

テレワーク研究動向分析  
(日本テレワーク学会誌, 2002-2008年)

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in the Journal of Japan Telework Society in 2002-2008**

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### **An analysis of trends in issues discussed in the Journal of Japan Telework Society in 2002-2008**

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#### [抄録]

『テレワーク』が流行語となり、その潜在的な有効性が議論の的になったのは1990年代の中頃であったが、それ以来、『テレワーク人口』は増加し続けている。このような背景のもと、テレワークの有効性に関する研究と実践方法の提言に関する牽引車としての役割を目的として日本テレワーク学会が設立されたのは1999年であった。学会の発行する学術誌で議論される問題は多岐に亘るため、議論の内容は日本におけるテレワークの全容を反映していると考えられるだろう。そこで、本研究では、日本テレワーク学会誌における研究動向を分析することにより、日本におけるテレワークの実情を明らかにする。

#### [キーワード]

形態素解析、多変量解析、研究動向分析、  
テレワーカー、テキスト・マイニング

#### Abstract

It was in the mid-1990s that the word “telework” became a vogue and its effectiveness and potential came under review in Japan. Since then the number of “teleworkers” has been increasing. Against such background Japan Telework Society has been established since 1999 to act as a vehicle for promoting broad-ranging research for assessing the effectiveness of telework programs and proposing the best practice on the telework. Because issues discussed in the articles published in their journal cover wide variety of topics, they may be considered to reflect the actual aspect of the telework in Japan. So, in this article, trends in issues discussed in the Journal of Japan Telework Society are figured out and an actual aspect of telework in Japan is discussed based on the results of the analysis.

## Key Word

Morphological analysis, Multivariate analysis,  
Research trend analysis, Teleworker, Text mining.

## 1 INTRODUCTION

The word “telework” became generally accepted as a style of working in Japan in the mid-1990s when a vogue and its effectiveness and potential came under review in Japan<sup>[1]</sup>. Since then the number of “teleworkers”, who are employed or self-employed and working more than eight hours a week (regardless of time or place) using IT-related tools<sup>[2]</sup>, has been increasing. Actually, according to the ministry of land, infrastructure and transport, the teleworker ratio, that is, the ratio of the number of teleworkers to that of total of workers has increased from 6.1% in 2002 to 15.3% in 2010<sup>[3,4]</sup>. Thus the telework has been diffusing to the whole country for the last decade in Japan. Against such background Japan Telework Society (<http://www.telework-gakkai.jp/>) has been established since 1999 to act as a vehicle for promoting broad-ranging research for assessing the effectiveness of telework programs and proposing the best practice on the telework.

Because the aim of Japan Telework Society is not only to support academic research on telework but to have such a style of working diffuse nationwide, issues discussed in the articles published in their journal cover wide variety of topics as follows:

- ・ Reviews of the effectiveness of telework
- ・ Surveys on actual conditions of teleworkers
- ・ Case studies
- ・ New business models
- ・ Issues and resolutions in business by teleworkers

Thus issues concerning the above topics may be considered to reflect the actual aspect of the telework in Japan. So, in this article, trends in issues discussed in the articles published in the Journal of Japan Telework Society are figured out and an actual aspect of telework in Japan is discussed based on the results of the analysis.

Our aim in this study is not only to analyse keywords included in articles in academic journals but to figure out overall trends in issues discussed in them. Such an aim, however, would not be accomplished if ordinary procedures for text mining were applied to the analysis. So, in the next Section 2, a new procedure for analysing academic articles is introduced combining the methods for the text mining<sup>[5]</sup>, for the language morphological analysis in Japanese<sup>[6]</sup>, for the factor analysis for categorical data and the cluster analysis based on factor scores. In this procedure, by taking note of the grammatical features in Japanese, we can select keywords concerned with issues mainly

discussed in articles without confusing them with keywords regarding criticisms, citations or reviews of previous studies. Further the introduced procedure enables us to comprehend similar relationships among articles while several previous ones<sup>[7]</sup> are for figuring out appearance relationships among keywords. The results of applying the introduced procedure to the analysis of trends in issues discussed in the Journal of Japan Telework Society are shown in the following Section 3 which is followed by Section 4 where the aspect of telework in Japan is discussed based on the results of the analysis.

