Conceptual Foundations of Information Systems

Memorandum on ISCO4 – Workshop 1

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Abstract: This memorandum reports on the first workshop of the ISCO 4 conference which had the "Conceptual Foundations of Information Systems" as its topic. A total of nine contributions of workshop participants addressed the general FRISCO goals, scope and position in the scientific world. In particular, it comprised a thorough review of the FRISCO report, including its target groups, purpose, line of reasoning, structure and particular concept definitions. The last section addresses the future of FRISCO including concrete suggestions for a possible revision of the report.

1. INTRODUCTION

This memorandum reports on the first workshop of the ISCO 4 conference which had the "Conceptual Foundations of Information Systems" as its topic. In the introductory section, the goals and participants of the workshop are listed and a brief overview of its agenda and its course is given. The main part (sections 2 and 3) deals with the central issue of the workshop, a review of the FRISCO report, its goals, structure and contents and discussions on possible revisions. The last section addresses the future of FRISCO including suggestions for concrete actions to be taken.

Goals of the workshop

Originally, the following goals of the workshop had been formulated::

(1) Review the scope, targets and achievements of the FRISCO work in general

(2) Review the FRISCO line of reasoning

(3) Review the structure and contents of the FRISCO report - including particular concepts and definitions

(4) Clarify the relationship of FRISCO to adjacent fields like Conceptual Modelling, Natural Language-based modelling and contemporary modelling methodologies and notations

(5) Suggest concrete actions to be taken to disseminate and further develop the FRISCO achievements

Workshop participants

The following persons participated at the workshop:

- El-Sayed Abou-Zeid (Concordia University, Montreal, Canada)
- Hubert v. Braun (ASG München, Germany)
- João Carvalho, (Universidade do Minho, Portugal)
- Felice Cardone, (Università di Milano-Bicocca, Italy)
- Samuel Chong (Staffordshire University, UK)
- Eckhard Falkenberg (Germany)
- Wolfgang Hesse (Philipps-Universität Marburg, Germany):
- Anastasia Pagnoni Holt (Università di Milano-Bicocca, Italy)
- Bart-Jan Hommes (TU Delft, Netherlands)
- Hannu Kangassalo (Univ. of Tampere, Finland)
- Christian Kop (Univ. Klagenfurt, Austria)
- Andreas L Opdahl (Univ. of Bergen, Norway)
- Yair Wand (Univ. of British Columbia, Vancouver, Canada)

Workshop agenda

The agenda of the workshop was as follows:

- *First session:*

  - Short review of the workshop goals
  - Presentations of workshop participants

- *Second session:*

  - Discussion on FRISCO in general and review of the FRISCO report
  - Discussion on the future of FRISCO and suggestions of concrete actions

The workshop took place according to the agenda. Initially, the workshop goals were approved - with the limitation that goal (4) could certainly not be achieved in this breadth during the workshop. There was an agreement that the review of the FRISCO report and discussion of its future should be given highest priority.

There were nine presentations of workshop participants. They had been brought into an order roughly following the structure of the FRISCO report (addressed topics and chapters of the report are indicated below by an → arrow).

List of presentations

- A. Holt: FRISCO and its relation to Human Organisation (→ FRISCO in general, Ch. 2)
- Heinrich C. Mayr, Christian Kop (presented by Ch. Kop): Natural language as a basis for information systems concepts (→ FRISCO basis and NL relationships, chs. 2 & 3)
- Y. Wand: General observations on IS foundations (→ FRISCO basis, chs. 2 & 3)
- H.v. Braun: Logic of language and relationship types in the FRISCO conceptual structure (→ FRISCO basis, ch. 3)
- W. Hesse: Towards a better structure of the conceptual framework (→ FRISCO report structure, including particular concepts and definitions, chs. 3 & 4)
- E. Falkenberg: Comments on the FRISCO report structure and particular definitions (→ chs. 3 & 4)
- J. Carvalho: Comments on FRISCO and system theory (→ chs. 2, 3 & 4)
- A. Holt: Remarks on the Japan Wines Example and the purpose of a case study (→ FRISCO sample application, ch. 5)
- El-Sayed Abou-Zeid: What is missing in the FRISCO report (→ all chapters, in particular chs. 2 & 3)

The presentations were followed by a discussion on FRISCO at present and in the future, its scope and localisation in the scientific field. This point will be further addressed in section 2.

