

A systems thinking study of the New Zealand Army electronic technician trade group

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Abstract

Since the mid-1990s, the New Zealand Army has experienced difficulty retaining personnel in the Electronic Technician trade. The problem will be exacerbated by the Army's force modernisation programme, as the introduction of new technologies into service will place increasing demands on this diminishing specialist trade group.

In late 2002 and early 2003, a qualitative system dynamics study was undertaken to establish a better understanding of the causal factors of poor retention, their interconnections and complex relationships, and to identify leverage points to develop a turn-around strategy. This involved using systems thinking concepts to work with the different stakeholder groups associated with the electronics trade group, to develop mental models based on the soldiers perception of the system in which they serve. Separate group model building workshops were held with the apprentices, tradespeople, management, and external stakeholders.

The shared mental models (or causal loop diagrams) developed for each internal stakeholder group were combined. This was used as the basis for the analysis of leverage points within the system, and to facilitate the development of action plans for the trade group. The paper will outline this systems thinking study and the subsequent implementation of the recommendations.

Introduction

Retention of personnel in the Electronic Technician (Electech) trade of the New Zealand Army has been challenging for a number of years. The experience profile of the current trade group is very weak and the trade is in imminent danger of collapse. Attrition among NCO ranks has outstripped the ability to sustain the trade with replacement qualified military tradespeople. As the Army approaches a major force modernisation programme with the introduction of significant new technologies into service in 2005, there will be an increasing demand placed on this diminishing specialist trade group as shown in figure 1. It is vital to the successful introduction of these technologies that the issues underpinning the current poor health of the Electech trade are identified and that measures are implemented to rectify problem areas and increase the trade's equipment support capacity as soon as possible.

Army Requirements for Electronic Technicians

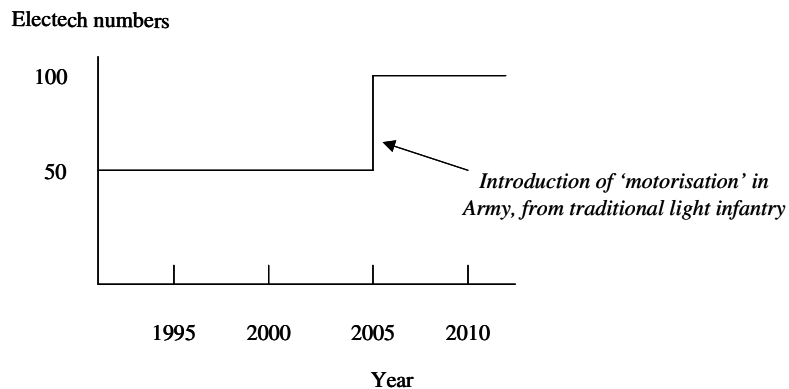


Fig. 1. Reference mode for the study

Concerns about continuing problems have been raised on a number of occasions but have consistently been unsuccessful in instigating meaningful remedial action. In 1996 a retention bonus was paid to selected ranks within the Electech trade in order to bolster the trade's strength but this was not followed up with any other initiatives to identify or address underlying issues. More recently a project was initiated in March 2001 to investigate a range of HR factors, but unfortunately little progress was made due to the strain on staff resources brought about by operations in East Timor.

It was apparent that there was no standout issue(s) affecting the Electech trade group; rather, there seemed to be a plethora of frustrations contributing to low morale. This is consistent with the willingness to serve model developed by McCone (1997) where he used the metaphor of a brick wall to illustrate the idea of there being an obstacle in the path of individuals to further military service. The bricks that make up the wall are representative of an accumulation of negative perceptions or experiences accrued by a person over time (Figure 2). As bricks are added to the wall, or grow in size, there comes a point when the person can no longer see beyond the wall and will begin to look for alternative employment. For the Electech trade group there is no shortage of alternatives with high demand for skilled technicians in the private sector.

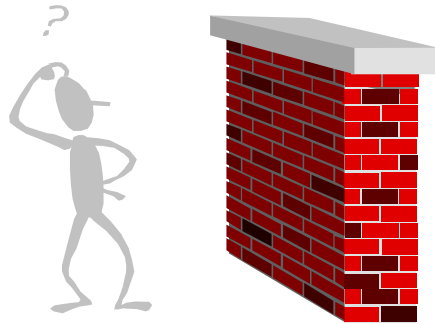


Fig. 2. Accumulated negative perceptions

This complex web of contributing factors prompted consideration of the use of ‘systems thinking’ techniques to investigate the problem. Systems thinking provides “... *a framework for seeing interrelationships rather than things, for seeing patterns of change rather than static snapshots*”. (Senge, 1990, p68).

Systems thinking or qualitative system dynamics is particularly useful in situations where there is limited data, and the emphasis is on understanding causal relationships between factors, rather than the development of a quantitative system dynamics simulation model. Army had some understanding of the concepts of systems thinking and the related field of system dynamics and had used these concepts in manpower modeling and recruitment forecasting. However, Army’s knowledge was not sufficiently mature to apply these disciplines effectively in this type of ‘soft’ problem solving situation. A proposal was developed to engage the first co-author of this paper, considered to be a NZ ‘expert’ in this field, to facilitate a systems thinking study of the Electech trade. This paper provides an overview of the study.

Electronic Technician Trade Background

The Electech trade is responsible for the second line maintenance and repair of all in-service electronic equipment (this was recently expanded to include all radio equipment repair) and a range of instruments such as binoculars and compasses. The trade is small relative to other Army trades. The average trade strength over the period Dec 97 until Jul 01 was 43 people, recent increases in recruitment and transfers from the Telecommunications Engineer trade has increased this to 51 since Jul 01. The small size of the trade and the long training time required to achieve a high level of proficiency makes it particularly vulnerable to attrition shocks. This is clearly demonstrated in Figure 3 below, where a significant number of junior ranked personnel left in the period March to July 1996. The ripple effect can be seen through to a depletion of senior ranks in 2002.

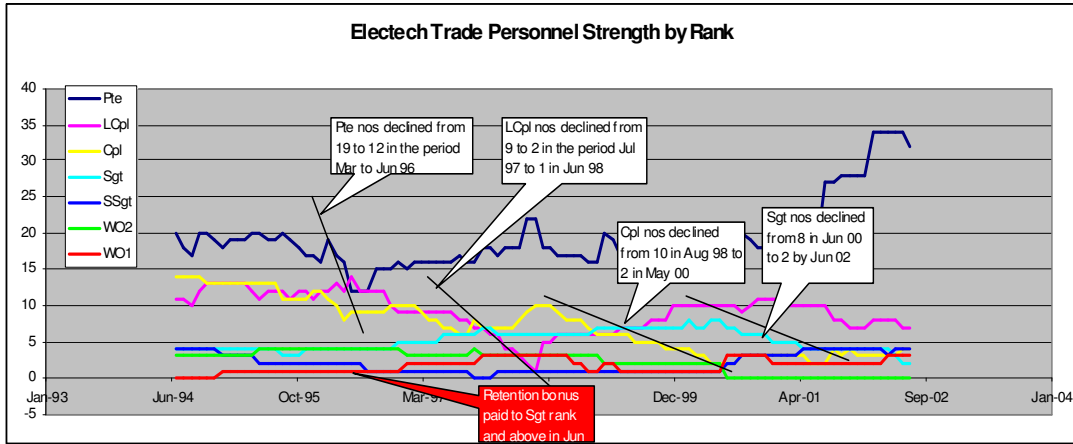


Fig. 3. Electronic technician trade group personnel numbers, 1994-2004

The availability of appropriately skilled and experienced Electechs to meet the trade's authorised establishment has been highly problematic for almost a decade. The structure is not well balanced. Structural changes in the second half of the 1990s, driven largely by decisions to out-source non-deployable functions, not only reduced the overall trade establishment but also interfered with the rank balance of the establishment. Out-sourcing of base level repair has also had an impact on career satisfaction for Electechs as they no longer have the opportunity to be involved in these activities. Figure 4 shows the current authorised establishment and trade strength for Electechs.

