# DOING BUSINESS IN SPACE: HOW TO GET THERE FROM HERE

by

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## ABSTRACT

Space represents a business frontier which may eventually overshadow such growing industries as telecommunications, microelectronics, and computers. The challenge facing American industry is to find the best means of developing this new frontier and reaping its rewards.

This paper presents a step-by-step process by which a company (or an individual) can find out:

1) How to identify the ways in which space may benefit them

2) How to identify and prepare the experimental work necessary to demonstrate the concept

3) How to arrange to carry out the experiment

4) How to continue development through a prototype to production

5) How to safeguard proprietary information throughout the process

6) How to carry out the entire process in the shortest time with a minimum of cost and risk

7) If necessary, how to locate and secure financing.

Forward looking technology-oriented businessmen and inventors will be directing their attention to space opportunities, and will want to find the most direct route to profits in space.

## INTRODUCTION

In response to President Reagan's announcement* of a dual commitment to a permanent manned space station and to the commercialization of space, private sector companies and investors are looking much more closely at the opportunities afforded them by the various attributes of space. Despite the establishment of several ventures designed to exploit these unique attributes, it is still difficult to determine the best way to initiate and carry out such new ventures.

* See excerpt to State of the Union Address, January 25, 1984, attached.

The purpose of this paper is to describe the step-by-step process through which a company can develop a commercial space mission from concept through production, with particular focus on making use of available cooperation from NASA. In order to illustrate this step-by-step process of Commercial Mission Development, exhibits have been prepared which deal with the three most common scenarios:

- o Exhibit I – Existing Enterprise – Space-based Production
- o Exhibit II – Entrepreneurial Ventures
- o Exhibit III – Existing Enterprise – Ground-based Production

Each of these exhibits has been designed to illustrate the steps through which a new space venture might be approached in each scenario. Certain alterations would have to be made depending on the specifics of the mission or missions involved.

The Commercial Mission Development process can be divided into five phases:

- o Concept Development
- o Feasibility Assessment
- o R&D Program
- o Prototype Development
- o Production

The following sections describe the process within each of these phases, as well as how this process differs among the three scenarios.

## CONCEPT DEVELOPMENT

### Existing Enterprise – Space-based Production

The development of any new commercial space mission must of course begin with a technical concept. Mission concepts often begin as broad technical areas of interest, such as "crystal growth" or "biological separations," and may be generated either as a by-product of ongoing research within the company or from monitoring the activities of competitors.

With one or more broad mission concepts in mind, a company can perform some preliminary analysis to determine what specific concepts for space missions exist or have already been examined by others. The firm may also be able to derive new specific mission concepts within the same technical area through its own unique or proprietary skills. Once an array of several specific concepts has been assembled and analyzed, one or more preferred concepts may be selected as the most interesting ones for further consideration by the company. The identification of specific concepts from broad areas of interest is important for a company which already operates in a non-aerospace industry; because of the limited understanding of the attributes of space in many non-aerospace firms, the incentive for pursuing a venture may not

become obvious unless the specific benefits of a particular mission concept are examined. Without this examination of specific concepts, the general idea of a space venture may be improperly rejected out of hand.

Another source of specific mission concepts is a NASA-sponsored intermediary. Using its knowledge of specific space attributes and its familiarity with non-aerospace industries, a third-party intermediary can present firms with specific concepts tailored to their activities. Booz, Allen & Hamilton has developed this "seed concept" approach to commercial user development under its contract to NASA to provide intermediary services.

Once identified, the preferred mission concepts can then be compared with the long range goals of the company: "Would such a venture fit into our plans?" For those concepts which appear to be appropriate, a first cut can then be made at understanding the economics of developing and operating such a venture. This economic analysis must take into account both the potential market value of the product or service and the estimated cost of providing it. Development time and costs must also be taken into account, but to a certain degree some of these costs (particularly flight costs) may be offset through NASA's cooperative programs.

