An analysis of the trend in studies in Japan Telework Society

NOBUTANE HANAYAMA
Department of Information Technology, Shobi University
655 Shimomatsubara, Kawagoe 3501153, JAPAN
nob-hanayama@jcom.home.ne.jp

ABSTRACT

It was in the mid-1990s that the words Telework became the vogue and their effectiveness and potential came under review worldwide. Since then Telework has been offering significant benefits to employers, employees, self employed individuals and entrepreneurs, and giving local economy advantage in developing. In Japan, to act as a vehicle for promoting broad-ranging research in the Telework field, for assessing Telework program effectiveness and proposing best practice, Japan Telework Society was established in 1999 and has been supporting research activities on Telework for the past decade. In this study, for figuring out the trend in studies on Telework promoted by the society since its establishment, articles which have been published in their academic journal are analyzed using tools for the text mining and the multivariable analysis. Further based on the results of the analysis of those articles the future aspects of Telework are presumed.

Keywords: Cluster analysis, Dummy variable, Factor analysis, Morphological analysis, Text mining.

1 INTRODUCTION

It was in the mid-1990s that the words Telework became the vogue and their effectiveness and potential came under review worldwide in Japan [1]. Since then Telework has been offering significant benefits to employers, employees, self employed individuals and entrepreneurs, and giving local economy advantage in developing. To act as a vehicle for promoting broad-ranging research in the Telework field, for assessing Telework program effectiveness and proposing best practice, Japan Telework Society was established in 1999 and has been supporting research activities on Telework for the past decade.

Because the aim of Japan Telework Society is to have such a style of working as Telework prevail nationwide as well as to promote academic studies, the articles published in their journal include ones dealing with the following topics (http://www.telework-gakkai.jp/):

(i) Reviews of the effectiveness of Telework

(ii) Surveys on acctual conditions of Teleworkers

(iii) Case studies

(iv) New business models

(v) Issues and resolutions in the business by Teleworkers.

Thus the topics dealt with in the journal may be considered to reflect the actual aspect of Telework in Japan. So, our aim in this article is to figure out the trends in topics dealt with in the Journal of Japan Telework Society using the method for text mining [2] and multivariate analysis and discuss the role of Telework in the future.

In the next Section 2 a procedure for figuring out the trends in topics dealt with in the journal is proposed using the method for the text mining, the language morphological analysis in Japanese [3] and the factor analysis of categorical data. In the proposed procedure, by focusing the grammatical rules in Japanese, we can extract keywords concerned with issues discussed in articles without confusing them with words unconcerned with them. By using this procedure it become possible to comprehend degree of relatedness of studies in addition to the output obtained in the previous study [4]. In the following Section 3 the results of applying the proposed procedure to the analysis of trends in topics dealt with in the Journal of Japan Telework Society are shown, where it is seen that the number of articles dealing with

topics such as "introduction of telework" has decreased while that dealing with topics such as "sustain" has increased. Finally in Section 4 the role of Telework in the future is discussed based on the results of trend analysis.

2 PROCEDURE

The procedure proposed in this study consists of the following steps.

(I) Keyword extraction using the language morphological analysis method

(II) Keyword Selection based on frequency distribution

(III) Factor analysis of categorical data

(IV) Cluster analysis based on factor scores

Morphological analysis [5] 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. For applying this method to the analysis of our data the following morphological parsers are commercially available: Rosette by Bases Technology, GENGORO by Zoo Corporation, MARIMO by MUTA Inc. These parsers are, however, rather expensive, hence we use a morphological parser for the Japanese language CHASEN given for free by Matsumoto Laboratory in Computational Linguistics Laboratory Graduate School of Information Science Nara Institute of Science and Technology.

In the step (II) morphemes are selected as keywords concerning topics dealt with articles based on frequency. Such morphemes (keywords), however, does not necessarily concern topics discussed in articles, hence, in this step, focusing the property of academic composition in Japanese, we select morphemes (keywords) which hold the following three conditions as topics discussed in the articles:

(a) They are included in (the) sentence which includes the phrase "in this article" or "in this study" or "in this paper"

(b) They are nouns conjunctive to verves, that is, nouns used like "do nouns".