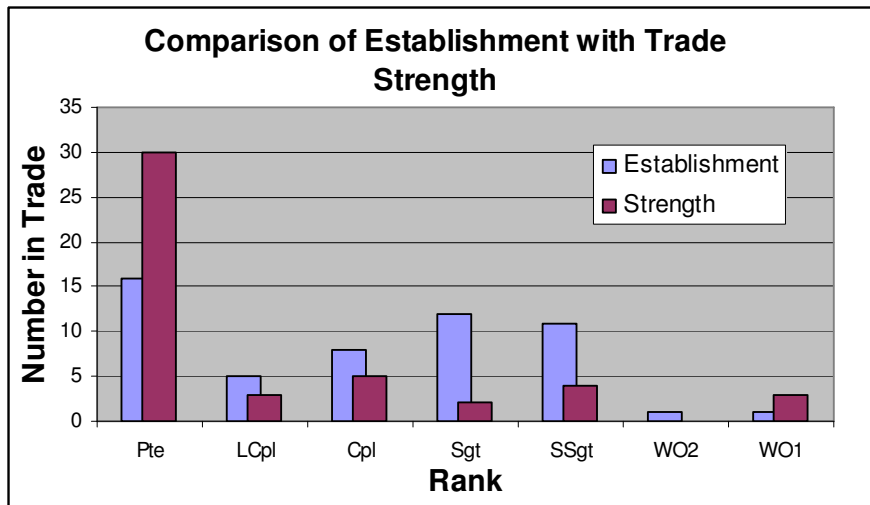


Fig. 4. Comparison of establishment with trade strength for Electech group

Retention of trade-qualified personnel is undoubtedly a problem. Electech trainees are subject to a return of service¹ (ROS). For those completing four years training the ROS is normally two years. In analysing trade release figures it is useful to consider the trade in two parts; those subject to ROS, i.e. in their first six years of service, and those who have completed their ROS. Release rates are only one

measure and do not provide a comprehensive understanding of the trade's current dilemma. Examination of the length of service (LOS) of serving tradespeople is revealing. Of the 47 Electech tradespeople in the Army in February 2003 there was an even distribution of six in each year of service to year five reducing slightly to five people in year six. However, in the year seven LOS, i.e. those who enlisted in 1995, there was only one person remaining in the Army. Most significantly, there are no tradespeople still serving from each of the cohorts from year nine until year 15 LOS category (those that enlisted between 1987 and 1994). This gap in the LOS profile correlates strongly with the deficiencies in Senior Non-commissioned Officer tradespeople. On average it takes 6.7 years from enlistment for an Electech to attain promotion to Corporal, for promotion to Sergeant the time from enlistment is 15.4 years on average.

Anecdotal information suggests that the genesis of the Electech trade problem lies in recruitment cutbacks in response to reductions in the Defence budget in 1990. Figure 5 below shows the number of new recruits enlisted annually into the Electech trade since 1980. Certainly the gap in LOS from year nine to year 15 covers this period. However, while the recruiting years of 1989 – 1991 (LOS years 12 to 14) were undoubtedly lean, there were 10 new entries to the trade in 1992 (LOS year 11). This suggests that other adverse factors were operating against retention.

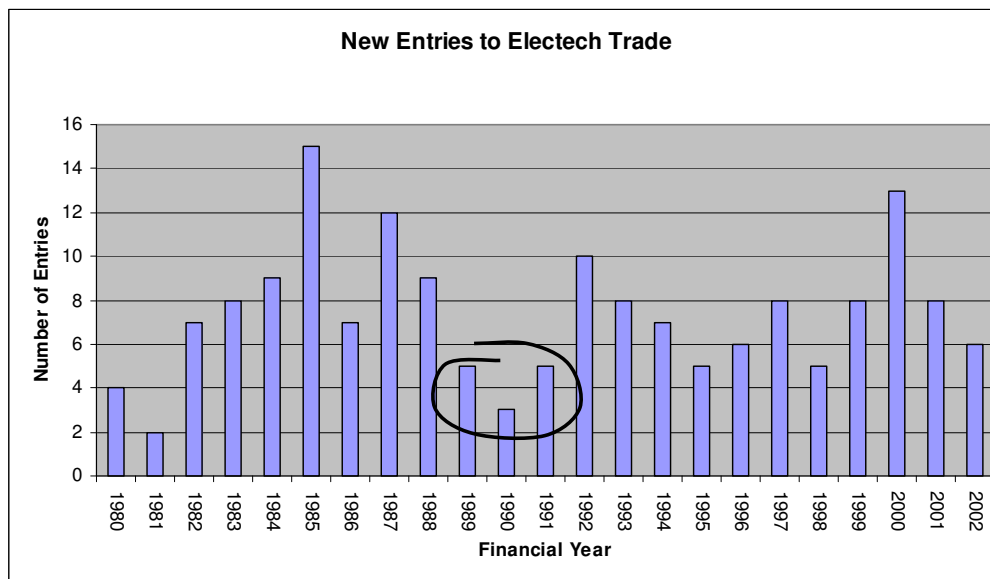


Fig. 5. New recruits to Electech trade group, 1980-2002

Methodological approach

The general methodological approach used for this study is called systems thinking² or qualitative system dynamics³. The systems thinking approach was selected for this study, since it was widely known in the Army that there were multiple factors, both perceived and real, contributing to the poor retention rate among the Electech trade group. The situation was seen to be very complex, and subject to considerable change over time.

The systems thinking approach is particularly useful in situations where there is limited data, and the emphasis is on understanding causal relationships between parts or factors within the system. The approach used group model building⁴ methods to develop mental models of the 'system', which in turn were used to identify leverage points, or points of influence, within the 'system'. In this study the group models helped shape an understanding of the factors contributing to the perceived 'bricks in the wall'.

A number of different stakeholders that could influence, or be influenced by, the Electech trade group were identified. These are summarised in the stakeholder map (Freeman, 1984) in Figure 6. These stakeholders were then grouped into three internal Army stakeholder groups: tradespeople, apprentices and a management group; and one external stakeholder group. Army participants were allocated to the first three groups on the basis of their occupation grouping and the three authors worked with each group for the planned sessions (two as facilitators and one to record the 'extra comments'). Representatives of the external stakeholders identified in Figure 6 were invited to participate.

Separate workshops for each of the main internal stakeholder groups were conducted to allow the individual stakeholders (e.g. apprentices) to put forward their issues and concerns, without fear of prejudice or other adverse consequences later from the other stakeholders in the system (e.g. apprentice technicians and their instructors or managers).

