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Work-Process-Analysis in VET-Research

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Georg Spöttl

Work-Process-Analysis in VET-Research

ITB-Forschungsberichte 22/2007
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**Work-Process-Analysis
in VET-Research**

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Zusammenfassung:

In den vergangenen zehn Jahren etablierte sich in Deutschland die berufswissenschaftliche Forschung. Der Anspruch dieser Disziplin ist die Erschließung des praktischen und theoretischen Wissens und Könnens in der betrieblichen Arbeitswelt mit besonderer Berücksichtigung der Facharbeit. Um diese vor allem Kontext bezogene Forschung zu ermöglichen, wurden einige zentrale Methoden entwickelt. Eine davon ist die Arbeitsprozessanalyse, die auf der »shop-floor«-Ebene stattfindet. Die Konzeption dieses methodischen Zugangs wird in vorliegendem Forschungsbericht vorgestellt. Eine Erprobung fand inzwischen in mehreren Ländern im Rahmen der Qualifikationsforschung statt.

Abstract:

During the past decade, the educational scientific research has been established in Germany. This discipline aims at the access to the practical and theoretical knowledge and skills in the corporate world of work with special emphasis on skilled work. In order to pave the way for this context-related research, some central methods have been developed. One of them is the work process analysis which is taking place on the »shop-floor-level«. The concept of this methodological approach is presented in this research report. It has meanwhile been tested in several countries within the framework of qualification research.

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1. Introduction of problem¹

Vocational Education today is seeking solutions for at least three central challenges:

- a.) First and foremost it is important to find out what skilled workers have to know and be able to do in order to successfully cope with concrete work processes. This means their practical and theoretical knowledge; their implicit and explicit knowledge has to be identified.
- b.) Secondly answers have still to be found for the question how the vocational education and training sciences can more deeply underpin vocational and vocational field specific research questions in terms of qualification development.
- c.) Thirdly it is necessary to develop a set of research instruments which is suited to close the gap between traditional qualification research and the development of professional ordinances and occupational profiles.

From the »vocational scientific point of view« there is consensus regarding the relevance of the above mentioned challenges. Without dealing further with the potential and at the same time the limits of empirical social sciences, of research approaches of work sciences, of the work psychology, the sociology and other disciplines we would like to state that vocational educational research at universities does not play a considerable role in the field of qualification research so far, nationally as well as globally. The first mentioned research methods are as a rule oriented towards social sciences and must therefore be critically reflected with regard to their impact on vocational educational scientific research as these approaches deal with technology and work on a more general structured level. As soon as a vocational educational scientific dealing with the dimensions vocational education, work and technology and aimed at the development of vocational educational plans is involved, social scientific research approaches can only give limited answers. We therefore think that it must be an original task of vocational educational sciences to deal with the change of the contents and the forms of occupationally organized work and with the respective work processes. If we consequently pursue this path we can contribute to the development of a sound profile of an empirically based vocational educational scientific qualification research (cf. Petersen/Rauner 1996; Rauner/Spöttl 1995; Schweres 1998).

Several surveys (cf. Petersen/Rauner 1996; Rauner/Spöttl 1995; Spöttl 1996; publications 2002; 2003) underpin conceptual weaknesses of established occupational profiles, such as e.g.:

- Confinement of occupational profiles to the surface of technological change or a lopsided orientation to technology;
- Occupations as a grouping of activities according to the performance principle (e.g.

¹ This is an enhanced and modified article first published in German in Spöttl, G.: Der Arbeitsprozess als Untersuchungsgegenstand berufsfeldwissenschaftlicher Qualifikationsforschung. In: J.-P.- Pahl; F. Rauner; G. Spöttl (Hrsg.): Berufliches Arbeitsprozesswissen. Ein Forschungsgegenstand der Berufsfeldwissenschaften. Nomos Verlagsgesellschaft, Baden-Baden 2000, S. 205 – 222.

turning, milling) which are set up according to an analysis-synthesis-process (task analyses and synthesizing of work tasks).

- Correspondence of industrial and handicraft occupations with a specialized systematics of technology sciences rather than with the work process structures of the world of work.
- Discrepancy between the contents of occupational profiles and corporate work processes.

