Virtual enterprises and vocational training

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The experience of the Leonardo da Vinci project "Virtual Enterprises in Initial Vocational Training" (ISIS) suggests that the innovative concept of virtual enterprises can be successfully implemented in vocational education and training.

Introduction

Decentralised business structures are on the increase as a reaction to the new demands of competition. Management of these structures is facilitated, or made possible in the first place, by the intensive dissemination and development of information and communication technologies (ICTs). As a result company structures known as 'virtual enterprises' develop.

Interpretations of virtual enterprises range from the notion of enterprises that do not really exist (practice firms), to enterprises that transact business through the Internet, to loose associations of independent companies that trade under a common name and are organised exclusively by means of ICTs.

Under the last interpretation of virtual enterprises, the characteristics of such virtual structures can be defined as follows:

a) strong focus on finding solutions to specific problems (extremely client-oriented);

b) temporary working organisation that breaks up after the problem has been solved;

c) decentralised organisation of the 'problem-solving group';

d) no permanent location, existing only on the Internet/intranet (extensive ICT application).

Setting up virtual enterprises in vocational training involves eliminating the traditional distinction of internal and external training. Interested groups such as teachers, pupils, classes, technical/trade schools, commercial/administration schools, school principals and external consultants form a problem-solving collective and work closely together using ICT. To outsiders the virtual enterprise functions as if it were an independent enterprise or project. A teacher or a school class launches a learning project by offering it on a virtual market to other classes who want to contribute their specialised skills to a problem-solving exercise.

Virtual organisation structures

Virtual organisation structures can be formed at different company levels, as illustrated in table 1 (Hofmann/Kläger/Michelsen, 1995).

Intraorganisational virtual structures exist within the legal perimeters of an independent enterprise (Klein, 1995; Kirn, 1995; Mowshowitz, 1986).[1] Technical implementation is achieved via an Intranet. Winand (1997) explains this as follows:

> 'The principle of virtual projects or processes in particular can now … be applied to both intercooperation and intracooperation of organisations. In the first case cooperation is established beyond organisational perimeters. In the case of intracooperation, partners from different sections or departments of an institution are combined into virtual units... .'

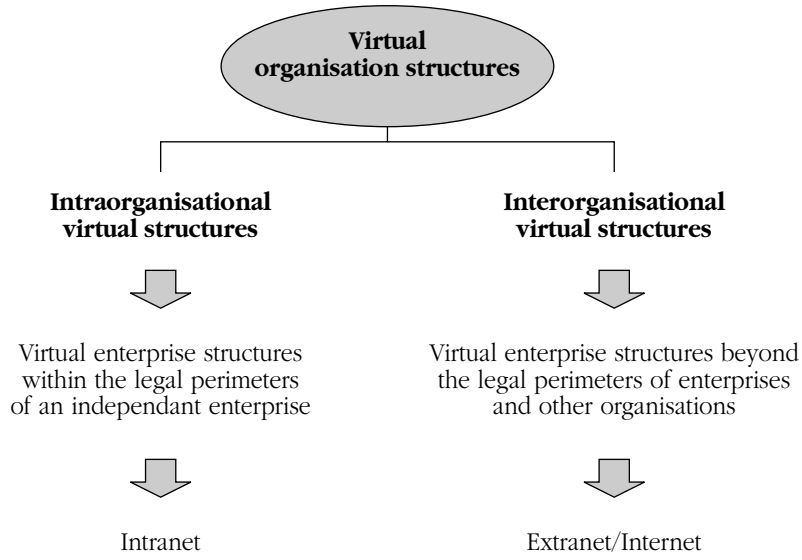
Interorganisational virtual structures are formed beyond the legal perimeters of

([1]) In this context Olbrich refers to 'fake virtual enterprises' (see Olbrich, 1994).

individual enterprises and other organisations. Here technical implementation is achieved via an extranet or the Internet. The extreme form of interorganisational virtual organisation structures typifies virtual enterprises. Besides their intended temporary character, which is not necessarily inherent in intraorganisational virtual enterprise structures, virtual enterprises differ above all from the more widespread concept of virtual organisational structures in that they refer exclusively to interorganisational structures.

Table 1:

Virtual organisation structures



Virtual enterprises

The concept of the virtual enterprise (VE) has received the greatest attention in the work of Davidow and Malone. They define VEs as enterprises that can supply customised goods and services, in large quantities where necessary, economically and quickly. Davidow and Malone refer primarily to goods and services and avoid any concrete definition of the term 'virtual enterprise' (Davidow and Malone, 1993). Nevertheless, their work has significantly advanced the debate on virtual enterprises and engendered many attempts to define the term.

