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ABSTRACT

This report describes the DELTA (Development of European Learning through Technological Advance) Pre-Pilot project, which was designed to develop a European Learning System Reference Model that would bring structure into discussions of European Learning Technology, and would function as an intermediary and consensus-identifying tool. The first section of the report provides the background on project organization and assumptions. The second section summarizes some of the activities and conclusions of the four project task forces on: (1) definition, selection, and validation; (2) standards and interoperability; (3) educational requirements; and (4) authoring and prototyping. The model is shown in the third section, represented by a cubic framework with activities, actors, and resources as the three dimensions, and descriptive terms assigned to each dimension. Applications of the model as a communication tool, as a guide to critical processes, and as a reference to critical issues are assessed in the fourth section. The final section offers an overview of the next phase of the DELTA program and suggests further elaboration of the model. Three references are listed, and a detailed overview of the terms associated with the cubic framework is appended. (MES)

Report on Participating in the DELTA Pre-pilot project: Building a Reference Model for European Learning Systems

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June, 1989

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5: FURTHER RESEARCH

FOREWORD

The DELTA Pre-Pilot served many important functions. Some, of course, related to its immediate output (for example, over 110 reports were formally submitted). However, many of the valuable lessons learned during the Pre-Pilot activity will have application in the future as much as or even more than in the present. It is inevitable in this future that demands for cooperation among Europeans of different professional backgrounds and mother tongues for the development of technology-supported learning systems will escalate. The DELTA Pre-Pilot gave partners from ten such diverse groups the opportunity to experience the potential in such cooperation but also to better anticipate the problems.

And problems there are. Communication, even among professionals with common work experiences, becomes more challenging as complexity of concept and terminology becomes more important. Standardization of communication and interaction procedures become as important as standardization of hardware and software environments if productivity and common purposes are to be maintained. The DELTA Pre-Pilot gave us the opportunity to contribute to a better level of communication through the vehicle of the so-called "cubic framework" of a learning systems reference model (LSRM) which the Pre-Pilot evolved.

Bestebreurtje, the author of this report, is well qualified to write such a summary. He was an active member of the University of Twente team in the Pre-Pilot and was closely involved in the preparation of several key reports as well as in the evaluation of the cubic framework. In his summary he clarifies not only the progress of the Pre-Pilot from the perspective of a participant but also identifies a number of key points for further development in the area of European learning systems. Thus this summary is not only on insightful description and analysis but also has strong proscriptive value. There are various members of the DELTA Pre-Pilot team from the

University of Twente who are currently involved in the next stage of DELTA; among these are Bestebreurtje, Moonen, and myself. The experiences gained while participating in the DELTA Pre-Pilot, as summarized by this report, gives us a valuable entry point to the new project.

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30 May 1989

SUMMARY

1. Introduction.

The main purpose of the DELTA-Pre-Pilot project (Development of European Learning through Technological Advance) was to develop a European Learning System Reference Model (LSRM). This LSRM serves the purpose of bringing structure in the area of European Learning Technology in order to function as a kind of intermediary and consensus-identifying tool.

2. Activities.

In this paper a description is given of various activities occurring within the Pre-Pilot and how these activities generated a "Cubic Framework".

3. The Model.

The collaboration produced a framework represented by a three-dimensional cube which has as dimensions:

ACTIVITIES / ACTORS / RESOURCES

Each dimension exists of major terms which are subdivided. So the cube has 15 x 13 x 4 = 780 main-cells, each of which can be described in the context of:

"What is done / by whom / by what means"

4. Applications of the Model.

The framework is seen to have at least three areas of application. In this paper all three areas are illustrated.

The first application is for communication purposes. The description of each cell's subdivision is in standard(-ized) terms to facilitate communication throughout Europe.

Another service of the framework is as a guide to critical processes occurring within some aspect of development, distribution, or use of learning materials. An example is given of how the framework can serve as a guide to a set of critical processes by taking a particular "slice" of the "Cubic Framework" belonging to the term "Specify" (of the general term "Develop") and ordering its "activities" and their specific sub-cells using a flow-chart approach. This example demonstrates both the use and the limitations of the guide-function.

Finally within the DELTA Pre-Pilot project some areas of critical problems surrounding the development and use of learning materials on a Europe-wide basis were explored. The flow-chart approach provides a mechanism by which the cubic framework can serve as a reference to these critical issues at stages in which they are (or seem to be) relevant. Outcomes of these investigations are discussed.

5. Further Research.

In future this model is to be elaborated in the next phase of DELTA (the "Exploratory Action"). There is a specific Action Line (AL. 1) designed as the place for harmonization and integration of all the research done within the other Action Lines. One component is the refinement and further development of the LSRM, as built upon the "Cubic Framework", as a setting for the research in the DELTA area. Another component is the foundation of a European Learning Technology Association (ELTA) as the place for exchange of information.

1: INTRODUCTION.

1.1. Background.

"Learning" as it is seen in the initial Studies on DELTA, is an important information gathering activity and a major basis for the ability to solve problems within a society and to shape its future. In the modern western societies Information Technology -- all methods, techniques and products stemming from computer science and related disciplines -- is a major stimulus of essential social, economical and cultural changes. Within the European Communities the European Commission desires to be a catalyst for cooperative activities in the area of Learning and Information Technology. This is mainly based on the assumption that in the early 21st century the average European will have to be retrained about four times in her/his 'active life' and on the knowledge that the European countries have excellent educational systems and a high standing in Learning Technology -- Information Technology applied in the area of Learning -- (see Initial Studies, 1987, p. XXXII).

The general idea is that if, on the one side, there is a growing ("accelerating") need for retraining and development of specific courses in specialistic areas and on the other side, there is a small --but also growing-- infrastructure of advanced learning, use can be made of the large market possibilities that the European Communities can offer. This can lead to cost reduction and efficiency in often small, but fast changing specialist areas (one does not have to invent the wheel again).

