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Influences of decision under uncertain information on IT - management

Wpływ procesu podejmowania decyzji w warunkach niepewnych na IT - zarządzanie

Abstract: *To navigate an enterprise successfully in a global market means to recognise changes and risks correctly and to decide how to act and react. Agitation is only possible, when countermeasures have been undertaken before the risk emerges. This implies a target system, which besides the target variable provides a behaviour pattern also. On the basis of this behaviour the following basic questions can be postulated: How can we make decision making more secure with regards to the target system? What kind of IT - support is necessary in this respect? In this article we will show the importance of decisions based on uncertain data and their influences on IT - management and IT - platforms. First of all, we show the basic theories in dealing with turbulences and uncertainties. By presenting examples of two different branches, in medical health and in architecture we demonstrate a systematic solution for diminishing and even avoiding risks in the operational context of an enterprise.*

Streszczenie: *Zarządzanie przedsiębiorstwem na rynku globalnym wymaga rozpoznania zmian i ryzyka. Niepokój jest możliwy tylko wtedy, gdy środki zaradcze zostały podjęte przed pojawieniem się ryzyka. Wpływa to na wybór systemu docelowego, na który oprócz zmiennej docelowej składa się również wzór zachowania. Na podstawie tego zachowania wyłaniają się podstawowe pytania: Jak możemy podejmować decyzje bardziej bezpieczne w odniesieniu do systemu docelowego? Jakie IT jest konieczne, aby wesprzeć w tym zakresie działania? W artykule przedstawiamy znaczenie procesu podejmowania decyzji w oparciu o niepewne dane i ich wpływ na IT zarządzanie i IT platformę. Przede wszystkim przedstawiamy podstawowe teorie umożliwiające podejmowanie decyzji w turbulentnym i niepewnym otoczeniu. Na przykładzie dwóch różnych obszarów, w służbie zdrowia i architekturze, proponujemy systematyczne rozwiązania dla zmniejszenia, a nawet unikania zagrożeń w kontekście działań operacyjnych przedsiębiorstwa.*

1. Basic knowledge and topic

Risk management does not only include the systematic recognition and valuation of risks by which you are confronted on the way to reaching your targets, but also contains the action and reacting to risks detected as well

as control of the measurements established, derived from the basis of the actual knowledge.
Risk management starts with an enterprise strategy and is continually updated by the change management and control regarding the change of influences, critical success factors and their evaluated context [1].

Very important changes are visualized by a turbulence map which combines these changes with the experiences or these turbulences. By this map the requirements for the risk management team has to be crystallized. After each risk evaluation an organizational measurement has to be initiated. In order to fight risks effectively the following three points are a “sine qua non”:

1. the information has to be of utmost actuality
2. the relevant condition people have to be at hand
3. decisions have to be realized in real time

This demands a well performing communication platform, which normally is the responsibility of the IT management.

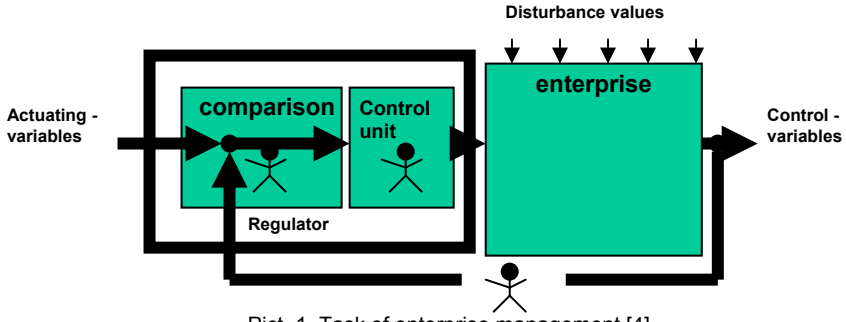
Since early days workflow-management-systems (like INCOME) used the “Monitoring” for early detection of diagnosis parameters (risk ratios). These enabled a quick reaction before the critical point had been reached.

Simulation programmes have been used to pre-estimate the consequences of the measurements planned regarding the future of the enterprise.