## 2 PROCEDURE

In this study, for figuring out overall trends in issues discussed in academic journals, we introduce a new procedure consisting of the following four steps:

Step I : Keyword extraction using the language morphological analysis method.

Step II: Keyword selection based on frequency distribution and the features of Japanese way of academic writing

Step III: Factor analysis of categorical data

Step IV: Cluster analysis based on factor scores

The details of the above procedure are described for each step as follows.

**Step I.** The morphological analysis method is applied to text data on articles. This method is a basic technology for language processing using computer, where text is divided into the smallest units of syntax (morphemes) with word class which can be recognized as words having certain meanings<sup>[8]</sup>.

**Step II.** Morphemes (keywords) extracted at Step I, however, may not be necessarily concerned with main issues discussed in the articles because keywords regarding criticisms, citations or reviews of previous studies, for example, do not directly reflect contents of the articles. So, for addressing such a problem, we focus the features of Japanese academic writing as follows:

Feature 1: Main aims are described in sentences with the phrase “in this article” or “in this study” or “in this paper”, which may be a common feature for academic articles in other languages.

Feature 2: Significant verbs concerned with aims of studies take the form “do noun”, for examples, we do not write “analyze” but “do analysis” or we do not write “measure its effectiveness” but write “do measurement of effectiveness” in academic way of writing.

Feature 3: In the sentences with the phrase “in this article” or “in this study” or “in this paper” phrases regarding citations, criticisms or reviews of previous studies are included in clauses located before negative conjunctions.

Considering those three features, we select keywords which satisfy the following conditions as ones concerned with main issues discussed in the articles:

- (a) They are included in sentences which includes the phrase "in this article" or "in this study" or "in this paper".
- (b) They are nouns conjunctive to “do”.
- (c) They do not locate before negative conjunctions in sentences.

**Step III.** At first in this step we make (article, keyword)-table consisting of dummy variables which equal one if corresponding articles include the keywords selected in Step II or zero if they do not include them. In this table dummy variables are considered to indicate attributes of corresponding articles, hence, by comprehending the similar relationship among the articles based on data on (article, keyword)-table, overall trends in the articles may be figured out. So in this step the factor analysis is applied to the categorical data on (article, keyword)-table for comprehending the similar relationships among the articles based on the factor scores for the articles.

**Step VI.** Though the similar relationship among the articles could be comprehended at the previous Step III, it is rather difficult to get interpretable findings from the result of factor analysis because of its complicity. So, at this final Step IV, the cluster analysis is applied to the data on factor scores calculated from the result of factor analysis at the previous Step III, where attributes of clusters of articles are interpreted based on the average values of factor scores of articles belongs to the same clusters. Further the trends in numbers of articles by those clusters and years are indicated for for discussing the aspect of telework in Japan.

In the introduced procedure, for applying the morphological analysis to the articles at Step I, we use CHASEN which is a morphological parser for the Japanese language given for free by Matsumoto Laboratory in Computational Linguistics Laboratory Graduate School of Information Science Nara Institute of Science and Technology. Besides, in Steps III and IV the Japanese software "Excel TAHENRYO" for Windows by ESUMI Co., Ltd. are used for the factor analysis and the cluster analysis.

### 3 RESULTS

In this section the results of the analysis of issues in the articles published in the Journal of Japan Telework Society obtained through the introduced procedure are given for every step.

#### 3.1. Result of Step I

Figure 1 indicates the image of output given by CHASEN. As seen in the figure text is divided into the smallest units of syntax (morphemes) with word class. From the outputs morphemes belonging to word class of noun are selected as candidates of keywords associated with issues discussed in the articles.

### 3.2. Result of Step II

Table 1 indicates morphemes (keywords) ranking top 18 based on appearance frequencies which satisfy the conditions (a), (b) and (c). The English words in the table are given by translating Japanese morphemes (keywords) to English, hence they may be a kind of unnatural as keywords in academic journals.

