

ABAS: ANNALS OF BUSINESS ADMINISTRATIVE SCIENCE

Vol. 1, No. 3, October 2002

SHIMIZU, Takashi 39

The longevity of the Japanese big businesses

FUJITA, Hideki 47

The reproduction of Hofstede Model

IGARI, Eijiro 57

Learning process of core technology in sporting gun industry of Japan



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The Reproduction of Hofstede Model

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Abstract: G. H. Hofstede (1980) *Culture's Consequences* is a result of an extensive research on the international comparison of corporate culture in 40 countries through 1967 to 1973. Hofstede identified four dimensions of culture from the investigation data of IBM's 40 subsidiaries. He developed four indices, but did not explicitly present the exact computation formulas for Individualism index and Masculinity index. This paper reproduces the formulas and proves how to conduct a factor analysis that Hofstede employed for development of these indices. Hereafter, supplementary analysis could be done using all four indices of Hofstede. Also a factor analysis could be done in Hofstede's method.

Keyword: Hofstede, dimensions of culture, factor analysis

1. Introduction

During 1967 to 1973, Hofstede (1980) conducted a questionnaire survey targeting about 70,000 employees in total at the sales and administration departments of IBM in 40 countries, to conduct international comparison between corporate culture. Though four dimensions of culture appeared in the investigation data of IBM, only two of them, Power Distance Index and Uncertainty Avoidance Index, were given explanation on calculation methods. This paper reproduces the rest two of Hofstede's four

indices of which the exact computation formulas are not explicitly presented.

Virtually, *Culture's Consequences* (1984) of Hofstede is an abridged edition, in which all the descriptions on the statistical analysis and the simple totals of IBM data are omitted. However, by a detailed analysis on these two data which appear in 1980 version, calculating method of the rest two indices unexplained so far and the factor analysis outline in developing the indices were mostly discovered. Hereafter, analyses using all four indices

of Hofstede are possible, and also, factor analyses could be done in the Hofstede method of developing indices.

2. Multinational Comparison of Corporate Culture

Hofstede (1980) *Culture's Consequences* is a result of an extensive research on the international comparison between the corporate culture in 40 countries through 1967 to 1973. The survey was composed of two phases. Phase 1 was conducted during 1967 to 1969 to obtain 31,218 workers' data. As its result, questionnaire was modified, which was reportedly composed of 60 core questions (A1-A60) and 66 optional ones (B1-B66). The former questions were used through the entire process of Phase 2, while the latter were recommended for optional usage. Phase 2 was conducted during 1971 to 1973 to obtain 40,997 workers' data.

In total, 72,215 workers' data were selected for analysis. Finally, sample was limited to employees at sales and administration departments dropping production and product development departments.

According to Hofstede, four dimensions of culture were identified as a result of extensive surveys, that is, UAI (uncertainty avoidance index), PDI (power distance index), IDV (individualism index), MAS (masculinity index). As for the latter two indices, 14 questions were employed for factor analysis, but Hofstede (1980) did not explicitly present the exact computation formula (Takahashi, 1995, chap. 5). The detail on the computation

formula is reviewed hereafter.

PDI (Power Distance Index)

Power Distance is a measure of the interpersonal power distance between B (boss) and S (subordinate), which is defined as "the difference between the extent to which B can determine the behavior of S and the extent to which S can determine the behavior of B" (Hofstede, 1984, p. 72). In actual analysis, PDI is employed so that it becomes higher when the followings become high:

- (1) Frequency of employees' perception that they are afraid to disagree with their managers.
- (2) The ratio of those subordinates who prefer not to work for superiors with a consultative style of decision making.
- (3) The ratio of those subordinates who perceive their boss as autocratic or persuasive.

By definition, the higher PDI is, the higher Power Distance becomes. The formula used is as follows:

$$\begin{array}{ll} \text{PDI} = 135 & - 25 \times B46 \\ & (\text{mean}) \\ & \text{Employee afraid to} \\ & \text{disagree with} \\ & \text{managers} \\ & - A54 (3: \%) + A55 (1 + 2: \%) \\ \text{Preferred managers} & \text{Perceived} \\ \text{consultative} & \text{managers as} \\ & \text{autocratic or} \\ & \text{persuasive} \end{array}$$

The constant 135 has been added to give the index value a certain range. The actual range of PDI is 11 PDI 94, while theoretical range is -90 PDI 210. The full question of B46, A54, and A55,

Reproduction of Hofstede Model

which compose the formula, are shown in Appendix 1 (Hofstede, 1980, pp. 403-410).