There exist many ways and methods to manage an enterprise. For example the “Scenario technique” is used to make future developments visible and provide a general orientation. Well known methods in the field of quality management are TQM (Total quality management), EFQM (European foundation quality management), ISO9001 or Business process redesign, FMEA (Failure Mode and Effects Analysis), SIX SIGMA. Other applications are knowledge based management systems (BAMBOO), project planning systems, trouble shooting systems, mailing systems, neuronal networks, early warning systems, combined with Fuzzy logic or cockpits. Success factors are outcomes like order situation or customer satisfaction. Success is controlled continually: if it does not come up to the expectations, reaction is necessary.

Risk management enables a quick response and is an advantage factor in competition. Here the influences and the success factors are collected systematicly. Influence factors normally are calculated by a market analysis and are documented in an unstructured data collection. Usually a market analysis is done, when a new product, and this means a new business process (BP) is implemented in an enterprise. BP’s are efficiency-oriented and require a transparent information exchange between the players.

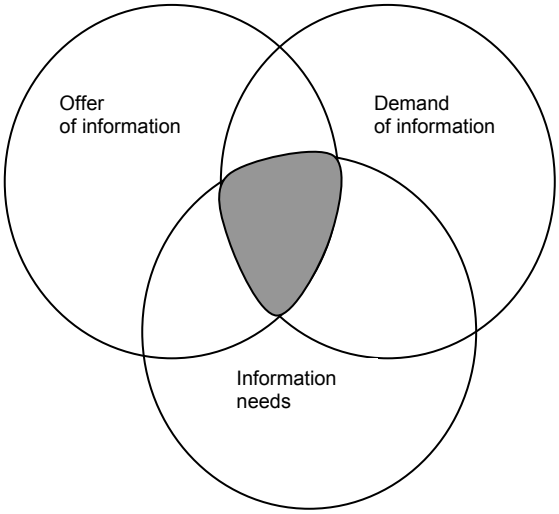
But it would mean hard work for a player, to inform all people concerned that there has been a change in the business environment since the last BP has been released or even to find out if there has been a change and if yes, what precisely the change was. This demands a fully automated regularisation, so the action is not the responsibility of the player.



Pict. 1. Task of enterprise management [4]

Should the action rest on the shoulders of the player, the result could be different according to the risk tolerance. Therefore a cooperation platform is necessary before an initiative is taken, as well as an appropriate information platform to store empirical values and to retrieve condensed values [7].

From the point of view of coordination we have to implement a control unit, where the enterprise has the role of the actuating variable which is regulated by the control unit. This unit guarantees that the actual value independent of the disturbances is kept on a guidance level (Pict. 1).



Pict. 2. Level of Information [5].

From the point of view of risk management the cooperation platform has to support the decision making, in contrast, the latest knowledge will be collected in the Information platform.

Observers the different levels of information – this also belongs to risks (Pict. 2) - we discover that it is necessary to divide knowledge. But it is sometimes also necessary to keep information dark. The division of knowl-

edge is possible if the people understand the background. The complexity can grow quickly way. IT has to solve these problems.

Using the cooperation platform new experts can operate to discuss every thing. So the locating of the best measurements accelerte. Also the newest evaluations, set of regulations, norms and standards will enlarge the functions of the information platform.

2. The Information platform

In this chapter we wish to show the intension and task of an information platform in the field of Medical Health: „Fighting against cancer“ by an example of the Clinical Cancer Registry CCR [10] of the Comprehensive Cancer Center Ulm CCCU. We will show the problems in the field of cancer treatment and discuss the solutions and give a glance into the future.
We define an information platform as a set of tools which enables the player to fulfil his role in cancer treatment and to reach the goal aimed for. i.e. to ensure the diagnosis and treatment of the patient is state of the art.

The information has to be:

- relevant regarding the problems, task
- condensed and quickly available
- understandable for the person concerned
- comply with his educational background
- the people concerned have to speak with the same tongue, they have to know the technical terminology (often a problem between Doctors of Medicine and IT Specialists)
- data has to be comparable, in the field of cancer this is ensured by a standardized key or codes, which describes the diagnosis (i.e. ICD 10) and the degree of the disease at the time of diagnosis.

The tools of the information platform can be realised by databases, EXCEL-sheets, condensed data, standardized and individual data analysis, e-mails(automated or part of a structured information procedure, path), Internet Platform (password ensured or public), Blogs, chat rooms, collection of problem oriented internet links, collection of technical or mandatory descriptions (Quality handbooks, SOPs (Standard operation procedures), networks, organized information paths, or simply organised communication paths.