In contrast to Davidow and Malone, who assume the existence of virtual enterprises, Fischer defines 'virtual enterprises' as short term organisations formed on an ad hoc basis comprising teams or individuals, i.e. a temporary combination of specialists (Fischer, 1995). In this definition Fischer refers to the characteristics of virtual enterprises, which he presents as follows:

a) geared towards solving problems;
b) quick;
c) adaptable;
d) partnership oriented.

More recently, temporary collectives of legally independent enterprises, reliant upon information technology, have been considered under the term 'virtual enterprises'. These exist only for the limited duration of a jointly pursued project so that the project-specific skills of the various partners can be utilised flexibly (see, for example, Winand, 1997; Pribilla, Reichwald and Goecke, 1996; Hoffmann, Hanebeck and Scheer, 1996; Reiß, 1996; Winand, 1995; Flynn and Flynn, 1995; Klein, 1994). The 'problem-solving collective'[2] thus formed comprises different enterprises and breaks up after the successful conclusion of the project or after the problem has been effectively solved. Frequently this leads to new alliances, with different constellations according to circumstances.

To the 'problem possessors', the clients, such an alliance appears to be a business entity from which they receive a service as they would expect from a classical company. Yet there is no permanent physical structure behind the problem-solving collective.

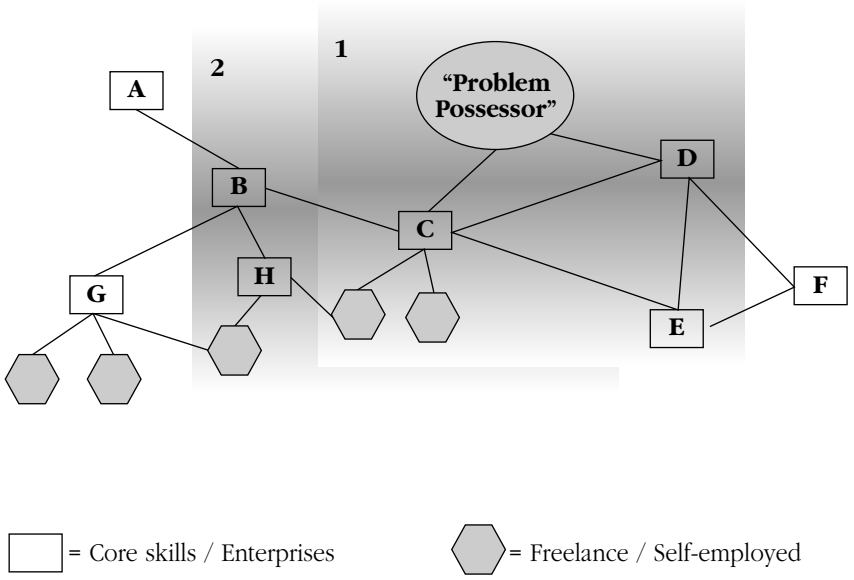
Mertens and Faisst (1997) extend the definition to include individuals in the organisational alliance of virtual enterprises:

> 'A virtual enterprise is a form of cooperation between legally independent enterprises, institutions and/or individuals who provide a service on the basis of a common business under-

(2) See Fischer, 1995, p. 56 on the concept of 'problem-solving collectives'.

Table 2:

Virtual enterprises



standing. The cooperating entities participate in horizontal and/or vertical cooperation primarily with their core skills and act toward third parties as a single enterprise during the provision of the service. Institutionalisation of centralised management functions in the organisation, control and development of the VE is largely avoided and the required coordination and harmonisation covered by suitable ICT systems. The VE is bound up with a mission and ends when the mission is accomplished.'

Virtual enterprises can be illustrated diagrammatically as shown in table 2.

Virtual enterprises are characterised by:

a) strong focus on finding solutions to specific problems (extremely client-oriented);

b) temporary working organisation that breaks up after the problem has been solved;

c) concentration on the core skill;

d) avoidance of institutionalising centralised management functions;

e) legally independent entities;

f) based on trust and a common business understanding;

g) learning and adaptive orientation;

h) decentralised organisation of the problem-solving group;

i) no permanent location, existing only on the Internet/Intranet (great dependence on ICTs) (see Zmija, 1998).