If we take these weaknesses seriously and at the same time aim to focus on work coherences, the following research questions emerge as a consequence:

- What is the contents of skilled work and which know-how and know-that is required?
- How is skilled work changing and what are the parameters for these changes?
- How can these work changes be accessed?
- How should »tasks« and work processes promoting learning be identified and mapped?
- How can the know-how and know-that (Benner 1948) incorporated in practical work as well as the implicit know-how that has an impact on professional knowledge be explored?

The knowledge of objective requirements for skilled workers is a crucial prerequisite for the determination of the contents and the creation of occupational profiles, curricula and vocational educational plans for vocational training. The following chapters try to find out which vocational educational scientific research concept(s) are adequate to answer the current questions from the point of view of the vocational educational sciences.

2. The traditional research concept

The procedure for the answering of research questions in use in Germany for a long time and partly still applicable is a hypothesis-guided procedure for the development of training ordinances (cf. Benner 1996, p. 56 ff.). It is basically composed of four steps:

- | | |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 st step: | Description of problem
The occupational profile is formulated as a hypothesis (work hypothesis with regard to tasks and requirements). |
| 2 nd step: | Survey of representative work places with the aid of case studies:
The work hypotheses are verified. |
| 3 rd step: | Verification of work hypothesis with the aid of task analyses and definition of occupational range of requirements:
Creation of a data base in order to configurate contents. |
| 4 th step: | Development of a complete training ordinance:
Training contents are selected and training steps are structurized. |

Although this procedure has so far been successfully applied, there is some criticism with regard to the fact that predetermined hypotheses anticipate decisions crucial for the training occupation(s). Above all this hampers a thorough assessment of the work tasks

and the change of tasks at »shop-floor-level«. The procedure is therefore prone to neglecting decisive changes in the coping with tasks which are of high relevance for new occupational profiles.

3. Open process oriented research approach for the access of a work process

A closer look at the different methods of quantitative social sciences and at the results of their application (cf. Büchter 1999, p. 12 ff.) leads to the conclusion that

- work contents and work processes relevant for vocational training plans cannot be precisely enough accessed and
- the concrete handling of »work tasks« and technology by the working person remains unclear.

It is highly relevant for vocational education and training to access technology and work not only at the level of general structures but also to identify the knowledge incorporated in practical work designed via work processes. If we can successfully access this knowledge the related findings will have a revolutionary impact on curriculum research and curriculum development, because we can deal with a deep insight into the internal structure of work as well as into the secret capabilities of the workforce.

Concepts of vocational educational scientific qualification research which are currently being developed (cf. Rauner 1997; Rauner/Spöttl 195 and 1997; Stratmann 1971) presume three central methodical elements (cf. Rudolph et al. 1987) which are important for the creation of vocational educational scientific work studies:

1. Analysis of overall occupational impact: This helps to identify the »dimensions of skilled work« in a sector.
2. Work task analyses: The change of tasks and the contents of work tasks is assessed with all implications. The findings serve to newly configurate and further develop occupational profiles and vocational educational plans as well as curricula.
3. Work process analyses: They serve to decode the skills and knowledge incorporated in practical occupational work – the »opening of practical work« is in the focus.

The most important starting point of all three methodological steps is the skilled worker – i.e. the human being – in his or her work process and the challenges he or she is facing. This requires to formulate the analytical range of the determination of requirements in a way that

- a.) all work relevant contents, objects and further implications can be identified and
- b.) that those properties which can contribute to the personal development of a person and his or her successful work in an occupation can be clearly identified.

A successful exertion of an occupation in this connection also means the access to and the co-shaping of fields of work by the development of shaping competency. This can only be safeguarded if the exact access to work processes is safeguarded in order to

identify concrete starting points of learning processes. This again forms the basis of the curriculum construction.

Studies in the automotive sector carried through by Rauner and the author and in the recycling sector carried through by Blings and the author (e.g. Rauner/Spöttl 2002 and Blings/Spöttl 2003) on behalf of the European Commission provided the opportunity to further investigate these questions. Therefore it was necessary to develop an adequate methodological set of instruments which will be explained below. It was more or less obvious to focus on the companies and their workforce as the centre of the surveys and to draw an adequate »picture« of occupational challenges.

4. The steps of the survey

4.1 Step 1: Analysis of overall occupational impact (sector analyses)

Through analytically oriented work selected factors are investigated which ensure

- to provide an overview of a sector (field of business dealing with the same product related requirements, e.g. car service, IC-Technology, agriculture etc.) and
- at the same time to find out details of the impact of innovations, corporate reorganization, product changes etc.

on occupations and occupational structures prevailing in the sector (cf. Figure 1).

