

## The Employment Structures of Space Agencies in Three Regions and Implications for Competitiveness

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### Abstract

*While space organizations are present worldwide, dominant organizations are NASA in the US, ESA in Europe and JAXA in Japan. Each of these organizations has a high budget, which is a strong indicator of its political, economic and scientific dominance in the field. We investigate the flexibility of these agencies' employee structures and show how their competitiveness is affected by those structures. We develop propositions on regular vs. non-regular employment, on long-term employment and on job security and conclude that, in the short run, it is difficult for ESA to compete against the more flexible hire-and-fire structure at NASA and against Japan's highly developed non-regular employee system mentality, which is employed at JAXA. However, the European system has visible advantages in the long run. Implications for organizations are discussed.*

**Keywords:** Corporate Governance, Job Security, Space Organization, Strategic Decision

**JEL Classification:** G34, L14, M51, R41

### 1 Introduction

The financial and non-financial burdens of keeping and attracting talented employees are enormous (Harris & Brannick, 1999). As pointed out, "A good firm has good employees," and this observation is particularly true for space organizations, as they are under considerable pressure to bring excellent results. There are several reasons for the fierce competition in this industry, some direct and some indirect. In particular, direct reasons include national prestige, military power and political power, while indirect reasons include the survival of the orbital launcher industry (through national operators), technology improvements (which could have positive external effects on other industries) and employment retention or creation (through the existence of space agencies and their suppliers).

First, the competition in the space industry is high compared to that in other industries because of its high-quality products and zero-error policy. Even the so-called "fail-safe strategy" typically applied in the aviation sector is less demanding. Fail-safe describes a device or feature that responds to a failure in a way that causes minimum or no harm to personnel or other devices (Howard, 2000). To achieve the same high level of fail-safe probability for space systems, much more effort in terms of human-resource capital (e.g., specifically educated engineers), infrastructure (e.g., clean rooms) and organizational architecture (e.g., detailed process documentation) is required.

A second reason for the fierce competition in this industry is that the competition is global, and only a few players are in the field. Each of the countries or regions with successful space agencies has a keen interest in stimulating its launcher market and gaining or defending its global position and market share. In addition, the association of the agencies with national security issues means that there are also political demands on the national level. For example, the American space transportation policy of 1994 requires US government payloads to fly only on US-launched vehicles (The White House, 1994).

Third, any country with an ambitious space organization program must draw on significant amounts of tax-payer money, which results in pressure from the government concerning the management of the organizations. Another stream of payment can come from the private sector, where the pressure from shareholders on the management of the organizations may be even greater. In all three regions (US, Europe and Japan), the phases of basic research, concept and definition are financed by the governments, while development, production and operation are privately financed (Goehlich & Bebenroth, 2008).

This research considers the basic research, concept and definition phases for NASA in the US, ESA in Europe and JAXA in Japan. Other areas include operation, which is mainly covered by Boeing in the US, Arianespace in Europe and Mitsubishi in Japan. The purpose of this research is to shed light on the employment structures of these three space organizations. In the next section, we use a knowledge-based view of the firm, combined with the national cultural differences postulated by Hofstede (1980, 2001), to illustrate how all three regions differ to some extent in terms of their fundamental cultural characteristics. The third and fourth section addresses the employment systems of the three regions in order to develop three propositions in the fifth section. After a discussion of these propositions, we draw conclusions.

## **2 Theoretical Approaches**

We discuss two theories as the theoretical basis for our investigation of space organizations in three regions: the knowledge-based view, which considers knowledge as a firm's most important resource (Kogut, 2000), and the cultural characteristics proposed by Hofstede (1980, 2001), which show country-specific differences among our three areas.