2. FRISCO AT PRESENT AND IN THE FUTURE

There was an unanimous consent that the FRISCO group has undertaken a fairly difficult task, has reached many of its goals and has produced a comprehensive report which cannot fulfil everyone's expectations but, as a whole, forms an important (one participant called it even "tremendous") step towards a well-founded theory of the IS field. All participants affirmed the suggestion that the work done so far deserves to be continued and concluded with the goal to produce a (physically available) book. This should be based on the achieved results but present them in a reasonably modified and better recognisable form.

FRISCO goals

The overall goals of the FRISCO approach can be summarised as follows "FRISCO helps to understand the basic concepts of IS better than before. This implies in particular to understand the relation of symbols to reality better than before." (H. Kangassalo). A method is sometimes characterised as a notation together with a process (e.g. UML & RUP - Rational's Unified Modelling Language & Process). However, there is a third (kernel) part: the *basic concepts and their foundations*. One FRISCO goal is to provide this kernel part for the field of Information Systems.

FRISCO target groups

A brief review of the target group of the FRISCO report resulted in the suggestion to focus on its *primary target groups* - advanced students (on the master's or Ph.D. level), researchers, methodologists - without loosing track of the idea to support system developers who beyond their daily work activities are interested in the foundations and fundamental principles of their working area.

A careful review of the report (including possible rewriting of some sections) following these general goals was suggested.

FRISCO scope

There was a debate on the scope of the FRISCO report, in particular on the question whether it is too narrow and should be extended in some way. Possible extensions were suggested in the position statements of some participants as well as in the general debate. The latter focussed on the question how far modelling aspects and, in particular, relationships to former CRIS work and to UML should be covered. At present, the FRISCO authors consider the report to be a common basis for various methodologies (including UML-related ones) but it does neither cover methodological aspects of

modelling in detail nor elaborates on links and relationships to particular method and method-specific concepts.

An argument for extending the FRISCO report in this direction was that it might get more attention by such an extension. The counter-argument was that this would imply a major effort and that this field cannot be covered in an encompassing way by a small group like FRISCO.

Particular suggestions for possible extensions will be addressed in the section 3.3 (omissions and gaps).

3. REVIEW OF THE FRISCO REPORT

The review was based on the FRISCO report in its final form published on the Web (cf. [FHL+ 98]). Due to time constraints, most of the discussions could neither address their themes in full depth nor come up with definitive conclusions. Insofar, many of the reported results are to be understood rather as suggestions and hints for further investigation than as final decisions.

The review results are structured according to the following topics:

- Strengths and merits
- Errors and open problems
- Omissions and gaps
- Over-definitions (material which should be left out)
- Changes of the report structure
- Further remarks and suggestions

3.1 FRISCO strengths and merits

In the following respects, the FRISCO report is considered to have made essential achievements which should be kept (modulo suggested modifications in some details), further developed and, if necessary, used for better "selling" FRISCO:

- Its profound philosophical anchoring, the constructivist view adopted in the baseline definitions,

- the fact that FRISCO brings the philosophical basis to the forefront (admitting that this may be a problem for "selling" it in North America),

- its independence from particular methods or methodology schools,

- its effort in testing the informally presented concepts by a formalised counterpart in chapter 4 (which should, however, be presented in a better readable form in the revised report),
- the overall approach to build a layered framework and follow a systematic construction plan rather than to build just a glossary of terms,
- the uniqueness of FRISCO in filling the gap between reality and modelling concepts, in yielding a first summary of the ontology we use.