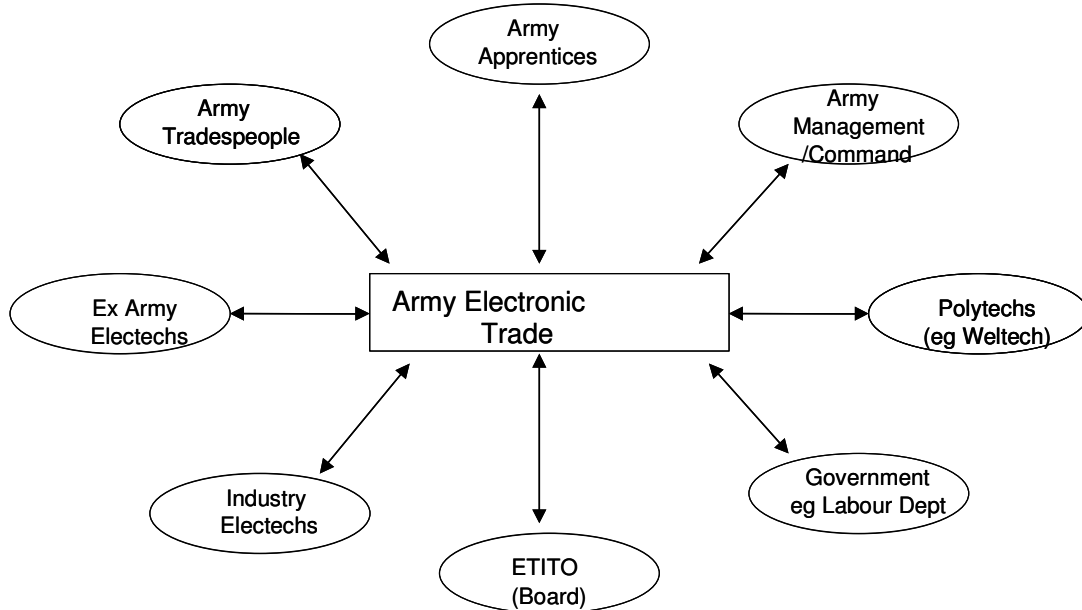


Fig. 6. Stakeholder Map for Army HR Electronics Trade Project

The stakeholder groups met separately for a full day workshop during the period 18 Nov to 2 Dec 2002. This was followed by a further four hours back-brief workshop on 29 Jan 2003 at the Trentham Army Camp to discuss the preliminary findings, causal loop diagrams (CLDs), interpretations and the insights that emerged from the workshops and subsequent analysis. Workshops were held with each stakeholder group as follows:

Tradespeople Group. This group was comprised of 11 members of the Electech trade group who had completed their apprenticeship training (77 issues/concerns were generated by this group).

Apprentice Group. A total of 18 apprentices were brought together for the workshop (85 issues/concerns were generated by this group). Notably this group was very negative about service life.

Management Group. Five senior staff members were present at this workshop and 90 issues/concerns were generated.

External Stakeholders Group. This workshop comprised of a range of people from industry, educational institutions and government. A total of 91 issues/concerns were generated.

As any system is ultimately made up of a number of sub-systems and is also part of larger system, it is useful to agree on a focused organising question in a systems thinking study. This helps to limit the scope and boundaries of the investigation and will improve the likelihood of reaching some conclusions from the study and implementing the recommended changes. At the first workshop the following organising question for the project was developed and this was also vetted and agreed to by the subsequent workshops:

“What steps could or should the Army take to better attract and retain Electronic Technicians?”

The authors used coloured hexagons (see Kreutzer’s (1995) FASTBreak™ process) as a facilitation tool to construct the CLDs in each workshop. A discussion of the use of hexagons (*idons*) at the preliminary issue conceptualisation stage of modelling can be found in Hodgson (1994). The general approach used for the workshops is outlined in Cavana et al. (1999) and Maani and Cavana (2000). The process is illustrated in Figure 7.

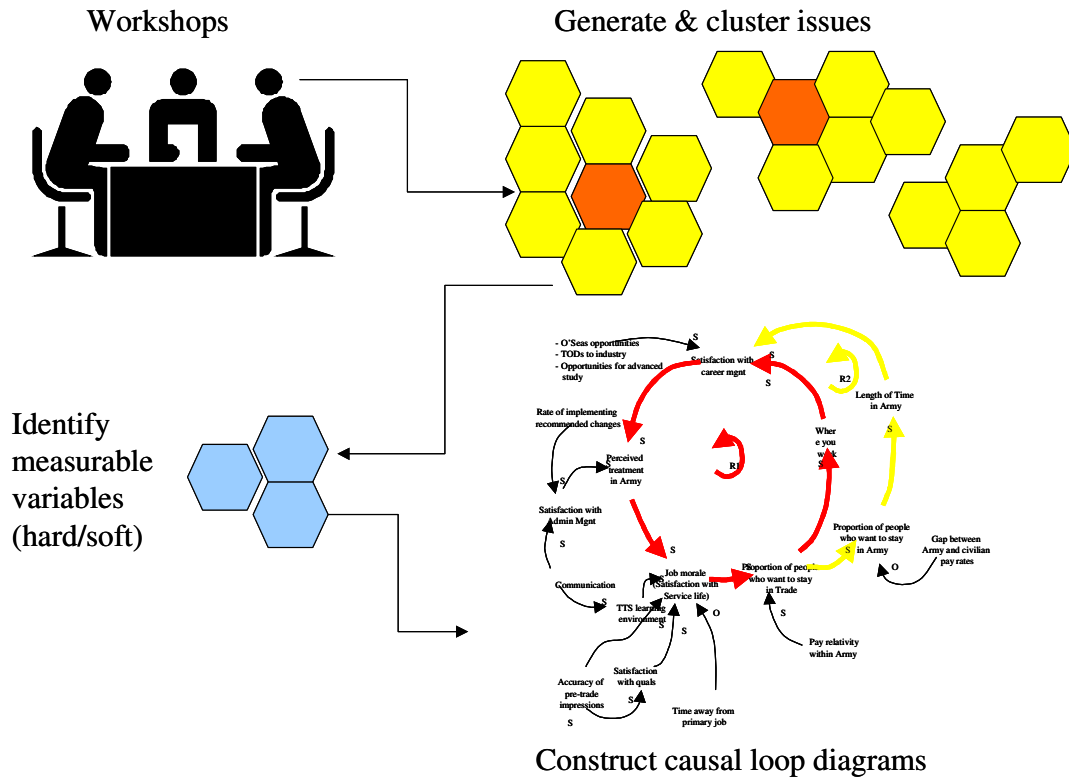


Fig. 7. Summary of the group model building process

Each participant was given equal and ample opportunity to raise issues of concern, or anything relevant to the organising question. This 'fair and exhaustive' process was repeated until participants had exhausted themselves of issues and concerns. Care was taken to record the discussions of each group, thus the terms used in the clusters and CLDs that follow are the terms used and agreed by the group.

The CLDs developed by the end of each stakeholder group workshop were at a very rudimentary stage due to insufficient time being available for completion of this phase. Consequently the authors were obliged to complete the CLDs after the workshops.

The separate CLDs for the internal Army stakeholders were combined into a single CLD to allow the analysis of the feedback loops and strategic leverage points in the system. The CLD for the external stakeholders was kept separate, but the issues and concerns of the external stakeholders regarding the organising question were incorporated into the analysis of the combined Electech CLD.

A brief analysis of the apprentice group and combined internal stakeholders CLDs will now be presented.

Analysis of the Apprentices Group CLD

The CLD⁵ generated for the Apprentice Group (Figure 8) is provided here since it draws attention to the main issues faced by the wider Electech group. A behaviour over time chart (Figure 9) is also provided as it illustrates the dynamic behaviour of concern of the main variables of interest.