### **Knowledge-based View**

The knowledge-based view suggests that firm knowledge has strategic implications and that better knowledge helps firms outperform their rivals (Nonaka & Takeuchi, 1995). This theory is based on the resource-based view, which was first proposed by Penrose (1959) and later expanded by Wernerfelt (1984) and Barney (1991). In the knowledge-based view of the firm, employees' knowledge is considered the most important resource a firm holds, as it is socially complex and difficult to imitate. Knowledge is embedded in the organization's culture, systems and employees, and it is a significant determinant of the competitive advantage of a firm.

According to Barney (1991), for a firm to have a competitive advantage, it must have resources that are Valuable, Rare, Inimitable and Non-substitutable (VRIN). "Valuable" in this sense refers to transaction costs, such that the costs of a resource are lower than the discounted cash flow of the returns. "Rare" means that a given resource is scarce; for example, a Japanese-speaking American space organization engineer, which is rare, could be used for joint projects with Japanese partner firms to give the US firm a competitive advantage (Barney, 1986). An "inimitable" resource is one that competitors are not able to imitate, leading to a competitive advantage. "Non-substitutable" indicates that substitutes cannot be found for the resource. A resource that is valuable, rare, and inimitable would not be sufficient to create competitive advantage if a competitor can find a viable substitute.

### **Cultural Characteristics**

Our second theoretical lens focuses on the aspect of culture, which refers to knowledge that people acquire through social behavior. From cultures values are formed, attitudes created, and behavior influenced (Luthans, 1995, pp. 534-535). The concept of culture that has received the most attention from the literature and that has been widely recognized (and also strongly criticized) as a way to measure a national culture is the dimensions described by Hofstede (1980, 2001). Hofstede (1980) based these dimensions on a survey of 88 000 IBM managers and employees in over 60 countries. Hofstede's original identification of four cultural dimensions was extended to a fifth one (long-term vs. short-term orientation) in 2001. Country scores were provided for all these dimensions, given as index numbers on a continuum from 0 to 100 (except for long-term vs. short-term orientation, which scales until 120 points), where weak dimensions receive low scores and strong dimensions high scores. The five cultural dimensions are:

- Uncertainty avoidance (tolerance of uncertainty)
- Individualism versus collectivism (degree of individualism)
- Power distance (autocratic versus democratic management style)
- Masculinity versus femininity (degree of masculine assertiveness)
- Long-term versus short-term orientation (degree of future orientation)

We use two of these five dimensions in our study of employment at space agencies: uncertainty avoidance and individuality, since the other three dimensions are less relevant to our specific case.

### **Uncertainty Avoidance Index (UAI)**

The Uncertainty Avoidance Index (UAI) deals with a society's tolerance for uncertainty and ambiguity, indicating to what extent a national culture programs its members to feel comfortable in unstructured or novel situations.

Uncertainty-avoiding cultures try to minimize such situations through strict laws, rules, and safety and security measures and, on the philosophical and religious level, through a belief in absolute truth (Hofstede, 1980). People in countries that score high on uncertainty avoidance also tend to be more emotional (although they are not expected to express emotions), phlegmatic and contemplative and to be more motivated by inner nervous energy than are people in cultures with low scores in uncertainty avoidance. In uncertainty-accepting cultures, people tend to be tolerant of opinions different from their own; they try to have as few rules as possible, and on the philosophical and religious level, they are relativist and allow many currents to flow side by side (Hofstede, 1980). In our three regions, Japan, scores the highest in this dimension with 92 points, which means that Japanese people prefer to avoid uncertainty. On the other hand, with only 46 points in uncertainty avoidance, people in the US tend to be willing to accept uncertainty. Germany's uncertainty avoidance score of 65 falls between those of the US and Japan. For the purpose of our study, Germany represents Europe since there is no score for Europe available.

