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# The GPS Auto-navigation System Verification Project

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1. \*This case study is based in part on actual events and has been prepared solely to provide material for student learning in Project Management.
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## BACKGROUND

Hangzhou AUTONAV, Inc. is an organization whose main business is the production of high reliability auto guidance and navigation systems for various customers, from both the government as well as the private sector. It has made a profit by following a philosophy of careful development and maintenance of a competitive strategy. The strategy has been to “produce the most technologically superior and most reliable electronics equipment in the world”. They are known in the industry as excelling in technological sophistication and high reliability products. As one customer stated, “Hangzhou AUTONAV, Inc. products are durable and exceed our expectations, leaving the competition well behind – the products work, work well, and continue working well.”

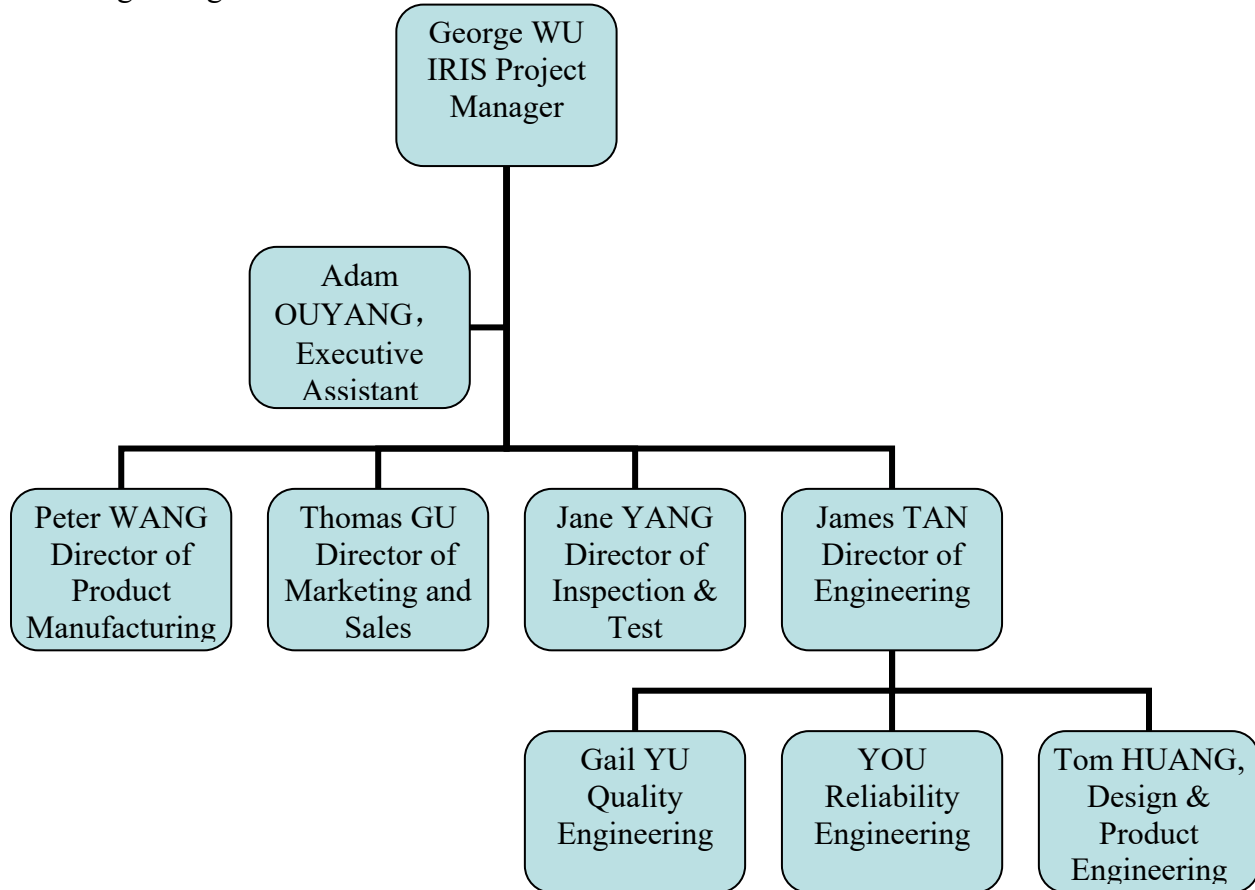
In the Spring of 1997 the company launched development of a new product. The project for development of the product was called the IRIS project. You came on as the Manager of Reliability Engineering under James TAN, the Director of Engineering. The company was doing well and the IRIS was thought to represent the transition of the company into a new market. The strategy for the IRIS was “first to market with technological superior and high reliability at a reasonable cost”. This was a new strategy where costs would be as important as technological and reliability superiority.