The last point was in particular addressed by the presentation of Y. Wand. He formulated eight principles concerning our human approach to reality (which is to be reflected by IS analysis and design methods). One key point is the role of the observer: "Reality" is always "viewed" by people, knowledge is created by humans through their experience, reflections and reasoning and it is shared through human communication. Foundations for such an approach are: cognitive sciences, linguistics, speech act theory, formal languages. This conforms well to the overall FRISCO approach and, in particular, to its philosophical foundation.

3.2 FRISCO errors and open problems

Some participants pointed out that - besides its well-acknowledged strength and merits - the FRISCO report in its present form contains some errors (in particular: circular definitions) and raises some problems which should be corrected or removed in a possible future book edition. The following errors and problems (listed according to the present report structure) were addressed in the position statements and/or discussed in the workshop plenary:

- Chapter 2: The notion of "added value" (addressed by A. Holt).

  In chapter 2, the report suggests that "value" can be measured in an unambiguous, objective way and ignores the relativity of any "value system". In fact, different people, groups and societies have different priorities on "values" and this is a frequent reason for disputes and even fights. According to E. Falkenberg, the FRISCO report tacitly assumes a specific sort of value, e.g. making the organisation more prosperous. According to E. Abou-Zeid, a value in the FRISCO sense might be "some common (shared) understanding of all members on the organisation's welfare". This should be clarified in the corresponding paragraphs of chapter 2.

- Chapter 3: The use of standard relationship types in the basic definitions, e.g. of the "is-a" relationship (addressed by H.v. Braun)

  As is commonly known, "is-a" might be interpreted in various ways, for example as "is-subset-of" or as "is-element-of" - the first being a transitive relation, but not the latter. To give an example from chapter 3:

  (1) "a predicator is a thing" and
  (2) "a thing is a conception"

  If these relationships are considered to be transitive, then one can say that

  (3) "a predicator is a conception"

  which will possibly cause problems within the semiotic triangle context.

- Chapter 3: Logic of language (addressed by H.v. Braun)

  Is *conception* a predicator (according to FRISCO) or rather a meta-predicator (according to the logic of language)? What impact would the latter notion have - if applied - on the FRISCO line of reasoning? This point addresses the overall structure of the framework and was further discussed in a broader context (see section 3.5 below).

- Chapter 3 and 4: The treatment of "conception" and "thing" (addressed by H. v. Braun, W. Hesse and other participants)

  The "explanatory definition" of *conception* in chapter 3 (which has caused much debate in the FRISCO community) should be revised and more focused on its social aspects (in the sense of "shared knowledge"). The explanation using *perceptions* might be reduced to some introductory remarks (explaining how individual conceptions are formed) - or even skipped at all. If *conception* is considered a base level concept (see section 3.5 below) the corresponding (axiomatic) "definitions" in chapter 4 could (and should) be dropped

  The relationship of the two concepts of *conception* and *thing* should be clarified. A constructive proposal addressing these issues can be found in [BHA+ 99]. The *thing* concept seems to be particularly overloaded which is, for example, reflected in the many (and very heterogeneous) examples.

- Chapters 3 and 4: Circular definitions and the need for a clearly layered structure of concepts (addressed by W. Hesse)

  Chapters 3 and 4 follow the general principle to build a layered conceptual framework where concepts on higher layers may depend on those of

lower layers but not vice versa. This principle is acknowledged since it reflects the overall hierarchical structure of the framework and prevents from errors like circular definitions.

According to W. Hesse, chapter 3 in its present form hurts this principle at some places which leads to circular definitions - some of which are considered to be quite harmful - but can be removed by a better layering. An example of such a circular definition can be found if definitions E1, E13-E15 and E20 of chapter 3 are considered in connection:

Roughly spoken,

- a *conception* is explained as a (special) *actand* using the *actor* concept (def. E20),
- an *actor* is explained as a (special) *thing* (def. E13),
- an *actand* is explained as a (special) *thing* (def. E15), and
- a *thing* is explained as a (special) *conception* (def. E1).

