

# Reki-Show Authoring Tools : Risk, Space and History\*

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## 1. ABSTRACT

In social sciences, most events occur in specific time and space. We call such events here “Spatiotemporal Events”.[1] It is obvious that events, having always a beginning and an end, appear at a specific place or in particular space.

Generally speaking, we describe spatiotemporal events by using the factors such as the temporal attribute “when”, the spatial attribute “where” and the observation of act or phenomenon “who did what/what became how”.

Suppose there exists an conceptual data model regulating some rules to describe those factors, it enables us to store various spatiotemporal events as data and to refer with one another. We, therefore, define a simple spatiotemporal data model, calling “**Reki-Show**”[2]. We also call the information system, consisting of Reki-Show data model, “**Reki-Show System**”, and consider Reki-Show System as the basic information system to deal with the various events in human society. At this point, we don’t mention any particular software or program. “**Reki-Show System**” is an conceptual design of information system.

This information system is not novel at all, but would be rather used “ordinarily” in various fields. For instance, when researchers arrange the information in chronological tables, it indicates the data operation focusing on the temporal attribute in the events. When they mention the information in maps, it indicates the data operation focusing on the spatial attribute in the events. It usually requires, however, a great deal of labor to rearrange from the viewpoint of the spatial attribute the information through the temporal attribute. This would occur not only to researchers but also to those who have ever dealt with various spatiotemporal events such as policy makers, analysts and so on. In short, it is no exaggeration to say that we have been tackling with “Reki-Show” data without any tools for Reki-Show System use.

Accordingly, we have recognized that it is indispensable in the future social sciences to have the database and tool for both the temporal and spatial attributes, and have been developing Reki-Show Authoring Tools based on the conceptual framework in Reki-Show System.

At present, the fundamental component has been developed already through some steps, and the system is now applied to the empirical research. We would like to make a report of the outline at this stage.

This paper explains the basic concept in Reki-Show (Conceptual

Data Modeling), followed by the outline of the implemented system. Furthermore, some cases used in our actual research are introduced, and the future roadmap and prospect are referred to at the end.

**Keywords:** History, Database, Education, Spatiotemporal Information, Data Visualization, GIS

## 2. CONCEPTUAL MODEL OF “Reki-Show”

First of all, we take the following case to think over a conceptual model of Reki-Show:

“At 22:24 on May 21 1927, Charles A. Lindbergh succeeded his first nonstop solo flight across the Atlantic to arrive in Paris.”

In this event, the temporal attribute is “22:24 on May 21 1927” and the spatial attribute is “Paris”. Now we define **REKISHOW** as the entity type describing the event or the spatiotemporal event, and write

```
REKISHOW (e)
```

to indicate that the entity is a **REKISHOW** type.

Next, we define three attributes of **REKISHOW(Event)**: “Description” is descriptive attribute of “Event”, “Time” is temporal attribute and “Place” is spatial attribute.

```
REKISHOW (Event) {  
  Event→Description  
  Event→Time  
  Event→Place }
```

Place is a **PLACE** type entity, having the attributes of “Name”, “Latitude” and “Longitude” as follows[3]:

```
PLACE (Place) {  
  Place→Name  
  Place→Latitude  
  Place→Longitude }
```

Now, we apply Lindbergh's case to the definitions of those attributes.

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```

REKISHOW (Flight) {
  Flight→Time = '1927/05/20 07:52'
  Flight→Place→Name = 'Paris'
  Flight→Place→Latitude = 48.962
  Flight→Place→Longitude = 2.436
  Flight→Description =
  'At 22:24 on May 21 1927, Charles A.
  Lindbergh succeeded in his first nonstop
  solo flight across the Atlantic to arrive in
  Paris.' }

```

Although this REKISHOW(Flight) describes only the fact of his arrival, it is obvious that Lindbergh actually took off at 7:52 on May 20 1927. Consequently, **TIME** type can be expanded as follows:

```

TIME (Time) {
  Time→Begin
  Time→End }

```

Then, Time is rewritten as follows:

```

Time→Begin = '1927/05/20 07:52'
Time→End = '1927/05/21 22:24'

```

The above definition means that the event continued for a certain period of time. In addition to **TIME** type, this event describes that “his success of the first nonstop solo flight across the Atlantic” was observed in Paris, whereas it is obvious that the event appeared in the space between New York and Paris. Then, the definition of Place should be expanded in **PLACE** type as follows because the above definition is insufficient:

```

PLACE (Place) {
  Place→Name
  Place→Latitude_NW
  Place→Longitude_NW
  Place→Latitude_SE
  Place→Longitude_SE }

```

In this definition, “Latitude\_NW” and “Longitude\_NW” are the latitude coordinate value and the longitude coordinate value respectively at the upper left (or northwest) of the rectangular area. The event appeared somewhere in this area. Likewise, “Latitude\_SE” and “Longitude\_SE” are the latitude coordinate value and the longitude coordinate value at the lower right (or southeast).

Suppose Lindbergh made a flight in the rectangular area between New York and Paris (although the data on his actual flight pass would enable us to assume the whole rectangular area, we omit such assumption here because this paper describes just the explanation), **PLACE** type can be written as follows:

```

PLACE (Area) {
  Area→Name = 'Flight Area'
  Area→Latitude_NW = 49
  Area→Longitude_NW = 74
  Area→Latitude_SE = 40.8
  Area→Longitude_SE = 2.5 }

```

Consequently, this event is described as follows:

```

REKISHOW (Flight) {
  Flight→Time→Begin = '1927/05/20 07:52'
  Flight→Time→End = '1927/05/21 22:24'
  Flight→Area→Name = 'Flight Area'
  Flight→Area→Latitude_NW = 49
  Flight→Area→Longitude_NW = 74
  Flight→Area→Latitude_SE = 40.8
  Flight→Area→Longitude_SE = 2.5
  Flight→Description =
  'At 22:24 on May 21 1927, Charles A.
  Lindbergh succeeded his first nonstop solo
  flight across the Atlantic to arrive in
  Paris.' }

```

The above is the conceptual model of Reki-Show Data.

Unfortunately, it is not sufficient. The reason is the above-mentioned model does not include any entity describing “Charles A. Lindbergh”, the person concerned in this event. Then, can we solve the problem by expanding the model to add another attribute showing the person? It is not as simple as we think because the person needs to be considered as an independent entity. We will, therefore, refer to the method of describing the data on the person (the subject) next.

### 3. CONCEPTUAL MODEL OF PERSON

The person in Reki-Show is required to be the entity having the following characteristics:

1. The temporal attribute such as birth and death (could be unknown)
2. Not only his or her name but also childhood name, alias, title, pen name, etc.
3. The spatial attribute such as a birthplace (could be unknown)

Based on the above characteristics, we define **PERSON**, the entity type describing the person, as follows:

```

PERSON (Person) {
  Person→Name
  Person→Alias
  Person→Born
  Person→Dead
  Person→ComeFrom
  Person→Gender
  Person→Description }

```

In the above-mentioned definition, “Born” and “Dead” are **TIME** type entities and “ComeFrom” is a **PLACE** type entity. That is,

```

TIME (Born) {
  Born→Begin
  Born→End }

```

```

TIME (Dead) {
  Dead→Begin
  Dead→End }

```

```
PLACE (ComeFrom) {
  ComeFrom→Name
  ComeFrom→Latitude_NW
  ComeFrom→Longitude_NW
  ComeFrom→Latitude_SE
  ComeFrom→Longitude_SE }
```

It might seem curious that “Born” and “Dead” have a beginning and an ending in the temporal attribute. When taking up a historical person, however, we cannot usually help allowing the expression some latitude due to uncertain birth and death years. This model is created in consideration of such a reason.

Similarly, there is a case in which his accurate birthplace is ascertained, whereas there is another case in which only his obscure area is ascertained. In the former case, we use only “Latitude\_NW” and “Longitude\_NW”, leaving “Latitude\_SE” and “Longitude\_SE” not applicable.

The following is the description of Lindbergh in accordance with this model:

```
PERSON (Lindbergh) {
  Lindbergh→Name = 'Charles. A. Lindbergh'
  Lindbergh→Alias = 'Lindy'
  Lindbergh→Born→Begin = '1902/04/02'
  Lindbergh→Born→End = N/A
  Lindbergh→Dead→Begin = '1974/08/26'
  Lindbergh→Dead→End = N/A
  Lindbergh→ComeFrom→Name = 'Detroit'
  Lindbergh→ComeFrom→Latitude_NW = 42.5
  Lindbergh→ComeFrom→Longitude_NW = -83
  Lindbergh→ComeFrom→Latitude_SE = N/A
  Lindbergh→ComeFrom→Longitude_SE = N/A
  Lindbergh→Gender = 'Male'
  Lindbergh→Description =
  'American aviator, one of the best-known
  figures in aeronautical history, ...' }
```

We see that person is modeled in this manner. In the next section, we refer to the model describing the relation between events and person.

#### 4. ASSOCIATION OF ENTITY

The former sections explain the models of *REKISHOW* type entity “Flight” and *PERSON* type entity “Lindbergh”. When dealing with an actual event, we need to describe the events having appeared to a person and his or her relation with other people. In Lindbergh's case, we think about a finite set “E” gathering all events he encountered in his life (*REKISHOW* type entity). That is,

$$E = \{REKISHOW(e_1), REKISHOW(e_2), \dots, REKISHOW(e_n)\}$$

with a proviso that “n” is a positive integer.

The two-item association of the whole factors in this finite set “E” and “Lindbergh” is described as follows:

$$\langle Lindbergh, e_1 \rangle \langle Lindbergh, e_2 \rangle \dots \langle Lindbergh, e_n \rangle$$

We consider each of these associations as an entity to define a new entity “ACTIVITY”.

```
ACTIVITY (<Lindbergh, Flight>)
  ↓
ACTIVITY (Biography) {
  Biography→Label = 'Accomplishment'
  Biography→Description = '....'
  Biography→Subject = PERSON (Lindbergh)
  Biography→Event = REKISHOW (Flight) }
```

By interpreting the association of the two independent entities *PERSON* and *REKISHOW* as another entity, we describe flexibly the various relations between the person and events. Likewise, it is possible to describe the relations between an event and an event or a person and a person by interpreting the two-item association as an entity type and defining an appropriate attribute.

$$P = \{PERSON(p_1), PERSON(p_2), \dots, PERSON(p_3)\}$$

$$\langle Lindbergh, p_1 \rangle \langle Lindbergh, p_2 \rangle \dots \langle Lindbergh, p_n \rangle$$

```
CONNECTION (Friends) {
  Friends→Label = 'Friends of Lindbergh'
  Friends→Description = '...'
  Friends→Subject = PERSON (Lindbergh)
  Friends→With = PERSON (p_1) }
```

$$E = \{REKISHOW(e_1), REKISHOW(e_2), \dots, REKISHOW(e_n)\}$$

$$\langle Flight, e_1 \rangle \langle Flight, e_2 \rangle \dots \langle Flight, e_n \rangle$$