Parameters to be surveyed are e.g. the consequences resulting from the permeation of new technologies, through changes by new corporate cultures and other philosophies, through modification of forms and structures of work organization, impact of prevailing working time models and remuneration systems as well as the consequences of new tools and challenges by the legal systems of the countries.

As for the first step of the survey the following instruments are suitable:

- a.) sector analyses and
- b.) case studies in enterprises

The sector analyses focus on:

- the interior and exterior structure of the sector,
- the overall development of a sector,
- the economic importance of a sector,
- the access of institutional coherences,
- the analyses of sector specific sources and publications,
- the employment and occupational structure.

The case studies focus on:

- the development of the company,
- the range of »production« and the business fields,
- the range of tasks,
- the holistic organization,
- the occupational structure,

- the forms of work organization,
- the development of the manpower,
- fields of work / grade of specialization,
- working conditions,
- fields with especially difficult work tasks

Interviews with sector experts of especially difficult work tasks.

Step 1		Step 2		Step 3	
Analysis of overall occupational impact		Vocational educational scientific task analysis		Work process analyses – work process knowledge –	
Sector analyses Case studies		Expert skilled worker – Workshop 1 –		Expert workshop	
↓		↓		↓	
Change of skilled work		Relevant work coherences and tasks		Knowledge and skills incorporated in occupational work	
Dimensions of skilled work		Expert skilled worker – Workshop 2 –		Differentiation of work tasks	
(Occupational) education concept		Evaluation of work tasks		Work process studies	
↓					
Interviews with sector experts		Evaluation / weighting of work tasks		Differentiation and vocational education plan	
Structurization of work contents					

Fig. 1 Research steps of »vocational educational scientific qualification research«

Both the survey itself and the documentation of the results require high quality as a reliable description of the ratio between change of tasks and vocational education must be ensured. At the same time important fields for the work process studies to be carried through later must be identified.

The research instruments of this first phase must be kept flexible. Apart from the evaluation of important sector specific documents, interviews with both key persons and social partners have to be carried through. The selection of the persons must be carefully coordinated with sector experts. Skilled workers and company representatives have to be involved in the case studies. They should give as precise information as possible on the development and on challenges in terms of skilled work and its environment. Interviews carried through with well-selected sector experts should help to analyse the findings and to ensure the results of the case studies.

The first research step – here presented by the example of the surveys carried through in the automotive sector² – revealed at least two innovative results which can be assigned to the closer interest to vocational educational research:

I. The change of skilled work could be determined pretty accurately. It is marked by several parameters.

Main variable of change

- Development towards the high-tech car with increasing integration of technological systems (material technology, construction, electronics),
- Introduction of computer-aided testing and diagnostic systems with a considerable impact on service (tools!),
- Influences by the shaping of work organization,
- Organization of service and repair tasks (work process, division of work, team concepts ...).
- Further variables of change:
- Influences by environmental legislation,
- Influences by legal stipulations on the operation of vehicles,
- Influences by safety regulations for workshops,
- Influences by standardization and module concepts,
- Stipulations by service concepts of manufacturers, structural changes concerning the size of the companies,
- Shaping of administration,
- Shaping of sales systems,
- Shaping of the company and meeting of quality requirements.

The findings with regard to the change of these parameters are suitable to give answers for questions such as:

- Does the sector need highly specialized and/or broadly qualified all-round technicians?

² The same is true for the recycling sector

- Which knowledge is required for skilled workers with regard to electronics, diagnosis and repair?
- What is the role of business and work processes for the skilled worker (even if a work process has not yet been identified so far)?
- What are the corner stones determining the tasks of a skilled worker?

After this assessment phase it is possible to make clear statements on the impact of the changes with regard to profile and contents of skilled worker occupations in the automotive service as well as on the holistic processes in enterprises influencing the skilled work. Sociologists, work scientists and work psychologists may, however, criticize that they would be just as well be able to take care of these tasks.

The representatives of education must therefore ensure during this first survey step that the corner stones are defined which are most important for an occupational science. This corresponds to the second innovative result:

II. The concept of vocational education traditionally oriented towards the »object of skilled work« must be amended.

Working and learning has at least three dimensions for a skilled worker:

- The object of skilled work (composed of: technology, functions, phenomena ...; customers may be objects as well!)
- Tools, methods and organization of skilled work (work organization and tools thus are assigned a great importance in vocational education);
- Requirements for skilled work and technology (laws, service concepts, manufactures, customer).