UAI (Uncertainty Avoidance Index)

As for Avoidance of Uncertainty, UAI is employed which is designed to become higher when the followings become high:

- (1) The degree the employees considering that company rules should not be broken even if they think it is not in the company's best interests.
- (2) The ratio of those who believe to continue working with the present company more than another five years.
- (3) Frequency they feel nervous or tense at work.

"Stress" question is introduced in (3) since following relations are observed in which (3) relates to (1) and (2); two means to avoid uncertainties, via the anxiety level and the desire for safety:

- (3) anxiety level desire for safety (1) and (2)

The used formula is as follows:

$$\text{UAI} = 300 - 30 \times B60 \text{ (mean)}$$

Rule orientation
-A43 (1+2: %) -40 × A37 (mean)
Continue working less than five years Nervous/ tense at work

The actual range of UAI is 8 UAI 112, while its theoretical range is -150 UAI 230. UAI was correlated to the average age of the respondents. UAI has been compiled on the basis of the country mean scores for three questions, that is, B60 (rule orientation) and A43 (continue working less than five years) as well as A37 (nervous/tense at work)

which is relative to the former two variables.

IDV (Individualism Index) and MAS (Masculinity Index)

As for IDV and MAS, though a factor analysis was used for the development of the indices, how to calculate them has not practically been explained (Takahashi, 1995). Though the research of Hofstede is known very well, a supplementary examination by third party researchers in the strict meaning has not been done so far. We intend to follow the analysis of Hofstede as requested in Fujita (1999) which gave the first explanation on how to calculate these two indices.

Hofstede conducted a factor analysis on the basis of the mean scores of every country computed from 14 "work goals" questions. Then he focused on two main factors that could explain 46% of the variance of the mean scores, and related the first factor to the degree of individualism, and second factor to the degree of masculinity. The first factor was named "individual-collective" factor because it opposed goals that did not stress independence from the organization to goals that stressed independence (Hofstede, 1980, pp. 220-221). The second factor was named "social-ego" factor because it was characterized by high importance of manager and cooperation, and low importance of earnings (Hofstede, 1980, p. 277). By substituting the factor scores (INV, SOC) of these two factors for the following formulas, IDV and MAS are calculated so that the value of the indices may be within range

between 0 and 100 (Hofstede, 1980, pp. 242, 299).

$$IDV = 50 + 25 \text{ INV}$$

$$MAS = 50 - 20 \text{ SOC}$$

However, minus 1 is multiplied to the factor score of the second factor to reverse the sign, because the respondents of the questionnaire were mainly men and factor loadings of the goals that men take seriously are minus. Formula of each index appears only in 1980 and 1991 versions.

However, in 1980 and 1984 versions, Hofstede partly mentions 14 factor loadings respectively of the first factor and the second factor (only factor loadings over 0.35; 9 factor loadings respectively of the first and second factor in 1980 version, and 6 and 8 factor loadings respectively in 1984 version; see Table 3). Therefore the factor structure in “work goals” questions is not clear. And standardized scoring coefficients (or factor score coefficients) to calculate the estimated value of factor scores (INV, SOC) from the matrix of standardized variables are mentioned only in the section of statistical analysis in the 6th chapter which was omitted from 1984 version. Nonetheless, practically, Hofstede made it impossible for third party researchers to calculate factor scores by the data of supplementary examinations, because “the former process” of the analysis was made a black box (i.e., the procedure was in such a way of the standardization of the data matrix).

3. Reproduction of IDV and MAS

As mentioned above, two versions exist in *Culture's*

Consequences, one is 1980 version, which is the first edition, and the other is 1984 version, which is the abridged edition. Descriptions on the statistics and so on used for the analysis of IBM data are removed from 1984 version. Even though the analysis made in *Cultures and Organizations* (Hofstede, 1991), to which data in 13 countries were added newly, is the same, descriptions on statistics is much simpler.

Four dimensions of culture were identified in IBM data, that is, PDI, UAI, IDV, and MAS. How to calculate PDI and IDV was made clear, and also the computation formulas were mentioned explicitly. However, from reasons stated above, not only the computation formulas of the factor scores needed for calculating IDV and MAS but also the method of factor analysis used to develop the indices were not explained. Table 1 shows the degree of disclosures of the processing and statistical analysis of IBM data needed to calculate these two indices in each version.