1.2. The DELTA Programme

In order to achieve both the development of a "European infrastructure on Advanced Learning" (i.e. the area of Learning and Information Technologies) and more standardization in the development of courses in specialist areas, the Commission of the European Communities initiated the DELTA programme (Development of European Learning through Technological Advance) in 1987. This project is intended for a duration of about ten years.

The DELTA programme aims at developing and establishing an European capability in distance learning and supporting communications infrastructure. The "Pre-Pilot project" was a preliminary phase to the DELTA programme. The main purpose of this Pre-Pilot project was to develop a "European Learning System Reference Model" (LSRM). The LSRM serves the purpose of bringing structure into discussions within the area of European Learning Technology and of functioning as a kind of intermediary and consensus-identifying tool.

1.3. The organization of the DELTA Pre-Pilot project.

In the DELTA Pre-Pilot project ten organizations representing industry, publishers and academic institutions from five European countries worked together in a consortium during 1988 [1]. In the contract for the Pre-Pilot, eleven tasks were described and grouped together in four "Task-Forces". Each task would be ended with a summarizing Final Report on that task.

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1) The participants in the DELTA Pre-Pilot project are:
- -Bull (F);
- -Klett Verlag (FRG);
- -MacMillan Intek (UK);
- -Olivetti (I);
- -Open University (UK);
- -Philips (NL);
- -CEN/Saclay (F);
- -SESA (F);
- -SIDAC (I);
- -University of Twente (NL).

Besides that the European Commission required two Intermediary Reports during 1988 and a Final Report at the end of the Pre-Pilot project. The execution of the eleven tasks was to first evolve and then assess a "Learning System Reference Model" (LSRM).

1.4. Assumptions.

Three general assumptions lay behind the DELTA Pre-Pilot project:

1. The general idea behind modeling the "DELTA area" in the initiating literature of the European Commission was that there should be one "shell-system" in Europe (e.g. called "DELTA"), that mediates all demands and supplies in the area of "advanced learning". Strategies for this mediation refer to the application of advanced technologies. This shell-system should be theoretically grounded on the basis of the LSRM. However the primary question, if the need and the will for this kind of centralizing exists, was not posed.
2. A second assumption was that there was already a definition of such a model (refer to: Initial Studies, 1987). However, during the project this assumption emerged as being wrong: there was no clear definition of an LSRM or even a common concept for it.
3. This second assumption was based upon another, namely that generally standardized practices in producing and using advanced learning materials were already existing. It was thought that out of these practices the model could be generated easily. However, there was little consensus about practice or on a development methodology which could be generalized. So halfway through the Pre-Pilot project its workplan was rescheduled and refocused on developing some kind of framework towards an LSRM.

In this paper this development process, the outcome, the results (a "Cubic Framework") and its assessment will be discussed. Also some remarks will be made about input for the next phase of DELTA research.

2: ACTIVITIES.

2.1. Introduction.

As mentioned before, the Pre-Pilot project of DELTA was divided into eleven tasks, which in turn were grouped in four Task Forces covering the major aspects of this Pre-Pilot.

2.1.1. An overview of the task forces.

Task Force I was meant to define the sample for the further activities of the DELTA Pre-Pilot project with regard to the setting of these activities, as was written in the Initial Studies of DELTA (refer to: Initial Studies, 1987).

In the Task Forces II and III specific issues were explored. This was to shape the context for a second thrust of work for Task Force I, the task of further evolving a "European Learning System Reference Model" (LSRM). Finally Task Force IV was to prototype some of these findings in the context of the LSRM and provide input to the overall Task Force I, so that Task Force I could complete its third general activity, the assessment of the LSRM in the context of the chosen prototyping aspects.

In this section a description of the outcomes of the context-shaping task-forces (II and III) will be the major focus.

2.2. Task Forces within the Pre-Pilot.

2.2.1. Task Force I: Definition, Selection and Validation.

The major purpose of Task Force I was to define and select a sample field of learning and a subset of a target audience, including their assumed prerequisite knowledge, for the prototyping activities of Task Force IV. Also the validation of the prototyping at the end of the project was part of the assessment of the LSRM which was also the responsibility of Task Force I.

Outcomes of Task Force I will be presented in Sections 3 and 4 of this paper.

2.2.2. Task Force II: Standards and Interoperability.

In this Task Force, in which we (University of Twente) were not involved, several aspects were considered. Below they are briefly described.

The considered aspects were related to the current and future state of market standards --possible media mixes, technological trends, and general functional requirements-- and to alternative options for the delivery of learning material (learning support systems).

Outcomes of the studies within Task Force II are:

A: About standardization:
A plea for system interoperability including:

- Hardware compatibility.
  CD-I (closed system) or an MS-DOS PC (open system).
- Systems configuration, to increase the likelihood of portability.
  Basic Intelligent Workstation and enhancements (CD-ROM/CD-I, voice treatment, videodisc player + graphic overlay adapter.
- Presentation/Interaction.
  Ease for use of unskilled users and uniformity in the user-interfaces. (Note: OS/2 Presentation Manager is assumed to soon be a standardized approach to the user interface across different classes of systems, from MS-Dos to Unix.)

- Open access to resources and systems interconnections.
  The interconnection of different systems implies the choice of protocol standards. The ISO\OSI layers (International Standards Organization/Open Systems Interconnection) could be that standard.

B: About Learning support systems:

Three different educational situations were distinguished. They are not mutually exclusive: in reality we can see combinations of two or all three of them. These three theoretical situations can be described in the following models:

- Self-instruction model.
  The tutor is embedded in the technology-based system. An adequate system could substitute for the human tutor.
- Local area model.
  In a local area environment there is interaction among learners and between a learner and a (human) tutor, as well as access to local information resources.
- Distance interaction model.
  There is remote interaction among learners and between a learner and a (human) tutor, as well as access to (distant) information resources.