Mertens and Faist (op.cit) found three different types of virtual enterprises in their field study (table 3). Crucial to the success of virtual enterprises is the trust factor. Even before the separate business partners amalgamate into a virtual enterprise, confidence-raising indicators from their working practices are necessary. For this reason the networking form defined by Mertens and Faist as Type A is a common variant. Under Type A, virtual enterprises are contabled on the basis of an already available pool of companies that already know each other, so that a certain level of trust among the business partners can be assumed. If a specific skill needed for solving the problem is unavailable or insufficiently available in this pool, a partner will be temporarily brought in from outside for the duration of the VE (Type B). Subsequent admission of this external partner into the pool is very likely if the cooperation is successful. Only rarely are virtual enterprises founded by partners who have had no previous relationship, so that no bond of trust has been able to develop (Type C).

The trend towards virtualisation is being promoted by business start-up support schemes and existing businesses establishing offshoots. At the same time there is a trend towards smaller, usually independent or semi-autonomous business units. The development of existing software standards is strengthening the trend towards fewer software systems, and greater work force flexibility has become evident in recent times (Mertens and Faist, op.cit).

Restraining factors are also apparent. Contrary to the theories occasionally voiced by organisational theoreticians and practitioners, that in future large-scale enterprises will be the exception and networking alliances will be the rule, a growing trend towards large-scale enterprises and the associated effort to gain greater market power can also be observed (Mertens and Faist, 1997, op.cit). Factors that speak against virtual enterprises are:

a) lack of long-term experience of those involved and therefore, lack of insight into the disadvantages of speed;

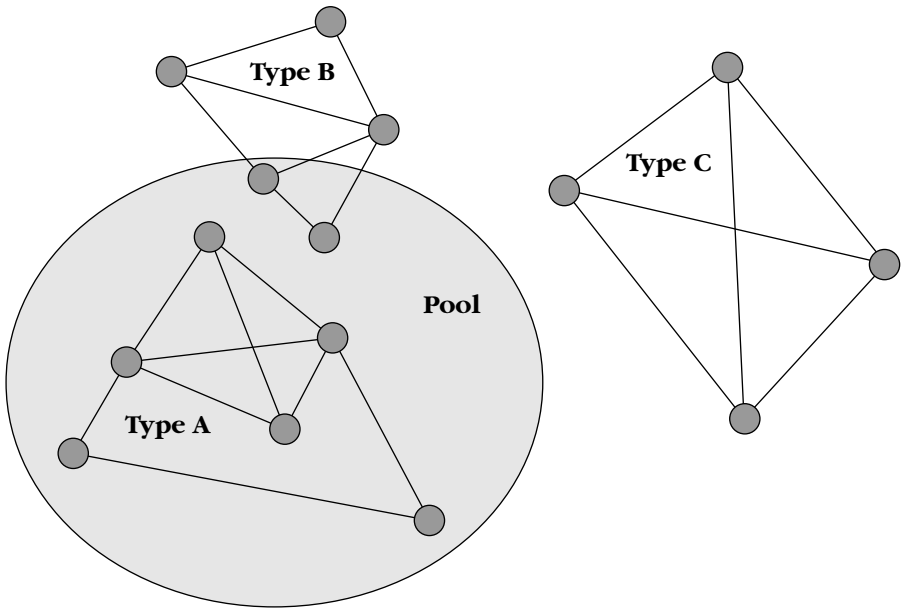
b) lack of permanent commitment of specialists to an enterprise;

c) stance of employees' organisations, which have a very sceptical attitude to this concept;

d) complexity of virtual enterprises;

e) obstacles that arise during the period of cooperation.

Table 3:
Types of virtual enterprises (see Mertens/Faist, 1997)



Problem areas

A Leonardo da Vinci project[3] examined the impact on vocational education in respect of the observations on virtual enterprises outlined above. Which skills are important in virtual forms of organisation, and particularly, in virtual enterprises? How should vocational education and training, particularly initial vocational training, be structured to meet the needs of the future?

Skills

As is clear from the interpretations of virtual enterprises described above, a number of problem areas become apparent with regard to the requirements virtual enterprises place on vocational education and training. In the Leonardo da Vinci project ISIS these were identified as discussed below.

Project work

During the implementation of a project, both the appropriate expertise and a multiplicity of different skills are expected and required from individual project members. Interdisciplinary communication with partners for jointly defining and demarcating the areas of work is just as necessary as specialised knowledge and interpersonal skills for resolving problems. Participants must be equally familiar with project planning tools and with the procedures and rules for discussions, meetings and presentations.

