

N67-21972

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THE PROGRAM MANAGERS' PROBLEM: DR. ARTHUR RUDOLPH, NASA, Director, Saturn V Program

Office, Marshall Space Flight Center, has a Bachelor's Degree in mechanical engineering from College of Berlin, and an honorary D.Sc. degree from Rollins College. He was Chief, Fabrication, Chief Planning Engineer, and Technical Director for pilot V-2 manufacturing and testing at Peenemuende; and established the underground plant for mass producing V-2. He worked at White Sands with the V-2 and Hermes II programs. He was with Dev. Opr. Div. and Industrial Division of ABMA; was Technical Director of Redstone Missile Weapon System, Project Director of Pershing System, and was Assistant Director, Systems Engineering, Office Manned Space Flight.



SATURN HISTORY DOCUMENT  
University Of Alabama Research Institute  
History Of Science & Technology Group  
Date ..... Doc. No. ....

Gentlemen:

The Saturn V Vehicle System is big. The number of governmental and industrial organizations and the number of people within these organizations, working on the Saturn V, is big. The problems are big. With a few figures I will try to illustrate for you the immensity of our hardware.

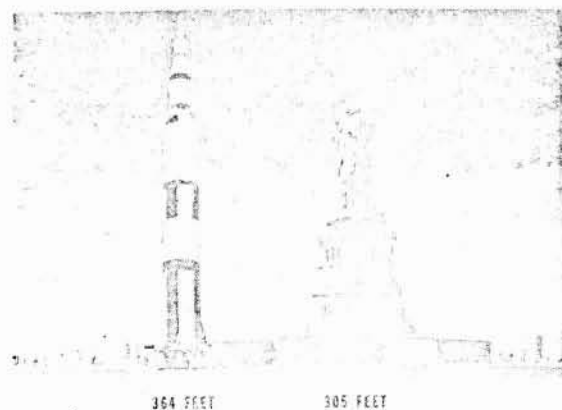


FIGURE 1. SATURN/STATUE OF LIBERTY

In this figure you may compare the height of the Statue of Liberty of 305 feet with the Apollo/Saturn V Space Vehicle which stands 364 feet high and weighs

6,000,000 pounds at lift-off. The Saturn V itself stands 282 feet high and develops 7.5 million pounds of thrust at launch.

The four Saturn V stages see each other for the first time at the Kennedy Space Center, where they are assembled, "stacked," as we call it, to make the Saturn V Launch Vehicle. This stacking, followed by checkout, is accomplished in the Vehicle Assembly Building, the VAB. It is the largest building in the world.

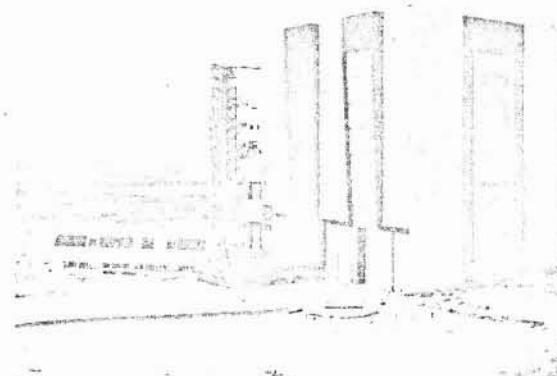


FIGURE 2. 500F ROLLOUT OF VAB

In this picture you see the rollout of the Saturn Facilities Vehicle from the VAB. The size of this vehicle system, its performance requirements, its complexity, and the continent-spanning activities to make and support it, surpass, to my knowledge, anything previously attempted.

In Figure 3 you see the First Stage or basement booster (S-IC). It is being built by Boeing in the Michoud Plant at New Orleans.