  These three models are not exclusive to computer assisted learning. However, when applied in a CAL-setting, consideration should be taken of the issues summarized under A: Standardization. (Refer also to: Final Report, 1989, Chapter 4.3.).

2.2.3. Task Force III: Educational requirements

In this Task Force elements important for the core activities of developing learning materials (mainly: "specify", "design". See also Section 3, below) were considered.

Major conclusions from this Task Force were:

A: After defining the precise learning objectives relative to the target population and to make these objectives explicit in measurable terms, one has to take account of the specific requirements of the course that is needed. The following eight types of courses are distinguished:

- General interest courses, assuming no prior expertise;
- Training and re-training courses, to improve skills (practical or intellectual);
- Up-dating courses, to teach additional knowledge to already qualified specialists;
- Awareness courses, to teach knowledge and understanding (instead of skills) at a fairly superficial level to specialists in other fields;
- Undergraduate courses, to teach knowledge, skills and understanding for the purpose of gaining a first degree;
- Up-grading courses, to obtain higher (vocational) qualifications;
- Conversion courses, to assist people who are (highly) qualified in one field as they move into another;
- Post-graduate courses, similar to up-grading but mainly focused on gaining a higher degree, instead of being vocationally oriented.

The use of this categorization can lead to selection of related pedagogical strategies by the authors of a course and to more effective focusing on the selection criteria on behalf of the learner.

B: The selection of pedagogical strategies depends on the type of course that is required (see above) and the kind of learning situation that will be "used" (see TF.II, above). Parallel to these, aspects such as the presumed skills and understandings of the intended learner should be taken into account and made explicit. Other considerations in this stage of development of courseware include how to anticipate different learning styles and how to build in assessment of the learner's progress in order to optimally reach the learning objectives.

C: To anticipate the European context, which finally should be the major scope of the DELTA programme, the following general notions were also stated:

- There is a need for a well-organized information base on the availability of various kinds of learning materials throughout the European Community. In the context of costs-reduction this material could also be available for re-use (translation, transfer or adaptation)
- There is still a lack of compatibility of equipment standards. It is especially in the European interest to solve these problems. The way towards a "European Learning Market" is only via their solution. (Suggestions were given in the description of Task Force II, above.)
- National differences are perceived in the European countries, because of separate development of their educational traditions. This can be coped with by anticipating specific learning styles and by actively using a standard set of icons, which has still to be developed. Another option is to develop courseware that has separate text, pictorial and structural elements. The translation (which is only one kind of re-using) of courseware could then be focused mainly on the text elements.

2.2.4 Task Force IV: Authoring and prototyping.

The prototyping activity was set up to address some of the specifications made by the DELTA Pre-Pilot studies and to assess the "LSRM" as it was evolved in Task Force I. However, because of the rescheduling of the DELTA Pre-Pilot project the actual activities of this task force fall outside the scope of this paper.

2.3. Remarks.

Some remarks can be made:

As noted in the previous section, the assumption that there was already a kind of an LSRM appeared to be not true. This implied that Task Force I could not further evolve that model. When starting the prototyping activity the lack of agreement about a kind of model became clear. At that time, halfway through the project, Task Forces I and IV were reorganized: Task Force IV should, in their prototyping, seek to validate selected issues arising from the work of the other two task forces and at the same time Task Force I should outline a first framework for an LSRM, which the prototypers should use when reporting on their findings. The general idea at that time was that in this way the DELTA Pre-Pilot project could still do both of the following things:

- deal with some major issues and
- build and assess a Learning System Reference Model.

3: THE MODEL.

3.1. Introduction.

The major goal of the DELTA Pre-Pilot project was to (further) develop ideas about a "European Learning System Reference Model" as a kind of intermediary and consensus-identifying tool.

The first idea (see e.g. Delta Initial Studies, 1987) was to articulate one central system (an "LSRM") within which suppliers and users of learning materials could communicate. This system-to-be-developed would involve a number of restrictive factors that should be considered:

- Suitability for centrally stored information or centrally placed tools;
- Cost and speed of communications, especially if use is made of conventional broadcasting media, audio and video cassette;
- Timescale of usage growth and possibilities of duplicating the databases in member countries at reasonable distribution rates and acceptable costs as well as setting up the necessary organization to run such facilities;
- Possibility of offering free communication outside "busy traffic" hours.

This concept was worked out in the DELTA Pre-Pilot project, among others, in a paper called "Towards an LSRM" within the context of Task-Force III. Its essence was that the model it described, was a blue print for one system in which a combination of distance learning and in-company (corporate) training was developed. The role of the DELTA Pre-Pilot project was seen in that paper as being of help to clarify the objectives, structure and possible modes of operation of such a European Learning System Reference Model. Beyond that the need for research, specification, and development of standardized resources (tools) and interfaces required to bring the system into existence was felt to be the most important task of the (10 years duration of the) DELTA programme.

3.2. Evolution of a "Cubic Framework".

At about halfway through the project, the participants who maintained their focus on modelling the area of European Learning to continue the building of an LSRM made the choice to take current (European) learning-material-development environments as a point of departure for description and to focus upon certain aspects, such as which actors are involved in which activities and what tools do they use. This implied a choice for a three-dimensional description, that in turn led to the construction of a "cube".