```
RELATIONSHIP (Impact) {
  Impact→Label = 'Impact of Flight'
  Impact→Description = '...'
  Impact→Subject = REKISHOW (Flight)
  Impact→Object = REKISHOW (e_1) }
```

#### 5. “CO-Set”:RELATION OF ENTITY

The former entities are independent of one another. In order to deal with actual events, however, we need to consider those events as a set of entity belonging to a specific interest field without conscious of an entity type. Accordingly, we introduce a composite object consisting of several different entities (*REKISHOW*, *PERSON*, *PLACE*, etc).

This composite object is called *CRONO-OBJECT*, and defined as follows:

$$CRONO-OBJECT(c) = \{REKISHOW(e), PERSON(p), PLACE(l), ACTIVITY(a), CONNECTION(c), RELATIONSHIP(r)\}$$

A finite subset, consisting of more than one *CRONO-OBJECT*, can correspond to any interest field. This is called *CO-set* (*CRONO-OBJECT set*), and defined as an entity describing an interest field in Reki-Show.

$$CO-set(\Theta) = \{c_1, c_2, c_n\}$$

**6. FUNDAMENTAL CONCEPT AND PURPOSE OF THE “Reki-Show Authoring Tools” PROJECT**

The purpose of Reki-Show Authoring Tools Project is to construct the basic information tool for recording various events, researching and analyzing social phenomena based on the conceptual model of Reki-Show.

As obvious from the conceptual model of Reki-Show, the spatiotemporal information is regarded in this project as a gathering of the events independent of one another. It means that only the observed facts are adopted as information whereas the explanations and interpretations related to the events are regarded as additional information. Strictly speaking, however, the “observed facts”, totally excluding recorders' subjectivity, cannot exist. After due consideration, we tried to abstract the factors of events, based on the conceptual model, as much as possible.

We never try to exclude those explanations and interpretations, but have a plan to construct a platform where various interpretations of the events can be related and studied mutually. That's why it is necessary to identify the basic information and use the conceptual model as the conceptual framework.

“Chronology” is the abstracted spatiotemporal information placed along the time axis, and “topography” is the one placed along the space axis. These two in the project are totally different from the general chronologies and topographies. In general, chronology cannot help reflecting the user's historical view whether intentionally or not. The historical view is a magnificent “meta-story” describing the whole chronology. It is, therefore, called “descriptive chronology”. We think it possible to compare with various chronologies mutually and study them by relativizing these “meta-stories”.

In the chronology output by Reki-Show Authoring Tools, Reki-Show Data is independent by definition of data model. That is, it can be the raw data of the “descriptive chronology”. The

historical view is included just as a context in the “descriptive chronology”; while it is presented clearly as the “Association of Reki-Shows” to be a constituent factor in another chronology. This type of chronology is called “editable chronology”[4] in contrast to “descriptive chronology”. That goes for the “topography” as well.