The Information platform is the basis of all decisions, measurements, action and reaction.

2.1. introduction Cancer treatment

To understand the problems in cancer treatment You have to know the characteristics of cancer. We distinguish between two kinds of cancer: solid Tumours which are manifested in an organ (i.e. breast, colon, prostate and systemic tumours which are diseases of blood like Leukemia and Lymphoma, i.e. they can’t located to a specific part of the body.

Cancer is a very special kind of disease. The mystery of cancer origin still is not solved. Patient treatment covers a long period, often several years and takes place at different locations inside and outside of the clinic.

There are disease free intervals replaced by phases of intensive care. Many disciplines are involved in diagnosis and therapy (pathology, radiology, surgery, inner medicine …etc.). There exist lots of very differentiated treatments and combined treatments (i.e. Operation, operation and radiology, operation and chemotherapy) There are new approaches like gene therapy. There are many aftercare programmes (cancer site oriented). Some cancer is very rare with only a few cases a year, European cooperation is needed to get experience on these sites. Last but not least the development of the disease is very individual. Results can not be predicted.

This results in a wide range of activities, combined with many problems still not resolved. In interdisciplinary tumorboards the procedure of treatment is discussed by a group of highly specialised personnel.

Organ specific research is done on a wide range. There are programmes in the front end of the disease like Cancer prevention (Minimising the risk of getting cancer by avoiding carcinogenic food contacting carcinogenic material, baying smoking, etc. and early detection, i.e.) and cancer prevention at an early stage**.** Experience has shown for a lot of cancer sites, the earlier the detection, the better the prognosis. Therefore a lot of screening programmes have been initiated in Germany, actually for breast, Colon and lung cancer ...etc. These activities are in the hands of the national and federal authorities.

From these characteristics arise a lot of problems. The activities have to be coordinated to avoid redundancy. Competences have to be defined to avoid competence debates and unnecessary treatment. The follow up information is hard to get, when patients leave the clinic and are treated by specialists outside the clinic. It is hard to distinguish between relevant and irrelevant information. The doctor has to be informed of special treatment studies at the time of diagnosis. Cancer treatment is costly therefore the resources have to be distributed carefully. All in all quality assurance is necessary in all activities.

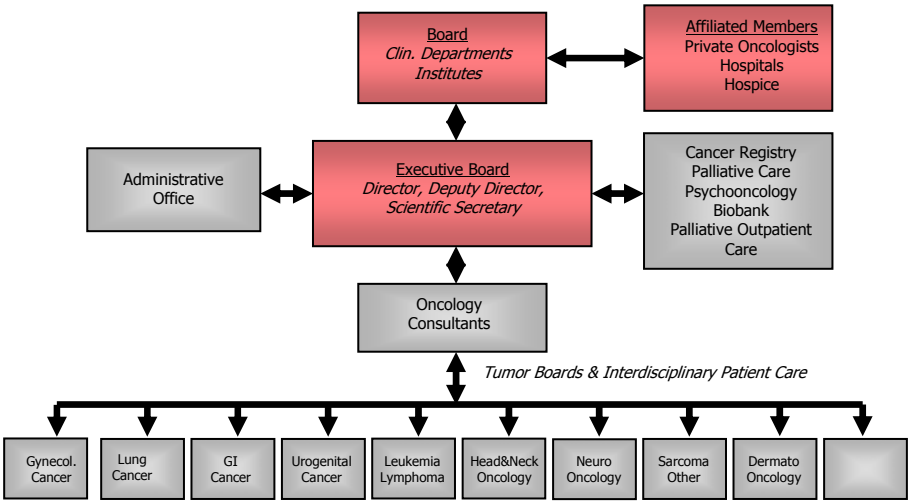
General problems are to comply with the legality of data privacy.

2.2. Comprehensive Cancer Center Ulm CCCU and Cancer registry [8]

The center is led by an Executive Board, composed of the Director, Deputy Director, and a Scientific Secretary (Pict. 1). The Executive Board is nominated by the Board of Directors of the University Hospital for a three-year term. Directors of the clinical departments and institutes which have a focus on clinical care and/or research in oncology constitute the CCCU Board. Members of the Executive Board have weekly business meetings, and Board meetings are held once a month.