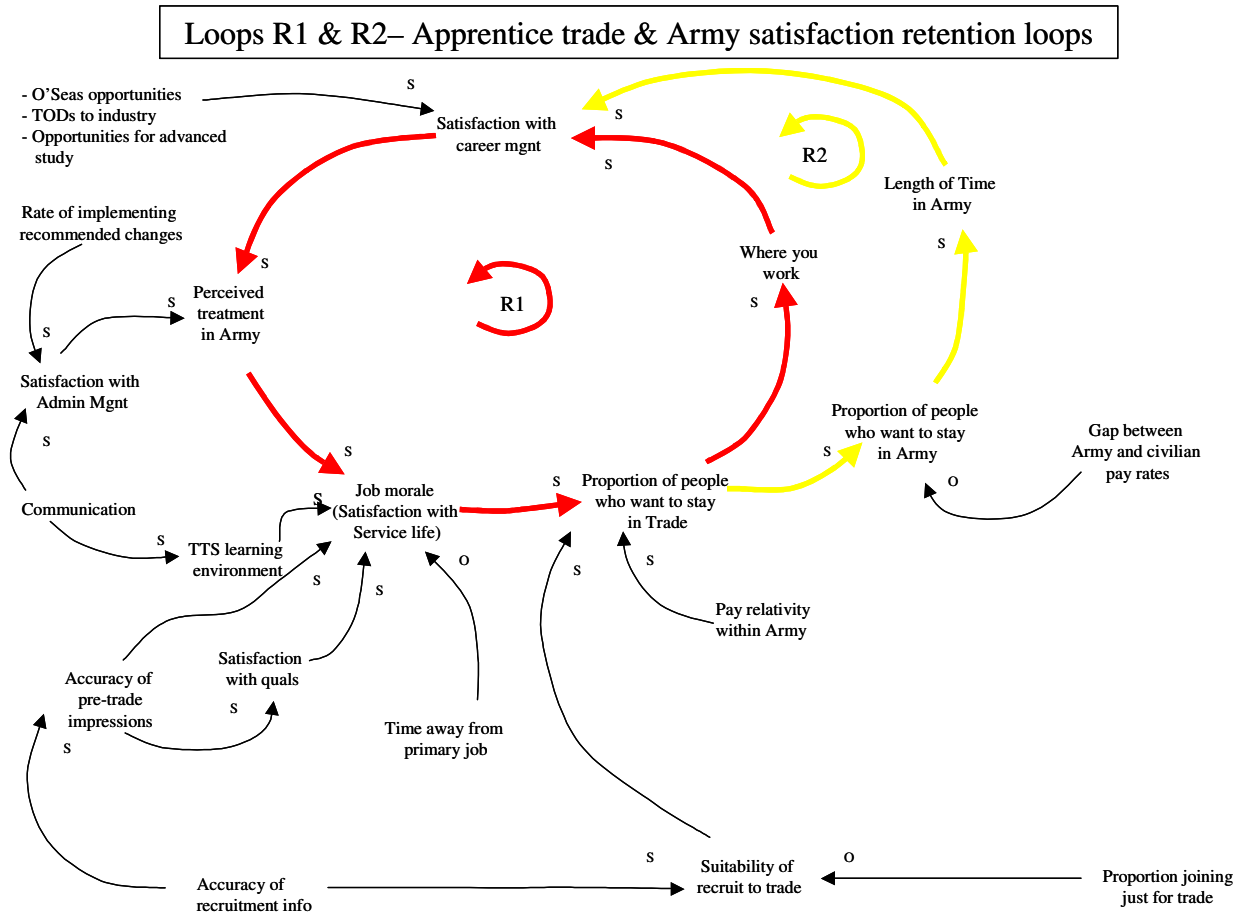


Fig. 8. Causal Loop Diagram for the Apprentices Group

Loop R1 – Apprentice trade satisfaction retention loop. This feedback loop helps to explain the declining job morale among the apprentice Electechs in the Army, and subsequently the low number who want to stay on in the trade in the Army. At the time of the workshops the reinforcing loops R1 & R2 were operating as vicious feedback loops, displaying downward trends in morale and proportions staying. However, these vicious cycles could be turned into virtuous cycles if attention is paid to the retention factors identified in the CLD. For example, an improvement in these factors will result in apprentices perceiving their treatment to be better in the Army (ie a reduction in ‘shaftings’⁶), which will lead to an increase in their job morale (or satisfaction with service life). This will result in a larger proportion of people wanting to stay in the trade, and thereby increasing the chances of Electechs getting the locations they desire to work in. This will lead to an improvement in their

satisfaction with the Army career management, and hence an overall improvement in their perceived treatment in the Army.

Loop R2 – Apprentice Army satisfaction retention loop. This loop behaves in a similar fashion to loop R1, except that some people who wish to leave the trade may also stay on in the Army. However, this also depends on the gap between Army and civilian pay. If Army pay is seen to be too far below civilian pay, then this will reduce the proportion of people who want to stay in the Army, thereby decreasing the average length of time per person in the Army, and resulting in a reduction in satisfaction with career management and their treatment. This will result in less people wanting to stay in the trade and Army. However, a reduction in pay differences between Army and civilian Electechs, will have the effect of turning this vicious cycle into a virtuous cycle.

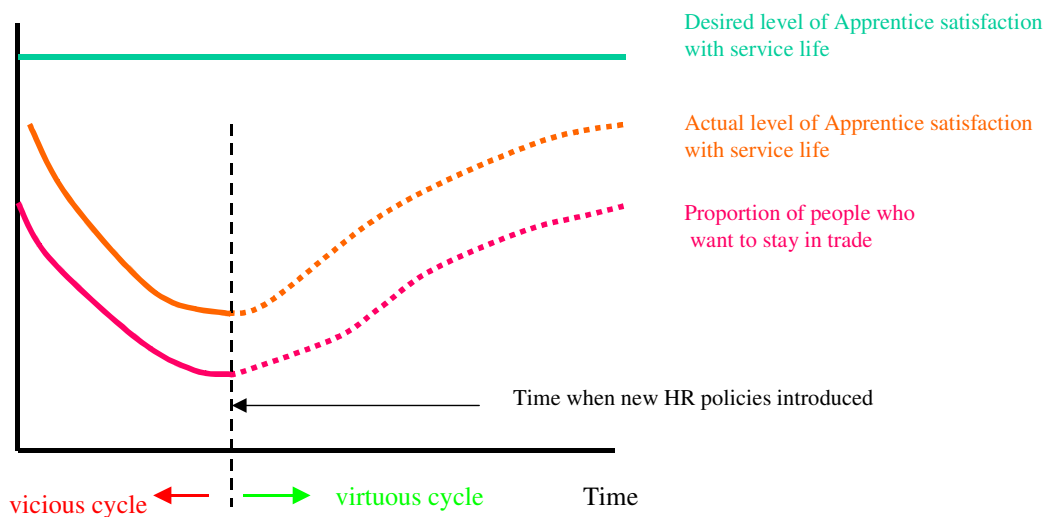


Fig. 9. Behaviour Over Time Chart for the Electech Apprentices Group

The effects of the current vicious cycle (Loop R1) are represented in the behaviour over time diagram in Figure 9, whereby the levels of apprentice satisfaction with service life has been decreasing in the recent past. This was causing the proportion of apprentice Electechs who wanted to stay in the trade (& Army) to be declining, leading to increasing release rates when the apprentices have completed their return of service after about 6 years.