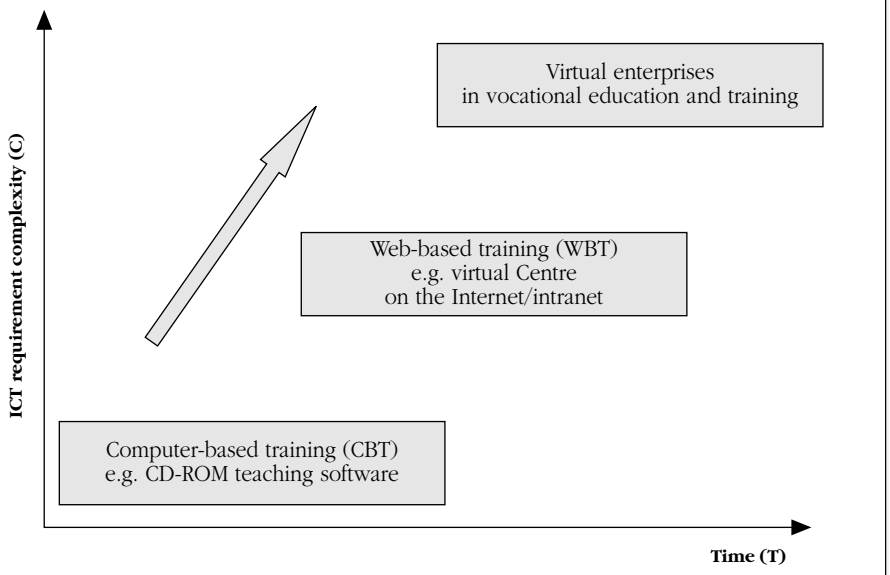
Independent recognition of information and operational deficits and the resultant independent acquisition of the necessary information and knowledge are facilitated by projects and are, at the same time, a project objective.

In all modern occupations, besides technical information and communication expertise, consultation and service provision are growing in importance. Specialists cannot create barriers by using jargon, but must recognise their client's problem and use their specialist skills to find appropriate solutions. Thus successful vocational training of the future must build a bridge between respective specialist competence and appropriate technical communication and commercial knowledge.

([3]) Leonardo Project: 'Evaluation, Intervention and Transfer of the Leonardo Project 'Virtual enterprises in initial vocational training (ISIS)' – OSIRIS' headed by Prof. Dr.-Ing. Hans Martin, Institute of Industrial Science at the Comprehensive University of Kassel with project partners in Germany (HRM Consult, Hessisches Landesinstitut für Pädagogik), Greece (University of Thessaloniki) and Ireland (Cork Institute of Technology). Duration of the project 1997-2000.

Table 4:

Virtual personnel training



Experience shows that in this day and age expertise becomes outdated at an ever increasing pace. As a result there is a urgent need for constant, flexible adaptation and lifelong learning.

Information and communication technologies

Due to the immense deployment of ICTs in VEs, workers in such organisations must have the appropriate skills. Apart from user skills, which these days are essential even in conservative organisational structures, knowledge on the networking of ICT systems is the key requirement. The Leonardo da Vinci ISIS project needed over a year to install the necessary technical infrastructure in all the participating institutions and schools, particularly in the German vocational schools. This indicates just how important it is to have not only good data-processing equipment, but above all, skills in handling and servicing ICTs.

Internationalisation

Besides technical specialist skills, language and intercultural skills are particularly important in transnational virtual enterprises. Cultural differences can lead to problems in interpreting information. An understanding of the other culture and its customs and manners prevents misunderstandings and irritation.

Job-related skills

VEs create new work forms and new workplaces. Work is decentralised, done from home or on the client's premises. Occasionally non-commercial workplaces, such as local teleworking centres or office hostelling, might even be established. Workers should therefore be familiar with labour law and health and safety standards. Relevant industrial safety regulations also apply in places of work outside actual company premises (e.g. regulation concerning VDU operator workstations).

Job descriptions and requirement profiles for particular jobs are not helpful in VEs since 'the' job in the narrow sense of the word no longer exists. The demands made on workers depend on the project. There is no job profile for a particular job since tasks are constantly changing according to project requirements. This results in constant training and continuing training which must be undertaken as required.

