FLEET DOCTOR TO AIRPOWER 2100

From Tailored Solution to Learning Environment

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Abstract

The Royal Australian Air Force (RAAF) operates a fleet of 36 F-111 aircraft based at Amberley in South East Queensland. The fleet is a multivariate system with complex dynamics constrained by economic and human resources. In 1994, the aircraft fleet was experiencing declining availability and operational capability. The implementation of long term strategic planning was extremely difficult due to the complexity of the system and the rotation of military staff on a three yearly basis. To analyse the system, a dynamics simulation model was developed in Ithink software coupled with a database and graphics software. The model was then used to develop a fleet strategic recovery plan. However the system learning gained through model development has since dispersed and the need for an F-111 system learning environment was recognised.

Furthermore the Australian Government Audit Office has recently investigated Defence preparedness. The report 1 highlighted the same basic systemic problems as were found in the F-111 fleet were more widespread and generic in nature. To address the specific F-111 learning environment problem, and to reinforce the system solution, a game has been developed called Airpower 2100. The game was created to sensitise people to the interactions and dynamics involved in managing a complex aircraft weapon system as well as weapon system preparedness. The game play takes 3 hours and coupled with a tailored education program aimed at developing better management strategies. Evaluation of the effectiveness of the game is being monitored by a capability based survey given before and after the game play. This survey, similar to the College and University Classroom Environment Inventory (CUCEI) model 2, measures participants perceptions, attitudes and confidence in their ability to control the weapon system after the gaming experience.

This paper will outline the movement from a tailored system dynamics solution to addressing the generic learning problem. It reports the initial stages of achieving a learning organisational culture and the implications for future applications of these techniques.

Background

The RAAF utilise a fleet of General Dynamics F-111 aircraft for strategic strike missions and reconnaissance. This fleet consists of F-111C strike, RF-111C reconnaissance and F-111G aircraft. The F-111 fleet is currently subject to a major mid life avionics modernisation program and a number of ongoing less major capability enhancements. The objective of fleet management is to sustain current operational availability, be capable of escalated operational demand and continually upgrade the weapon system capability. This task can be represented by a complex interaction of logistics, maintenance, facilities, human resources, and capital acquisition programs.

Strategic Analysis

In 1994 it was recognised that the F-111 fleet was experiencing declining availability and capability with deteriorating future trends. In order to analyse the system a strategic model of F-111 fleet operations was developed. The model, entitled FleetStrat2020, investigates the interactions within the system that were leading to reduced availability and capability. This model, incorporating many assumptions, treats the F-111 system as one amorphous fleet structure. The model was used to derive a set of strategic corrective actions to be applied to the F-111 fleet. However, the strategic model was inadequate for detailed tactical implementation of these actions and so further development was carried out.

Tactical Analysis

The next phase was the development of Fleet Doctor®, an integrated F-111 fleet scheduling tool. This tool incorporated a detailed Ithink dynamic simulation model, a database engine, and graphical display software, as shown in Figure 1. The simulation now modelled the F-111 fleet in detail with all 36 aircraft and subfleets being steered through characteristic logistics, operations, maintenance and capability upgrade environments. Building on the knowledge gained from the strategic model the recovery strategies were simulated to generate a detailed 10 year plan of fleet recovery. Fleet Doctor® has been used for 18 months in fleet scheduling and has generated improvements in fleet capability and preparedness 3.

Systemic Problem

The Australian Government Audit Office report on the management of Australian Defence Force Preparedness found, amongst other things, that resource implications of different preparedness states were not adequately articulated. This replicated the systemic problem identified within the F-111 fleet environment. The report also stated that management information systems were needed to measure achievement of preparedness. Whilst Fleet Doctor® was capable of addressing this specific need for evaluating F-111 preparedness 4, it was concluded that the generic problems that were identified in the Auditors Report were similar to those seen in the specific F-111 fleet.

Learning Environment

The tailored systems dynamics solutions installed at Amberley for the specific F-111 fleet management were developed by a dedicated team. The systems knowledge gained through the process was only held by those within the team. This knowledge was being progressively dissipated as military staff rotations took place. It was recognised that a more generic learning environment would be required to retain this knowledge and broaden the exposure of RAAF staff to the use of system dynamics for effective weapon system management. To achieve this goal a prototype game was developed along similar lines to The Manufacturing Game 5 and Friday Night at the ER 6 . This game, in part, replicated the interactions within the F-111 weapons system but mimicked the underlying dynamic behaviour. The game, called Airpower 2100, encapsulated the need for strategy development in achieving availability targets. The script for the game introduces the players to environmental changes that are outside the players control, are unscheduled and are similar to the actual activities of the real environment. This includes rapid changes in flying rate to meet contingencies and illustrates the concept of being ëpreparedí.