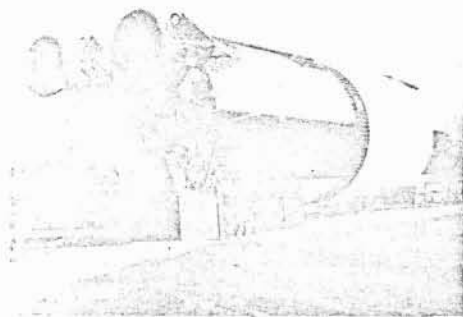


FIGURE 3. FIRST STAGE (S-IC)

It is moved by "river barge" to the Mississippi Test Facility (MTF) for captive acceptance firing, returned to Michoud by "river barge," refurbished, then shipped to Kennedy Space Center by a modified "ocean-going barge."

#### SATURN V TRANSPORTATION

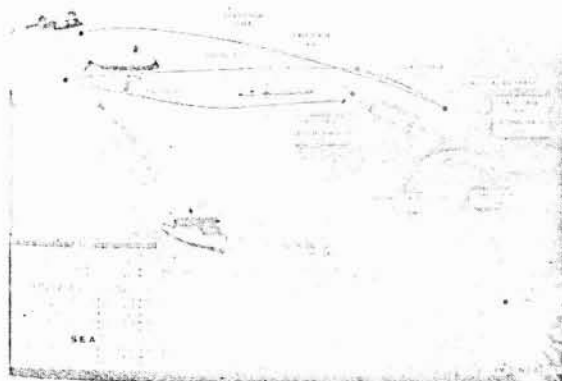


FIGURE 4. MAP OF UNITED STATES WITH SHIP LANES

Figure 5 shows the Second Stage (S-II). It is manufactured by North American at Seal Beach, California. It is shipped on a "Converted LSD" (Landing Ship Dock) through the Panama Canal to New Orleans. There it is transloaded to a "river barge" and moved to the Mississippi Test Facility for captive acceptance firing. After refurbishment it is taken back to New Orleans by river barge, loaded once more on the "Converted LSD," and shipped to KSC.



FIGURE 5. SECOND STAGE (S-II)

The Third Stage (S-IVB) is being built by Douglas at Huntington Beach, California. It is shipped to the

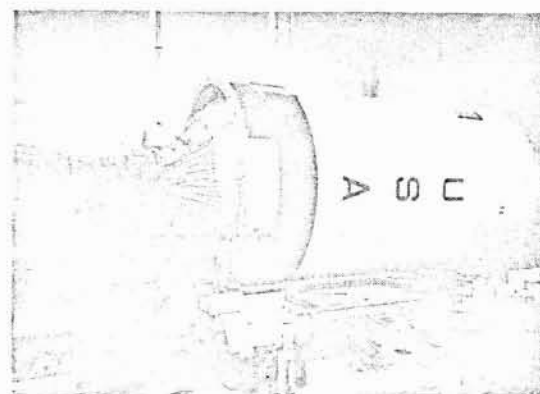


FIGURE 6. THIRD STAGE (S-IVB)

Sacramento Test Facility for captive acceptance firing either by "ocean-going barge" or by a uniquely designed aircraft, called "Super Guppy."

It is also flown by Super Guppy to KSC.



FIGURE 7. SUPER GUPPY WITH STAGE

The Instrument Unit (IU), shown in Figure 8, is manufactured by IBM at Huntsville, and is flown to KSC by Super Guppy.

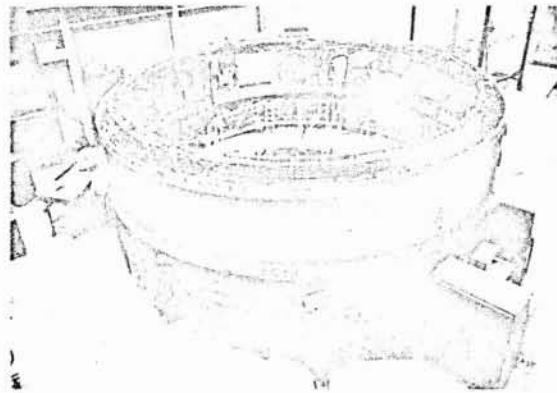


FIGURE 8. INSTRUMENT UNIT

Now, let me give you a thumbnail sketch of the Launch Vehicle Ground Support Equipment (LVGSE). It is that complement of Ground Support Equipment furnished by the Marshall Space Flight Center to equip the Launch Site. It is manufactured by numerous contractors scattered all over the United States, and is transported to the test sites and to KSC by all known means of transportation. Because of its multifarious elements, this Ground Support Equip-

ment does not lend itself to a simple pictorial portrayal.