### **Individualism Versus Collectivism Index**

Individualism (IDV) deals with the degree to which individuals are willing to be integrated into groups. Ties between individuals in individualistic societies tend to be loose; everyone is expected to look after himself or herself and his or her immediate family, while in collectivist societies, people are integrated into strong, cohesive in-groups from birth. Collectivist societies often feature emphasis on extended families (with uncles, aunts and grandparents), which continue protecting their members in exchange for unquestioning loyalty (Hofstede, 1980). The word "collectivism" in this sense has no political meaning: it refers to the group, not to the state (Hofstede, 1980). Japan scores in the lower middle range of individualism with 46 points, so the Japanese do not tend to be individualistic. The opposite is true for the US, which scores the highest with 91 points, so the US culture is extremely individualistic. Europe, represented by a score from 76 for Germany, again scores in the middle.

### **3 Differences in Employment Systems**

This following section examines and discusses the different employment systems in the US, Europe and Japan.

#### **The Employment System in the US**

Unlike the European examples, the US employment market is characterized by a "hire-and-fire" mentality. US business practices tend to be profit-oriented, self-centered and competitive, resulting in efficient business interactions and fast results (Ehrenfreund, Peter, Schrogl & Logsdon, 2010). This short-term orientation strongly influences the employment market. US organizations are used to having significant amounts of flexibility, and their employees understand that they can be fired easily. In the short run, this employment structure may provide cost-savings, but in the long run it may become problematic when highly qualified experts, who have little reason to be loyal, move from job to job readily. Employees who spend only a short time in an organization often lack commitment to the tasks and to their colleagues, and longstanding employees may not want to compensate for newcomers' shortcomings (Bushe, 2010). The US's very low score for uncertainty avoidance and a high score for individualism supports this view of the employment structure in the US.

#### **The Employment System in Europe**

The employment system in Europe is generally more stable than that of the US or Japan. This employment system has evolved because of at least three factors: First, Europeans tend to prefer being settled and not to move geographically too much in their careers. In contrast to US citizens, who tend to be flexible about moving to other states within the US, Europeans hesitate to move to other countries in Europe. Second, European organizations are influenced strongly by unions, so there is relatively high stability in the contracts of the workers. Among the employees fairness is taken for granted, so they often talk openly about their salaries. The prevalence of unions also means that there is a low percentage of workers from temporary work agencies. Third, European politicians encourage organizations to commit to their employees through legislative amendments. These three factors result in employees' having long tenures in their organizations. We argue that, in the long run, it results in better performing organizations.

According to the knowledge-based view and the resource-based view of the firm pointed out by Barney (1991), this stable employment structures has advantages. Ehrenfreund, Peter, Schrogl and Logsdon (2010) characterize Europe as multi-cultural patchwork of solidarity with a tendency for long-term planning that is followed by radical implementations. There is also a fit with the cultural research by Hofstede, which puts Europe in the middle of the uncertainty avoidance and individualism indices.

**The Employment System in Japan**

Japanese employees can be categorized into regular and non-regular employees. Under traditional Japanese employment practices, regular employees are allowed to stay in the same organization until mandatory retirement age. Although regular employment does not juristically refer to an employment for a lifetime, these employees operate under a “gentlemen’s agreement” in that they do not have a fixed term written into their contracts. In contrast to the employment in the western world, in Japan lifetime employment is assumed, and it is a social norm for large companies that regular employees are rarely dismissed until they reach mandatory retirement age.

Non-regular employees, on the other hand, lack job security and are usually employed on a temporary or part-time basis. Non-regular employees can be further divided into “hakken” employees, “keiyaku” employees and “pato-taimu” employees. Hakken employees are sent from temporary work agencies. The word *hakken* is characterized as “triangular employment relationship,” so hakken employees are legally employed by temporary service agencies but perform their work in client firms. Keiyaku employees are contract workers who normally work full time but do not receive the benefits that regular employees receive. Keiyaku employees are usually employed on fixed-term contracts or on a yearly basis. Pato-taimu employees are part-timers, also called “arubaito” employees (derived from the German language’s “Arbeit”, meaning work). All of these non-regular employees have in common that their employment with a firm is limited either through a contract or by an understanding that they will leave the firm first if the firm enters a time of hardship. Most studies about the Japanese Human Resource Management (HRM) focus only on regular, lifetime employment.