If the economics of the venture appear attractive, it now becomes reasonable to contact NASA to discuss the possibility of initiating a development program. Carrying out the preliminary economic analysis is important before talking with NASA since it can give the company an idea of the level of assistance it may wish to negotiate with the Agency, and what consideration of value to the Government it can offer in return. NASA has a variety of means available through which ground-based and space-based research and development can be carried out at a reduced cost to the firm. With the introduction of the Agency's new Commercial Space Policy, even more ways will be made available in which NASA may assist new users of space to develop mission concepts.

The contact with NASA may have several objectives. One of these might be to locate and talk with NASA scientists and engineers who have worked on some aspect of the preferred concept and thus may be able to provide further technical details. Another goal should be the identification of the relevant programs or agreements through which NASA might be able to assist the company. The most prominent of these agreements is the Joint Endeavor Agreement (JEA), under which NASA provides free Shuttle flights for the company during its R&D phase in exchange for some form of quid pro quo. One typical quid pro quo commits the company to processing some NASA samples with its experimental apparatus so that the Agency may further its understanding of space phenomena. Other forms of quid pro quo are likely to be developed as NASA's Commercial Space Policy is put into effect.

The first contact with NASA may be complicated by several factors. The first of these may be the proprietary nature of a company's concept. Companies often are reluctant to discuss specifics with NASA for fear of losing control of their concept. However, by working through an independent third party intermediary, a company can safeguard the proprietary portions of its concept while still carrying on a useful dialog with NASA.

A second factor complicating the approach to NASA is the difficulty in determining which NASA office or individual a company should contact. A number of offices at NASA Headquarters in Washington and at various NASA Centers around the country are involved in NASA's commercially-oriented activities. Identifying the appropriate office to deal with has been difficult in the past, but again the services of an intermediary have been useful to a number of firms in both finding the right office and initiating productive discussions.

Booz, Allen is presently under contract to NASA to function to assist private sector companies in their dealings with the Agency. In 1981, Booz, Allen developed the concept of an intermediary from its experience with private sector clients, and has been functioning in this role for NASA for over two years. A number of firms are presently working with NASA through Booz, Allen, several of which have entered into confidential agreements under which Booz, Allen buffers the proprietary portions of their concepts from NASA. In at least two cases (with NASA's cooperation), Booz, Allen has not yet revealed the firms' identities to NASA.

Under NASA's new Commercial Space Policy, a high level Office of Space Commercialization is to be established. As a focal point for coordinating the Agency's initiatives designed to stimulate, encourage, and assist potential new users of space, this office should greatly alleviate the problems which private sector firms have had in working with the Agency in the development of commercial space ventures.

## Entrepreneurial Ventures

For entrepreneurial ventures, the concept development process is very similar to that for an existing enterprise. But for new ventures, there are often no established long range business plans against which to assess the fit of the preferred concepts. In many cases the company is being formed specifically to pursue the space venture in question, and it is necessary to use the first cut economic analysis as a basis for establishing the company's long range goals, building a business plan around the concept and its economics.

## Existing Enterprise – Ground-based Production

For an existing enterprise interested in conducting space research to improve some aspect of its ground-based production process, the concept development phase is nearly identical to that for space-based production. The distinction is that the concepts which are considered and chosen are oriented toward a particular ground-based process for which space research may hold the key to significant improvements. The comparison with long range goals is not essential because the space venture is likely to be a straightforward extension to the firm's R&D program. For a similar reason, combined with the absence of an expensive space production phase, the economics will probably be simpler.

## Summary – Concept Development

The concept development stage is an important first step in any venture, particularly for a space venture where a company or individual may be unfamiliar with the technology involved. But even in this stage, before a firm may know enough to have a useful first meeting with NASA, the Agency has resources which can be useful in identifying appropriate concepts. NASA seminars, studies, and publications can be excellent sources of information on the state of research in a particular field, and under the new Commercial Space Policy, seed-funding is expected to be made available for the investigation of new concepts. Also, a NASA-supported intermediary can help a company or individual identify concepts which would be directly applicable to a firm's technology. And by virtue of having assisted numerous companies in their dealings with NASA, that same intermediary can simplify a company's approach to NASA and protect its proprietary interests at the same time.