In the past, vocational education and vocational educational research mainly concentrated on the object of skilled work and in an often reduced way on technological aspects. This lead to a dominance of technology in the curricula and during instruction in vocational schools. Already in the first survey step – of the sector analysis and the case study – it was, however, shown that it is necessary to have an expanded idea of the object and of the two other dimensions – i.e. »tools, methods and organization of skilled work« as well as »requirements of skilled work and technology«.

All this results in a concept for vocational education only if the occupational working practice – represented by the work tasks – is confronted with adapted educational goals. The interrelationship between work – technology – education – society is underpinned by the three dimensions of skilled work and the related poles »work tasks« and »targets of vocational education« (cf. Figure 2).

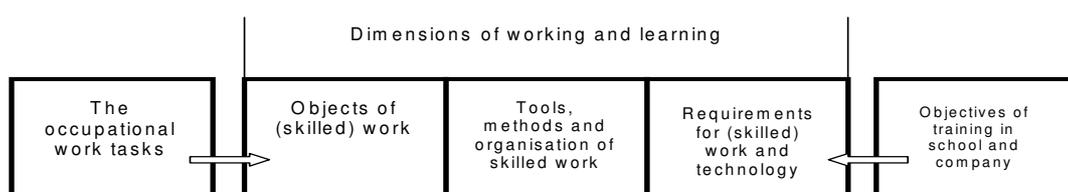


Fig. 2 Structure of training teaching contents by considering occupational qualification requirements and education targets

Already during this research phase it became evident that the work tasks represent very different challenges. Some of the tasks may be tackled by a novice, some only by an expert. It is obvious that work contents should be structured by orienting them to the strongly differing level of the work tasks. These work contents eventually define the work process.

As for the automotive service we identified four knowledge levels in this phase:

- Level 1: The car as an entity: The basic service.
- Level 2: The car and its architecture: Service and wear repair.
- Level 3: The car and its aggregates: Trouble shooting and repair.
- Level 4: The car and its construction: Expert diagnosis and repair.

In the recycling sector which is structured in a completely different way compared to the automotive sector, we were also able to identify four highly relevant knowledge levels:

- Level 1: Recycling and the principle of material flows.
- Level 2: Material closed loops.
- Level 3: Used materials and their utilization.
- Level 4: Used materials in recycling plants.

Based on Dreyfus/Dreyfus (1987), these levels represent development levels of human skills beginning from the novice to the expert. The lowest level of Dreyfus/ Dreyfus is the novice. This level is quickly overcome. On his or her way from a novice to an expert, skills are developed »from the analytical behaviour of a distanced subject who breaks down his or her environment into recognizable elements and who adheres to rules up to participative skills based on former concrete experiences and on an unknowing recognition of similarities between new and former holistic situations« (Dreyfus/ Dreyfus 1987, p. 61). Of course this goes along with a gradual immersion into know-how, eventually into the depths of systematic knowledge required to identify the most difficult failures in complex plants and knowledge also providing for continuing vocational education.

Each of these four levels differs from the others in a considerable way: in real situations, in the skills necessary for the coping with situations and the respective actions. Each level contains learning opportunities which are determined by the corporate work tasks as a crystallization point of corporate organizational forms and the business processes. It is therefore crucial for this second survey phase to exactly determine the occupational work tasks and their relationship to the work process. (cf. Figure 1). Work process knowledge includes the understanding of work processes and the production processes in the organization as an entity. It is a synthesis of theoretical and practical knowledge.

4.2 Step 2: Vocational educational scientific task analysis

The second survey step (cf. Figure 1) aims at

- the identification of work coherences characteristic for an occupational profile and for qualification requirements and

- the identification and differentiation of work tasks.

This phase is one of the most important phases during the entire research process. It does not concentrate on a micro analysis of work tasks but on the identification of overall, meaningful work coherences and work tasks that are constituting an occupation.

The following demands must be met:

- to represent an occupational action,
- to be part of corporate value-added,
- to be object of the corporate business process,
- to record concrete daily tasks,
- to encompass decisive factors and processes which define skilled work,
- to represent tasks for skilled work with regard to complexity and impact
- to encompass focal points of corporate organization development and new situations.