### 3.3. Result of Step III

At this Step III, the factor analysis is applied to the data on (article, keyword)-table consisting of dummy variables which equal one if corresponding articles include the keywords selected in Step II or zero if they do not include them. Table 2 indicates the (article, keyword)-table consisting of dummy variables. And Table 3 indicates a summary of the result of applying factor analysis to the data on the (article, keyword)-table. From the table each of those three factors is considered associated with the following keyword:

Factor 1: "organization", "proposal", "in existence" and "introduction"

Factor 2: "at home" and "definition"

Factor 3: "relation" and "analysis".

In Figure 2 the factor scores calculated based on the results of the factor analysis for the data on the (article, keyword)-table are plotted on the factor coordinate systems. Though the similar relationship among the articles could be comprehended from the figure, it is rather difficult to get interpretable findings from it because of its complicity. So in the next Step IV the cluster analysis is applied to the data on those factor scores.

### 3.4. Result of Step IV

In Table 3 the factor scores calculated based on the results of factor analysis obtained through Step III are given, and the results of cluster analysis is indicated in Figure 3 where the articles are hierarchically assigned into clusters base on similarities of patterns of their factor scores. In the cluster analysis it is needed to opt the number of clusters based on external information concerning the purposes studies, in this case, we opt to get four clusters so that clusters consisting of only one article will not be appear. In Figure 4-7 the average values of factor scores for articles belong to Clusters 1-4 are indicated respectively. From the figures each of Clusters 1-4 is interpreted as cluster associated with the following terms:

Cluster 1: Ordinary Telework study

Cluster 2: Confirmation by survey or interview without the definition of Telework

Cluster 3: Confirmation by survey or interview with the definition of Telework

Cluster 4: Proposal or introduction of Telework to organizations in existence.

Finally let us see trends in the numbers of articles by those clusters and years indicated in Figure 8. As seen in the figure it is found that the numbers of articles in Cluster 2 and Cluster 4

are decreasing while the numbers of articles in other clusters are constant. From this finding it is conclude that the issues discussed in the articles published in Japan Telework Society has departed from the phase where it is simply proposed or introduced without rigorous discussions.

## 4 CONCLUDING REMARK

In this article, the trends in issues discussed in the articles published in the Journal of Japan Telework Society have been figured out through a new procedure using the methods for the text mining and the multivariable. The conclusion obtained from the results of analysis may suggest that Japan has been becoming a developed country for Telework for the last decade in the meaning that issues discussed in the articles published in the journal has departed from the phase where it is simply proposed or introduced without rigorous discussions as well as in the meaning of technological aspect<sup>[9]</sup>.

According to the definition by the ministry of land, infrastructure and transport<sup>[10]</sup>, teleworkers are defined as people who satisfy the following conditions:

- ・ They earn revenue from their regular jobs.
- ・ They work with IT tools.
- ・ They have more than one work places or one work place outside their company's office which are equipped with IT tools.
- ・ They are working more than 8 hours a week at work place outside their company's office.

Because the above definition is mainly concerned with people working at corporations, home-based teleworkers<sup>[11]</sup> may not be sufficiently considered. So the conclusion obtained in this article may be biased toward the aspect of people working at corporations. In this meaning it will be needed to investigate the aspects of home-based teleworkers in the next study.

Though the teleworker ratio has increased for the past decade and as described in Introduction, it has been pointed out that the success factors in introducing the telework varies depending on types of jobs<sup>[12]</sup>. So it might be needed to review the aspect of telework considering types of jobs in the next study.

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Table 1. Top 18 morphemes (keywords) which are hold the conditions (a), (b) and (c)

survey	research	discussion	analysis	introduction
implementation	relation	review	organization	definition
induction	consciousness	conformation	in existence	at home
take root	proposal	comparison		