This (double) loop can be resolved

- by a better definition and separation of the framework layers (see below), and
- by splitting the *actor* into two concepts:

  (1) the general "world observer" (from now on to be called *observer*) addressed in the assumptions at the beginning of chapter 3 and in the explanations of FRISCO's constructivist view

  (2) the actor involved in the development or use of an IS (still to be called *actor*). Such a split would also help to clarify "self-reflection" processes by distinguishing the *subject* and *object roles* of the self-reflecting person.

  The presence of definitional circularities was objected to by E. Falkenberg. He pointed out that some loops in the explanatory presentation of chapter 3 in the FRISCO report are inherent to the complex nature of the overall subject. Its section 3.2 it was attempted to clarify the "explanatory loops" by pointing out the different contexts for the definitions in question. However, in the axiomatically oriented chapter 4, circularity is (formally) avoided by choosing "thing" as the most primitive concept and exempting the link between "conception" and "thing" from formalisation.

- Chapter 5: The "Japan Wines Inc." sample application (addressed by A. Holt)

A. Holt reported that he expected to find an introductory example and that this one did not motivate him at all. It should be more operational and, for example, start with the "problems" to be solved. E. Falkenberg pointed out that this example was not meant to be a modelling exercise at all. Its only purpose was to demonstrate the most important FRISCO concepts using a coherent example.

3.3 FRISCO omissions and gaps

The contributions to this topic are ordered in a top down way, stepping from the more general to the more specific ones:

- "Localisation" of FRISCO in the science landscape, its relation to Computer Science, System Science and other related areas (addressed by J. Carvalho and other participants).

  It was suggested to better illuminate these relations in the introductory chapters. The FRISCO inclusion that the Information System be a part (or subset) of Organisational System was questioned. It should be reviewed, e.g. with respect to inter-organisational or world-wide IS. Furthermore, system dynamics would need more attention.

- Motivation of the potential FRISCO "clients" (addressed by A. Holt)

  There should be more and better motivation for the approach as a whole. For example, it might be explicitly shown how members of the FRISCO target groups can profit from the results. (See also the above section on FRISCO goals)

- The identity and evolvability of IS (addressed by El-Sayed Abou-Zeid)

  Like organisations, IS have an "identity" but evolve over time. Which are its stable and its changing parts? The evolvability of IS should be covered by FRISCO, including the role of communication in IS evolution. El-Sayed alludes to the "fractal nature" of IS and recommends an "autopoietic view" to them (further detailed in his conference contribution [A-Z 99]).

- The role of the computer in Information Systems (addressed by A. Holt)

  There are strongly opposed positions with respect to this point. A. Holt claims that in the FRISCO report, "almost nothing" is said about the computer. On the other hand, Ronald Stamper (in various other sessions of the conference) repeatedly expressed his disappointment that - as far as he can see - the technical view excessively dominates the social view. In a revised version of the report, FRISCO's position should be clarified.

- Dependency chart of FRISCO definitions

  It was suggested to supply in a revised version a dependency chart of all concepts defined by FRISCO. Hints for that and an example application on UML concepts can be found in X. Castellani's contribution to this conference [Cas 99].

3.4 **"Over-definitions"** (to be removed from the FRISCO report)

- Set membership (addressed by W. Hesse)

  In chapter 3 (def. E4, p. 38) "set membership" is introduced as a FRISCO concept, which is in conflict to the use of (mathematical) set theory underlying the whole definitional framework (for more details cf. the appendix of [BHA+ 99]). "Set membership" should be used in the traditional mathematical sense only, without being subject to a definition as such. This position is to be clarified early on (accompanied by the customary caution to avoid self-reference and other potential paradox causing statements). Thus, it can be freely used for defining a number of concepts in the framework, as recommended by E. Falkenberg. On the other hand, concepts such as "composition" (or "decomposition") and "aggregation" might be introduced for enhanced expressiveness.