We have a series of tries with Reki-Show Authoring Tools in order not to deny the traditional method in the former history and geography, but to hold in common effectively the enormous descriptive information regarding the research (chronology, annals, topography, area study, etc.). Our final purpose is to construct the interoperable research environment where the researchers can share spatiotemporal information on Reki-Show Authoring Tools.

**7. APPLICATION FIELDS OF “Reki-Show Authoring Tools”**

The application fields of Reki-Show Authoring Tools include not only the scientific research, but also the following researches:

**Education:**

Teaching materials for social studies such as history, geography, etc. Support tools for students' self-learning.

**Research:**

Research support tools for various sciences dealing with the temporal information such as history, geography, folklore, politics, sociology, bionomics, etc.

**Administration:**

Support tools for the data control and case study in the risk management.

**Prevention of disasters and epidemics:**

Support tools for the case study of measures to deal with calamities and the analysis of infection routes.

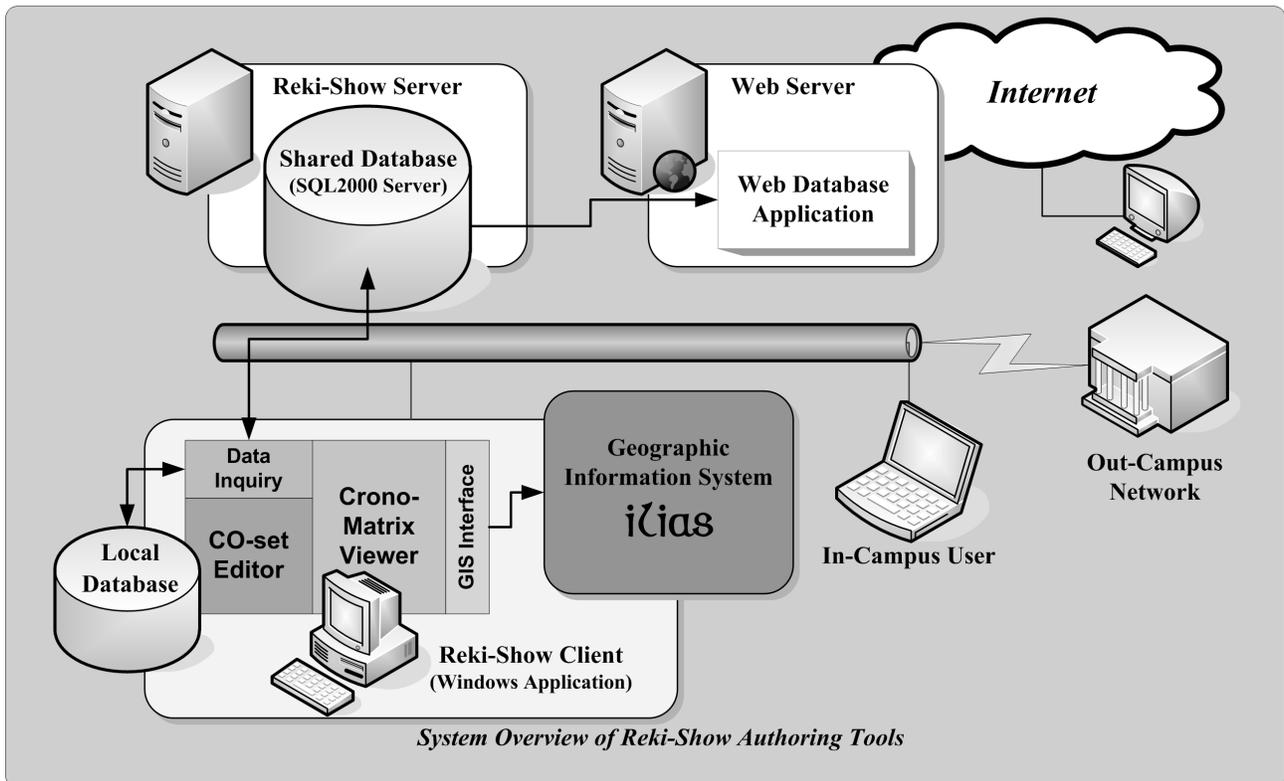


fig.1: System Overview of Reki-Show Authoring Tools

## Local Community:

For authoring of local community's histories. Reki-Show needs to be dealt with from the viewpoints both of the temporal attribute and the spatial attribute since it is the spatiotemporal information. The spatial attribute has been already researched to some extent in the field of the GIS. We, therefore, designed this system thinking much of operating the temporal attribute. As a result, the tool is now developed particularly in terms of a unique data visualization technique. The following is the outline of the system.

## 8. OVERVIEW OF “Reki-Show Authoring Tools”

Reki-Show Authoring Tools are designed for operating as Server-Client System.

Reki-Show Server, a simple Database Server, is equipped with Reki-Show Database on the relational database (Microsoft SQL Server).

Reki-Show Client, an application running on Windows PC, connects to Reki-Show Database using ODBC, and provides all the user environments such as data inquiries, data set download, data visualization, data authoring, etc.

It operates in a stand-alone state after necessary data is downloaded from Reki-Show Server to a local database, applicable to a non-network environment as well.

Furthermore, Reki-Show Client, having the interface transmitting the data to GIS, displays Reki-Show Data on maps. In addition to Reki-Show Client and Reki-Show Server, we have developed Data Entry Tool supporting a package input of the data and Database Administration Tool controlling the database. The following is the outline of the major functions in the system:

### 8.1 Reki-Show Data Inquiry

This is a general function for database inquiries. Inquiries are executed based on the conditions gathering key words, periods, areas, classifications, etc. Reki-Show, Person, Place, Association and CO-set are optionally set as inquiry objects, or only the data created by a specific user can be set. Furthermore, this function enables users to narrow the research result by adding more conditions and to add new results inquired into based on the other conditions. The inquired information can be registered collectively as CO-set. The object registered as CO-set can be browsed in the Crono-Matrix Viewer.

As a whole, we focused mainly on setting up statistics data when developing the functions.