## FEASIBILITY ASSESSMENT

### Existing Enterprise – Space-based Production

The initial discussions between a company and NASA will provide additional technical information which the company will want to factor into its technical feasibility assessment. This information may relate to prior NASA or NASA-funded research related to the mission concept, but it will also include data on the Space Shuttle and any existing pieces of space fixtures, instrumentation or other hardware which may be useful to the company in the development of its concept. Further information on available space services can be obtained at this stage from private sector suppliers of these services.

In addition to technical information, NASA will be able to provide more detailed information on its available incentives and cooperative programs to support commercial space research, as well as information on the cost of the space services which might be required to support space-based production. Here, again, private sector suppliers of these services can be considered. With these inputs, the company can conduct a more detailed economic feasibility analysis, including an assessment of the level of investment in development which might be necessary and the ongoing cost to support space-based production. This analysis must also consider the size of the market(s) for the new product or service and the price at which such a new or improved product would have to sell to produce a fair return on the investment.

From the technical and economic feasibility analyses the company should have enough of an understanding of its concept to propose some form of cooperative agreement with NASA. Often the first step in the agreement process is to develop a Memorandum of Understanding between the company and the Agency. This document usually states that the company has an interest in exploring a particular concept, that NASA is willing to offer its assistance in that effort, and that the two sides will attempt to develop a joint agreement during the time in which the MOU is in effect. This document is useful to both sides in that it expresses the commitment of the other side to developing an agreement, but carries no other commitment beyond their intention to negotiate.

With or without an MOU, the negotiation of a joint agreement with NASA will require that the company have enough of an understanding of the development process for its concept to determine what type of assistance it would require from NASA. This would probably include the number of flights that might be necessary, the time necessary between flights to evaluate results and prepare for the next flight, the type of apparatus to be flown and the Shuttle accommodations it would require, and the type and level of technical assistance that might be required from NASA to support the company's development efforts. With this type of information a company can develop and enter into a joint agreement with NASA.

### Entrepreneurial Ventures

For entrepreneurial ventures, feasibility assessment follows basically the same path, but takes on a much more critical flavor, since most or all of the new company's assets may be committed to the project. Thus the firm should also be developing an initial business plan in parallel with the negotiation of its agreement with NASA. Once an agreement is reached, both the agreement and the business plan will be necessary for obtaining capital, which will be the

first step in carrying out the R&D program. While it is certainly possible to obtain some financing before an agreement with NASA is reached, the agreement lends significant credibility to the venture and would enhance its attractiveness in the eyes of potential investors.

### Existing Enterprise – Ground-based Production

The process for assessing the feasibility of a ground-oriented research program closely parallels the space-oriented one, with the exception that the more expensive and complex space production is not contemplated. The company should always be alert to the possibility that its research may determine that space-based production offers a significant economic advantage over an improved ground process, and hence should keep open its options to pursue space-based production at some time in the future.

### Summary – Feasibility Assessment

The accurate assessment of a concept's technical and economic feasibility is essential both to the continued development of the concept and to the negotiation of a joint agreement with NASA. It is crucial to an entrepreneurial venture because the resulting business plan will be the basis for soliciting capital.

As in the concept development phase, NASA has resources available which can assist the company in carrying out a feasibility assessment and negotiating a joint agreement. A NASA-supported intermediary can assist the company in finding the necessary technical and economic information, both inside NASA and elsewhere. It can also guide the company through its negotiations with the Agency, using its understanding of previous agreements, the quid pro quos which NASA may be obliged to seek, and in particular the NASA organization and the negotiation process itself.