Career development and continuing training

Career development in VEs is not planned as a position in a hierarchy, but in terms of project history. Successful completion of a project leads to a higher rung on the ladder of success rather than being responsible for personnel or belonging to a company for a certain number of years. The configuration of the team is crucial to the success of VEs. Uniform standards with regard to training, methods and procedures and behavioural patterns should be specified. Team supervision is straightforward. This also results in changes in initial and continuing training. If traditional jobs are no longer relevant, traditional training makes little sense. Training must therefore also be project-related. Continuing training becomes individualised. People 'working for themselves' and core staff have to invest in themselves and continuously advance their own training. A substantial demand for continuing training is foreseeable.

How can this demand be met, or how should training and continuing training be organised in VEs?

Organisation

A possible solution is offered by the virtualisation of training and continuing training (table 4). This cannot and will not replace traditional training and continuing training, but will supplement it.

In the first place, suitable educational software has to be developed. Good computer-based training programs are already on the market. These can usually be installed locally on a PC, by CD-ROM. Content is adapted when the software is redistributed. The learner can work through the program on a PC workstation with multimedia capability. The design of such systems requires a high level of didactic knowledge.

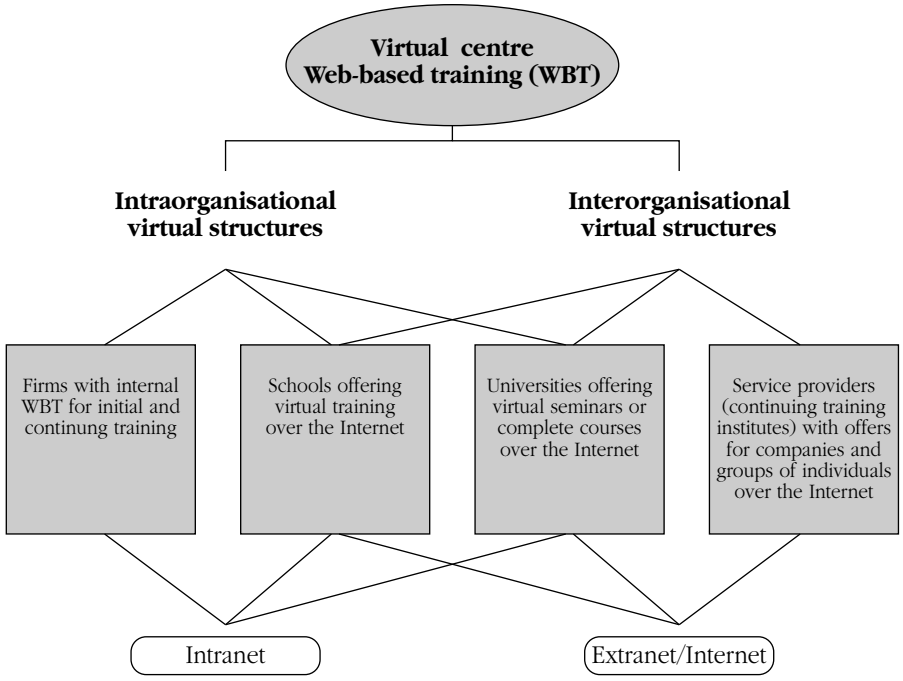
To meet the requirements of virtual enterprises, initial and continuing training should lose their stationary nature and likewise become networked. Web-based training concepts on the Internet or Intranet permit quick changes of educational content. Users can access the appropriate training program and work through the modules at any time and from any place where they have access to the Web. Intelligent use of the media capabilities to achieve the educational objectives are important for the success of these systems, too.

Virtual enterprises can also be organised in vocational education and training. At the initial stage, VEs of Type A are available. A virtual learning group in the sense of a virtual enterprise can be formed from a permanent pool of employees, continuing training participants, teachers and pupils. Each individual can formulate their learning needs on the virtual market or look for a supplier for their individual educational requirements. An expansion of this system to Type B or C is conceivable. Such structures, however, bring about a sharp increase in ICT requirements and consequently, are far more complex.

Various providers of virtual personnel training exist. These can be subdivided into intraorganisational and interorganisational virtual structures (Table 5).

Table 5:

Various forms of virtual learning centres



Schools can offer courses on the Internet. It is conceivable that teachers make supplementary training material accessible to their pupils over the Internet. Users of such material could be pupils or other teachers. A Type A or B VE can evolve if pupils and teachers work together on the material as a team.[4]

Enterprises and companies are increasing their own web-based training for their own in-house and continuing training. Their target groups are clearly their own permanent staff. A Type A VE can develop.