1980 version is most particular with the explanation on the processing of IBM data. In this version, Hofstede mentions the factor analysis used for the development of each index and the simple totals of IBM data. These descriptions are omitted from 1984 version. In *Cultures and Organizations*, there is hardly explanation on statistical analyses such as factor analysis. Yet, even in 1980 version where the descriptions are most detailed, it is difficult for following researchers to compute IDV and MAS from originally collected data. And it is impossible to reproduce the factor analysis. In 1980

Reproduction of Hofstede Model

Table 1. The State of Disclosures on Processing and Statistical Analysis of IBM Data

Information needed for reproduction of IDV and MAS	Book title/Published date		
	<i>Culture's Consequences</i>		<i>Cultures and Organizations</i>
	1980	1984	1991
(1) Simple totals of IBM data		×	×
(2) Factor loadings			×
(3) Formulas of IDV and MAS		×	
(4) Standardized scoring coefficients		×	×
(5) Computing formulas of factor scores	×	×	×
(6) Processing of raw data		×	×
(7) Method of factor analysis	×	×	×
(8) Interpretation of factor structure		×	×

Note: : mentioned, **x** : not mentioned, : mentioned insufficiently.

version, Hofstede mentioned the standardized scoring coefficients, but the explanation on how to calculate factor scores is insufficient and computation formulas are not clear (Hofstede simply claims to take the summation of product of standard scores and standardized scoring coefficients).

What Hofstede did not refer is (1) how to read the simple totals of “work goals” questions, (2) the summary of factor analysis on “work goals” questions, (3) the interpretations of the factors extracted from the factor analysis. These three points are cleared in the following.

How to Read the Simple Totals

The simple totals of 14 “work goals” questions appear on Table A3.1 of Appendix 3 in 1980 version. Respondents replied to these questions in five-point

Likert scale, that is, from “1. of utmost importance to me” to “5. of very little or no importance.” The mean scores (or the standard scores) of every country are used to compute IDV and MAS. However, the numerical values which appeared in Table A3.1 are not the mean scores (raw data) of these answers but ones that are given the following operations.

First, five-point Likert scale of raw data is run in reverse so that the numerical value of the question may grow larger when respondents reply that it is an important goal. Practically, the value of the answer is subtracted from 6 and made as the value of that variable. Though Hofstede did not refer to this operation at all, this point was confirmed from the author’s factor analysis, which will be explained later. Second, on the basis of this reversed values, the mean scores of every country is calculated and standardized (calculation of standard scores). Third, the standard scores are changed to have an average 500 and standard deviation 100 to avoid negative numbers and decimals. Therefore, it is decided that the goal of high importance takes the value beyond 500 and the goal of low importance takes 500 and under (Hofstede, 1980, pp. 79-80).

As a matter of fact, the latter half of this operation is substantially the same as the calculation of deviation value. Though deviation value is 50

added to 10 times standard score (standard score is modified to mark an average 50, standard deviation 10), Hofstede designed a similar calculation to deviation value on his own.

Therefore, the reversed standard scores are 500 subtracted from the numerical values in Table A3.1 and divided by 100. The whole mean and variance of each question are used to acquire the country mean scores of raw data. The values (MEA) in the second row from the bottom of Table A3.1 are the whole mean scores of each question yet standardized scores, thus it is needed that standardization is removed by using the whole mean scores and the variances of all the questions (IMP and SD on the bottom left of Table A3.1, respectively 1.91 and 0.28). Because IMP and SD are raw data values, reversed mean scores are what IMP is subtracted from 6. To remove standardization of the whole mean scores of each question and the country mean scores, 0.28 and 4.09 ($= 6 - 1.91$) are used, standard deviation and whole mean score of each question are used respectively. Each mean score is reversed Likert scale, thus it is possible to get raw data mean by subtracting from 6.

Summary of Factor Analysis

The factor scores calculated from factor analysis on 14 “work goals” questions are used to compute IDV and MAS. The procedure for this factor analysis is mentioned in the statistical analysis section of the 5th chapter (Hofstede, 1980, pp. 237-259).

Not the numerical values themselves of the answer but the standardized values from following

process are used in factor analysis. First, the values of “work goals” questions are averaged by seven types of job in every country, then they are standardized. Every country’s standard scores are mean of these seven standard scores (Hofstede, 1980, pp. 78, 237, note 19 in p. 90).