The current focus of management attention in the Army is on managing outputs (electronic equipment support capability), rather than on managing satisfaction levels of this trade group. However, it is a major challenge for management to turn this declining trend around, and find ways of improving apprentice's levels of satisfaction, and hence their desire to stay in the trade and Army. In order to do this, it will be necessary to monitor the apprentice's levels of satisfaction against a 'desired' level of satisfaction⁷.

Analysis of the combined Electech CLD

The causal loop diagrams for the internal Army stakeholders; i.e. the apprentices, tradespeople and management groups were combined into a single combined CLD⁸ (Figure 10) to facilitate analysis of the feedback loops and strategic leverage points in the system. The naming of the variables differed slightly from those used in individual stakeholder groups models. Nevertheless, most of the individual group variables can be identified in this model.

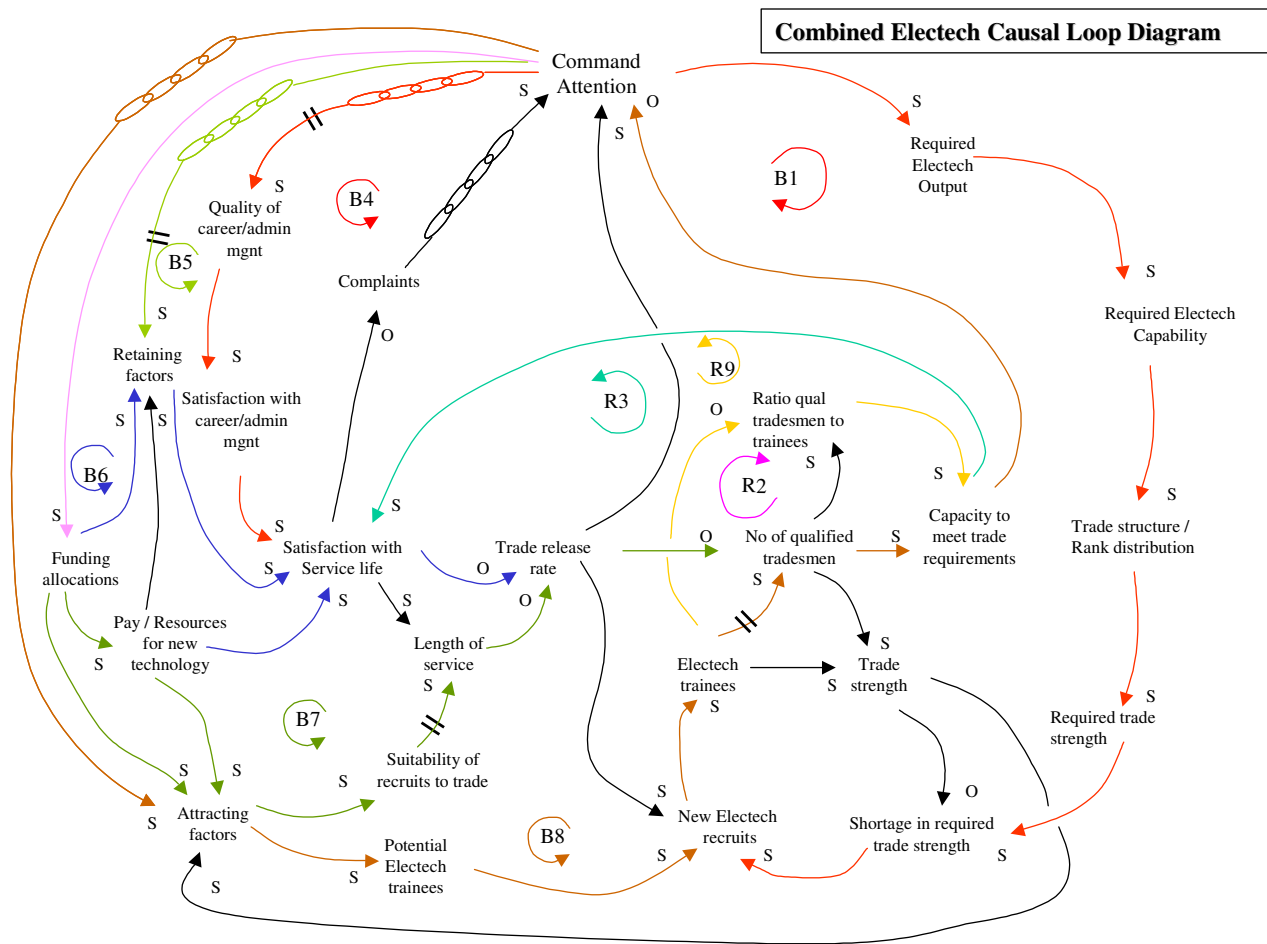


Fig. 17. Combined Causal Loop Diagram for Electech HR Project

A total of 9 main feedback loops were identified in this diagram (3 reinforcing and 6 balancing loops). Some of these loops will be briefly discussed below to illustrate the type of analysis that was undertaken with the CLDs in the study. These feedback loops will also be used to identify the key leverage⁹ points within the 'system' and to analyse the implications of changes to the variables influencing these leverage points.