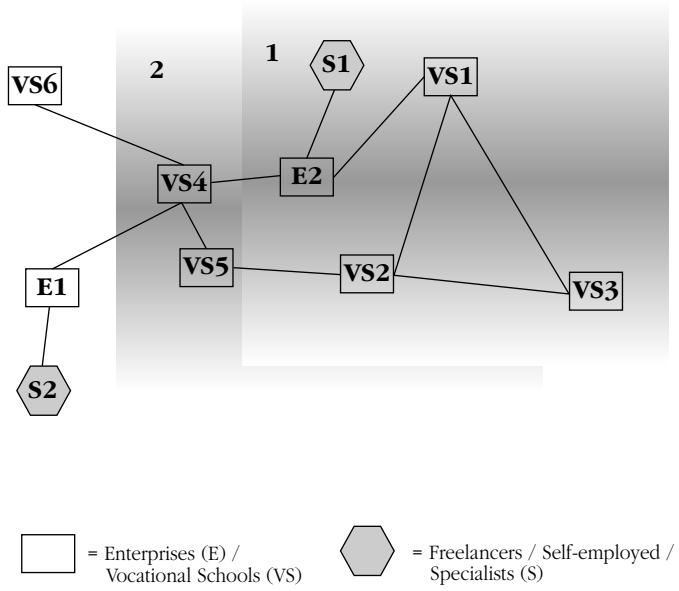
Increasingly, service providers (usually continuing training institutes) are offering training to enterprises and groups of individuals over the Internet. Some enterprises are opening up parts of their internally developed web-based training modules to other enterprises or individuals. While this offer corresponds to a Type B VE, Internet service providers are more properly classified under VE Type C.

Universities are also developing virtual seminars or entire courses and offering them on the Internet. A mix of VE Types

([4]) An example of this are the schools and educational institutions participating in the Leonardo Project 'Virtual Enterprises in Initial Vocational Training (ISIS)' in Germany, (Schulze-Delitzsch Schule, Wiesbaden; Max Eyth Schule, Alsfeld; Friedrich Ebert Schule, Wiesbaden), Greece (Chalkis College of Technology, Chalkis) and Ireland (Cork Institute of Technology, Cork). The ISIS Project is being scientifically monitored under the OSIRIS Project.

Table 6:

Virtual enterprises in initial vocational training



A and C arises. This is organised internally within the university (Type A) or on an inter-university level (Type C), depending on the users.

All forms of virtual personnel training comply with the requirements of virtual enterprises. A high degree of networking by means of ICTs is necessary. Users become familiar with the required technologies and the core skills needed in virtual structures. Virtual teams are formed as learning groups and can employ the technical potential for optimising their work.

Virtual enterprises as an extreme form of interorganisational virtual organisational structures in vocational training have very specific requirements. Internal and external groups requiring vocational education disperse. Teachers, classes, pupils, school principals, external lecturers, enterprises and consultants join forces in a pool (Type A or B) or an open virtual market (Type C) where they contribute their respective specialist skills. A project or a problem is advertised on the virtual market on the Intranet or Internet. This leads to the formation of a problem solution collective. Its composition depends on the problem to be solved (Table 6). All the necessary core skills are combined to carry out the project. Results are fed back to the alliance. When the project is finished, the group reconfigures and new virtual enterprises are formed.

This theoretical concept can be clarified using the example, 'Construction of a wind power station'. A class from a technical vocational school wants to build a wind power station. Much information is required to do this successfully. Marketing, design, production planning, accounting, cost-benefit analysis, sales and purchasing, all have to be considered. Questions arise that the class teacher probably cannot answer without outside help.

An action-based training project involving other classes would provide the solution. The project can now be advertised on the virtual market in a search for potential partners. A class from a vocational commercial administration school wanting to take part in the project turns up. A craft trade enterprise is also interested and promises its cooperation.

The next stage is founding the virtual enterprise. Tasks have to be allocated and the necessary communication structure specified. Information is exchanged between the project members. Finally the wind power station is built and the project is finished. The vocational commercial class now tries to set up a new alliance, because contacts have developed through this project and the new class topic, 'European payment transactions', is also to be tackled in the form of a virtual enterprise. A new alliance is forged.

The hypothetical case is no doubt incomplete and can certainly be extended. High demands are placed on teachers and pupils. Nevertheless, the experience of the Leonardo da Vinci project 'Virtual Enterprises in Initial Vocational Training (ISIS)' suggest that the innovative concept of virtual enterprises can be successfully implemented in vocational education and training.

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