**4 Space Agencies and Their Employment Structures**

This section introduces three space agencies, one each from the US, Europe and Japan, in support of our discussion in the next section on propositions related to the employment systems. Typically, space agencies are responsible for the basic research, concept and definition phases of most space-related projects. Basic research covers areas such as fundamental research, with programs that can span several years or decades. The concept phase includes the preparation of a conceptual design and a system analysis. During the definition phase, system specifications, an assessment of political restrictions, and advanced development of high-risk items are completed. Table 1 lists the key facts about the space agencies from the US, Europe and Japan. The full context of case studies for these three organizations can be found in Goehlich and Bebenroth (2008).

Table 1: Comparison of Key Facts About Three Space Agencies

Key Facts	USA	Europe	Japan
Name of Agency	NASA	ESA	JAXA
Year Founded	1958	1975	2003
Budget (in USD)	\$18.7 B (2010) <sup>1</sup>	\$5.4 B (2010) <sup>2</sup>	\$2.5 B (2010) <sup>4</sup>
Number of Staff	23 000 <sup>1</sup>	2200 <sup>3</sup>	1600 <sup>5</sup>

Source: <sup>1</sup>NASA (2010a), <sup>2</sup>ESA (2011a), <sup>3</sup>ESA (2011b), <sup>4</sup>JAXA (2010), <sup>5</sup>JAXA (2011)

NASA employs over 23 000 civil servants at nine centers, the headquarters, the NASA Shared Services Center and the Jet Propulsion Laboratory. NASA’s FY 2010 budgetary resources totaled \$18,7 billion. (NASA, 2010a) Around 2200 staff members work for ESA, including scientists, engineers, information technology specialists and administrative personnel (ESA, 2010, 2011b). ESA’s headquarters is located in Paris, where policies and programs are decided. ESA has six other locations, in Cologne, Madrid, Darmstadt, Frascati, Noordwijk and Harwell, each of which has different responsibilities. ESA also has liaison offices in Belgium, the US and Russia; a launch base in French Guiana and ground/tracking stations in various parts of the world (ESA, 2011a). ESA’s budget for 2010 was \$5,4 billion (ESA, 2011a). ESA operates on the basis of geographic return; that is, it invests in each member state through industrial contracts for space programs an amount more or less equivalent to each country’s contribution (ESA, 2011a). JAXA had around 1600 regular staff members as of fiscal year 2009, not including domestic and overseas researchers, graduate students and staff from the private sector (JAXA, 2011). JAXA, whose 2010 budget was \$2,5 billion (JAXA, 2010), underwent a drastic reduction of staff in the last decade; since then, increased focus has been put on the International Space Station (ISS) program. In order for Japan to ensure the continuous development of highly advanced technologies as well as the implementation of JAXA’s vision (JAXA, 2005), the Japanese space agency seeks to secure and sustain its human resources.

### 5 Propositions about Space Agencies

From our theoretical research and research on the employment structure of the three space agencies, we developed propositions concerning (1) regular vs. non-regular employment, (2) long-term vs. short-term employment, and (3) job security vs. job insecurity. We argue that, based on the knowledge- and resource-based views of the firm, a long-term employment strategy increases agency’s knowledge and so its competitiveness.

#### Regular vs. Non-regular Employment

As discussed above, the three regions differ in their cultural characteristics and in their employment style. In Japan, non-regular employment is heavily practiced in the space industry. Non-regular employees work on a contractual basis, so they do not know whether they will remain in this industry or whether they will have to switch to another industry to remain employed. De Witte and Näswall (2003) show that employees with temporary contracts have no bargaining power, so a relatively small pool of experts reliably remains in these organizations.