Hofstede conducted a factor analysis on the basis of 40 countries \times 14 questions matrix (Hofstede, 1980, p. 241), but did not refer to whether or not to standardize and reverse Likert scale of the values of answer. Therefore, the author’s factor analysis was actually done on both the 40 \times 14 matrix composed of raw data’s mean scores and the 40 \times 14 matrix composed of the reversed standard scores. The factor analysis adopted two factors criterion and principal components method in accordance with Hofstede (1980). Because an initial factor method was not presented clearly, the factor analysis was done with both principal components method and principal factors method. As a result of the factor analysis, not only factor scores but also factor loadings and standardized scoring coefficients of all the questions were computed (Table 2: but only the factor score SOC is multiplied by minus 1 in accordance with Hofstede).

Signs were opposite when factor scores were compared before and after the reverse of Likert scale. Though the signs of standard scores and factor scores are reversed by the reverse of Likert scale, it is confirmed that Hofstede conducted a factor analysis on the standard scores of raw data because the factor scores before reverse are same as those in

Reproduction of Hofstede Model

Table 2. Factor Loadings and Standardized Scoring Coefficients of “Work Goals” Questions

Questions	Abbreviation	factor loadings		standardized scoring coefficients	
		1st factor	2nd factor	1st factor	2nd factor
A5	Challenge	-0.45	-0.54	-0.13	-0.17
A6	Desirable area	-0.36	0.59	-0.11	0.19
A7	Earnings	-0.03	-0.70	-0.01	-0.22
A8	Cooperation	0.37	0.69	0.11	0.22
A9	Training	0.83	0.02	0.25	0.00
A10	Benefits	0.40	0.09	0.12	0.03
A11	Recognition	-0.24	-0.59	-0.07	-0.19
A12	Physical conditions	0.70	0.00	0.21	0.00
A13	Freedom	-0.49	-0.03	-0.15	-0.01
A14	Employment security	0.05	0.48	0.01	0.15
A15	Advancement	0.18	-0.55	0.06	-0.18
A16	Manager	-0.16	0.69	-0.05	0.22
A17	Use of skills	0.63	-0.40	0.19	-0.13
A18	Personal time	-0.86	0.01	-0.26	0.01

Note: appeared in Hofstede (1980).

Table A3.1.

As for the factor loadings and the standardized scoring coefficients of the first factor, signs were reverse to the calculation result of Hofstede. Because factor loadings are, so to speak, the weight coefficients of the common factor in each variable or the correlation coefficients between standard scores and factor scores, the signs of data do not determine the signs of factor loadings. Therefore, there are no relations between the reverse of Likert scale and inconsistency of the signs of the factor loadings and the standardized scoring coefficients of the first factor; they are multiplied by minus 1 for some other reason.

Reinterpretation of Two Factors in “Work Goals” Questions

Hofstede regarded the two factors extracted from the factor analysis on “work goals” questions as the factors of “individualism” and “masculinity.” However, the factor structure (relations between the factor loadings and the contents of the questions) calculated from the author’s factor analysis indicated that the first factor was related to “collectivism” and the second factor to “femininity.” The factor structure of these two factors is reinterpreted here.

First, the factor loadings of the first factor (Table 2) are examined. The questions that have positive factor loadings are “Training” (A9), “Physical conditions” (A12), “Use of skills” (A17), “Benefits” (A10), “Cooperation” (A8), and “Advancement” (A15). The factor scores of the first factor rise as much as these goals are taken seriously. The questions that have negative factor loadings are “Personal time” (A18), “Freedom” (A13), “Challenge” (A5), “Desirable area” (A6), “Recognition” (A11), and “Manager” (A16). Therefore the first factor’s characteristics become stronger as the degree of dependence to the company

increases and cooperation is placed importance, while weaker as personal interest and respect for privacy are valued. The first factor has the confrontation structure of “collective-individual” because strong loyalty to company organization and emphasis on group harmony are the expressions of collectivism. The higher the degree of collectivism is, the higher the factor scores of the first factor are. It was revealed that Hofstede multiplied factor loadings and standardized scoring coefficients by minus 1 and interpreted the first factor as a factor of individualism.

Second, the factor loadings of the second factor (Table 2) are examined. Hofstede conducted the following analysis prior to the interpretation that the second factor was related to “masculinity.” This analysis aims at confirming whether there is any difference between men and women concerning importance placed on different work goals. He selected occupations that have sufficient numbers of employees of both gender to allow statistical treatment of data, and where employees of both gender engage in equal tasks. A *t*-test between men and women was done on the basis of the mean scores of “work goals” questions (Hofstede, 1980, pp. 271-275). Result is in Table 3.