Table 2. (Article, keyword)-tabulated data on dummy variables

	survey	research	discussion	analysis	introduction	implementation	relation
Toward Telework Adoption Methodology for Japanese Organizations : Case-based Approach	1	1	0	0	1	1	0
A Research of Impeding Elements on Taking Root of Telework into Japanese Enterprises	1	1	0	1	0	0	0
An Analytical Model of Telework Centre Development Patterns : UK Case Studies	1	0	0	0	0	0	0
A Study on Implementation of an Organizational Telework	1	1	1	1	1	1	1
A Study on the Trends of Japanese Research for Telework	1	1	0	1	0	0	0
Perceived Telework Obstacles : Tenacious Misconceptions in Survey Free Responses and the Role of HRM	0	1	0	0	0	0	0
Communication Pattern of Telework Groups	0	1	1	1	0	0	0
The Formation of Community Support with SOHO Workers : A Successful Path for Network Business of Private Sole Proprietors	0	0	0	0	0	0	0
A study of way of classifying SOHO-workers and factors deciding earnings of SOHO-business Based on Analysis of Data on a Survey	1	1	1	0	0	0	0
Why do SOHOs gather in a city? : A study on the location of SOHO	0	0	1	1	0	0	0
A Study on Implementation of Telework in Large-scale System development	0	0	0	0	1	0	0
Management Failure : Work Hours, Paid Leave and Occupational Health Issues and Telework	0	0	1	1	0	0	0
A Study on Workstyle Diversification and the Role of Telework in Human Resource Management	0	1	1	0	0	0	1
A Study on An Organizational Strategic Model for Network Society : The Symbiotic Organization Model with Telework and Coevolution	0	1	1	0	1	0	0
Corporate HRM Issues and Introduction of Flexible Work Styles in JAPAN Job Contents, Discretion for Working Hours and Place, Women's Continuous Working	1	0	0	0	1	0	1
A Telework Introduction Policy Linked to Paid Leave : A Proposal for "Leave with Telework"	0	0	0	0	1	0	0
Telework & CSR	0	0	0	1	0	1	1
Where is SOHO?	0	0	0	0	0	0	0
A study on the employment promotion effect of telework : Mainly issues about work environment of disabled people and childcarers	1	1	0	0	0	1	0
Mentoring and the Mitaka City "SOHO Venture College"	1	0	0	0	0	0	0
The Actual Conditions of SOHO Businesses and SOHO Aspirants	1	0	0	0	0	0	0
A Study on Telework as BPR Strategy of Companies : A Case of A Japanese Company	1	0	1	0	0	1	0
Using ICT for telework and education	0	0	1	0	0	0	0

review	organiza- tion	definition	induction	conscious- ness	in exis- tence	at home	take root	proposal	compari- son	conforma- tion
0	1	1	0	0	1	0	0	1	1	0
0	0	0	1	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	1	1	0	0	1	1	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1	0
0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	1	0	0	0
1	0	0	1	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	1	1	0	0	0
1	0	0	0	0	0	0	0	1	0	1
1	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1	1
0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	1	0	1	0	0	0	0
0	0	0	0	1	0	0	0	0	0	1
0	0	0	0	1	0	0	0	0	0	0

Table 3. Summary of the result of applying the factor analysis to the data given in Table 2

Eigen Values (rotated)			
Factor	Eigen Value	Contribution Rat	Cumulative (%)
1	2.49	13.85	13.85
2	2.08	11.56	25.40
3	1.70	9.46	34.86

Factor loading (rotated)			
	Factor 1	Factor 2	Factor 3
organization	<b>0.76</b>	0.21	0.02
proposal	<b>0.63</b>	-0.01	-0.37
in existence	<b>0.59</b>	0.31	0.28
introduction	<b>0.54</b>	0.27	0.02
at home	-0.05	<b>0.80</b>	0.48
definition	0.33	<b>0.62</b>	-0.01
relation	0.10	0.12	<b>0.66</b>
analysis	0.16	-0.18	<b>0.51</b>
survey	0.03	0.44	0.07
research	0.45	-0.19	0.13
discussion	0.14	-0.04	0.10
implementation	0.40	0.30	0.08
review	0.01	-0.32	0.18
induction	-0.18	-0.37	0.17
consciousness	-0.37	0.44	-0.26
take root	-0.12	0.00	0.42
comparison	0.42	0.02	-0.19