On the opposite side of the spectrum, European organizations have a strategy of reducing the number of non-regular employees. Even though there has been a recent small increase in the number of non-regular employees, its proportion is still small compared to that in Japan. ESA runs many internal initiatives (e.g., training and development of current staff, knowledge sharing, orientation of young graduate trainees) and external initiatives (e.g., exchanges with other industries and secondments, coverage in the media, job fairs and promotional campaigns) that “help to ensure the continuity and availability of a highly qualified and motivated workforce that will, in turn, play a critical role in strengthening the position of ESA in the European space sector” (Walsh, Donzelli, Danesy & Bonnefoy, 2008, p. 55). However, related to ESA’s internal challenges, experienced staff is not always able to provide on-the-job training to the extent necessary for inexperienced staff to obtain skills and competencies required to perform the job.

The US space agency is closer to the European system than to the Japanese system in terms of a regular employment system; however, in the US even regular employees can be laid off easily because pressure from the unions is weak and because many employees seem to accept a more flexible style. A job-hopper who switches firms frequently may receive higher remuneration after every hop, so a change to a new firm can increase power and lead to a higher salary. NASA’s key employment principle is illustrated by its statement concerning the “hire-and-fire” mentality: “Term and temporary hiring authorities [are]: (...) among the most important of the human resources strategies the Agency plans to use in addressing competency issues. NASA is committed to moving to a more flexible and scalable workforce as a means of responding to the evolving nature of workforce requirements. Nonpermanent appointments, especially term appointments, provide an excellent method of obtaining skills without the long-term commitments made to permanent employees. Particularly because of the additional flexibilities available to NASA, term appointments provide an attractive employment package for applicants, while still not burdening the Agency with the obligations of permanent employees. In addition, temporary appointments of retirees offer a means to retain capabilities in the skill base when they are needed for finite periods” (NASA, 2006, p. 30). This discussion leads us to proposition 1:

*Proposition 1:* The European space organization has a relatively high proportion of regular employees, while Japan has many non-regular employees (Figure 1). The US comes in the middle in the number of regular employees, but it has a faster fire mentality. In all, the European organization faces hardship in the short run but should see long-run advantage against Japan and the US from its employment structure.

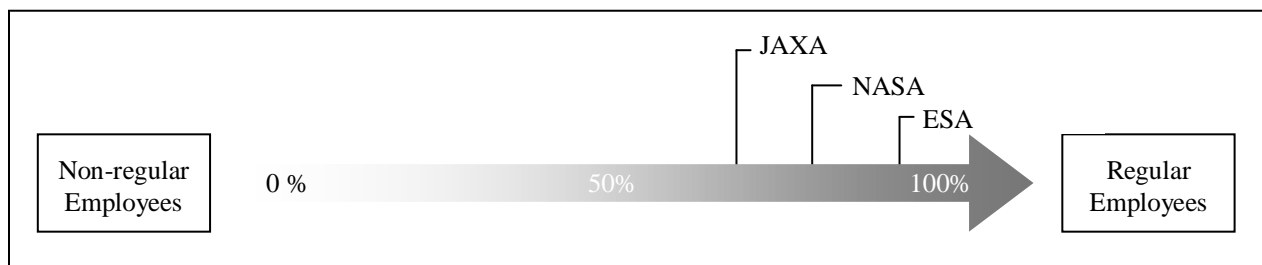


Figure 1: Illustration of Proposition 1

**Long-term vs. Short-term Employment**

Koller (2002) argues that the aerospace industry, like all key industries that handle advanced technology, requires constant updating and that attention has to be paid to both the employees who enter the workforce and existing employees. Grimshaw, Rhoades and Williams (2004) complement this statement with the observation that, historically, technicians have come into the space industry with a technical aviation background and supplemental training from their employers. Therefore equipped with a shortage of employees, space organizations need to invest heavily in training for new employees. Put differently, the more short-term employees a space agency keeps, the more the organization suffers from inefficiency and increases risk for itself in the long run in terms of adequate staffing.