(c) They locate after negative conjunctions in sentences.

Now it is noticed that Most of Japanese academic articles have sentences such that "in this article we do *noun*". In the step (III) or (IV) we use one of the Japanese software "Excel TAHENRYO" for Windows by ESUMI Co., Ltd. for multivariate analysis

3 RESULTS

In this section the proposed procedure is applied to the analysis of the articles published in the Journal of Japan Telework Society since 1990s.

3.1 Keyword extraction using the language morphological analysis method

Figure 1 illustrates the image of output given by CHASEN.

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

Based on the output by CHASEN we select nouns as candidates of keywords associated with topics discussed in every article published in the Journal of Japan Telework Society.

3.2 Keyword Selection based on frequency distribution

Table 1 indicates 18 morphemes (keywords) which are included in at least three articles in the Journal of Japan Telework Society and hold the conditions (a), (b) and (c).

Table 1. 18 morphemes (keywords) which are included in at least three articles in the Journal of Japan Telework Society and 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		

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.

2.3 Factor analysis of categorical data

For proceeding the third step let us consider data on dummy variables of the morphemes (keywords) in Table 1 for every article which equals one if the article includes the corresponding morpheme (keyword) nor equals zero, and we get a set of (article, keyword)-tabulated data on dummy variables as Table 2.

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

	survey	research	discussion	analysis	introduction	implementation	relation	review	organization	definition	induction	consciousness	in existence	at home	take root	proposal	comparison	conformation
Toward Telework Adoption Methodology for Japanese Organizations : Case-based Approach	1	1	0	0	1	1	0	0	1	1	0	0	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	0	0	0	1	0	0	0	1	0	0	0
An Analytical Model of Telework Centre Development Patterns : UK Case Studies	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A Study on Implementation of an Organizational Telework	1	1	1	1	1	1	1	0	1	1	0	0	1	1	0	0	0	0
A Study on the Trends of Japanese Research for Telework	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Perceived Telework Obstacles : Tenacious Misconceptions in Survey Free Responses and the Role of HRM	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Communication Pattern of Telework Groups	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	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	0	0	1	0	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	0	0	0	0	0	0	0	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	0	1	0	0	0	0	0	0	0	0	0
A Study on Implementation of Telework in Large-scale System development	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Management Failure : Work Hours, Paid Leave and Occupational Health Issues and Telework	0	0	1	1	0	0	0	0	0	0	0	0	1	0	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	1	0	0	1	0	0	0	0	0	0	0
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	0	1	0	0	0	0	0	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	0	0	0	0	0	0	1	1	0	0	0
A Telework Introduction Policy Linked to Paid Leave : A Proposal for "Leave with Telework"	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	1
Telework & CSR	0	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0
Where is SOHO?	0	0	0	0	0	0	0	0	0	0	1	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	0	0	0	0	0	0	0	0	0	1	1
Mentoring and the Mitaka City "SOHO Venture College"	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
The Actual Conditions of SOHO Businesses and SOHO Aspirants	1	0	0	0	0	0	0	0	0	1	0	1	0	1	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	0	0	0	0	1	0	0	0	0	0	1
Using ICT for telework and education	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0

Then we can apply the factor analysis to the (article, keyword)-tabulated data given in Table 1 for figuring out the relation among the articles in the meaning of topics discussed in the articles in the journal. A summary of the result is indicated in Table 3.

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

Eigen Values (rotated)

Facor	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	**0.76**	0.21	0.02
proposal	**0.63**	-0.01	-0.37
in existence	**0.59**	0.31	0.28
introduction	**0.54**	0.27	0.02
at home	-0.05	**0.80**	0.48
definition	0.33	**0.62**	-0.01
relation	0.10	0.12	**0.66**
analysis	0.16	-0.18	**0.51**
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

From the above table it is found that Factor 1 is associated with the morphemes (keywords) "organization", "proposal", "in existence" and "introduction", Factor 2 is associated with the morphemes (keywords) "at home" and "definition", and Factor 3 is associated with the morphemes (keywords) "relation" and "analysis".

