Avionics Maintenance Problem – A case from Indonesian Air Force.
(A case to demonstrate the use of Linear Programming)

For any Air Force the main objective is to maintain their fighter jets in readiness for any combat operation. One of the aspects in its preparedness is to maximize readiness of the equipment serviced at its Avionics Shop. The primary objective of the avionics shop is to maintain and repair highly technical products namely communication, navigation, airborne radar, and guidance equipment. These equipment is used to support fighter and transport aircraft. While maintaining its objective of being in readiness, how much money can be saved is also an objective. The maintenance of these equipment can be carried out using the Air Force's own maintenance organization as well as repaired using outsourced maintenance contract. The costs of carrying out maintenance in house are obviously cheaper than outsourced but the limited capacity of in house facility necessitates the use of outsourced maintenance contract. The amount of money saved depends on properly allocating the equipment between in house maintenance and outsourced maintenance contract.

Each piece of equipment that is repaired in the Air Force's avionics maintenance operation must pass through the following steps.

- Receiving /physical inspection and writing up a work order (Phase I)
- Pre-Inspection and fault diagnosis using Automatic Test Equipment (Phase II)
- Repair (Phase III)
- Final inspection (Phase IV)

Documentation is part of each of the phases. The flow chart of the avionics maintenance process is shown below:

From User → Phase I → Phase II → Phase III -- > Phase IV

Receiving Physical Inspection | Pre-Inspection | Repair modifying Servicing | Final inspection

The average time required (in hours) for carrying out the work in the different phases is given below (Table I)

Table I : Time required (in hours) in different phases for various equipment.

Equipment	Phase I	Phase II	Phase III	Phase IV
Communication	0.25	0.25	5	0.75
Navigation	0.25	0.25	6	0.75
Airborne Radar	0.25	0.50	7	1.5
Guidance	0.25	0.50	8	1.5

At present the time available in the maintenance shops (in hours per year) for each Phase and the minimum annual production requirement to fulfill the Air Force's operational requirement are shown in Table 2.

Phase	Annual Capacity (hours)	Product	Minimum Annual production (units)	In house Cost including spares and labour costs
I	1,540	Communication	750	$1500
II	770	Navigation	700	$1250
III	52,360	Airborne Radar	475	$2250
IV	1125	Guidance system	400	$7750

The annual capacities have been worked out based on 31 hours available per week and 50 weeks in a year.

Before the Air Force avionics maintenance facilities were established, the Indonesian Air Force had avionics equipment repaired outside the Air Force trough a maintenance contract with a private vendor. However, it took more “turn around time” and was more expensive. Based on the data of a few years of contracting, the average cost of a “maintenance contract” for each type of equipment can be summarized as shown in Table 3.

Table 3: Maintenance contract cost when sub-contracted with outside vendor

Equipment	Communication	Navigation	Airborne Radar	Guidance System
Cost	$4750	$4750	$8000	$24000

The questions facing the Indonesian Air Force was as follows:

1. Finding the best way to handle in the house facility so that the overall cost of both in house as well as using maintenance contract would be the lowest.
2. If the annual capacity for Inspection (phase IV) is increased to 1200 hours, what will be the effect to the total cost.
3. If Airborne radar requirement is increased to 500 units annually, what would be the implication on cost.

This case has been prepared based on a term paper submitted by Sumardjo in Dec 1994 to Naval Postgraduate School , Monterey, California. The figures in the said term paper have been modified in order to protect confidentiality.