Analysis of Trade Capability Requirement Loops B1 & R2

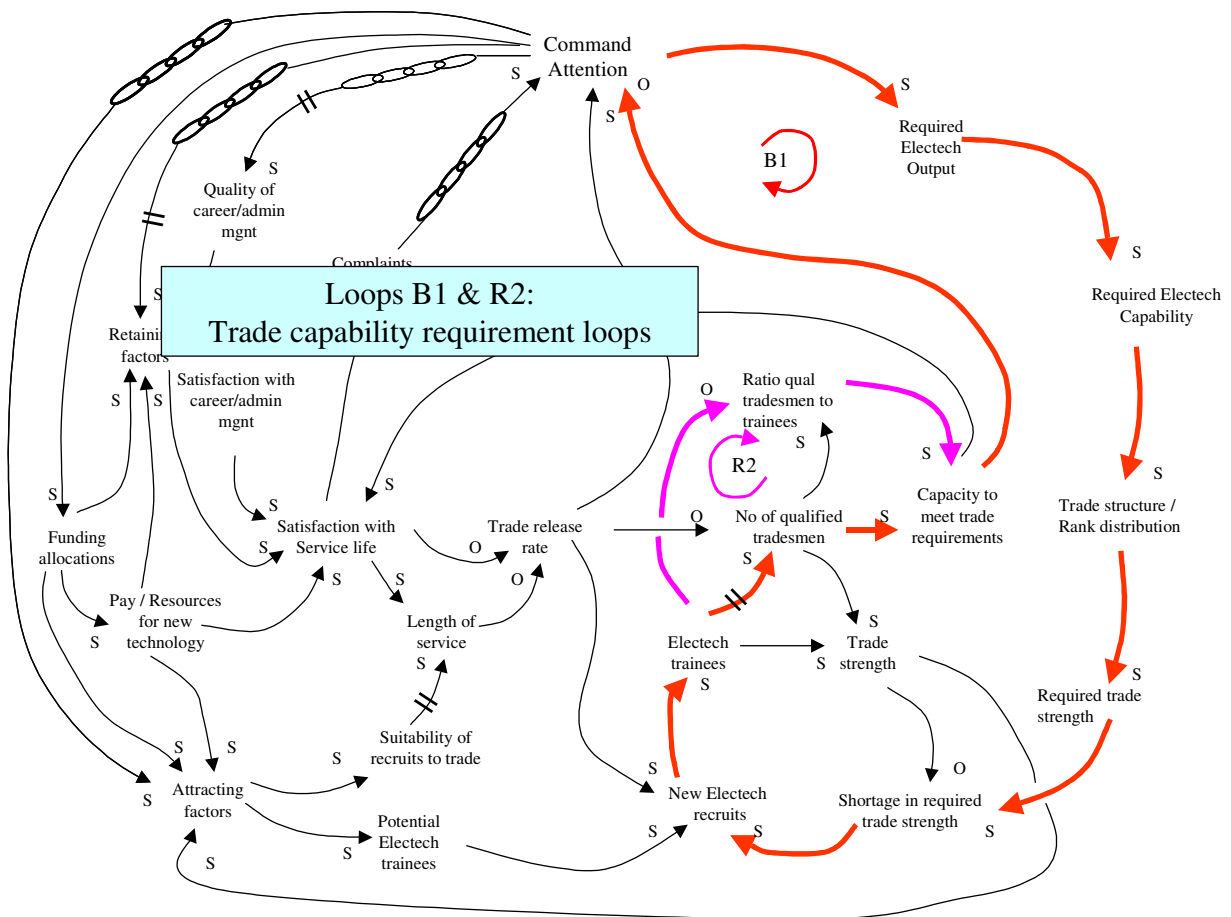


Fig. 11. Trade capability requirement loops B1 & R2

Loop B1 illustrates the influence of command in determining the trade outputs and capability requirements. This ultimately determines the trade strength required and shortage (or surplus) of personnel available. The trade structure is predicated on meeting the required trade output and required capability. As the required output increases the required capability will have to increase also, this in turn will have the effect of increasing the trade structure required. As the trade structure increases the shortage between currently qualified tradespeople and the required strength will increase. Logically this will drive an increase in the number of new recruits and Electech trainees entering the system. After a time delay (about 4 years) the number of qualified tradespeople will increase which will increase the trade group's capacity to meet the required capability, thus closing the initial balancing loop (B1).

Paradoxically, an increase in Electech trainees will require more tradespeople to train and supervise, thus lowering the Army's capacity to meet trade equipment support requirements in the short run (*Loop R2*). This will have the effect of increasing the trade's training output and therefore further increasing the required

Electech output and capability, thus inadvertently starting the vicious reinforcing cycle again, of increasing staff numbers to meet trade requirements.

Leverage points on trade capability requirement loops B1 & R2

The critical variable on loops B1 & R2 from Command's perspective is the capacity to meet trade requirements. There are a number of ways to influence this variable as follows:

- a. Alter the **required Electech output** - Command determines the level of output required, within the bounds of Government defence policy.
 - (1) Output is going to change significantly as a result of motorisation in 2005, which will be a major technological change from the traditionally light infantry model. It is expected that almost double the Electech trade strength will be required from 2005 onwards (illustrated in Figure 1).
 - (2) Change the equipment support doctrine; serviceability levels required (Implications for carrying spares, JIT etc).
- b. Adjust the **required Electech capability** – must be sustained over time
 - (1) Is further outsourcing/sub-contracting possible (possibly on a temporary basis to allow the trade time to recover)? This would reduce the dependence on internal Electechs to meet the Army's needs.
 - (2) Could reduce capability requirement, in terms of the training bill, by developing joint training initiatives and reducing personnel overheads.
 - (3) Electronics equipment is increasingly more reliable, so trade scope has declined. People don't repair equipment, but now replace components; equipment doesn't break down as often as it used to. This has impacted upon perceptions of the trade and the requirements for Electechs. However, against this is the growing range of equipment now available, thus increasing the requirements for Electechs.
- c. Consider **trade structure / rank distribution** – needs to be carefully attended to and optimised. Structural overlay¹⁰ will have a large part to play in required trade strength. Need to consider how Electechs are trained and developed; how are Electechs employed on operations. What is the operational capability in each trade band?
- d. **New Electech recruits** – the traditional option of addressing a shortage in trade strength is to bring in new recruits and provide full

electronic training. Other options include re-enlistment, overseas recruitment, qualified civilians, not just new recruits.

- e. **Electech trainees** - review philosophy of front-end loading all training. An increase in trainees exacerbates the vicious loop R2, as tradespeople are taken out from production duties to train new apprentices thus reducing capacity in short term.

An objective for Army HR planners is to try and speed up the balancing loop B1 and slow down the impact of the reinforcing loop R2.

Analysis of Retaining Factors - Satisfaction Loop B5

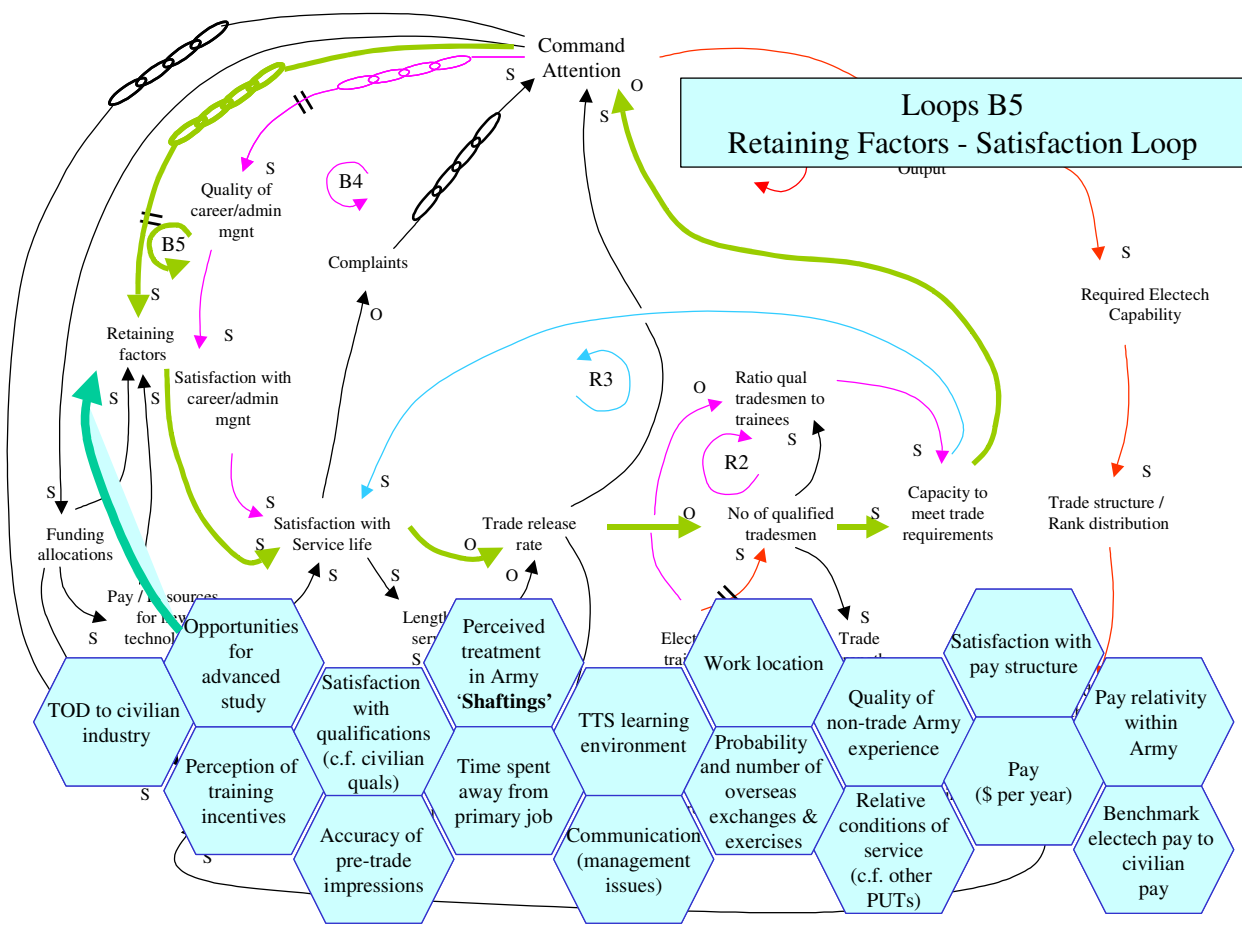


Fig. 12. Retaining Factors - Satisfaction Loop B5

A number of independent variables were clustered together as ‘retaining factors’ (some shown on Figure 12). Should one or more of these variables operate in an adverse way the ‘satisfaction with service life’ variable will decrease, triggering an increase in release rate, a reduction in ‘capacity to meet trade requirements’ and

ultimately prompting a command response to adjust the retention factors, through the command chain.