It must also be revealed which work tasks can only be managed safely and efficiently after long years of professional experience or which work tasks can already be tackled by beginners. Eventually all those work tasks have to be compiled that answer the question of why a thing is what it is and not anything different.

In order to get results in this phase, it is recommended to carry through

- expert skilled worker workshops of a day's duration and
- an evaluation with other experts.

The expert skilled worker workshop should encompass about 7 to 9 expert skilled workers who

- represent the profession to be further developed in terms of skills and biographies;
- are able to critically and perspectively describe and assess their current (occupational) skilled work, to systematize it according to areas of tasks or to develop ideas for a new or modified occupation and
- reflect their own initial and further training in connection with the change of tasks.

The majority of the experts should still be actively working in their trades as skilled workers, i.e. they should be productively working, whereas a smaller group should belong to the indirect field and could work e.g. as a master craftsman or technician (human resource managers, foremen etc have to be excluded).

As for the researchers who prepare and carry through the workshop, at least one must have a clear-cut vocational educational training and an adequate occupational biography. One prerequisite without the other is inadequate. In case of a lack of vocational educational studies there is no access to questions of vocational education resulting in the fact that important vocational scientifically relevant coherences are not perceived. If there is no clear-cut occupational career, the access to the specific language and the contents of skilled work is hardly possible. This results in a lack of findings. The second researcher should at least have one of the indicated qualifications, better both, and should be at the same time able to act as a facilitator. During the course of the workshop it is important that the workshop inspires itself and that the inspirations are triggered by impulses of the researchers and workshop participants. »Theoretical« inputs of the researchers should

rather be omitted, least of all pre-structured introductions. It is crucial that researchers provoke the conversation, the statements and the explanations by context-related questions; by questions asked in the language of the skilled workers and that they are not in the centre of the conversation. The experts have to speak and explain whereas the researchers give impulses, summarize and ask back. The structurization of the contents, the work tasks, is one of the most important tasks of the experts. They are the only ones who are able to construct a development logical order as they still well recall how they have learned and are still learning their trade. The researchers must flawlessly and inconspicuously provide the instruments, the materials for the documentation, the changing of orders, the amendments and the precisioning. Only if researchers and experts speak the same language at the same level, when researchers are able to ask the questions or to set impulses in the »inner context« of the understanding of the workers and when the results of the experts reflect the corporate work coherences, the work contents and the work tasks in their real forms can be identified.

A possible course of such a workshop is sketched in Figure 3.

As a result the characteristic work coherences and their qualificational requirements should be identified for each occupational profile. A preliminary differentiation of the work tasks according to their special relevance is an advantage. This can, however, also be realized in one of the subsequent phases.

A workshop atmosphere marked by confidence and creativity is one of the most important prerequisites for the success of a workshop as all involved expert skilled workers are thus able to contribute their entire experience and competency into the analysis process³.

Realization of the first expert skilled worker workshop

The course of the first workshop (cf. Figure 3) must be exactly planned. It should, however, not be structurized too closely if it should be successful. Two corner points have to be ensured by the researchers by all means:

- The experts must quickly realize that their »professional« know-how is in demand.
- The contribution of know-how must be possible without structural restrictions or improvements.

As soon as the »expert material« is available, re-working or touching up can be easily organized within the framework of the evaluation of the first workshop.

³ Researchers with the same professional background such as the experts easily tend to correct or improve expert statements and to hint at the latest developments. According to the experiences made by the author, this leads to a affront of the experts and cannot easily be compensated. It is much more promising if researchers who wish to »shine« are not taking part in these round table discussions.

Steps	Focus on contents	Time
1	Objectives of the workshop Method of the workshop	
2	Expectations of researchers and workshop participants <ul style="list-style-type: none"> • functions/ fields of tasks of participants • short professional biographies (methods promoting the communication are preferable)	1 h
3	Identification, selection and formulation of professional work tasks (Method: Brainstorming, deepening expert talks, instruments such as Meta-plan, posters, transparencies ...) Facilitators and experts develop an understanding for the work tasks <ul style="list-style-type: none"> • Work tasks must represent work coherences! • Work tasks have to be relevant for the occupation. Hint: Expert talks of high relevance (interview guidelines aiming at specialized questions is preferable)	3 h
4	Exact formulation and structurization of work tasks Grouping of work tasks	2 h
5	Relevance of the work tasks for the current and prospective occupational profile Guiding questions: <ul style="list-style-type: none"> • Which characteristic fields of work mark the occupational profile? • What are the most important skills for this occupation? • Expectations for the occupation (company, society, customer, person his- or himself) Amendment: Which are the challenges relevant for the occupation in the future?	1 h
6	Preliminary assessment of a high number of work tasks	1 h

Fig. 3 Structure of an expert workshop

Second expert skilled worker workshop: Method/ approach

The second workshop concentrates on the evaluation, the weighting and the final grouping of the work tasks.