Table 4. Factor scores

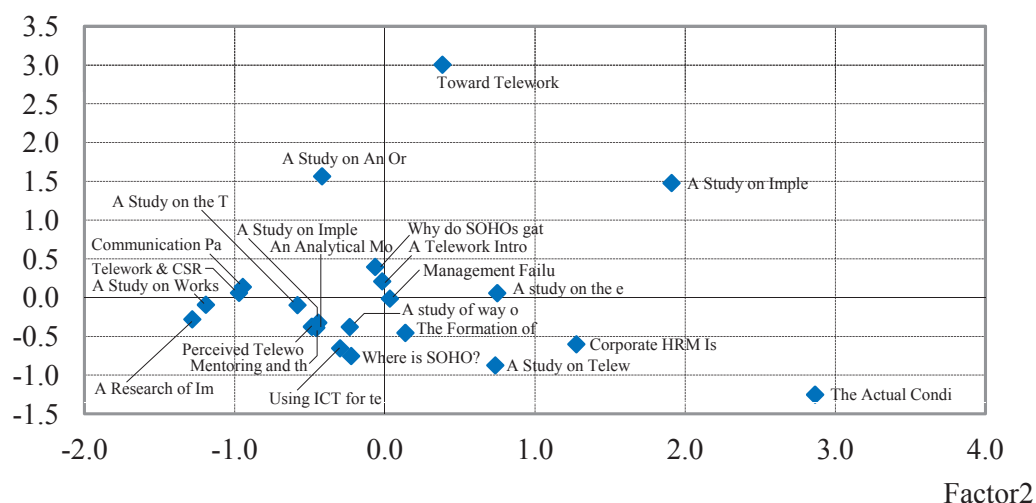
	Factor 1	Factor 2	Factor 3
1 Toward Telework Adoption Methodology for Japanese Organizations : Case-based Approach	3.01	0.38	-1.14
2 A Research of Impeding Elements on Taking Root of Telework into Japanese Enterprises	-0.28	-1.28	0.46
3 An Analytical Model of Telework Centre Development Patterns : UK Case Studies	-0.39	-0.46	-0.41
4 A Study on Implementation of an Organizational Telework	1.48	1.91	2.09
5 A Study on the Trends of Japanese Research for Telework	-0.10	-0.58	0.39
6 Perceived Telework Obstacles : Tenacious Misconceptions in Survey Free Responses and the Role of HRM	-0.37	-0.49	0.24
7 Communication Pattern of Telework Groups	0.14	-0.95	0.05
8 The Formation of Community Support with SOHO Workers : A Successful Path for Network Business of Private Sole Proprietors	-0.45	0.14	-0.98
9 A study of way of classifying SOHO-workers and factors deciding earnings of SOHO-business Based on Analysis of Data on a Survey	-0.38	-0.23	-0.30
10 Why do SOHOs gather in a city? : A study on the location of SOHO	0.40	-0.07	0.07
11 A Study on Implementation of Telework in Large-scale System development	-0.32	-0.44	-0.68
12 Management Failure : Work Hours, Paid Leave and Occupational Health Issues and Telework	-0.01	0.03	1.13
13 A Study on Workstyle Diversification and the Role of Telework in Human Resource Management	-0.09	-1.19	0.80
14 A Study on An Organizational Strategic Model for Network Society : The Symbiotic Organization Model with Telework and Coevolution	1.56	-0.42	-0.85
15 Corporate HRM Issues and Introduction of Flexible Work Styles in JAPAN Job Contents, Discretion for Working Hours and Place, Women's Continuous Working	-0.60	1.27	1.57
16 A Telework Introduction Policy Linked to Paid Leave : A Proposal for "Leave with Telework"	0.21	-0.02	-0.80
17 Telework & CSR	0.06	-0.97	1.14
18 Where is SOHO?	-0.75	-0.23	-0.04
19 A study on the employment promotion effect of telework : Mainly issues about work environment of disabled people and childcareers	0.06	0.75	-0.33
20 Mentoring and the Mitaka City "SOHO Venture College"	-0.39	-0.46	-0.41
21 The Actual Conditions of SOHO Businesses and SOHO Aspirants	-1.25	2.86	-0.05
22 A Study on Telework as BPR Strategy of Companies : A Case of A Japanese Company	-0.87	0.73	-1.05
23 Using ICT for telework and education	-0.65	-0.30	-0.89