- Overloaded "thing" concept (addressed by W. Hesse)

  The definition for "thing" (ch. 3, def. E1) should be narrowed - which would make some of the examples in the report obsolete. According to E. Falkenberg, any narrowing would result in a less powerful meta-model.

3.5 Changes of the report structure

- Overall report structure

  It was generally agreed that the report would gain by a number of structural changes. In particular, it was suggested

  - to merge chapters 1 and 2 into one introductory chapter (where parts of chapter 2 might be shifted to later chapters) and
  - to replace the present "vertical" structure of the central chapters 3-6 by a "horizontal" one according to the layers of the framework.

  Each new chapter would correspond to one layer and contain a series of concepts. Each concept is described by

  - an introducing textual definition (adopted from old chapter 3),

- a corresponding formal definition - as far as necessary (based on old chapter 4)
- explanations by examples, preferably using a common, continued case study like the Japan Wines example, cf. old chapter 5)
- further material elaborating on the concepts (optional, e.g. to be taken from old chapter 6).

- Layered structure of the framework (addressed by W. Hesse and other participants)

  Many of the problems identified might be remedied by restructuring the framework (reflecting any changes in the corresponding chapters). Specifically, a clearer and more rigid separation of layers is recommended: Concepts defined in a higher layer may depend on or derive from those defined in lower layers but not the other way around. The following layers were proposed (for more details cf. the appendix of [BHA+ 99])

  - Base level: Containing the *philosophical background* (constructivist view, the *observer* - to be distinguished from *actor*), *basic ontology* (assumptions), *semiotics, linguistics* (language, predicators etc.), *perceptions* (if still needed) and *conceptions*. Set theory is assumed to belong to the underlying basic knowledge like any other used concepts of mathematics, logic or philosophy.
  - Kernel level: Starting with *thing* and containing the main part of sections 3.1 -3.5 of the FRISCO report, but without the semiotics part (section 3.4*), per/conceptions, set membership* and with the *actor* reduced to his role in def. E13 (p. 43).
  - System level: Containing all system- and organisation-related concepts. This is the contents of sections 3.6-3.10 of the original FRISCO report.

3.6 Further remarks and suggestions

- FRISCO's relationship to Natural Language (NL) (addressed by Ch. Kop):

  Natural Language is considered an important tool for the early phases of system analysis and modelling (called "pre-design"). NL-based analysis applies filtering techniques to NL-documents like requirements catalogues and leads to a (systematic and coherent) glossary describing the application domain. Glossary entries may be associated to (and in fact:

are instances of) concepts which can be mapped to FRISCO concepts, i.e. FRISCO provides a possible meta-model for such glossaries. This correspondence might be used for a possible test of the FRISCO concepts.

4. CONCRETE ACTIONS

Based on the consensus that the FRISCO work should be continued and its results should be made better accessible in the future, suggestions for concrete actions to be taken were gathered and debated. In the following paragraphs, these are listed following an order from short-term to long-term actions.

- Actions for better dissemination of FRISCO-related material:
  - Do more advertising on FRISCO results - the report, conference proceedings and contributions.
  - Write and publish journal articles reporting on the FRISCO approach and the work so far done.
  - Publish a series of articles on particular FRISCO issues (which might eventually together form a book).
- Actions for revising the FRISCO report:
  - Form a small group responsible for a thorough revision of the report according to the above suggestions (and including re-structuring). The result should be a (printed) book and be published not later than 2001.
  - Rewrite the FRISCO report to form a textbook for advanced academic courses. (This would require more work than just a revision but probably find better acceptance by the publishers.)
- Actions for further development in the FRISCO field:
  - Form a successor task group which takes the FRISCO achievements as a baseline and starts with new goals (to be formulated by the group itself) as e.g. extending FRISCO for modelling tasks, merging the results of FRISCO and CRIS task groups, building a bridge from FRISCO to UML.

Acknowledgement

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5. REFERENCES

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