FIGURE 9. GSE MANAGER

My GSE Manager feels that he is literally inundated by the end items for which he is responsible.

Let me give you a perspective by comparing some PERT figures: Our four Stage Contractors track a total of 40,000 events, but for the Ground Support Equipment in excess of 60,000 events are being tracked.

### PERSPECTIVE OF GSE MAGNITUDE

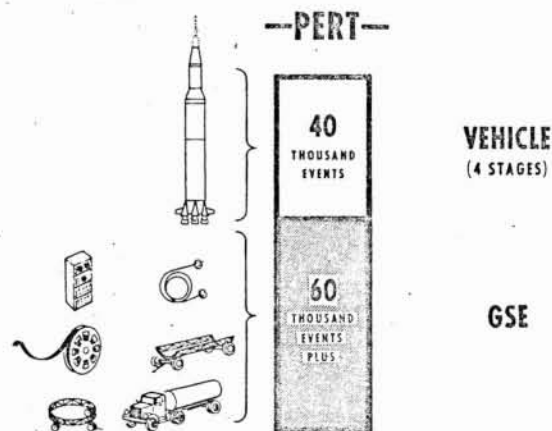


FIGURE 10. PERSPECTIVE OF GSE MAGNITUDE

My illustration of the Saturn V Launch Vehicle System did not provide you with much visibility; in fact it was just a bare glance. Even so, I think it will not be hard for you to visualize the demands placed on Logistics Management in a program of this magnitude and complexity.

In the early days of the Saturn program, a number of people stated emphatically that, since we were not

to field a weapons system in the sense that the military does, we did not, therefore, need a weapons system logistics program. And this is basically true. Certainly we do not need a program "identical" to the Minuteman or to the Army's Pershing, having been personally very familiar with the latter one. However, differences between launch vehicle system logistics and weapons system logistics exist only in certain aspects. The basic problems of the two systems are, in essence, identical. I am not at all sure that logistic support of a launch vehicle program, with its high rate of advancement in the state of technology and its associated highly complex ground support equipment, is not more difficult than logistic support to a weapons system.

The axiom: "We do not need a weapons system logistic program," unfortunately carried with it the implication: "We do not need a logistics program." Misinterpretation, then, caused neglect of an integrated logistics program. Thus, we have created for ourselves a considerable problem by not allowing enough thought and planning toward logistics at the very outset.

By the way, based on my experience, I strongly suspect that this may be the case in many other programs.

Well, the belated identification of the requirements of a logistics program led naturally to an aggravation of one of our biggest problems, money.



FIGURE 11. LOGISTICS AND THE "NOT ENOUGH DOLLAR"

In the Saturn V Program, where we have become accustomed to talking in terms of hundreds of millions of dollars, there now is simply not enough money to satisfy all of the legitimate demands, or to do all the

things that our systems analysis indicates should be done in logistics. Somewhere, something's got to give. And, of course, it is the program manager's job to decide what is going to give, and how much. That is, how much of a calculated risk can he afford to take.

With guidance and support of the Apollo Program Office in Washington, intensive, accelerated studies were conducted in order to mold the Saturn V logistics program to fit the status of launch vehicle system development and the prevailing monetary situation.

Within my Saturn V Program Office, each Project Manager has wide latitude to exercise management actions just as long as these actions meet established technical performance requirements and schedule and budget constraints.