It could be argued that every employee would like to stay as long as possible in a given organization. However, US citizens tend to be more short-term oriented than some in other cultures and may prefer a shorter stay at a given organization. NASA’s 2009 Workforce Plan guides and prioritizes the work of the management, ensuring that work priorities are aligned with higher-level mission support plans and other agency-level plans, such as the NASA Strategic Plan, the NASA Workforce Strategy and the Shuttle Human Capital Plan (NASA, 2010b). A key principle that underlies the workforce strategy is that “NASA must have a more flexible workforce with sufficient ‘bench strength’ to respond effectively to mission, programmatic, and budget changes as well as demographic and labor market fluctuations. As these changes occur, the agency must be able to adjust quickly to address staffing needs or skill imbalances. This is difficult to achieve within the constraints of the rules and processes governing permanent civil service employment. For that reason, NASA must evolve to a more appropriate blend of permanent and nonpermanent civil servants” (NASA, 2006, p.7).

Japanese – at least regular employees – enjoy long-term, permanent contracts. JAXA’s Vision 2025 describes an approach that, among others, could be vigorously pursued to strengthen JAXA’s human resources in an effective and efficient manner: “JAXA will take concrete steps to secure staff resources of high quality, pursue strategic staff placement and strengthen staff resources through training in an organized and systematic manner that would be necessary for the implementation of the Vision” (JAXA, 2005, p. 67).

European employees are in the middle in terms of long-term versus short-term employment. Since Japanese people tend to be more risk-averse than Europeans are, they are also more concerned with sustaining a long career at a single organization. US employees tend to take more risk in terms of their employment, and Europe falls between them. Therefore, we arrive at proposition 2:

*Proposition 2:* Japanese JAXA employees are more uncertainty avoidant than US NASA employees are, with European ESA employees in the middle. These levels of uncertainty avoidance lead to a longer tenure for Japanese employees, resulting in a long-run advantage for the Japanese organization, and a shorter one for US employees, with European employees in the middle (Figure 2).

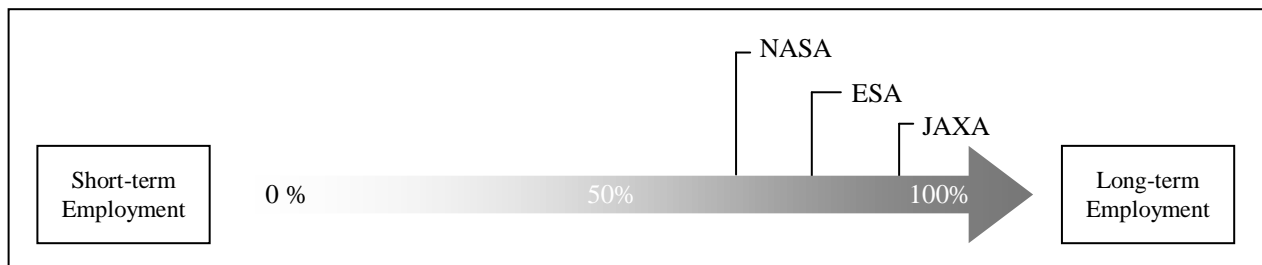


Figure 2: Illustration of Proposition 2

**Job Security vs. Job Insecurity**

Job security is often considered as one of the most fundamental issues for employees, and those in the space organization industry are no exception. Klandermans and van Vuuren (1999) distinguish between two types of job security: objective and perceived/subjective security. This paper refers only to the perceived/subjective type of job security – how employees feel about their job security – where a high unemployment rate leads to job security’s having more importance (Carlin & Soskice, 1990). The literature states that there is an inverse relationship between the rate of dismissals and subjective job security. In other words, the lower the actual dismissal rate is, the higher the employees’ perceived job security is (D. Hübler & O. Hübler, 2010).