Survey

To evaluate the prototype game representative cross section of F-111 personnel, based at Amberley, were surveyed prior to playing the game in order to establish a baseline profile of their knowledge. The results of this survey were scored in order to get an indicative profile of the players. Figure 2 shows this profile indicating the pronounced lack of F-111 system knowledge significant deficiency in preparedness knowledge and generally poor control knowledge. These results confirmed that a generic learning environment was required before sustainable improvement would be achieved.

First Trial

The game was trialed at Amberley on 23 April 1997 with players from F-111 operations, maintenance and logistics who had been surveyed. The Airpower 2100 game not only mimicked the complex dynamic behaviour of the system but players interacted as if in the real environment. Some of the noteworthy benefits observed were:

a. All players gained insight into the systemic problem.

b. Most players experienced a feeling of utter hopelessness when embroiled in the system dynamics.

c. No players questioned the limits of their control within the game.

d. Only one player requested the same short term ëget wellí method as used in the real environment.

Trial Conclusions

Players found difficulty in developing control strategies and were not sure of their level of control. Subsequently it was decided to modify the game script to incorporate a mid play break allowing an opportunity for players to develop strategy. The game was effective in illustrating system operation but was less effective in illustrating the concepts of preparedness. Players could be asked about planning activities that they could do to meet the increased operational effort 3 game cycles ahead.

Greater learning could be gained from game play if more opportunity existed for players to explore various control strategies. This outcome would address the deficiency identified in the survey. To achieve this approach greater flexibility within the game script for provision of extra resources was incorporated. To force a better understanding of preparedness players needed to be coerced into analysing their ability to meet projected future operational demand.

Four game boards with three players on each board were used in the first trial. The knowledge gap of some players caused net game cycle rate to be very slow. The game was modified to allow each game board team to cycle independently if required. Some players clearly needed more time to assimilate and

comprehend the system dynamics. Some players had difficulty adjusting to the paper recording system and it was concluded that a set of sample records should be produced to accelerate game familiarity.

What the Critics Said

Airpower 2100 was seen as an effective generic learning environment. The debrief survey indicated that all players gained insight into the F-111 system and to a lessor degree preparedness. To quote one respondent It didnít seem to matter how well I tried to play everybody ended up in strife. Now I donít feel so bad. One young F-111 pilot commented It should be played by the Air Commander. There appears only one way to win and that is to reduce the flying commitment.

Critical Observations

The military paradigm of not questioning the bounds of the game was observed. Reducing the maintenance interval was never questioned as a means of achieving better performance. The game was extremely successful in illustrating the effects of external influences on the stability of the fleet system. Most players acknowledged that without observing the total system there was no chance of achieving control. A significant benefit came from the personal interaction of players who normally did not interact in the real environment.

The first trial of the game also provided feedback to the trainers. There was a need for discussion early in the game facilitation as an ice breaker. The trainers realised that players had, in some instances, no base knowledge. A need for more elaborate explanation of the game process was recognised. The trainers also recognised that most players need more time to assimilate their learning. The facilitation process was adjusted accordingly.

Second Trial

A second trial of the game was performed on 20 May 1997 at the Australian Defence Force Academy (ADFA) in Canberra. The game players were more senior military staff and civilian personnel. The latter having no knowledge of F-111 operations. These players were given the same pre-game survey as the first trial group. Similar results were obtained.

Second Trial Conclusions

The adjustments made to the script to allow for more time for strategy development were very successful. The increased level of game facilitation made initial game learning more accelerated and effective. The ability of individual game teams to operate independently was also effective. Higher levels of Systems knowledge and Preparedness knowledge, evidenced in the pre-game survey helped the players develop strategy and understand control more rapidly.

Post Game Debrief

Most players recognised the benefits of team cooperation. The civilian players were able to see the relevance of Airpower 2100 game in a non military environment. Some notable quotes were:

Strategy requires experience and learning. The game provided both of these opportunities.

Not quite as good as sex but nearly as complicated.

Reinforced my understanding of the inherent complexity of the system and the need for mutual understanding between elements.

I did not feel in control and this was just how I felt when working in the F-111 environment.

It confirmed, in my mind, that this was not an easy system to manage, especially if people wonít compromise.

Future Direction

The game has been refined to the point where it can be introduced into the training and education processes within the RAAF. The measurement of educational improvement will be monitored using the College and University Classroom Environment Inventory (CUCEI) model. This activity is scheduled for August 1997. Furthermore, a more generic version of the game is being developed which deletes specific reference to the F-111 environment and to RAAF terminologies. This is to assist in playing the game in a totally non-military context and to "globalise" the game.

Conclusions

An F-111 system learning environment has been developed which increases the level of understanding and awareness of the F-111 fleer system dynamics. The learning environment captures generic dynamics and has applicability that extends well beyond the F-111 fleet and the RAAF.

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