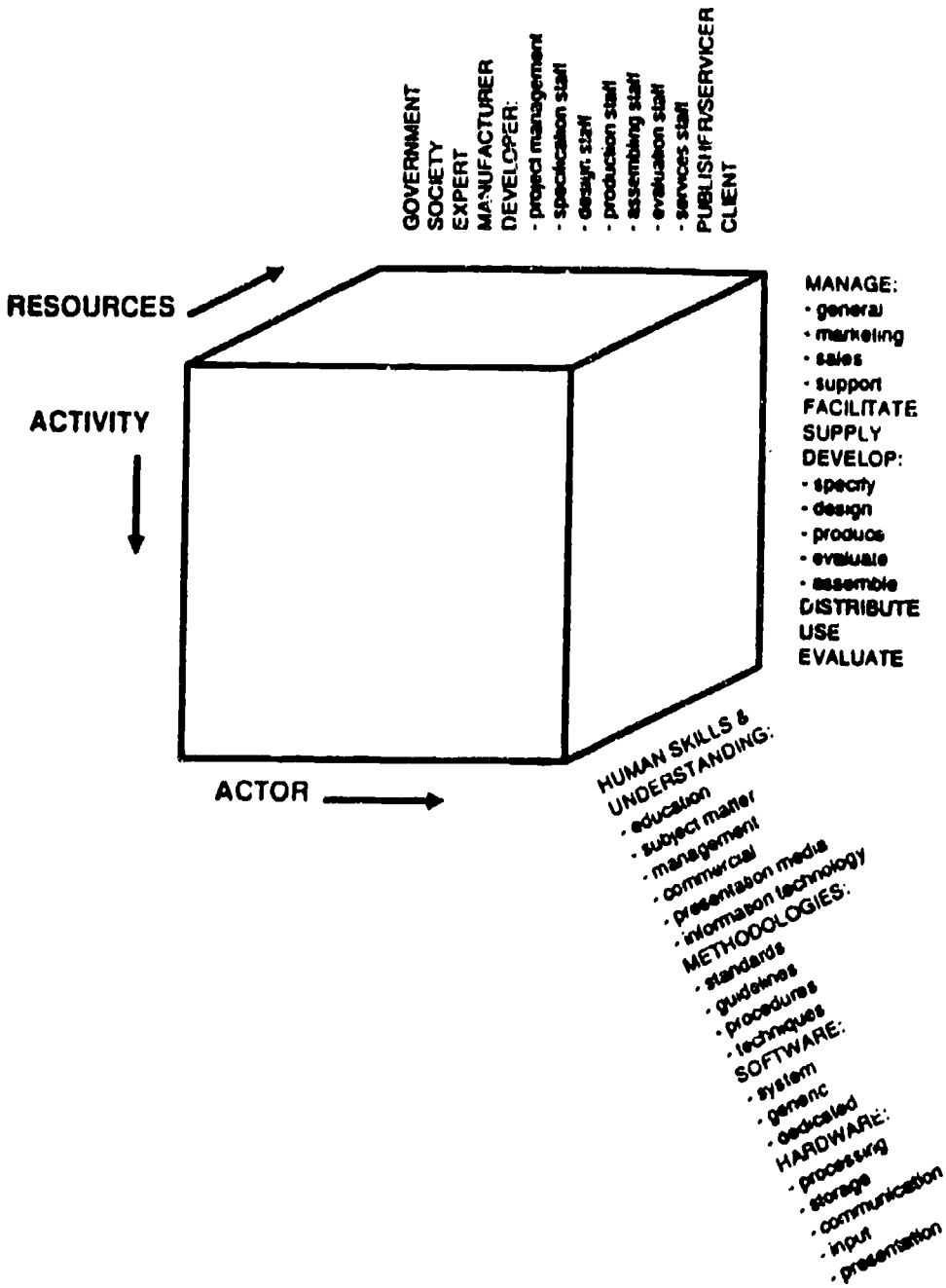
Four examples of production strategies for multi-media learning materials in Europe were described in terms of "who does what at which stage of the development and which tools/resources are being used". These examples were in the U.K.: Open University and Macmillan Intek and in the Netherlands: the POCO-project and an experimental authoring environment, called EDUC, of the University of Twente, Department of Instrumentation Technology).

After these descriptions generalizations about development and production environments were made by the coordinating team of Task Force I. The results of these generalizations were then used to re-describe the chosen environments in those general terms in order to check the applicability of the terms. The result of this exercise was a "cubic framework" with as dimensions "Activities", "Actors" and "Resources", with standardized descriptors on each dimension.

In the following overview (for the full developments, see the Final Report, 1989, Chapter 2) gives the major terms per each dimension involved in the "Cubic Framework" (see Appendix A for more details):

Dimensions:	Major terms:	
Activities:	-Manage	(incl.: General, Marketing, Sales, Support);
	-Facilitate;	
	-Standardize;	
	-Supply;	
	-Develop	(incl.: Specify, Design, Produce, Evaluate, Assemble);
	-Distribute;	
	-Use;	
	-Evaluate.	
Actors:	-Government;	
	-Society;	
	-Expert/Academic body;	
	-Manufacturer;	
	-Developer	(incl.: Project Management, Specification staff, Design staff, Production staff, Assembling staff, Evaluation staff, Services staff);
	-Publisher/Servicer;	
	-Client.	
Resources:	-Human Skills & Understanding;	
	-Methodologies;	
	-Software;	
	-Hardware.	

Figure 1: The cubic Framework.



Final Report, 1989, p. 23

During the development of this standardized "cube" as a framework for the DELTA LSRM, the following three characteristics emerged as being particularly important:

1. The DELTA LSRM should be an adequate communication tool, providing a general descriptive framework which can be applied to different European situations involving the development and distribution of learning materials.
2. The DELTA LSRM should provide a guide for critical processes within learning materials development and distribution.
3. The DELTA LSRM should be able to serve as a reference tool relative to critical issues and problems related to learning materials development and use.
   (Final Report, 1989, p.153.).

A specific task in the DELTA Pre-Pilot project was to assess the developed LSRM. The "Cubic Framework" was assessed according these three characteristics. The results of this -limited- assessment were optimistic (see Appendix K of the Final Report, 1989) and they will be described in the next section. However, after finishing the project, some observations can be made including reviewing the factors that were presented in the introduction of this section that should have been considered .