Lloyd (1999) shows that stronger regulations regarding employment increase individuals' subjective job security and improve workforce skills. In a study of the civil aerospace sector, Lloyd argues that a high supply of skills is necessary to compete effectively in high-quality production industries. While higher levels of objective job security result in higher costs during recessions (when employees are retained), it results in reduced costs during boom periods because of lower expenditures for training of inexperienced members and lower recruitment costs, as fewer new employees must be hired.

For ESA in particular, selecting the appropriate candidate for a given position is a time-consuming process. ESA advertised 336 vacancies in 2006, 12 percent of which had to be re-issued mainly because of a lack of qualified candidates for the required specializations. Another reason for the lack of candidates was the requirement to maintain an appropriate balance of nationalities from ESA's member states, which reduces the initial pool of allowable candidates. (Walsh, Donzelli, Danesy & Bonnefoy, 2008)

ESA's Annual Report 2009 addresses the individual job security of its employees in recognizing "that the people who work for the Agency are its most valuable resource, and that their health and welfare are essential to achieving ESA's objectives. ESA is therefore committed to producing a caring and supportive working environment, which is conducive to the welfare of both staff and contractors, and enables them to develop their full potential" (ESA, 2010, p. 83).

Thus, ESA's official company documents tend to emphasize health and welfare issues, rather than job security. Concerning job security, we develop proposition 3:

*Proposition 3:* Japanese employees at JAXA are more sensitive to the need for job security than are their US counterparts at NASA, and European ESA employees are in the middle (Figure 3). The higher individual sensitivity to the need for job security should pay off for Japanese and European aerospace organizations in the long run.

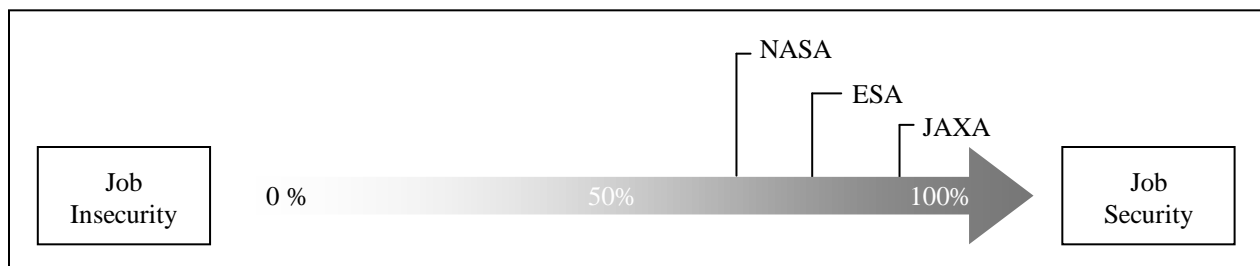


Figure 3: Illustration of Proposition 3

### Conclusions

We investigated employment systems in the US, Europe and Japan to show their impact on space agencies. In our first proposition about regular vs. non-regular employment, we point out that European ESA has disadvantages, as there are many regular employees. In contrast, American NASA states in their official documents that flexibility is required to allow employees to be laid off when needed, and Japanese JAXA can put employees in non-regular positions in order to increase their flexibility. Our second proposition deals with long-term employment. It shows that, because of their low level of uncertainty avoidance, US employees can be considered short-term oriented. Japanese employees, on the other hand, can be considered long-term oriented.

In regard to job security, our third proposition points out that NASA's strategy uses the American mainstream employment system of giving employees low job security. One disadvantage that can result is job-hopping, which may lead to a lack of resources in that industry. Training costs are high, and if an expert leaves the industry, the chance of getting an equivalent employee is low. This issue is addressed in the specific documents that refer to NASA's employment strategy. Our argument in this paper is that, in the long run, ESA may see benefits from the comparatively strict employment situation in which politicians and unions have placed it.