fig.2:Reki-Show Card View

### 8.2 Crono-Matrix Viewer

This is the most distinguish function in the tool. It visualizes Reki-Show Data. We call the virtual three-dimensional space “Crono-Matrix”, where the depth direction (z-axis direction) in the screen is regarded as a time axis. Users place Reki-Show Data in this space as a 3D object, and browse it as though it goes through time navigation.

Reki-Show is displayed in the shape of a 3D object called “Crono-Object”. Users allocate such attributes as latitude, longitude, the category of Reki-Show, types optionally to the horizontal axis, the vertical axis, the colors and shapes of Crono-Objects in the screen. When each Crono-object is double-clicked, the corresponding Reki-Show Data is displayed in a card-type view.

The viewpoints, shifting speed and directions to Crono-Matrix can be changed optionally.

This virtual space can be divided vertically or horizontally into two sections, where several Crono-Object Sets are displayed simultaneously.

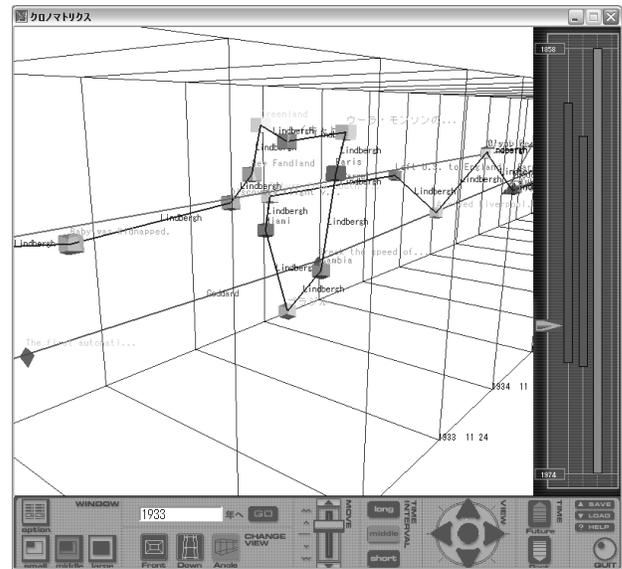


fig.3:Crono-Matrix Viewer shows Lindbergh's Data

### 8.3 CO-set Editor

This is the function for browsing and editing CO-set gathering any Reki-Show, Person and Place. It enables users to link Crono-Objects with Association. Crono-Objects can be registered easily by being picked up in the list of database inquiry results with a drag & drop action. Once saving the edit results, users can always retrieve them under the name of CO-set.

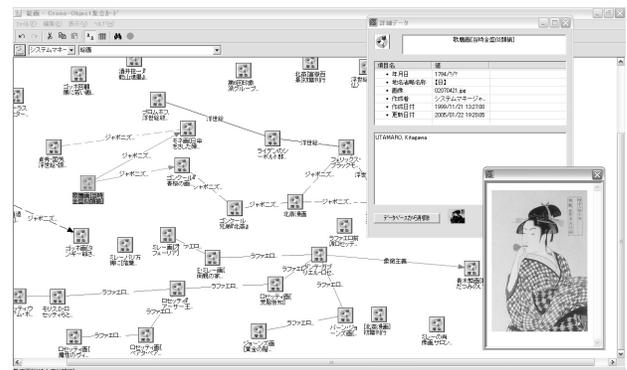


fig.4:Co-set Editor

## 8.4 GIS Interface

This is the interface function for transferring CO-set information to GIS as the spatial information. First of all, in order to display accurately the spatial information of Reki-Show, users create an interface file containing the information necessary to GIS and transfer the information to GIS. The Interface File is created as "SHAPE FILE", wellknown data format in the field of GIS. Although assuming the corresponding GIS is the license-free GIS "ILIAS" developed by Keio University.

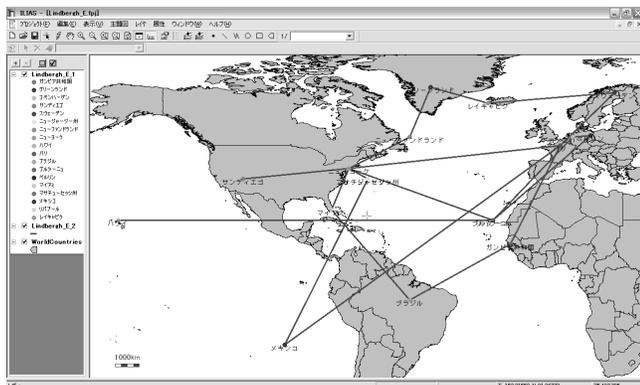


fig.5:ILIAS shows spatial tracking of Lindbergh's flight

## 8.5 Reki-Show Database

Reki-Show Database consists of Reki-Show Data, Person Data, Place Data, Association of Reki-Show (AOR), and CO-set. The following is the outline:

### 8.5.1 Reki-Show Data

Reki-Show Data is the most basic data type.

Each user can add his or her comments and items, which are called "User Item", to any Reki-Show Data. Users are allowed to refer to the User Items other users added, but not edit them. Only the self-added data can be edited.

### 8.5.2 Person Data

Person Data is the data type for describing the general attributes of Person. Person Data has three items, but Reki-Show Data does not: two temporal attributes of Born and Dead, another name (pen name, maiden name, nickname, etc.), and birth place. Each user can add his or her User Item to Person Data as well as Reki-Show Data.

### 8.5.3 Place Data

Place Data is the data type for describing the general attributes of Place. Place Data has two items, but Reki-Show Data does not: two temporal attributes of Begin and End, and another name (pen name, maiden name, nickname, etc.)