- An important change in the way of thinking can be noticed. The specific example of this change can be noted in the change in the way "LSRM" is spelled since the reset of the Task Forces halfway the DELTA Pre-Pilot project: Learning Systems Reference Model. This implies that the original notion of constructing a central model as a blueprint for a real system-to-be-developed, as was refered in the Initial Studies, 1987, no longer existed. So the first assumption underlying DELTA was dismissed and the restrictive factors (see Section 3.1.) were out of consideration.

The conclusion appears therefore, that the DELTA Pre-Pilot project has shaped its own criteria for a review.

Other general aspects to be mentioned here are:

- The area of description is extremely large. By trying to incorportate everything the model becomes meaningless. For example there can be a legislator who defines a general curriculum for a specific institute of education at the one side and at the other side there can be the Telecommunications operator who is involved in the technical realization of a connection with a specific network. The question is how fundamental are their contributions in terms of a useful European model on Learning Technology);
- The subdivision (see Appendix A) is very complicated because of the extremely large range of possibilities; however,from another perspective little definition of the terms has been made. This makes the model very complicated. Crossing all the dimensions at this subdivided level leads to 73,602 cells. The Final Report says about the Cube: "... (the Framework) appears to be a manageable instrument for structuring the complex environment in which DELTA is operating. It is a major step forward that all the project members agreed on this Framework." (Final Report, 1989, p.26.). The question remains however, if the Cubic Framework is still more than the sum of its construing parts, the dimensions.

The conclusion of this section is that the DELTA Pre-Pilot project has developed differently than its original purposes. However, although its delivery is not a system, the "Cubic Framework" at least can be a first step towards a more generally accepted methodology if it is able to function according the three characteristics mentioned above. This final aspect will be considered more closely in the next section.

4: ASSESSMENT OF APPLICATIONS OF THE MODEL.

4.1. Introduction.

As is stated in the previous section the application of the "Cubic Framework" should serve three purposes:

1. to be an adequate communication tool;
2. to provide a guide to critical processes;
3. to serve as a reference to critical issues.

In this section each of these three aspects will be discussed. Also some conditions are stated about the output of the DELTA Pre-Pilot project relative to the Exploratory Action as an introduction to the next section.

4.2. The "Cubic Framework" as a tool for communication.

The assessment of this aspect of the "Cubic Framework" was mainly done by redescribing the four considered "environments" of producing courseware '(the Open Univerisity, Macmillan Intek, POCO and EDUC) in terms of the "Cube". (For a detailed overview of this exercise refer to the Final Report, 1989, Chapter 3.)

Some aspects about this exercise can be mentioned:

- Within the context of all the four of the described environments, the terminology of the "Cubic Framework" could clearly be applied; however it should be noted that these four descriptions also grounded the "Cube" in that they contributed substantially to its development;
- The three dimensions were mainly considered separately, so the discussion was not focused upon the cells but on the individual terms;

- There were enormous differences among the four considered environments. The most striking difference was that three examples ("POCO", the "Open University" and "MacMillan Intek") described general approaches to courseware development, and were more or less focused on management aspects, while the other ("EDUC") described the more limited, but more specific aspects of the actual specifying, programming and testing of courseware.

It is obvious that the "Cube" has the potential to function as a tool for communication purposes. However, four remarks should be made:

1. The terms still need a precise definition. Within the DELTA Pre-Pilot project they were used with a "common understanding" but outside the project it should be clearly specified what is meant by each term (and each cell).
2. To become an general, accepted basis for standard terminology the "Cube" still needs to be extended, completed and refined relative to other environments for courseware development.
3. To remain usable and accessible, the "Cubic Framework" needs to be implemented in something like a hypertext-system, which could still be a substantial step towards the original purposes of setting up a DELTA-system (see also Section 3).
4. It will be useful if a selection of entry point or perspective can be made according the "type" of environment that is considered before accessing the "Cubic Framework".

These remarks should be considered in the next phase of DELTA. However, in the context of the DELTA Pre-Pilot project specific suggestions were made for an extension of the last two remarks relative to the use of an hypertext approach and to selecting an entry point according the level of organization. (see also Section 5)