In addition, NASA's new Commercial Space Policy includes a number of incentives designed to lower the cost of developing a space venture, and these will help make both the technical and economic aspects of new ventures more attractive. These incentives include:

- o Grants for commercially-oriented research
- o Access to NASA expertise and patents
- o Free and reduced-rate space flights through agreements such as the JEA
- o Use of NASA ground facilities, including cooperation through technical exchange agreements (TEA's)
- o Fewer safety and regulatory restrictions on payloads
- o More rapid payload integration and processing
- o Possible NASA purchase of commercial space products and services

- o Dedicated commercial payload opportunities or "stand-by" payload status
- o Potential tax, financial, and insurance incentives, subject to legislative action.

Many of these incentives will prove useful to both existing enterprises and entrepreneurial ventures as they develop and assess the feasibility of their concepts. While NASA will not normally agree to long term exclusive sourcing, the probability of government use of the firm's product or service can be a positive factor in the economic analysis, and should be developed in discussions parallel to those leading to joint agreements.

## R&D PROGRAM

### Existing Enterprise – Space-based Production

Once a joint agreement has been negotiated with NASA, the company can prepare a detailed R&D program taking advantage of the NASA capabilities provided through the agreement. Concurrently with development of this R&D program, an equally thorough time-phased business plan should be prepared, based again on the NASA assistance which will be provided through the agreement. The NASA input includes technical assistance and the schedule on which it will be provided. The economic aspects of NASA's support are a function of whatever incentives have been included in the agreement.

The R&D program is then executed, using the flights, ground facilities, and other incentives provided under the agreement. Based on the results of the R&D program, the company can update its economic analysis of the venture and prepare to move on to the development of a production prototype.

### Entrepreneurial Ventures

For an entrepreneurial venture, additional funds must often be obtained before it can afford to carry out the R&D program. Thus, in parallel with the development of the detailed R&D program, the company must obtain adequate financing to cover at least the demonstration portion of its R&D program. This is not to say that a new venture should necessarily wait until it has an agreement with NASA to begin seeking venture capital, only that in order to proceed into the R&D program sufficient capital must be available. Often capital can only be obtained on the combined strength of the business plan, the R&D plan, and the terms of the joint agreement with NASA. The R&D program thus becomes the "proof of concept" supported by an initial increment of funding. A successful R&D program would then be necessary before any additional funds could be solicited. The entrepreneurial firm may want to consider offering a stake in the venture to potential contractors as an alternative to a conventional venture capital solicitation.

Once the R&D program is underway and some results are available, the entrepreneurial firm can begin to update its business plan in preparation for seeking any additional financing which may be necessary to support development of a production prototype. The update to the business plan from the R&D program will include both more accurate technical information on the qualities of the product or service, and a more definitive set of costs for the economic portion of the plan.

## Existing Enterprise – Ground-based Production

The R&D program for a company exploring improvements to its ground-based production process will be somewhat different than the R&D program for space-based production. The business plan for the space-based process is replaced for the ground-based case by a process improvement plan – a time-phased plan for incorporating the knowledge gained in space into the company's ground-based operations.

Once the R&D program is underway, several iterations of assessing results and modifying subsequent experiments will probably be necessary to produce the desired results. Once satisfactory results have been obtained, the economic aspects of those results can be input to the process improvement plan, and the company can proceed to the next phase.

## Summary – R&D Program

For each of the three scenarios, the R&D programs design should allow for several experimental runs. The duration of this experimental loop should be controlled by both technical ("Can further useful data be acquired?") and business ("Do the potential benefits of further experiments outweigh the costs?") considerations. Planning too short an R&D program or terminating it too soon can be as big a mistake as pursuing poor results for too long. On the other hand, the potential value of very low cost "blind stabs" (e.g. Getaway Specials) should not be overlooked, since to date very little experimental work has been done in a number of fields, and the chance for serendipitous discoveries may be too good to pass up.

In all three scenarios it is essential that technical and business developments be carried out concurrently. Neither can afford to get very far ahead of the other, and in many cases conditions may be such that one cannot proceed unless the other is being properly executed.

Companies should also be sure to take advantage of as many of NASA's capabilities as possible in the R&D phase. In particular, NASA technical literature, facilities, and personnel should be used wherever necessary to simplify the execution of the program and reduce its cost. In particular, the commitment in NASA's Commercial Space Policy to shorten the time necessary to integrate and fly commercial experiments and payloads, combined with the increasing frequency of shuttle flights, should make the time needed to carry out the R&D program much more suitable for companies concerned with a return on their investment.

