

# Why System Engineering

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With a Foreword by **Jackson McGowen**

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TO BETTY AND JANICE

# Foreword

Engineers and managers in business today who know *what* system engineering is, might find the question “*Why* system engineering?” rather academic. They know that an organized, systematic approach to engineering is mandatory to the production of a competitive product. To a neophyte, however, neither the “what” nor the “why” are always general knowledge.

As an engineer and a manager, I have found the program contained in *Why System Engineering* to be the simplest and most effective explanation of both the “what” and the “why.” For a bonus, authors Corrigan and Kaufman have made the learning process enjoyable. If you are trying to unlock the doors to cost effectiveness, which are today the doors to success, here is your first key.

JACKSON MCGOWEN  
Group Vice-president, Aircraft  
Douglas Aircraft Company, Inc.

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# Why System Engineering?

## A Fable

Once upon a time there were two pigs (a third one had gone into marketing and disappeared) who were faced with the problem of protecting themselves from a wolf.

One pig was an old-timer in this wolf-fending business, and he saw the problem right away—just build a house strong enough to resist the huffing and puffing he had experienced before. So, the first pig built his wolf-resistant house right away out of genuine, reliable lath and plaster.

The second pig was green at this wolf business, but he was thoughtful. He decided that he would analyze the wolf problem a bit. He sat down and drew up a matrix (which, of course, is pig latin for a big blank sheet of paper) and listed the problem, analyzed the problem into components and possibilities of wolf strategies, listed the design objectives of his wolf-proof house, determined the functions that his fortress should perform, designed and built his house, and waited to see how well it worked. (He had to be an empiricist, for he had never been huffed and puffed at before.)

All this time, the old-timer pig was laughing at the planner pig and vehemently declined to enter into this kind of folly. He had built wolf-proof houses before, and he had lived and prospered, hadn't he? He said to the planner pig, "If you know what you are doing, you don't have to go through all of that jazz." And with this, he went fishing, or rooting, or whatever it is that pigs do in their idle hours.

The second pig worked his system anyway, and designed for predicted contingencies.

One day the mean old wolf passed by the two houses (they both looked the same—after all, a house is just a house). He thought that a pig dinner was just what he wanted. He walked up to the first pig's house and uttered a warning to the old-timer, which was roundly rejected, as usual. With this, the wolf, instead of huffing and puffing, pulled out a sledge hammer, knocked the door down, and ate the old-timer for dinner.

## 2

Still not satiated, the wolf walked to the planner pig's house and repeated his act. Suddenly, a trap door in front of the house opened and the wolf dropped neatly into a deep, dark pit, never to be heard from again.

- Morals:*
1. They are not making wolves like they used to.
  2. It's hard to teach old pigs new tricks.
  3. If you want to keep the wolf away from your door, you'd better plan ahead.

ROGER A. KAUFMAN



## How To Use This Book

How long has it been since you learned something by sitting down with an instructor and mastering a topic through the interchange of questions and answers? Most of us seem to learn best this way, but modern demands for proficient instructors and high trainee loads have resulted in large classrooms, which make a close teacher-student relationship impossible. We are attempting to recapture this valuable person-to-person relationship. To do this, we are using the technique of programmed instruction, a technique proved to teach things better and help you remember better the things that you have learned.

As you go through this programmed book, you will encounter the same interaction you would find if you were the only student of an instructor. One of the first things you will notice is that this book is different from any other book you have used. You will be given a unit of information, and the instructor (authors) will then ask you a question to determine if he has gotten the point across. When you select the answer that you think is correct, you will be directed to a page that is responsive to your answer and to your rate of learning. Each person goes through the material in a different order and in a different amount of time. This “scrambled” order is tailor-made for your particular learning needs. Because of this, you will not be able to “skim” pages as with a regular book.

To summarize the instructions: read the material on a page and digest it. Then answer the question at the bottom of the page and turn to the page that is indicated directly after the answer you have selected. Sometimes, you will be directed to go to another page without being asked a question. The program will work only if you follow these directions.