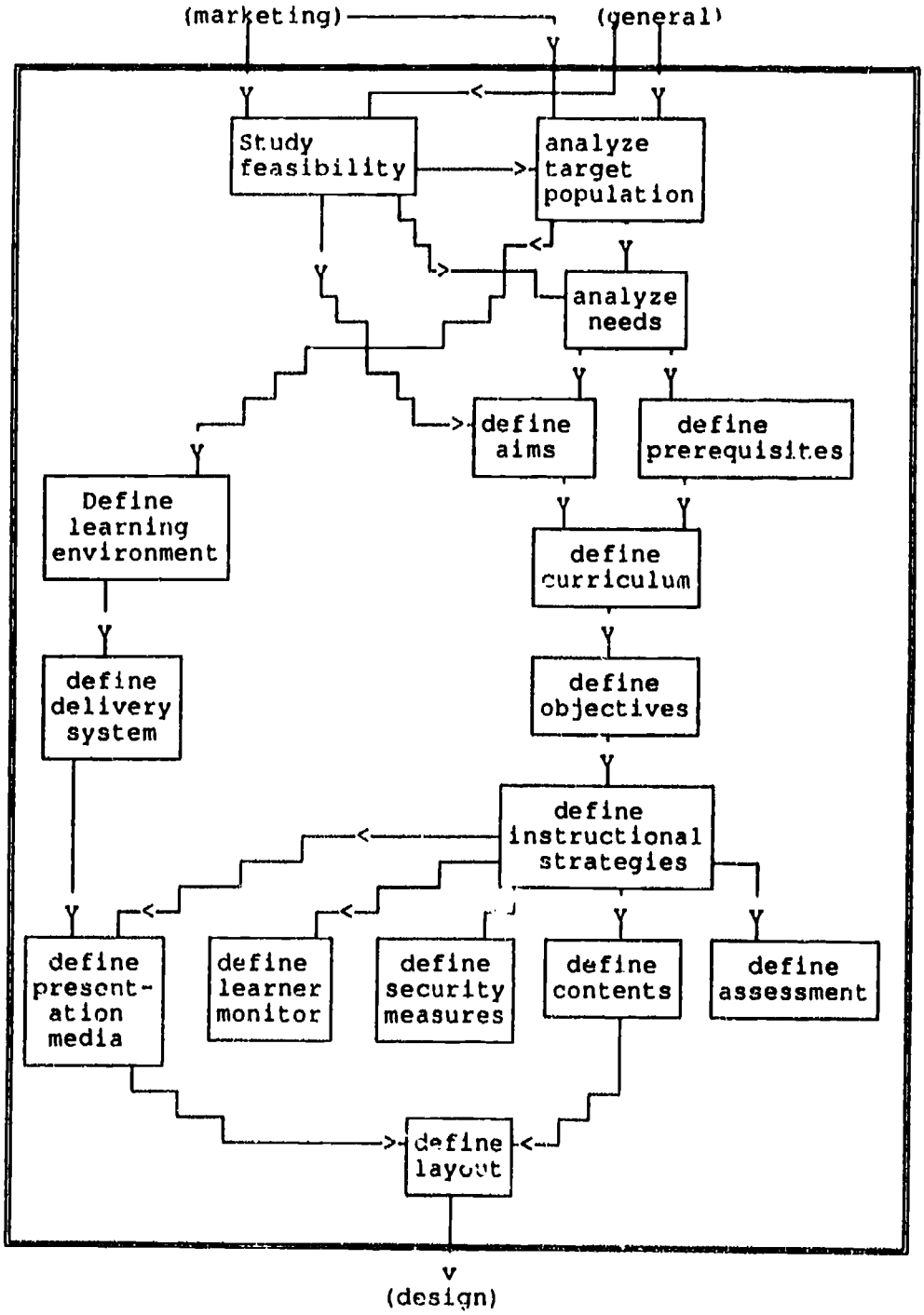
4.3. The "Cubic Framework" as a guide to critical processes.

Even though the assessment of the "Cube" as a guide to critical processes was explicitly stated in advance, the descriptions supplied of the considered environments related very little to this aspect. Still it is clear that a properly functioning "Cubic Framework" should be capable of being used as a guide or checklist for individuals involved in specific aspects of a courseware development process. The reason that this type of "guide" function did not emerge clearly could be the above-mentioned remark that the "Cube" was still not referred to as a whole of cells (and subcells), but only as its individual elements according the three separate dimensions.

In order to better fulfil a "guide to critical processes" function, we have elaborated an approach using a flow chart-structure, which will be presented below. It was a first attempt of showing how the "Cube" could be used as a guide to critical processes during the design and development activity.

Within the "Cubic Framework" the major terms can be subdivided into more specific terms. In the example shown in the flow chart, the Activity-term "Specify" (which is part of the overall activity-term "Develop") is subdivided into more detailed terms in order to be able to identify a specific sequence of these (sub-)activities. All of this can be visualized by a flow chart as is presented in Figure 2.

Figure 2.: Flow-chart example: "Specify"-slice.



As is obvious the flow chart gives an entry into the framework in more than a descriptive fashion: it tries to synthesize a sequence of activities and thus to function as a guide (checklist) to critical processes for developers. This approach can be followed at any specific entry point in the development-process. If the flow chart could be specified with enough detail (i.e., provides enough information), it can make the user aware of any activity (and actor/resource) and its successor(s) in the sequence of activities pertinent to a specific critical process, and of problems that can occur in that sequence.

The flow-chart approach has the potential of being an optimal elaboration of the framework for guiding purposes because of its representation of sequences within processes. However to increase future accessability, we would like to suggest to implement the "Cubic Framework" according to a hypertext representation form. If the "Cubic Framework" would be elaborated in such a form, it should be more generally recognized as appropriate for a European "LSRM". (For an elaboration of the hypertext approach refer to Section 5.)

4.4. The "Cubic Framework" as a reference to critical issues.

An important aspect of the "Cubic Framework" as a "Learning System Reference Model" is its potential to serve as a reference to the major issues that are and will be defined in the context of DELTA. As we have seen in Section 2, some conclusions could already be made on several of these issues such as:

- Systems interoperability (standardization);
- Learning support systems;
- Pedagogical strategies;
- Anticipating the European context.

However, the use of these and future outcomes of studies on critical issues depends on the accessibility of the results and recommendations. In order to be accessed, references to these issues should be a part of a hypertext approach, as will be proposed in the next section. Specific attention should be made to the format in which material relative to these issues will be available and also if suggestions on this format should be prescriptive or descriptive. About this last aspect a discussion should be held in the "European Learning Technology Association" which will be founded in 1989.

4.5. Conclusion.

The "Cubic Framework" has the potential to serve the three purposes indicated for its assessment. However, it should be noted that an elaboration should take place relative to the following aspects:

- the terms used need more specific definitions;
- there should be a clear entry into the framework according the type of development environment that is considered;
- for optimal functioning the "Cubic Framework" should be implemented in a hypertext system;
- for various specific aspects of the courseware development process flow charts should be elaborated;
- the conclusions of current and future research on identified issues should be in a specific format to be included in the hypertext-based "Cubic Framework".

5: FURTHER RESEARCH.

5.1. Introduction.

In this section an attempt is made to suggest the further development of a detailed elaboration of the "Cubic Framework" for a "Learning System Reference Model" as is supposed to take place in the next phase of the DELTA programme of the European Community.

First a short overview is given of this phase, which is called the "Exploratory Action" of DELTA. Then some suggestions from the previous sections are elaborated and an outline of a context is given for an optimalization of further elaborations.