In the next few years, the only readily available means of carrying out R&D programs in space will be the Space Shuttle, using either the mid-deck of the crew module, the payload bay, or possibly the Spacelab. At some point free-flying spacecraft such as Fairchild's Leasecraft, MBB's SPAS, or ESA's Eureca may be available, but unless they are somehow accessible through an agreement with NASA, they may not be economical for R&D purposes. In the early 1990's, the proposed Commercial Space Station Laboratory, with its ability to conduct experiments unconstrained by shuttle flight durations, should become an attractive alternative for carrying out commercial R&D.

## PROTOTYPE DEVELOPMENT

### Existing Enterprise – Space-based Production

The results of the R&D program are used to design, build, and fly a prototype production unit. Concurrent with construction and flight of the prototype, the firm must begin to execute its business plan, including the development of the initial product plan encompassing marketing, pricing, production, and distribution.

### Entrepreneurial Venture

For the entrepreneurial firm, construction of a prototype may require the influx of additional capital, preparation for which should start during the R&D program once some results are available. This may require taking on new venture partners in exchange for their financial or operational contributions to the venture.

### Summary – Prototype Development

Under the terms of NASA's Commercial Space Policy, the level of the Agency's support to a venture may begin to decline as it approaches operations. While it may be possible to include flights for the prototype in the joint agreement, it might be wise to anticipate that they may well begin to have more significant costs associated with them.

## PRODUCTION/INCORPORATION INTO GROUND-BASED PRODUCTION

In this phase, the design of the production unit is finalized from the results of prototype testing, the unit is built, the product plan is completed, and production is implemented.

In the ground-based production scenario, the results of the R&D program are applied to the ground-based process, the improved process is put into production, and modified product pricing and marketing are initiated.

For either of the space-based production scenarios, a particular location will have been chosen at which to carry out the production operation. In the late 1980s the available locations will probably only consist of shuttle flights of up to several weeks in length (if man-tending is required), or unmanned free-flying platforms such as Leasecraft, SPAS, or Eureca for durations of up to several months before maintenance or resupply is necessary. In the early 1990s, the space station should be available to handle a limited number of commercial production operations beyond those already foreseen for it (i.e., McDonnell Douglas/Johnson and Johnson electrophoresis units, and Microgravity Research Associates crystal growth units). While some provisions are being made to accommodate a few other production operations on the initial capability space station, the chance that additional space station facilities will be needed by the mid-1990s may turn out to be quite high.

## CONCLUSION

President Reagan's commitment in January 1984 to construction of a permanent manned space station and to government support of commercial space ventures has made private sector companies and individuals much more aware of the opportunities that the space environment holds for them. If they are to successfully undertake such ventures, they must do so in the same methodical fashion in which they would approach any other new venture.