The IRIS represented the movement by the company into very profitable and high growth areas of commercial navigation equipment. In this market cost were just as important as reliability and cutting edge technology. As one executive put it, “The IRIS represents the transformation of the company into a new line of products. These products must be cost competitive or we will not survive in the commercial markets”. Needless to say the project was receiving a lot of attention from senior management. The company also had a reputation of producing high technology products that were developed on time, within budget, and to all performance requirements --- they operated on a project mentality and had been quite successful.

Senior-level management of the IRIS Project includes George WU, Project Manager; Peter WANG, senior vice-president and Director of Product Manufacturing, Thomas GU, Director of Marketing and Sales, Jane YANG, Director of Inspection & Test, and James TAN, Director of Engineering.

You are the Reliability Engineering Manager for the IRIS prototype development project

and report to James TAN. The project is autonomous within the company and has the following configuration:



The IRIS Project Organization

The program had been moving along well and all indications were that the customers' initial testing of the prototype units was successful. Reports had come back from the field stating that users were "satisfied beyond their greatest expectations".

An external product audit had been conducted by randomly selecting three of the 15 prototypes for a "tear down" audit inspection. This audit involved disassembly of the guidance system piece by piece and reviewing the equipment for workmanship and retesting of components down to the module level. The inspection had been completed and the results delivered to the project manager and James TAN five days ago. You knew that there were some discrepancies in the audit, ranging from engineering design issues to workmanship. Up until now the audit discrepancies were not known to anyone but the customer, the senior management of the company, the IRIS Project Manager, and James TAN.

### **Lunch with James TAN**

Just yesterday you had lunch with James TAN. He has just completed a review of the audit discrepancies with the primary customer and senior managers of the company. The company is at odds with the customer and there are contractual issues to be worked out –

everything is still on, but the results of the “tear down” audit have to be dealt with – quickly, professionally, and with a high degree of confidence that the results and conclusions will stand up to the most rigorous engineering scrutiny. James has a meeting that afternoon with the other directors and George WU. The purpose of the meeting is to confirm the company response to the external audit. He wanted to give you an advanced warning about the results of the meeting with the customer so you can, as he put it, “get to work – this is an engineering issue now”. Each senior manager had been asked to provide a short memo detailing their perspective of the audit results. In addition, the customer has assigned Robert HOU, an internal customer representative to “work closely with the project team”. The instruction and scope of his responsibilities are outlined in the customer Memorandum.

The company has been going through some really tough negotiations with the customer concerning the product audit discrepancies (see Memorandum from customer). He has just recently finished the company draft engineering response to the external audit. The reason that he wanted to have lunch with you was to brief you on an agreement reached with the customer to resume production. The company claimed that the IRIS was a great system, capable of exceeding all field expectations for reliability. The senior managers had made an agreement to test 5 systems under operational conditions to support claims of reliability to convince the customer that the product design performance was stable and reliable.

In addition, simultaneously, 5 systems would receive a “tear down” workmanship assessment and engineering design review to determine any product/manufacturing implications of defects identified in the workmanship review. Since you are the Reliability Engineering Manager you will be responsible for planning, conducting, and evaluating the engineering implications of the reliability test as well as the “tear down inspection”. Additionally, you will act as the project manager for the test, evaluation, and inspection of the system. Needless to say, Peter WANG, Director of Product Manufacturing was not happy that Engineering would be taking the lead on the project.