5.2. The DELTA Exploratory Action.

The projects under the DELTA Exploratory Action are divided into five so-called "Action Lines". These action lines are:

Action Line 1: Learning Systems Research.
The major purpose of Action Line 1 is to gather and disseminate the outcomes of the other four action lines. It is the catalyst for exchange of information and more specifically for harmonization and integration activities;

Action Line 2: Collaborative Development of Advanced Learning Technology.
The aim of this action line is to complement the already existing efforts of the IT&T industry in order to achieve a European design of systems and equipment by collaboration. The results of this action line should be a "Portable Educational Tool Environment" ("PETE");

Action Line 3: Testing and Validation of Communications and of SOFT (Satellite based Open Facility for Testing)
This action line is intended for the specification of communications facilities to "serve the learning community" in Europe. In a special place here is the use of a satellite as a test-bed for important aspects of the other action lines;

Action Line 4: Interoperability
Central in this action line is:
- to ensure work on standardization;
- to identify relevant work in areas that are not currently considered;

Action Line 5: Promotion of Favourable Conditions
This action line will be focused on aspects in the social, fiscal and regulatory environment in which DELTA is intended to be embedded.

As its name ("Learning Systems Research") indicates, Action Line 1 includes the successive action on the LSRM and the elaboration of the "Cubic Framework". However aspects of this Learning System Reference Model can be found in any action line.

In reflection, the DELTA Pre-Pilot project can be said to have focused on providing input for Action Line 1. In the context of the start of this action line, some suggestions are elaborated in the next paragraph.

5.3. Suggestions for elaboration of the LSRM.

5.3.1. LSRM implemented on a hypertext system

A first, more detailed elaboration of the "Cubic Framework" is the identification of specific flow charts according to sub-parts of the "Cubic Framework". A short example of this approach was given in Section 4. But it should be noted that a two-dimensional flow chart has its limitations, although with more detailed information about the components such as the matching of actors and resources to specific activities, the identified critical issues and a description of all these aspects, should be reachable. A hypertext representation of the "Cubic Framework" can serve these purposes and has as surplus the possibility of constant updating and refining. A major condition for this approach is of course a clear structure, but also a wide area network system for storage and access.

Structure

A basic structure for a hypertext representation of the "Cubic Framework" according a flow chart elaboration could be:

- Start screen: an overview of the major terms of the activities-dimension and the first major choice: selection of the presentation of a specific flow chart;
- Second level: option to choose (the top-level of) a specific activity of that flow chart;
- Third level its place in the sequence, on basis of "input from"/"output to";
- Fourth level: references to the (top level of the representation of) possible actors and resources;
- Fifth level: a description of the activity and of its input and output (including references);
- Sixth level: references to (the top level of the representation of) specific problems (Issues).

Working out this approach in the next phase of DELTA (how or if this could be done was still not clear at the end of the DELTA Pre-Pilot project) would need a considerable cooperation with and input from workers throughout DELTA as well as the capability of almost constant updating. However, as noted earlier, if it can be developed this way, the framework will be more generally recognized as appropriate for a European "LSRM".

Limitation.

As is clear, the range of activities (and actors / resources) included in the Framework is a very wide one. Therefore it would be useful to provide a shell through which the implemented "Cubic Framework" can be accessed according the type of development environment that is considered. This shell should limit the width of the area or the depth of the area that is accessed. The aim of this limitation is to keep the overview manageable within the larger scope of the "Cubic Framework".

The limitation is suggested in accordance with differences that can be identified in the levels of organization of a "learning materials development project".

We see three levels of organization, related also to the function the courseware should have within a specific curriculum. These levels are:

1: *Experimental.* One team (e.g. an learning-material-developer, a subject-matter-expert and an instructional-expert), is making some courseware . This courseware can be experimental, but after an exploratory phase the developed courseware can also have a supplementary function within a curriculum. At this level there is hardly any direct influence from "outside" (government, society, manufacturer or commercial publisher).

2: *Organized.* After a group has worked at an experimental level and its courseware is used to supplement a curriculum, there may arise a need to formalize the development-process. The individuals making up the team are grouped within the organization (e.g., a group of learning-material-developers, a group of subject-matter-experts). At this level the influence from "outside" is growing, but still is not formalized. The developed courseware evolves from supplementary to, in some cases, complementary (necessary for specific curricula) and gets at least a more formal place within specific curricula.

3: *Institutionalized.* If the process continues, the courseware-developing activity exceeds the resources of one organization. The different groups involved in the development are becoming institutionalized and this means that the development-process becomes formalized.In addition the influence from "outside" becomes formalized. The courseware made by these institutions can be supplementary, but in general its goal will be to be complementary or even to be "substitutive" (enclosing the total curriculum(-part)).

5.4. The LSRM and the DELTA Exploratory Action.

First attempt for a further elaboration of the "Cubic Framework" as a Learning System Reference Model is given above. However, this attempt needs a critical refinement of the suggested shell and of the suggested hypertext structure. Both refinements should preferably take place in the context of the ideas which have developed since the launch of the Exploratory Action of DELTA.

5.4.1. ELTA.

One of these ideas is a major outcome of Task Force 1 called "ELTA": European Learning Technology Association. The major aim of this association is to establish a constant visibility for its members of the progress of projects within DELTA and related areas. One way to fulfil this aim is by an ELTA-bulletin and ELTA-Seminars in which outcomes of the action lines will be announced, described and discussed. Furthermore "ELTA" will organise a large DELTA-conference in October 1990.

ELTA can be seen as the common platform in which the several aspects of an LSRM can be discussed.

5.4.2. Implementation of the LSRM.

It still was not clear at the moment that this paper was written, if the elaborated "Cubic Framework" will be accepted by the European Commission as the LSRM and if it also will be implemented in the Exploratory Action of DELTA through a wide area network to be accessible to any DELTA-involved actor.