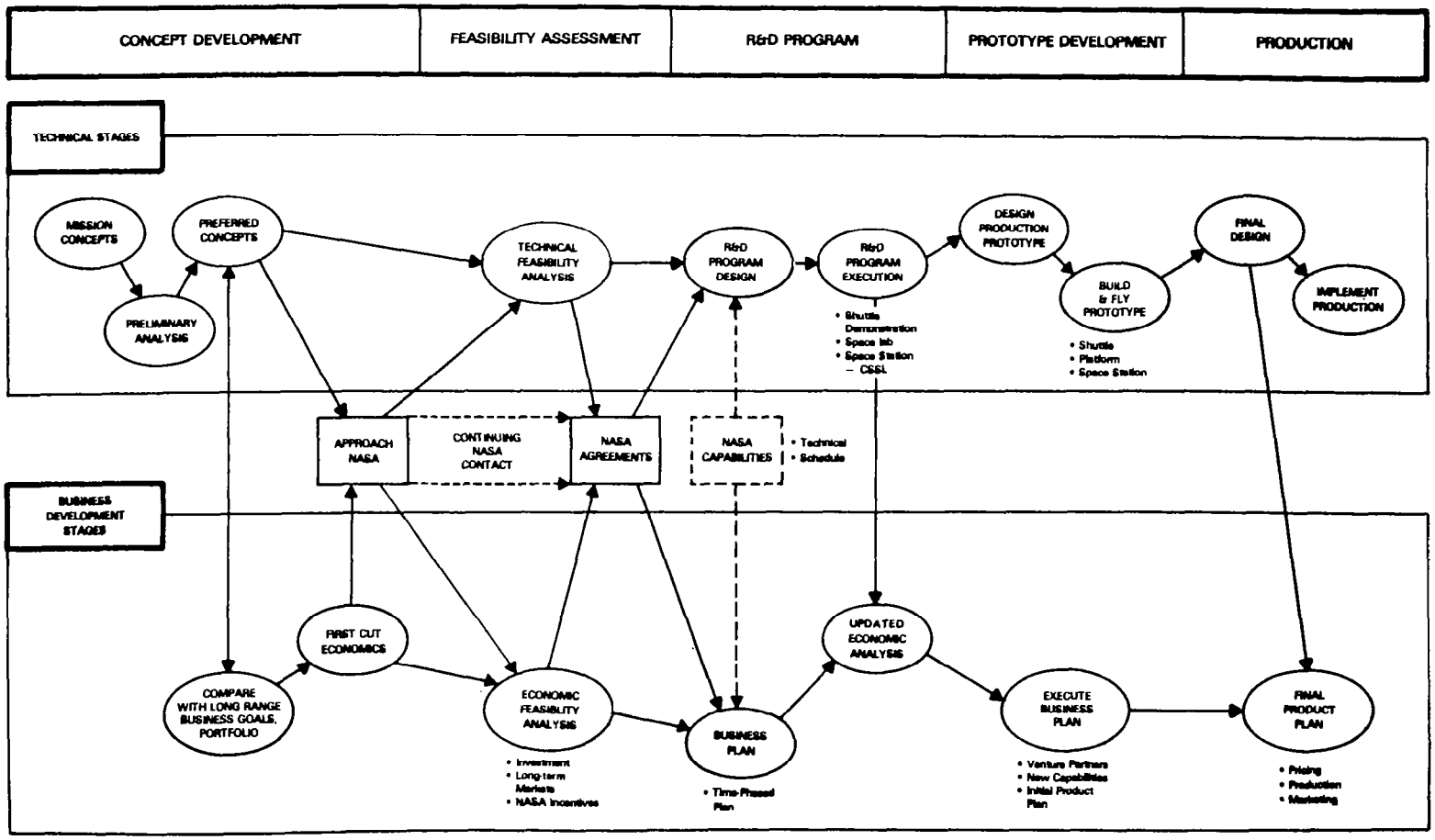
This paper has presented a step-by-step process through which an existing enterprise or an entrepreneurial venture can initiate and carry out a new space venture. It should be emphasized that throughout this process the business and technical aspects must be advanced in parallel with each other. Each depends on the other for its continued success, and companies may be unable to complete the venture if one or the other has been neglected.

While conceiving and developing a space venture has been difficult in the past, NASA's existing programs and the experience of early trailblazers provide sufficient examples and opportunities for other firms to undertake new ventures with confidence. With the introduction of NASA's new Commercial Space Policy, both the opportunities and the ease with which ventures can be carried out should increase significantly. Private sector firms should act quickly to take advantage of these opportunities created by the President's new emphasis on commercial space activities.

Booz, Allen and Hamilton is presently under contract to NASA's Space Station and Commercialization Task Forces to assist users in the development of their concepts for space ventures, and to aid NASA in developing appropriate policies, programs, and incentives for the support of private sector activities in space.