Remember, this form of instruction is not a test; it is a method designed to teach you what you need to know about system engineering. First, a decision.

1. If you want to learn this material from a conventional technical manual, get a copy of AFSCM 375-5.
2. If you want to learn by this programmed method, turn to page 13.

### What are you doing here?

This is page 4. The instructions told you to turn to page 13, *not to the next page!*

Remember, you will be reading this book in a way that is different from what you are used to. Follow the instructions and turn to the page number that is either beside the answer you select or indicated at the bottom of the page.

Let's sharpen up and start again! Turn to page 13 and follow instructions.

You are only partially correct. As a purchasing agent, it is of importance that you be able to specify the functions or jobs each truck is designed to perform. This requirement begins to approach the critical data you require to make a relevant design decision.

Your answer indicates your understanding of the requirement to specify functions before you can derive relevant design decisions. In this case, however, you are provided only the general functions for each vehicle. As a buyer, you cannot settle for general functions! You must be much more specific!

Return to page 14 and select the correct answer.

# 6

You selected the stake truck.

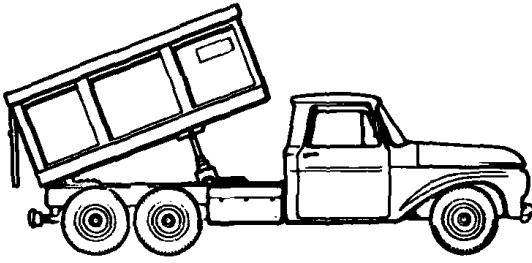
You are incorrect. Do you really know which one is best? What are you using for criteria?

Return to page 13 and select the correct answer.

The availability of road-test performance data will give you pertinent information concerning the general performance limits, design, and operating constraints for each truck. This answer, however, is not the correct one.

A more critical initial requirement facing you is the identification of jobs or functions to be performed by the vehicle selected for your system. Performance specifications for a vehicle will be of value provided the design of one of the three vehicles is appropriate to *your system requirements*.

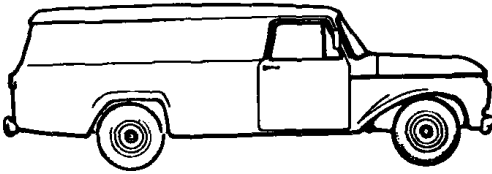
Return to page 14 and select the correct answer.



DUMP TRUCK

General Data

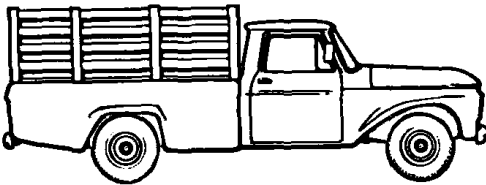
8-ply tires  
 Hydraulic brakes  
 Nylon gears  
 Power steering  
 Safety glass  
 Diesel engine



PANEL TRUCK

General Data

Aluminum frame  
 Rear double doors  
 Unibody construction  
 Four speeds  
 L-head engine  
 Safety glass



STAKE TRUCK

General Data

Metal bed  
 Automatic transmission  
 V-6 engine  
 Power brakes  
 Power steering  
 Removable stakes

You indicated your inability to determine the best design with the limited information available to you. You are correct.

To provide you with more specific design data, you are presented *general data for each of the three vehicles.*

← **See opposite page.**

With this additional information available to you, are you now able to specify which of the three vehicles presents the best design?

- 1. Yes . . . . . Turn to page 11.
- 2. No . . . . . Turn to page 14.

# 10

You selected the panel truck.

You are incorrect. Do you really know which one is best? What are you using for criteria?

Return to page 13 and select the correct answer.



You are incorrect. You are still not able to specify which of the three vehicles presents the best design. In your role as purchasing agent, you are missing critical data that you must have before you can make a relevant design decision.

Return to page 9 and select the correct answer.