I impose controls on my Project Managers only to the extent that I have assurance that the aforementioned parameters are met, that interfaces are maintained, and that redundancy is eliminated. This policy of management, by exception, has enabled us to operate effectively and efficiently and has given my people the incentive to perform to their fullest capabilities.

In accordance with that management concept, and in pursuance of the logistic studies I mentioned before, the major responsibility for adequate logistics support was placed directly on my hardware managers. Each of these managers examined with his contractor the existing arrangements to determine what logistic requirements were essential, which could be trimmed back, and, on the other hand, what additional procurement of logistics resources was required. This "agonizing reappraisal" lasted over many, many months, but, in this way, we were able to tightly tailor, I repeat, tightly tailor, our logistics program to meet the essential requirement of each stage, yet stay within budget limitations.

This improved Logistics Plan is, by now, a working part of Saturn V.

During preparation of that plan, it became clear that we did not have proper management visibility of the logistics activities of our contractors. It was mandatory that we know what had been accomplished--where we stood--and how we, or rather our contractors, were progressing toward our logistic goals.

To obtain management visibility is certainly not easy; it is especially hard in an area like logistics. Well, we tackled this task by, first, requiring the

contractors to report to us periodically against the Improved Plan, and, second, by maintaining control charts which depict the status of progress. Of course, neither of these means replaces the dynamic individual logistics manager but they are very effective tools for him.

Each one of my hardware managers now has a logistics manager, and I have one in my program office who reports to me and looks over the shoulders of these logistics managers, our contractors and our Marshall laboratories with their outstanding technical experience. All that effort is necessary to insure that the logistics program is progressing satisfactorily in step with the remainder of the program. Needless to say, my boss uses the same "over the shoulder" concept.

We place a great deal of reliance on our contractors to execute a realistic logistics program. And now that we have incentivized most of our contracts, we shall depend upon them to an even greater degree. This will require that the contractors place even greater demands upon their own organizations.

I have made no effort to catalog all the Saturn V logistics problems. Such a catalog would bore you and give all of us a wrong perspective. I think, though, that by facing squarely the prime cause of our logistics problems, that is, inadequate early planning, and by taking correspondingly firm and effective corrective action, late, yes, but not too late, we have put the show on the road for a realistic, facts-of-life logistic program.

I sometimes wonder if I don't present many appearances to many people, depending on the particular exposure.

To the contractors, I must seem to be a tight-fisted, penny-pinching, grouchy old so-and-so who is never satisfied with their progress no matter how hard they work, how often they are successful, and how much they cut their cost.

To my own people, I'm sure I frequently appear to be an irritable, nit-picking, hard-to-please manager,

who likes conferences which last far into the night.

To the logistician, I must seem thoroughly patient, heartily sympathetic, and completely understanding of all program elements, except logistics, and that I am not only completely ignorant of the subject but plan to keep it that way.

Please let me assure you that I am all and none of these.

Being a Program Manager and exposed to many conflicting demands, if I succumbed to all of them, willy-nilly, I would copy the Stephen Leacock character who "flung himself from the room, flung himself upon his horse, and rode madly off in all directions."

Perhaps this Figure 12 will strike a sympathetic chord with those of you who are managers.

● **WORK FAITHFULLY FOR 8 HOURS A DAY  
AND DON'T WORRY.**

● **YOU MAY BECOME PROGRAM MANAGER  
AND WORK  $1\frac{1}{2}$  HOURS A DAY AND HAVE  
ALL THE WORRY.**

FIGURE 12. TWO RULES FOR A PROGRAM MANAGER

Not the least of the problems in the Saturn V System is logistics. Nevertheless, I would like to state that we of the Saturn V team, and I mean the team of Government and industry, have found timely solutions, even to problems which hit us like thunderbolts out of the blue. Admittedly, we do not always come forward with the best solutions, but we can live with our solutions, and I am confident we will make our first Saturn V launch early next year.