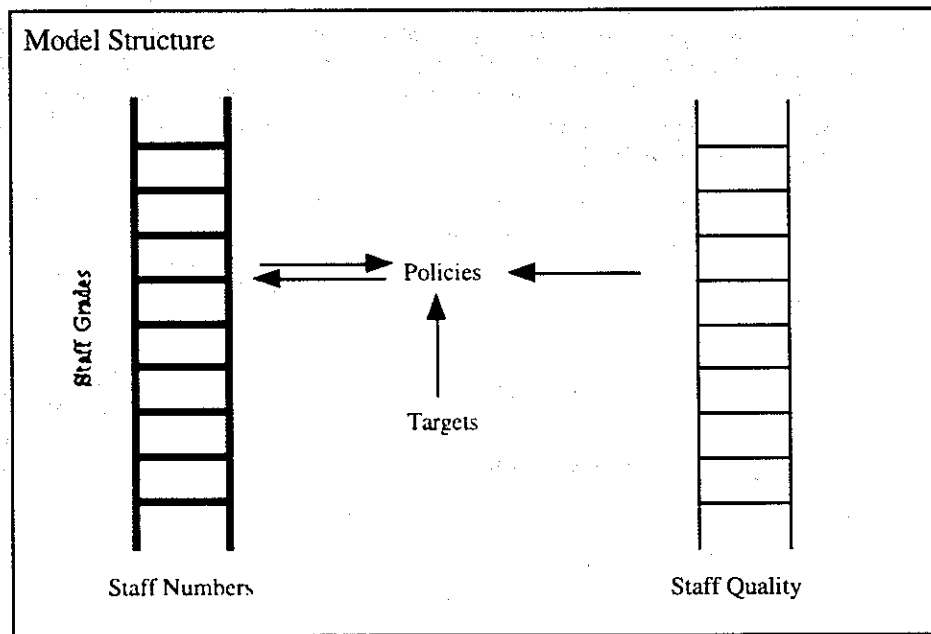


Fig 4 shows a basic outline of the structure of the model. Staff progress up the left hand ladder according to their quality and the difference between target staff levels and actual staff levels, in a manner which is defined by the policies in operation. Each of the rungs in the left hand ladder contains the logic shown in figures 1 to 3. The model itself is made up of a main flow of staff numbers and a co-flow representing the quality of staff (as defined by their potential).

The complete model consisted of 170 equations, although many of them were repetitive due to the repeating nature of the model. We spent some time ensuring that where there was a requirement for more complex modelling this was confined to the equations so that the diagram represented client understanding as closely as possible. This runs in the face of some of our previous experience when we had endeavoured to make the equations as simple as possible. We

based this decision on the level at which the client wished to interact with the model. In previous projects we had worked with clients right down to the equations, going through and revising them together. In this project the size of the management team and their more 'hands off' style of management meant that they would be involved only at a more conceptual level, best illustrated diagrammatically. This approach appeared to be justified as the clients showed little interest in the detail of the equations, only in the explanations and interpretations offered by the consultants.

Results of the Model

We ran the model to demonstrate the effect of using the four remaining policy levers (using short term contractors was excluded, having been previously modelled). The first run was of the 'Move by the Rules' scenario, the one that management said they were adhering to.

The results are summarised as follows:

- there is little control over the system as people's career paths are largely determined at recruitment;
- the current position is unstable as managers have moved into positions too soon, this leads to them facing a long time until their next promotion, resulting in high wastage rates and, ultimately, a dearth of senior management.

This led to two conclusions. Firstly, the policies that managers had been using were clearly different from those of 'Move by the Rules' and any attempt to manage by these policies was immediately subject to the objection that they couldn't start from here. Secondly, the structural rigidity of 'Move by the Rules' meant that, even given a stable starting point, they had no flexibility if targets were changed in the future: an event that was more of a certainty than a possibility.