Figure 4 illustrates the implications of space agencies' competitiveness related to their employment structures. This result is based on the assumption that the only variable is the employment structure, while all other factors are fixed. Thus, this study shows how competitiveness may change over time based on the employment structure.

Other factors that affect the competitiveness of space agencies, such as available budgets, technologies, political restrictions and stimulations, are not part of this study.

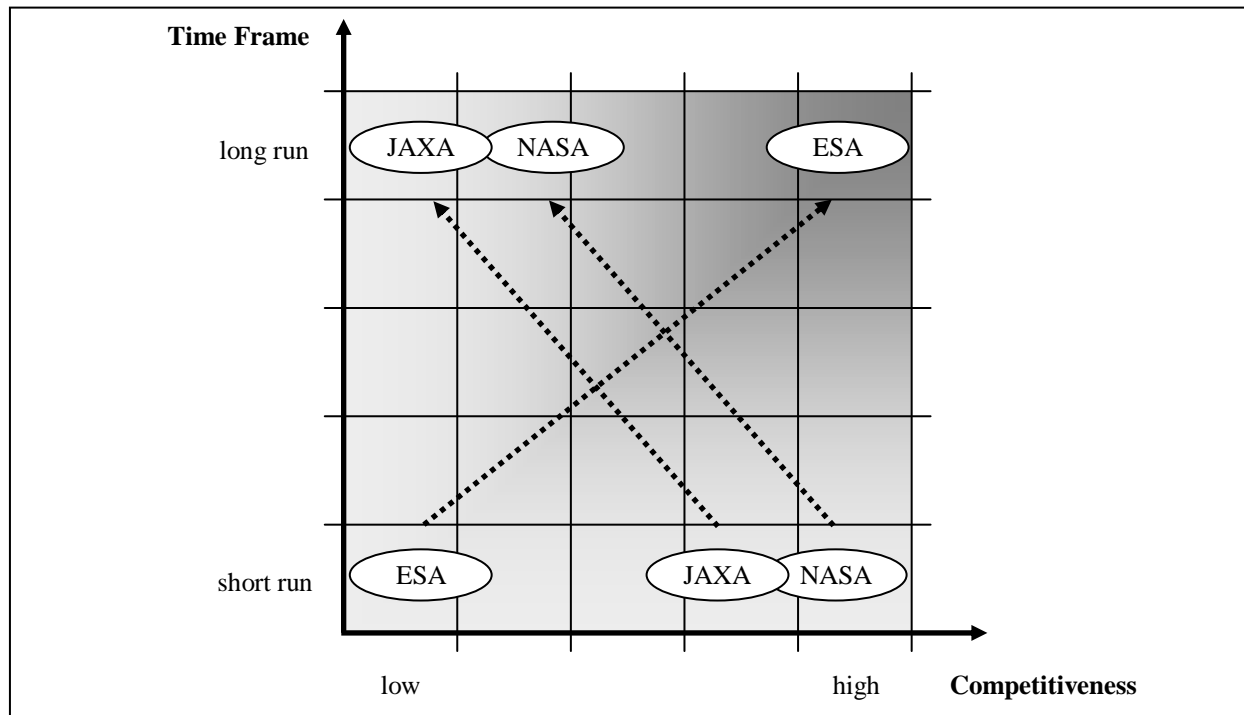


Figure 4: Illustration of Space Agencies Competitiveness Based on Employment Structure

Our study is not without limitations. This study uses information about employment structures from three space agencies as a first attempt to shed light onto the industry’s employment structures. Data other than official company reports were not obtained concerning specific problems for the industry, with its political and global implications. In addition, the few pieces of information obtained are from different sources, so a direct comparison was not possible. Furthermore, the types of contracts used by the three space agencies vary by region and agency, making direct comparison difficult. We were able to acquire more information from the European and US agencies than from the Japanese agency, which also limits our results. In spite of these limitations, we hope to have shed some light onto an industry with a growing importance for the future.

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