# COMMERCIAL MISSION DEVELOPMENT

## EXHIBIT I. EXISTING ENTERPRISE – SPACE-BASED PRODUCTION

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# COMMERCIAL MISSION DEVELOPMENT

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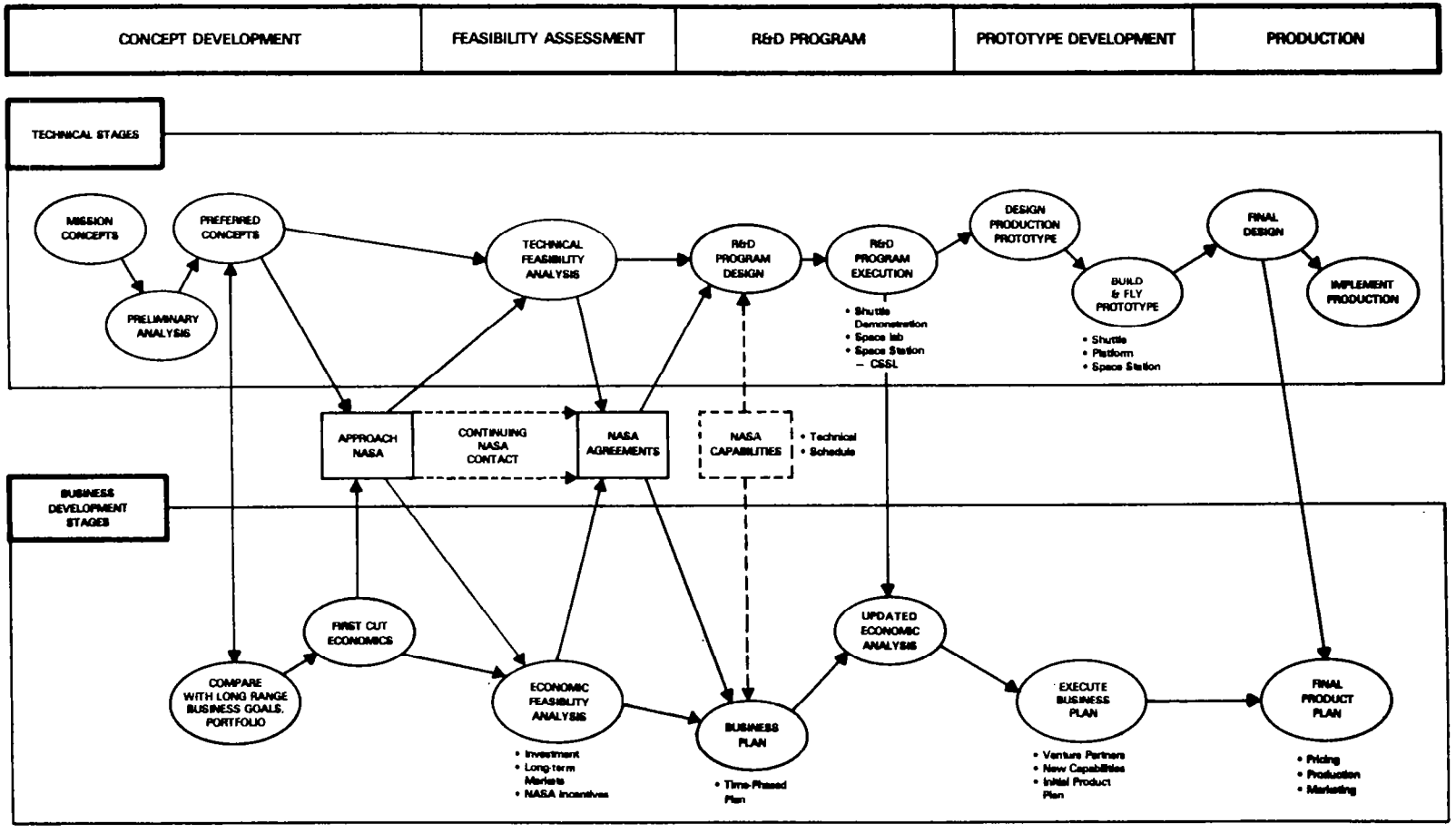


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