3.4 Cluster analysis based on factor scores

In this fourth step the trends in the topics in the articles are figured out by applying the cluster analysis to the data on Factor scores obtained in the third step. The factor sores are given in Table 3.

Table 3. Factor socores

		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 childcarers	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

The result of applying the cluster analysis to the data on factor scores are given in the figure 2 by tree diagram and the average values of factor scores in every cluster are given in figure 3-6.

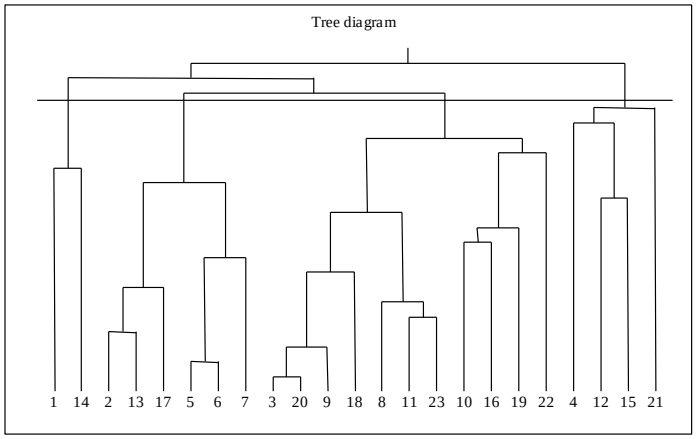

Figure 2. Tree diagram obtained from the cluster analysis of data on the factor scores