The names of places and countries usually vary with the period and area. This is because several names were often used in the same spatial position (Place) when Place existed for a long period of time. Each user can add his or her User Item to Place Data as well as Reki-Show Data.

### 8.5.4 Association of Reki-Show (AOR)

This is the data type for describing the association of Reki-Show. This data would not be generated as default data. All of them are created by users. In "CO-set Editor", users link any of two attributes together among Reki-Show, Person and Place, whereby AOR is created. This line is the object indicating AOR,

corresponding to the entity in the database.

Users can add any name and comment to AOR, and edit the AOR attributes as well.

## 8.5.5 CO-set

This is the data type for saving collectively any Reki-Show, Person, Place and AOR as a database entity. CO-set, the entity in the database, can be the subject of inquiries as well as other data. It enables users to display several CO-sets simultaneously in Crono-Matrix and unify them to create a new CO-set.

## 9. Reki-Show based on the statistical data

### 9.1 Time-serial phenomenon

We understand now that an emerging crisis is considered as Crono-Object with a start and an end. However, when focusing on the diffused phenomenon like an infectious disease, we would like to take a step forward and to grasp the degree of the spread. It is, therefore, necessary to understand a historical phenomenon as a time-serial phenomenon. That is, it is important to collect the quantitative data of official statistics such as an annual report. Thus, we have developed the function in Reki-Show where we can install the numerical value of a statistics report and displayed the outcome of a quantitative analysis on the screen.

### 9.2 Government statistics

We deal with the data of government statistics. When collecting the data from the long-term viewpoint, the continuity of government statistics is very attractive and practical for the statistical analysis. The government statistics, basically, is the cross-sectional data since it is summed up from those of the local governments. Furthermore, the data of government statistics covers the wide range of events. That is because the data is based on a legal duty like the certification of infectious disease and death. All the data is also disclosed to the public.

We store various data based on the government statistics. Other than the data of illness, there are the data of population, prices, wages, height and the weather. Moreover, we store not only the aggregated data of the government statistics but the individual raw data of research reports. Furthermore, we collect the data from research papers, which not collected by the government. For example, the data of age at menarche is one of them.

We also collect the chronological data of medical or agricultural technology to help us think about the relationship between CO-sets.

### 9.3 Visualization with statistical data

We show a screen shot of data visualization. This screen displays the number of typhoid patients of modern Japan by prefectures. It shows 47 objects and has a form of the Japanese Islands as a whole. Each object is divided into four colors based on the size of data. Here, those colors indicate the quartile deviation. The larger a value becomes, the darker the color of the object becomes. When we go on into the screen, the color of each object change. In Reki-Show based on the statistical data, we notice visually the changes of a set of an object related a certain area. Moreover, we can install four CO-set(s) in Reki-Show simultaneously. Reki-Show enables simultaneously us to discover a new relation of historical phenomena by displaying several data series. In other words, Reki-Show will visualize the statistics analysis by one dependent variable and three explanatory variables.