Figure 1. Image of output by CHASEN (in Japanese)

Factor 1

Factor score



Factor 2

Factor score

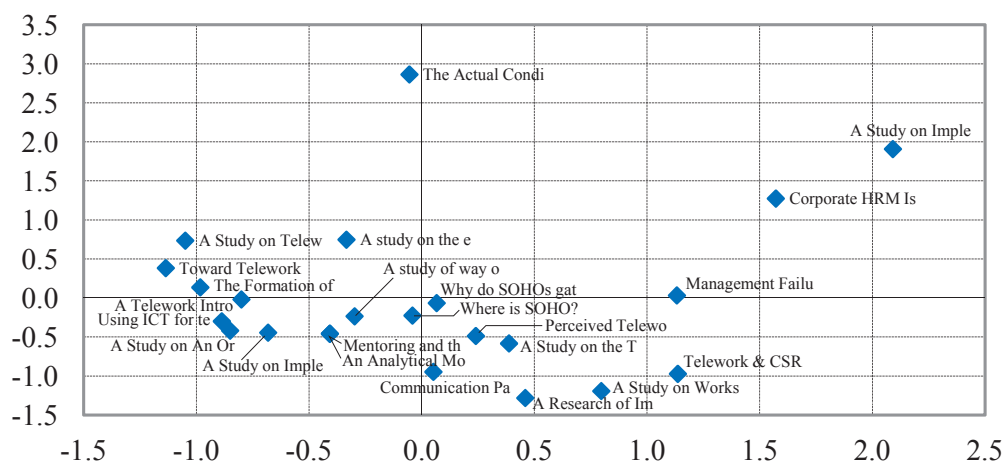


Figure 2. Factor scores on factor coordinate system

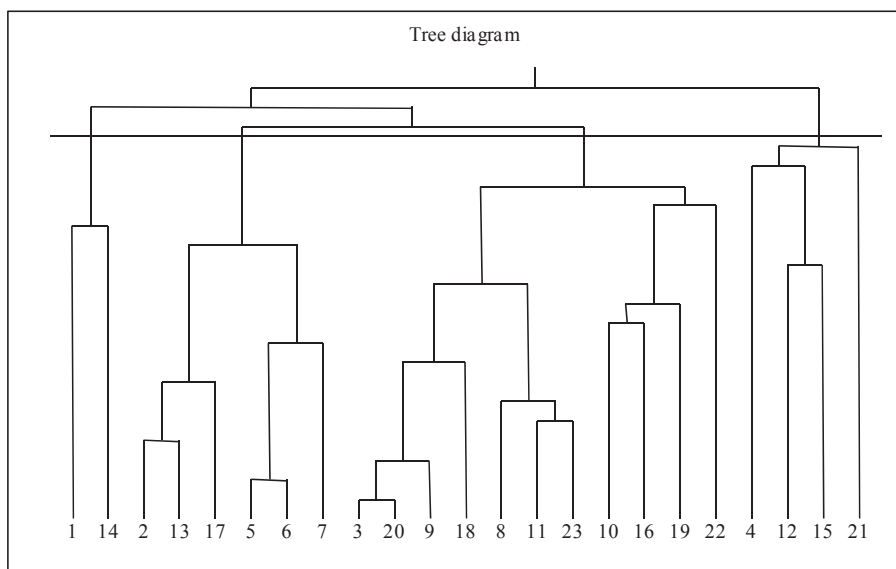


Figure 3. Tree diagram obtained from the cluster analysis of data on the factor scores where the numbers are corresponding the articles numbered in Table 3