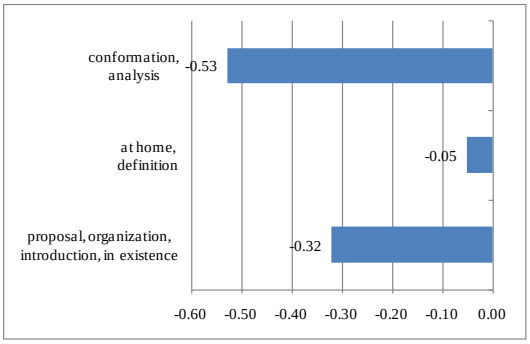

Figure 3. Average values of factor score for the articles belonging to Cluster 1

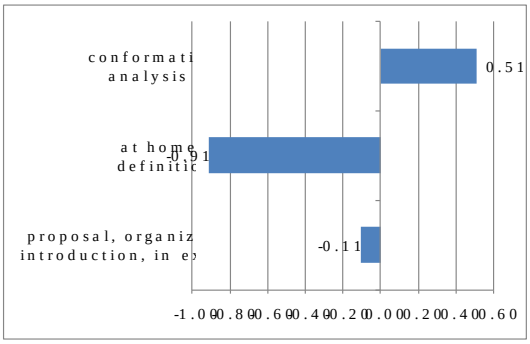

Figure 4. Average values of factor score for the articles belonging to Cluster 2

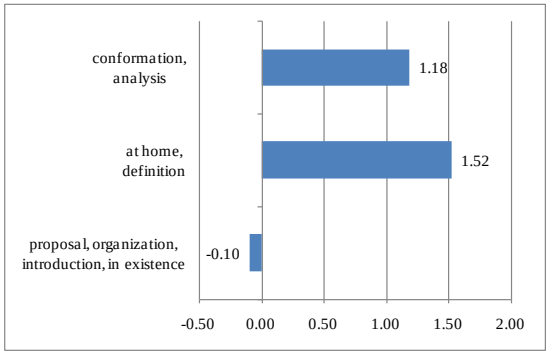

Figure 5. Average values of factor score for the articles belonging to Cluster 3

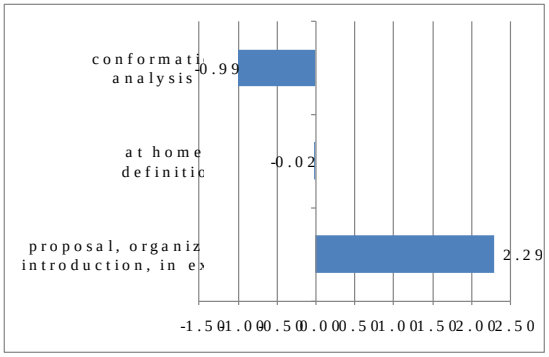

Figure 6. Average values of factor score for the articles belonging to Cluster 4

From the Figures 3-6 each Cluster 1- 4 are characterized as follows.

Cluster 1: Ordinary Telework study

Cluster 2: Analysis of Teleword without discussion of its definition

Closter 3: Analysis of Teleword with discussion of its definition

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

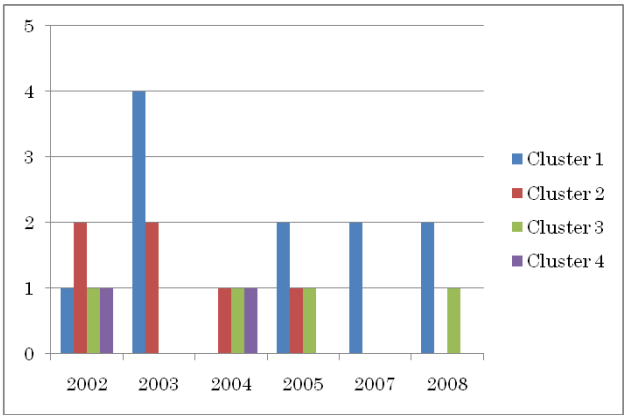

Figure 5. Numbers of articles in every year and cluster

Further it is seen, from the numbers of articles in every year and cluster given in Figure 5, the numbers of articles which are concerned with "analysis without discussion of definition of Telework" or "Proposal or introduction of Telework to organizations in existence" have decreased in recent years.

4 CONCLUDING REMARK

In this article, the articles published in the Journal of Japan Telework Society since 1990s have been analyzed using tools for the text mining and the multivariable analysis and classified into several clusters for figuring out the trends in studies on Telework in Japan. From the results of applying the proposed procedure to the data on the journal the trends in Telework studies in Japan has been presumed from the aspect of Telework study in addition to the technological aspect [6].

By following the procedure proposed in Section 2 the trends in studies over long periods of time has been figured out as shown in Section 3. In this meaning the proposed procedure is considered effective to analyze articles in academic journals which have a several decades of history.

REFERENCES

[1] Spinks, W. A. *Japanese way of management and satellite office in enterprise: Josai International University Institute of Inter-Cultural Research*.

[2] Feldman, R. and Sanger, J. *The Text Mining Handbook*, Cambridge University Press.

[3] Yoshimura K., Hitaka T. and Yoshida S. *Morphological Analysis of Non-marked-off Japanese Sentences by the Least BUNSETSU's Number Method: Journal of information processing.* Vol. 24, No. 1, (1983) pp. 40-46 (in Japanese).

[4] Yukawa, M. and Okano, M. *An analysis of responses of audiences to TV commercial messages. Bulletin of Bunkyo junior college.* Vol. 48, (2005), pp. 1-6 (in Japanese).

[5] Zwicky, F. and Wilson A. (eds.) *New Methods of Thought and Procedure: Contributions to the Symposium on Methodologies*, Berlin: Springer 1967.

[6] Uno, S. and Suzuki, J. *An Information & Communication Environment in an Office and CTI : The Result of the Resarch on CTI: the Journal of the Institute of Electronic, Information and Communication Engineers*. Vol. 97 (1997), pp. 55-62 (in Japanese).