The expert group should be composed in a similar way as in the first workshop albeit with a maximum of one third of the same persons. Two thirds of the participants should be changed in order to more easily revise potential erroneous trends of the first workshop.

In order to evaluate and group the existing work tasks, they are compiled in a list and evaluated according to the following questions:

1. How frequently does the respective task occur every day? (4 evaluation levels)
 - rarely
 - occasionally
 - weekly
 - daily
2. What importance does the occupational work task have for the skilled worker and what is the estimated future importance?
 - easy
 - less difficult
 - difficult
 - very difficult.
3. How difficult is it to carry out these tasks in a qualified and efficient way? (4 evaluation levels)
 - easy
 - less difficult
 - difficult
 - very difficult.

In addition to a questionnaire for the task analysis, the experts should be given a guideline for the completion of the questionnaire, the list with the occupational work tasks with corresponding explanations as well as the list of criteria with the description of the scales (cf. Figure 4).

<i>Occupational Work Tasks</i>	<i>Frequency</i>		<i>Importance</i>		<i>Difficulty</i>
	<i>Valuation (0 – 5)</i>	<i>Development (↑ 0 ↓)</i>	<i>Valuation (0 – 5)</i>	<i>Development (↑ 0 ↓)</i>	<i>Valuation (0 – 5)</i>
1. <i>Occupational Work Tasks</i>					
2. <i>Occupational Work Tasks</i>					
3. <i>Occupational Work Tasks</i>					
4. ..					

Fig. 4 *Questionnaire for the valuation of occupational work tasks*

The values of importance and frequency allow to assess whether the respective work task should be allocated to the core, the specialized typical or the company specific areas of an occupation. The core area encompasses tasks which are an indispensable part of the occupation and must be mastered by every automotive skilled worker. The specialized typical area comprises branch specific tasks. The company specific area is composed of special tasks which do not have to be coped with by everyone. The valuation of the difficulty gives hints for a time frame of training contents within the curriculum.

According to the result of the evaluation the work tasks are comparatively precisely assigned to four groups and internally sorted. The individual groups correspond to the concept of the structurization of learning and work tasks mentioned earlier.

The evaluation of the grade of difficulty and the subjective judgement of the experts is used to bring the work tasks in a training logical order and to assign them to the four learning areas.

These phases result in any case in a canalization of work tasks. The researchers must carefully monitor this process in order to avoid that the experts do not focus on a structurization of tasks of skilled work according to their relevance but according to partly or entirely known specialized systematics.

As for the recycling and automotive service sector, 17 work tasks describing the profession of a eco recycler or car mechatronic could be formulated in the second workshop (compared to approx. 70 tasks after Workshop No. 1 – see Blings/Spöttl 2003). The following overall structurization characteristics were identified:

- the basic service,
- the repair of wear and tear,
- trouble shooting and diagnosis,
- the expert diagnosis.

The structurization coherence corresponds to the above mentioned four levels:

- Orientation and overview knowledge ? basic service
- Coherent knowledge ? repair of wear and tear
- Detailed and functional knowledge ? trouble shooting and repair
- Specialized systematic deepened knowledge ? expert diagnosis.

In case of tasks reaching out into more fields of tasks training logical reflections must be made before deciding how to define them for an educational training plan in terms of amount and quality. It is typical for the entire structure and the individual tasks that they do not longer correspond to a specialized systematics. For experts from the practice the formerly acquired systematics has considerably lost importance. Today the challenges a skilled worker is facing form the basis. Therefore it is more than justified to apply the logic of work tasks relevant for skilled workers as the basis for the shaping of occupational profiles. Nevertheless it remains necessary not to neglect the prospective dimension.