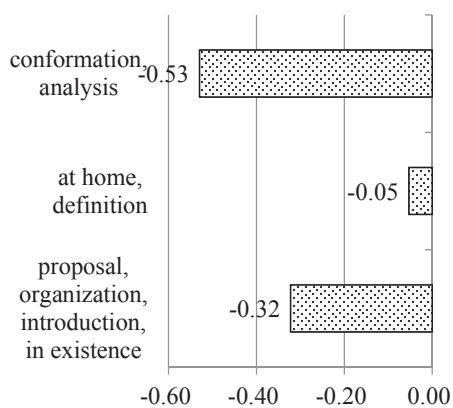


Figure 4. Average values of factor score for the articles belonging to Cluster 1

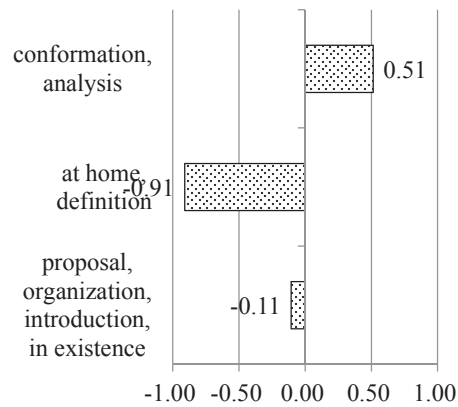


Figure 5. Average values of factor score for the articles belonging to Cluster 2

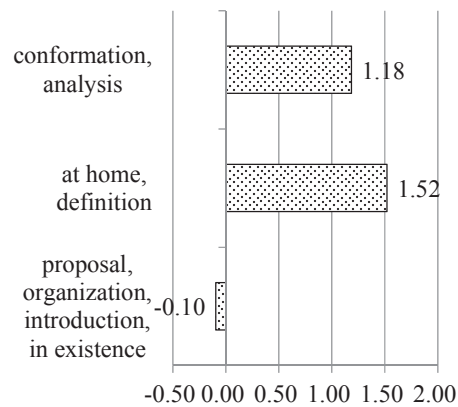


Figure 6. Average values of factor score for the articles belonging to Cluster 3

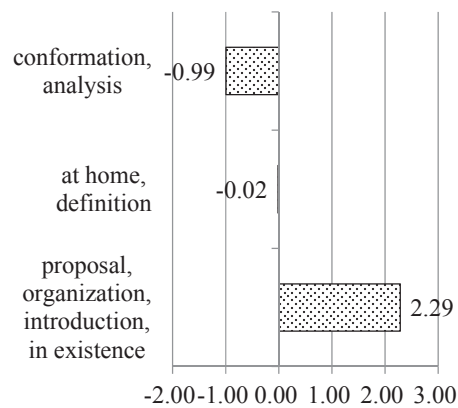


Figure 7. Average values of factor score for the articles belonging to Cluster 4

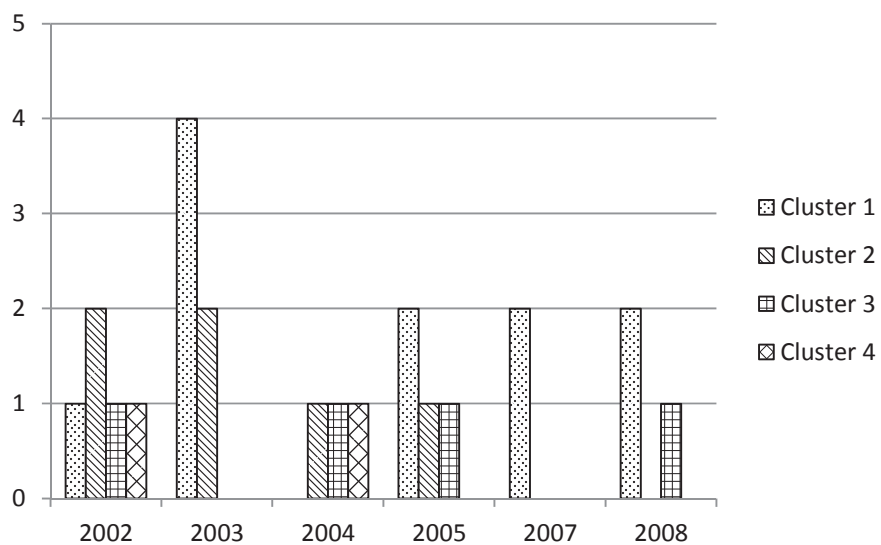


Figure 8. Numbers of articles by year and cluster