James was serious when he looked at you and said, “This thing is getting some huge visibility and pressure in the company. Make no mistake that it is high profile. If we don’t get this one right and convince the customer that we have done our engineering homework, we will have lost their confidence and they will be living in our operations for years. If we get it right, you will be looked at in the company as ‘the engineer’ and recognized as a candidate for becoming a major project manager by the senior management of the company.” James concluded that you could count on whatever support you needed from any area of the company – all you had to do was ask. The customer would be sending a representative to ‘work closely’ with the project team, they would arrive and be present at the brief to senior management. The senior management would require a briefing in one week concerning your plan for the reliability testing. The direction from senior management is that a full customer briefing will be conducted in 3 weeks and senior management wants a pre-briefing of the results and recommended actions prior to that meeting with at least a week to develop the company position and strategy. James told you that the testing would need to be managed as a project to make sure that everything was on track, the tight time requirements would be met, and the company commitments to the customer would be on schedule.

You have the challenge of your engineering career.

## REQUIREMENT 1: Project Organization

You quickly began assembling the project planning team. The team would have responsibility for: (1) developing the project plan and schedule, (2) conducting the reliability testing of the guidance systems, (3) conducting the tear down audit and interpreting the results, and (4) reporting the results of the project to Senior Management.

This is your project. Your project team consists of Gail YU, Manager of Quality Engineering, Tom HUANG, Manager of Design and Product Engineering, Jesse LIU, a senior engineer from Product Manufacturing, and Pete DONG, a senior engineer from Administration responsible for component purchasing and incoming testing of materials. Each member of your project team has access to whatever resources they need to support the project. This is a top priority for the company and you have been assured that you will “get whatever you need to complete the project”.

You decide that a first order of business is to develop a Project Charter. You will have an initial meeting in one day with the project management team. This is where you will develop the project objectives, roles, and responsibilities. You decide to go in with a draft and have the team work from there.

*In preparation for this meeting,*

*(a) develop an initial project charter,*

*(b) develop a complete Linear Responsibility Chart,*

*(c) complete a stakeholder analysis.*

## REQUIREMENT 2: Network Planning for the Reliability Testing and Workmanship Auditing

The team has quickly developed a sequence of major activities for the project. These activities are listed in the table below along with durations and predecessor relationships:

Task ID	Task Name	Duration (days)	Predecessor(s)
A	Reliability Testing Planning & Design	5	--
B	Review of Audit Discrepancies	2	A
C	Joint Conference with Senior Management	1	A
D	Phase I Tear Down Inspection: Electrical & Mechanical Testing	2	C,H
E	Phase II Tear Down Inspection: Assembly, Components, and Fabrication	3	D
F	Analysis of Tear Down Audit Results	1	E
G	Tear Down Inspection Planning & Design	4	--
H	Tear Down Inspector Briefing, Workspace Preparation, & Procedures Development	4	B,G
I	Reporting of Tear Down Audit Results	1	F
J	Production Procedures Audit & Evaluation	6	A,G
K	Reliability Test Preparations	2	A
L	Environmental Lab and Test Chamber Preparation	1	A
M	Operational Testing of Systems Under Full Load	11	K,L
N	Review, Analysis, & Reporting of Reliability Test Results	3	M

Given the table of project activities:

- Develop a CPM Activity on Node diagram for the project,
- Determine the critical path and the duration of the critical path for the project,
- What conclusions can you draw from the CPM diagram?,
- Discuss the assumptions, limitations, and implications for using the CPM as an approach for scheduling this project?

### REQUIREMENT 3: PERT as a method to schedule the Project

You want to develop a more realistic estimate for the project schedule. Therefore, you have requested that your project team develop PERT based estimates for project durations. The following table has been provided with the PERT data:

Task ID	Optimistic Duration (days)	Most Likely Duration (days)	Pessimistic Duration (days)	Predecessor(s)
A	4	5	6	--
B	1	2	8	A
C	1	1	1	A
D	1	2	8	C,H
E	3	3	9	D
F	1	1	5	E
G	3	4	5	--
H	3	4	11	B,G
I	1	1	5	F
J	4	6	7	A,G
K	1	2	2	A
L	1	1	2	A
M	10	11	12	K,L
N	2	3	4	M

Given the table of project activities:

- Develop a PERT Activity on Node diagram for the project (This diagram must specify the critical path and duration of the CP,
- Construct a table which identifies: Activity, duration, Early Start, Early Finish, Late Start, Late Finish, and Slack (Float), and Activity Standard Deviation (round to 1 decimal place),
- What can you conclude about the project duration from analysis of the PERT network diagram?,
- What are the primary concerns that a PM must consider in using PERT for project scheduling?