The questions that have positive factor loading are “Cooperation” (A8), “Manager” (A16), “Desirable area” (A6), and “Employment security” (A14). The questions that have negative factor loading are “Earnings” (A7), “Recognition” (A11), “Advancement” (A15), “Challenge” (A5), and “Use

Table 3. Gender Difference in “Work Goals”

More important for men	More important for women
Advancement	Friendly atmosphere
Earnings	Position security
Training	Physical conditions
Up-to-dateness	Manager
	Cooperation

Source: Hofstede (1980, p. 274)

of skills” (A17), absolute value of factor loading being higher respectively. When this is compared with Table 3, it is understood that the higher the scores of “work goals” which women place importance, the higher the factor scores of the second factor. It is proved that Hofstede formulated the index as “masculinity” by multiplying factor score by minus 1 in consideration of the larger number of male respondents (Hofstede, 1980, p. 277). However, essentially, the second factor should be related to “femininity.”

4. For Further Supplementary Examination

Based on the above analysis, data treatment process in supplementary examination by using IDV and MAS will be explained. Analysis can be performed in two ways. One is to compare the culture internationally or to examine diachronic change of culture in comparison with IBM data by using the calculation formulas of two indices that Hofstede developed. Another is to verify the validity of these two indices or to develop a new index of culture by using factor analysis as Hofstede’s.

Reproduction of Hofstede Model

Using Two Indices in Original Form

When using the computation formulas of IDV and MAS developed by Hofstede in original form, answers for “work goals” questions must be collected and factor scores should be estimated from that data. First, it is needed to calculate the following two kinds of mean scores and standard deviations of each “work goals” question. One kind is the mean scores of each question calculated for the country. These mean scores compose the matrix of country number \times 14. Another kind is the mean score of the whole sample calculated for each question. Standard deviations are calculated for every question as well. Second, country means are standardized by using whole means and standard deviations. Simply deduct whole means from country means and divide them by standard deviations of each question.

The estimated values of the factor scores are calculated from above standard scores by using the standardized scoring coefficients shown in Table 2. Though Hofstede did not explicitly show the computation formulas, they are proved to be as follows from the author’s factor analysis.

$$\begin{aligned} \text{INV}' = & - 0.13 \times A5 - 0.11 \times A6 - 0.01 \times A7 + \\ & 0.11 \times A8 + 0.25 \times A9 + 0.12 \times A10 - \\ & 0.07 \times A11 + 0.21 \times A12 - 0.15 \times A13 + \\ & 0.01 \times A14 + 0.06 \times A15 - 0.05 \times A16 + \\ & 0.19 \times A17 - 0.26 \times A18 \end{aligned}$$

$$\begin{aligned} \text{SOC} = & - 0.17 \times A5 + 0.19 \times A6 - 0.22 \times A7 + \\ & 0.22 \times A8 + 0.00 \times A9 + 0.03 \times A10 - \\ & 0.19 \times A11 + 0.00 \times A12 - 0.01 \times A13 + \\ & 0.15 \times A14 - 0.18 \times A15 + 0.22 \times A16 - \\ & 0.13 \times A17 + 0.01 \times A18 \end{aligned}$$

Values from A5 to A18 are the standard scores,

and “ \times ” shows multiplication. INV is INV’ multiplied by minus 1. These estimated factor scores, INV and SOC, are substituted into the computation formulas shown in Section 2 to calculate the indices’ numerical values. In other words, $IDV = 50 - 25 \text{INV}'$. SOC is multiplied by minus 1 within the computation formula.

Conducting Factor Analysis

When conducting the same factor analysis as Hofstede, it is necessary to calculate the correlation matrix of “work goals” questions. Then calculate the eigenvalues of this matrix, and conduct a factor analysis using the number of eigenvalues above 1 as factor number criterion. In fact, this correlation matrix is computed in the process of principal component analysis. Therefore conduct a factor analysis employing principal component method as initial factor method. That is, the factor analysis of principal component method using varimax rotation as rotation method is needed.

The data used in factor analysis of Hofstede (1980) is standardized. Yet it is required to conduct a factor analysis with raw data because standardization is automatically processed in general factor analysis programs.

Next, compare the rotated factor pattern computed from the factor analysis with the factor loadings shown in Table 2. It can be said that the factor of “collectivism” and “femininity” were extracted if the number of factors extracted and the signs/amount of factor loadings were about the same

as in Table 2. In that case, simply multiply the second factor by minus 1 and substitute the factor scores into the computation formulas shown in above section .

When the signs/amount of factor loadings do not align with Table 2, interpret what the factors extracted are. The way of analyzing a factor structure is to pick out in order from the higher factor loadings and classify them by plus and minus, then examine what kind of confrontation structure they have.

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