4.3 Step 3: Vocational educational scientific work process analysis/study

The work process analyses (cf. Figure 1) mainly aim at identifying (see Spöttl/Becker 2007)

1. the work process knowledge for the shaping of vocational educational processes and professional ordinances (vocational education plans),
2. the findings about the (qualifying) shaping of work processes promoting learning and of the work organization,

3. the findings on the shaping of man-machine-interaction as well as of other working systems by considering their qualifying tutorial quality (cf. Rauner 1997, unpublished manuscript).

The discussion of the contents of skilled work is considerably increasing compared to the determination of work tasks in order to gain detailed knowledge for the shaping of vocational education plans and work process oriented learning processes. The two most important goals are:

1. Genesis of the knowledge and skills incorporated in the practical skilled work oriented to the already assessed work tasks;
2. Developments of overall vocational training plans with several learning environments and a fine structurization encompassing all relevant contents.

In order to attain Objective 1, the expert group of workshop 2 - based on the identified work tasks and above all the work process oriented and training logical structurization – precisely identifies what marks

- the contents and
- the coherences

of the work tasks and which qualitative level can be assigned to the work tasks with regard to knowledge and skills.

The result is a catalogue of comprehensive and sorted differentiations of work tasks which represent the corporate work process in all details.

Only this phase marks the end of the second expert skilled worker workshop.

A still deeper access to the work process is achieved by vocational educational scientific work process studies which will be discussed below.

The next step is the development of a vocational education plan encompassing several learning environments in a highly differentiated way (this can be reduced later in order to shape the vocational education plan more flexibly). This can be done by a third (or the continuation of the second workshop amended by trainers and teachers) expert workshop of a day's duration involving the following persons:

- Sector experts: 2 to 3
- Instructors/ Training planners: 1 to 2
- Teachers: 1 to 2
- Social partners: 2 (if possible)
- Vocational educational scientists: 2

This group of experts has to perform three tasks:

1. Amendment of work tasks provided they are relevant for an occupation and have not yet been named.
2. Optimization of the structure of work tasks and formulation of the task profile in order to them correspond to a learning and training logic and to ensure that they are highly relevant for the occupation.

3. Differentiation of the work tasks which

- form a core area or
- an elective area and
- which correspond to a special regional or corporate interest.

Two perspectives play an important role in this last step:

1. The overall coherences of work processes remain unchanged as a characteristic of the work process and the requirements for qualification are clearly named.
2. The educational relevance of the work contents (in a shaping oriented perspective) is formulated.

After this phase the work may be regarded as accomplished due to the fact that a catalogue of comprehensive and differentiated work tasks has been created which is suitable to represent the corporate work processes in all details.

In order to work out more concrete links for a work process oriented learning, it is recommended to carry through work process studies. They considerably contribute to access the educational relevance of work contents (e.g. the shaping of diagnosis processes and devices) as well as to investigate the coherence of the work processes. Questions of the development of the personality during the work process are focused and thus also questions regarding the opportunities of a pedagogically justifiable shaping of work which promotes qualification and learning.

5. Conclusions for research and vocational education

The consequent carrying through of work studies, work process studies and expert workshops turned out to be suitable to access occupational work process knowledge in the automotive sector as well as in the recycling sector. In addition it was shown that this is no secondary knowledge which is deducted from a technical-scientific knowledge via didactical reduction. Moreover it shows its own quality. This results from corporate work processes and can only be accessed with the help of skilled workers who are experts in their field of work and furthermore have sufficient experience and are able to reflect their own learning processes.

Opposed to the tradition of the construction of occupational profiles according to fields of themes, courses, emphasis on technology etc. it is recommended to make use of the work process knowledge as a structurization aid. It already incorporates the coherences between the various models of work organization and the corporate interaction patterns and it makes the artefacts constructed by engineering with their real characteristics visible in the work process (cf. Spöttl 1996). Furthermore it may be reflected how e.g. learning processes are to be shaped in order to promote the development of the personality in the work process, how shaping tasks can be taken over or which opportunities of a pedagogically justifiable shaping of work promoting learning can be realized. With regard to the work processes this is likely to trigger a further discussion of learning fields and the »underpinning« for learning field concepts.

The explained set of instruments is suitable for vocational education sciences to get a completely new access to the world of work. They help with the development of adequate vocational education plans and to reflect a didactics of vocational education which does justice to vocational education as it is not simply copied from general education⁴.

⁴ The status of didactics in vocational education can be read in Pahl (1998).

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