Leverage points on retaining factors - satisfaction loops B5

Improvements in the retaining factors identified by the internal workshops will yield considerable benefits in terms of increasing Electechs' satisfaction with service life, and hence will help to reduce the outflow of Electechs from the trade and the Army. A number of suggestions were drawn from the issues generated at the internal stakeholder workshops. They provide an indication of possible points for action. However, they will obviously need to be evaluated quite closely in terms of their expected costs and benefits, and also their impacts on other trades and activities in the Army. The retaining factors with more substantial funding implications, eg pay, remuneration, overseas exchanges, etc, are discussed with the funding - satisfaction loop. The factors outlined here relate to training, supervision experience, compounding everyday issues, perceived inequalities, personnel under training issues and job satisfaction / morale. To further illustrate the analysis we will provide the factors related to training here:

Training – a range of training related factors were raised, including issues about the Trade Training School (TTS) learning environment, qualifications, support for training, methods of training etc

- (1) Investigate TTS resources. It has been suggested that the equipment is obsolete, the TTS test equipment is not compatible with purpose, and the training capacity of TTS needs to be increased/made more flexible, to handle surges.
- (2) Consider the impact of the following identified dissatisfiers:
 - camp duties /guards /parades etc impacting on training programmes;
 - cut lunches are considered below standard, and the contents sometimes off;
 - being treated like school children at TTS is demeaning for advanced course students; not enough internal recognition of status and needs of Electechs;
 - not enough flexibility when studying.
- (3) Examine closely the qualification needs of Electechs in Army, and the appropriate linkages to NZ Qualifications Authority qualifications. Will different qualifications achieve Army's objectives?
- (4) Find ways to bring potential Electech trainees up to minimum educational standards, and reconsider links between personnel signing up for courses and ROS.
- (5) Develop Electech retraining programmes.
- (6) Consider joint Service training for Electechs. However, the single Service training needs may differ. It has been suggested that Airforce training is theoretical, whereas Army training is practical.

Analysis of Attracting Factors - Recruitment Loops B8 & R9

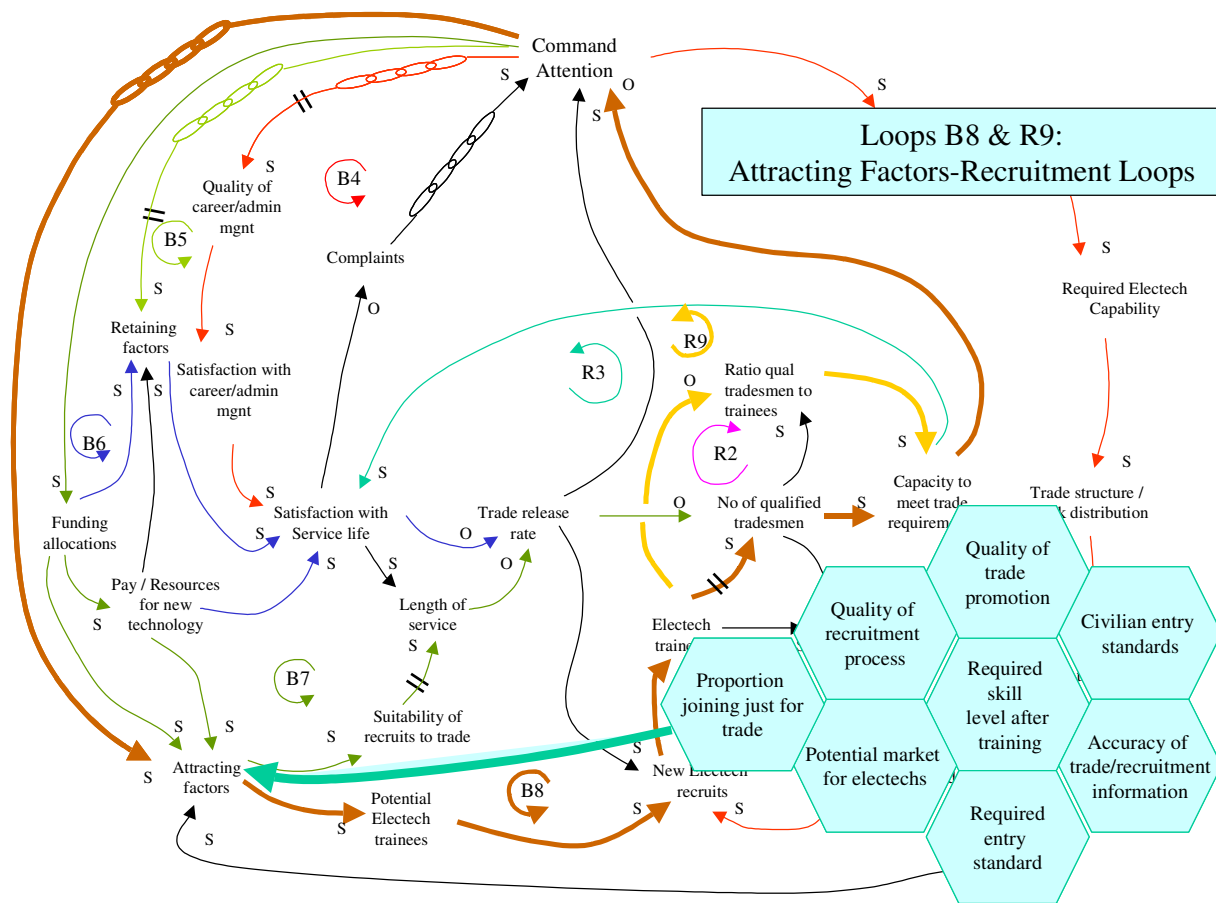


Fig. 13. Attracting factors -recruitment loops B8 & R9

In the balancing *Loop B8*, it can be seen that an increase in the ‘attracting factors’ will result in an increase in the potential number of Electech trainees, and hence the number of ‘new recruits’. After a time delay of four years, there will be an increase in the ‘number of qualified tradespeople’ and an increase in the ‘capacity to meet trade requirements’. ‘Command attention’ will decrease which in turn will have the affect of decreasing the ‘attracting factors’. However, the short term effect of the increase in Electech trainees will be to increase the time spent by qualified tradespeople in training, and hence a reduction in the capacity to meet trade requirements (*Reinforcing Loop R9*). This will keep command’s attention inclined towards continuing to support the attracting factors to increase the recruitment of trainee Electechs.

Leverage points on attracting factors – recruitment loops B8 & R9

There are a number of factors related to attracting and recruiting people into the Electech trade in the Army that could be improved to ensure a better supply of people more ‘suited’ to the trade. These include both changes to command/management in the Army, and a wide range of attracting factors (eg see hexagons in Figure 13).