### REQUIREMENT 4: Risk Management

James TAN is concerned about the failure in the project. There is a great deal at stake for the company, not to mention his career. He approaches you and says that he heard that, "Risk Management is an approach that can totally eliminate project failure." Based on your knowledge of risk management and the case situation:

- discuss the statement made by James TAN,
- identify primary sources of risk inherent in this project,

*(c) develop and discuss the role that risk management can play in successful accomplishment of THIS project.*

Supplemental Material

#### **Memorandum from the Customer**

We are somewhat troubled by the recent results of the teardown inspection. Based on our discussions, we have elected to assign Mr. Robert HOU to monitor the tear down inspection and reliability testing of systems. We expect full cooperation with Mr. HOU and his access to all data, procedures, testing, and inspection of hardware. He has a background in quality and reliability and should be a valuable team member for the Teardown Testing project. Please have your project representative contact Mr. HOU at your earliest convenience.

Peter MEN  
Program Oversight

#### **MEMORANDUM from Peter WANG, Director, Product Manufacturing**

The results of the audit indicate that we are missing a substantial amount of workmanship errors in inspection. Our operators can only correct what is identified in the detailed inspection. The inspectors have some large inconsistencies in how they identify deficiencies – we seem to have varying degrees of acceptability. We do our best in training, but the operators can't catch everything --- that is what the inspection function is supposed to do. I am not sure that the inspectors are adequately trained to catch many of the workmanship errors that got through the system. In addition, we have had some problems with processing chemicals. I suspect that some of the difficulties might be in trying to comply with the new Occupational Safety and Health Administration (OSHA) limits on amount of solvent that can be released in the factory environment – this has precluded our use of the amount of component cleaning chemicals that we were using before. They are monitoring us on a weekly basis and could shut down operations if we exceed allowable limits.

For the upcoming teardown audit, I will provide our most skilled operators to disassemble the system. I hope that the audit will find that the review of procedures, tools, and equipment used for product assembly are adequate and that the training and skill level of the operators is sufficient. We will make all records, equipment, and operations open to the project team. I will look forward to discussing the audit approach and results of the audit PRIOR TO the meeting with senior management.

#### **MEMORANDUM from Thomas GU, Director, Marketing and Sales**

The results of the audit have really put us in a bind with the customer. I don't know the technical specifics of the discrepancies, but I say the look on Pete Mitchell's face when he saw the teardown inspection results. The next day I had lunch with him. His boss had him cornered him just before lunch – his face was still red from the exchange. Needless to say, there is a lot riding on this inspection --- He also talked about Mr. HOU. HOU is a details guy. He likes data and control. Pete picked him specially for this assignment because he wants to know what is going on minute by minute. A kind of quirky individual, better watch out for him.

**MEMORANDUM from Jane YANG, Director, Inspection and Test**

We have been working on our inspection and test procedures over the last month. They have undergone a complete revision from the earlier procedures. I am not sure that we have the same system in place that we had when the prototypes were produced. There has been significant learning that we have experienced. However, there are some things that we cannot easily inspect. We have provided a listing to Engineering to see if we can do anything on the design side to make the inspection easier. In addition, we identified several “disputed” areas that engineering clarification was necessary to determine if the “potential discrepancy” was in fact a discrepancy. Manufacturing has in several instances called engineering to the floor to determine if the product reliability would be impacted by the “apparent defect” or was it OK to send forward.

In addition, the customer has conducted a recent audit of our inspection procedures – with assistance from engineering, and they found us to be in substantial compliance. I hope that the project team will investigate the new procedures that we are currently working under.

I will provide whatever assistance is necessary to assist in the effort. We are anxious to make sure that our inspection and test processes, procedures, and systems are sound.

**MEMORANDUM from James TAN, Director, Engineering**

The results of the teardown audit are discouraging to say the least. However, we are confident in the ability of the hardware to perform the intended mission without failure, even with the type and class of deficiencies that have been identified.

The reliability test group has done some preliminary analysis of the flaws and is confident that the deficiencies identified, while somewhat upsetting, are not of the type/class that would possibly compromise the mission. We look forward to the results of the teardown inspection and the reliability testing. We are confident that our systems will meet or exceed the specifications. Engineering is neutral in the process and will focus on providing an unbiased appraisal of the product.