The second set of runs were based on the 'Promote from Within' scenario. In this case the model was allowed to set its own promotion times to ensure that target levels were met at all levels. The most important fact about this scenario is that it is the only set of rules that allows you to manage staff levels downwards if this becomes necessary, rather than hope that the system will shake out any excess staff numbers.

These runs demonstrated that 'Promote from Within' gives far greater flexibility than 'Move by the Rules.' This was not, of itself, a surprising result, and could have been reached through use of the causal loop diagrams alone. However, it also became apparent that the corrections required based on the current position were so great that even this system did not have the required flexibility. In particular the following failings arose:

- in early years there was a high level of wastage amongst younger, more mobile staff, who respond to long promotion times more rapidly than their senior colleagues;
- in later years there was a shortage of more experienced senior management.

Further investigation at this stage revealed that the 'Promote from Within' policy was the one that managers had previously been using, despite the official line that they were operating 'Move by the Rules'. It is clear from our findings that this is by far the most flexible approach available to managers and had become adopted, albeit unofficially, because the constraints imposed by 'Move by the Rules' made that system unmanageable.

'Recruiting Fixed Term Contractors' was a policy that allowed managers to fill positions for three years. When positions arose that could be filled by staff internally through following the 'Move by the Rules' policy, this was allowed to happen: contractors were only brought in when there was no such internal candidate. The results of this were:

- short term targets can be met more quickly than 'Promote from Within' due to the time required to free a candidate from their current job commitments;
- it creates additional wastage at more junior grades due to the increased promotion time.

The overall effect of this policy was to exacerbate the problem of early wastage in junior levels which leads to a shortage of senior staff later.

The final policy was 'Recruit from Outside'. This worked in exactly the same way as 'Recruit Fixed Term Contractors' except that the people brought in joined the organisation permanently and began competing with existing staff for promotions. The effect is also similar to 'Recruit Fixed Term Contractors':

- short term targets can be met more quickly than 'Promote from Within' due to the time required to free a candidate from their current job commitments;
- it creates additional wastage at both this grade and more junior grades due to the increased promotion time.

Once again this policy proves to be worse than 'Promote from Within' in terms of exacerbating the problem of junior wastage followed by a shortage of senior staff. In general it is not as bad as 'Recruit Fixed Term Contractors' as when a contractor is recruited it not only causes wastage low down, but then frees up the position later, when there is no-one to fill it.

Conclusions

It rapidly became evident to the team members that however the system was managed, using whatever combination of policy levers seemed sensible, it was basically an unmanageable system. This led to the inevitable conclusion that the system needed to be changed allowing management greater flexibility to identify their future senior managers and develop them within the group. Such a system was devised, with the following characteristics:

- fewer permanent staff were employed, but they were given priority in filling positions, giving management the freedom to promote staff when they felt the staff needed to be promoted, not being dictated to by 'Promote from Within' criteria;
- a new way to manage contractors was developed that allowed staff who did not have senior management potential to be rewarded in a separate system, whilst also providing the flexibility to increase or decrease numbers and to create vacancies for permanent staff.

These policies were also tested and modelled and proved to provide the flexibility required by management, whilst also allowing staff to develop a career in the company, either as permanent staff or on a series of fixed term contracts.

Lessons

Perhaps the most important lesson we learned during this project was the power of the causal loop diagram as a means of keeping the management team up to date on the project. In previous projects we had either omitted the diagrams altogether or used them as an intermediate step to be superseded by the model itself. In this case, the diagram itself was too complex to present to the entire management team, even despite our efforts to keep it simple. We therefore, presented the model at three levels: causal loop diagram, Stella diagram and full model, depending on the audience for which it was intended.

We have since confirmed this belief in other projects, where the causal loop diagram has led not solely to system dynamics models, but to such diverse models as decision analysis, spreadsheets,

matrices and back of the envelope calculations. We have since further explored the integration of system dynamics with other process analysis techniques, particularly IDEF diagrams [see Johansson et al, 1993], at both ends of the consultancy process.

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