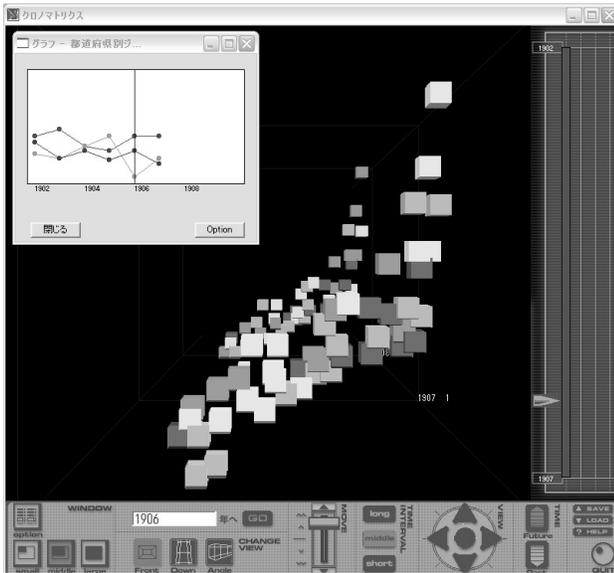


fig.6: Visualization of Statistical Data (align with spatial domain of Japan)

## 10. OUR FUTURE TASKS AND PLANS

Needless to say, this system is created as the first step of a new try in social sciences. The followings are our future plans on the usage of the project results[2]:

- **Spread as a research tool**  
We are going to introduce actively Reki-Show Database, the result of this project, as a system environment for the historical research at Keio University.
- **Spread as an educational support tool**  
We are going to undertake the consultation and guidance through a network, whereby teachers inside Keio University and outside, from an elementary and secondary education to a higher education, can use this system as a tool for education and study, and can create their own teaching materials. Furthermore, we add to the system the functions of saving the created materials, data and scenarios in the inventory and retrieving them.
- **Continuous expansion of Database**  
We expand Reki-Show Database in order to create the environment where researchers inside Keio University and outside accumulate their own research results as additional information or linking WWW information for the database.
- **Support for opening and introducing in the Internet**  
The present version does not have the function of conveying Reki-Show Client to users via the Internet. In consideration of the future spread, we need to provide users with the environment where they can operate a trial system to gain a real experience in the validity of this system.
- **Promotion of new "Education of Knowledge Literacy"**  
This system puts a paradigm shift into effect, the shift from the education attaching importance to knowledge memory to the education aiming for the

“discovery of relation” and the “adventure of methods”.

The paradigm shift enables users to adopt “Knowledge Literacy” such as the discovery, edit and dispatch of knowledge into their education, which was beyond their control under the former education. It is a significant target for this project to bring up the talent rich in flexible ideas by adopting the “Education of Knowledge Literacy” in all fields from an elementary education to a university and lifelong educations.

This project works on providing the system environment where the Knowledge Literacy can be applicable to spatiotemporal events in the information network. That is, it leads to the promotion of a future full-scale Reki-Show research and a new education method by making use of the Research & Study Support System. Furthermore, in the process of the development, we are required to continue to work on the systematic side such as a full-scale installation of multimedia functions.

Consequently, our future tasks are to expand systematically Reki-Show Database, to upgrade continually the version of the system and to launch the organization in order to promote the research based on Reki-Show.

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