Conclusions

There can be little doubt that the Army Electech trade group is in a precarious situation. The majority of apprentices are only being retained to the point of their return of service obligation and are then exercising their option to leave. Unless immediate action is taken the situation will worsen at a time when planned acquisition of new technologies will result in a significant increase in the required number of Electechs. It is essential that Army introduce meaningful initiatives to kick-start a turn-around in the behaviour over time of this trade (see Figure 9).

This study has identified the underpinning factors, and the cause and effect feedback relationships between them, that are responsible for the adverse situation in the Electech trade. The aim of the study was necessarily limited to determining key leverage points and how the system might be influenced to achieve a more favourable long-term behaviour over time profile for this trade group. The wider responsibility for developing an integrated strategic plan remains a task for the NZ Army Project Charter working group¹¹.

The advantages of holding separate workshops were that each stakeholder group could present the issues and concerns from their point of view in an uninhibited and 'collegial' way and to mitigate the risk of a dominant individual or group voice emerging. For example, it is unlikely that the apprentices would have been so forthcoming with their concerns if they had been in the same group as their supervisors (the Electech tradespeople). This was borne out at the combined debriefing session on 28 Jan 03, where the apprentices gave very little feedback. This was in stark contrast to their contributions during their workshop.

Shared mental models (or causal loop diagrams) were developed for each stakeholder group, and the internal Army CLDs were merged to form a combined Electech CLD (see Figure 10). A separate external stakeholder group mental model CLD was developed based on their view of the electronic industry in New Zealand. These CLDs were used as the basis for the analysis of feedback loops and identification of key leverage points within the system, which were used by Army to facilitate the development of strategic action plans for the Electech trade group. The CLDs confirmed there are many issues contributing to the poor retention of the Electech trade group.

A notable observation was that the CLDs provide some clarity to the differing world-views between the Electechs and Army command¹². Command tends to focus on the 'capacity to meet trade requirements' variable. By contrast, the focus of tradespeople is on 'satisfaction with service life'. As a generalization command is not overly concerned with the latter until it begins to jeopardize the former. The model demonstrates the importance of maintaining these aspects in a stable equilibrium. It also identifies the vulnerability of the system to time delays in identifying imbalances and initiating corrective action.

The study has generated considerable interest and expectation among the Electech trade. There is an urgent need for Army to demonstrate a commitment to change the current Electech employment environment and deliver some tangible evidence of change. Any delay by Army will be seen as organisational failure and will lead to a further decline in morale. The authors made a number of specific recommendations, based on the causal loop analysis, to address the situation.

Finally, the information gathered in this study was used as the basis for developing improvements in the employment environment for the electronic technicians in the NZ Army. The systems thinking process and the models produced also provide an excellent framework for considering retention and recruitment problems in other trade or professional groups.

Postscript - Implementation

This systems thinking study was completed in April 2003. Within one year, Army had taken a number of steps to address the issues and concerns raised in the study. These related to:

- (a) *Recruiting*. Army is exploring two recruiting initiatives. The first involves recruiting current polytechnic students and recent graduates - possibly paying off their student's loans as a recruiting incentive. Such personnel would only require training on the specific items of equipment that they will work with. In most cases (plumbers, carpenters) the transition will be straight-forward. The second initiative involves providing serving soldiers from other trade groups (eg, riflemen, drivers, etc) who are interested in learning a trade with the educational opportunities required to prepare them for trade training (eg, mathematics and english training).
- (b) *Apprentice sponsor/addressing Apprentice needs*. Although Army has not, as yet, appointed a 'sponsor of' or 'advocate for' apprentices, Army has implemented training policy that highlights the learning styles of young adults, and makes instructional staff more aware of their special needs. The situation will continue to be monitored.
- (c) *Pay*. The Chief of Army approved significant changes to the extant apprentice pay progression model, to reduce the gap between apprentices and other Army trainees. The changes took effect on 1 Apr 04. (Note that, for reasons of equity, the pay rise was applied to all apprentice trade groups [plumbers, carpenters, etc]). The Chief Instructor of Trade Training School reports that the changes have been very well received.

There has been an improvement in the retention of apprentices, although at this stage it is still too early to say that the problems have been dealt with completely. However, the trends are looking positive.

Acknowledgements

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¹ The apprentice training lasts approx 4 years and carries a return of service (ROS) contract of one year for every two years of training. Therefore soldiers in this trade must compulsorily serve for six years before becoming eligible to seek voluntary release.

² The general systems thinking approach used for this research is drawn from Maani and Cavana (2000), 'Systems Thinking & Modelling: Understanding Change & Complexity'.

³ For a recent discussion of merits of qualitative system dynamics vs a full system dynamics study (Forrester (1961); Coyle (1996); Sterman (2000)) including computer simulation see Coyle (2000, 2001) and Homer and Oliva (2001). In this research study we only embarked on a systems thinking or qualitative system dynamics study since we were dealing with a highly ‘messy’ situation involving a considerable number of soft variables and concepts. We considered that the costs and uncertainties involved in carrying onto build a computer simulation model would far outweigh the additional benefits that might be gained. For earlier work on qualitative system dynamics see Wolstenholme and Coyle (1983); Coyle and Alexander (1996) and Wolstenholme (1999).

⁴ For further information on group model building methods see Vennix (1996), and Vennix, Andersen and Richardson (1997).

⁵ The key to help interpret the causal loop diagrams is:

- B1 Balancing loop – seeks stability or return to control, or aims for a specified target
- R1 Reinforcing loop – are positive feedback systems. They can represent growing or declining actions.
- o Variable at the head of an arrow changes in the opposite direction to (or subtracts from) the variable at the tail.
- s Variable at the head of an arrow changes in the same direction as (or adds to) the variable at the tail.
- A causal relationship or influence between variables
- ⇨ Parallel lines on a link (arrow) represent a significant delay between the variable at the tail of the link (arrow) and at the head
- The chain symbol on an arrow represents the ‘chain of command’ or the information flowing up or down a series of management levels.

⁶ A heavily negative term coined by apprentices to label perceived unconstructive organisation and management of their day to day lives in the Army.

⁷ Questionnaires could be developed to monitor satisfaction levels using the rating scales outlined, for example, in Cavana, Delahaye & Sekaran (2001).

⁸ A feature of the combined CLDs is our introduction of a new symbol to represent the ‘chain of command’ or information flows up or down a series of management levels.

⁹ Leverage points are those points that can control or influence a system to bring about desired changes in behaviour over time (in this case to improve the likelihood that Army will have the resources and capability to meet the requirements expected from the Electech trade). The feedback loops in the Army stakeholders’ combined CLD can be used to identify leverage points within the ‘system’ and analyse the implications of changes to the variables influencing these leverage points. The issues generated at each of the stakeholder workshops, provide a rich source of material to begin exerting influence on the leverage points in the system.

¹⁰ Structural overlay is those additional positions required in a trade structure for the sole purpose of ensuring there is adequate numbers available to meet succession requirements through the rank pyramid. Such positions are redundant to trade outputs.

¹¹ The Project Charter working group was established with specific terms of reference to investigate traditional HR functional areas as they affect the Electech group. Our work was conducted under the auspices of this project charter and the ensuing report was considered an enabler to the objectives of the Project Charter.

¹² Differing worldviews between clinicians and policy mangers were also reported in Cavana et al (1999) in a systems thinking study in the NZ health sector.