However, the current elaborated "Cubic Framework" for a Learning System Reference Model has drafted an outline for the range of research of the whole area of DELTA and should therefore actively serve as an input for the activities of Action Line 1 in order to also have impact on the other action lines. The decision about continuation of the work on an "LSRM" is to be taken after a so-called LSRM-workshop, to be organized by the European Community in 1989. At this workshop the results of the DELTA Pre Pilot project concerning "LSRM" will be evaluated and depending on the results of that discussion, a decision will be made it the actual work on the "Cubic Framework" or and DELTA LSRM more generally will be continued.

5.5. Conclusions.

What has become clear is that the outcomes of the DELTA Exploratory Action need a more refinement of at least the following aspects:

- Definition of the used terms/terminology (e.g. Actors and Activities);
- Continued standardization towards one terminology;
- Agreements about standardization of equipment: Hardware & Software (tools) and Learning Support systems;
- Agreements about the directions to address specific issues (such as: pedagogical strategies, application of kinds of artificial intelligence, cultural (and subcultural) differences).
- Agreements that for optimal functioning, the "Cubic Framework" should be implemented in a hypertext system;
- Clear description (towards standardization) of specific sub-areas of the courseware developing process, e.g. by elaborating the flow charts approach;
- Agreement that there should be a clear entry into the framework according the kind of development environment that is considered;
- Specification of a specific format for the conclusions of current and future research on identified issues for effective inclusion in the hypertext-based "Cubic Framework".

There are at least two possible ways to reach this tuning:

- to have a further elaboration of the LSRM-concept towards a real-existing system as part of Action Line 1 (action 1.0).
- to strengthen the concept of an "European Learning Technology Association" (ELTA) as a ("the") leading association in Europe and the place of exchange in order to have the above-mentioned aspects solved in presumably generally accepted approaches.

It is for the Commission of the European Community to make the choice on continuation. However, we can make a statement about the impact of this choice. We believe that only through a choice of both of the above-mentioned ways to reach this refinement there will be continuity of the original ideas as were stated in the Initial Studies (integration, Standardization and a European wide cooperation towards one Learning System Reference Model, see: Initial Studies, 1987). A positive secondary effect is that there will be a continuity in all the money and energy of people that was invested in the DELTA Pre-Pilot project. Finally, it includes also the setting of the "Main-phase" of the DELTA-programme (1992-1998). In this phase the results of the harmonization and integration should be broadly explored and should lead eventually to European-wide applicable results.

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DIMENSION: ACTIVITIES

A. MANAGE

GENERAL

- find resources
- control costs
- develop own skills
- review
- improve
- run project
- plan project
- set up project
- negotiate contact
- commission (external) producer
- negotiate copyrights

MARKETING

- set targets
- identify market
- decide on action
- investigate market
- define product
- stimulate use of learning material
- mediate with other organisations

SALES
- promote & advertise
- visit (potential) clients
- handle order
- supply
- invoice

SUPPORT
- engage staff
- train the tutor
- support after sales

B. FACILITATE

- subsidise
- sponsor
- legislate
- promote

C. STANDARDISE

- define application standards
- define quality standards

D. SUPPLY

- supply delivery systems
- supply tools

E. DEVELOP

SPECIFY

- study feasibility
- define Learning Environment
- analyse target population
- define aims
- analyse needs
- define prerequisites
- define curriculum
- define delivery system
- define objectives
- define instructional strategies
- define presentation media
- define assessment criteria
- define assessment questions
- define layout
- define learner monitor
- define security measures

DESIGN
- investigate existing learning material
- design new learning material
- analyse subject matter
- design structure of learning material
- write script (AV/CBT/Kit/Books)
- design layout
- design learner monitor
- design security measures
- design package
- develop prototype

PRODUCE
- write course text
- record & edit Audio-Visual material
- code software
- make (experimentation) kit
- produce graphics
- test & debug modules
- write manual text
- write (technical) documentation
- transfer/translate

EVALUATE
- check with client during development
- evaluate (formative) during development
- perform field test

ASSEMBLE
- integrate package
- test integrated package
- reproduce package
- store material

F. Distribute

- administrate
- broadcast, download, or mail learning material
- charge / invoice

G. USE

- counsel
- select learning material
- coach / tutor
- learn
- monitor

H. EVALUATE

- maintain
- evaluate (summative) learning material

DIMENSION: ACTORS

A. Government

- legislator / ministery of education
- validating body
- visiting committe

B. SOCIETY

- professional body
- sponsor
- examiner
- standardisation board
- learner association

C. EXPERT / ACADEMIC BODY

- subject matter specialist
- professional institute
- librarian (academic)
- evaluator (external)

D. MANUFACTURER

- marketing staff
- sales staff
- support staff

E. DEVELOPER

PROJECT MANAGEMENT
- project manager

SPECIFICATION STAFF
- curriculum designer
- technical specifier

DESIGN STAFF
- instructional expert
- subject matter expert

PRODUCTION STAFF
- producer (AV / CBT / Kit / Book)
- production manager
- writer
- typesetter
- editor (AV / Text)
- graphic designer (illustrator)
- user interface developer
- programmer

ASSEMBLING STAFF
- programmer
- translator

EVALUATION STAFF

SERVICES STAFF
- librarian (of Learning Material)
- computing services staff

F. PUBLISHER / SERVICER

- marketing staff
- sales staff
- implementation manager
- warehouse manager
- administrator
- telecommunications Operator
- legal expert

G. CLIENT

- spokesman
- purchaser
- implementation manager
- mentor
- tutor
- learner (actual)
- learner (potential)

DIMENSION: RESOURCES

A. HUMAN SKILLS & UNDERSTANDING

Human Skills & Understanding can be related to:

- Education
- Subject matter
- Management
- Commercial
- Presentation media
- Information technology

B. METHODOLOGIES

- Standards
- Guidelines
- Procedures
- Techniques

C. SOFTWARE

- System
- Generic
- Dedicated (to Learning)

D. HARDWARE

- Processing
- Storage
- Communication
- Input
- Presentation

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