Core CCCU structures include an administrative office, the Clinical Cancer Registry, a palliative and psycho oncology service, the CCCU biobank, and the outpatient palliative care. Currently, the CCCU has 22 affiliated members outside of the University Hospital, including 12 private oncologists, 9 oncol-

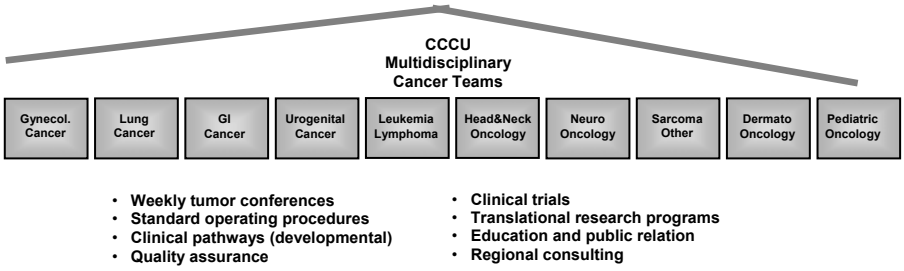
ogy departments in regional community hospitals. In 2007, a cooperation agreement was signed between the CCCU and 12 private oncologists.



Pict. 3. Current organizational structure of the cancer center [9]

Multidisciplinary care (Tumorboards)

One additional important core structure is the oncology consultant service that has been implemented since 2006/2007 for all multidisciplinary teams. Ten oncology consultants (see pict. 2) rotate from the various clinical departments to the CCCU for one to two-year terms. The main tasks of these consultants include preparation and organization of the weekly tumor conferences, updating of standard operating procedures, implementation of new treatment trials, consulting oncologists outside the CCCU (telephone hotline), quality management of the Clinical Cancer Registry, or education and public relation activities (electronic newsletter). These positions have been shown to be very attractive for medical and surgical oncologists for their further training and education in clinical care and clinical research activities as well as for their career development.



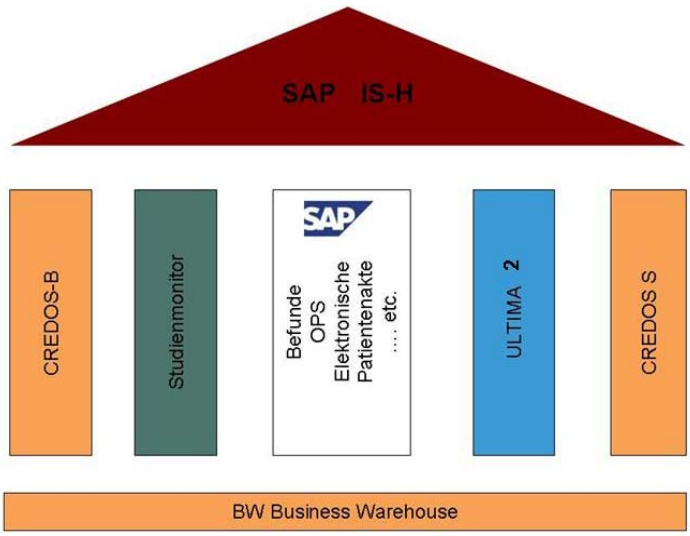
Pict. 4. Implementation of 10 multidisciplinary cancer teams – Tumorboards [10]

Over the last four years standard operating procedures for the diagnosis and treatment of all tumor entities have been established within the CCCU. These SOPs replace all so far existing departmental SOPs for cancer care and will be updated on a yearly basis or in case of particular advances in cancer care. These SOPs have been developed according to state-of-the-art evidence as well as national and international guidelines by the multidisciplinary teams led by the respective board consultant. Written approval has been obtained by all department directors who are actively involved in the treatment of the type of cancer for which the particular SOP applies.

Cancer Registry – IT technology

The general task of the cancer registry is to support the activities of the CCCU by IT-instruments (Pict. 3) at its best. These tasks are:

- to ensure information for data registration of the cancer registry and certification of Organ Centers,
- to support the tumorboard in organisation and preparing information for the discussion of the procedure of patient treatment,
- to ensure quality management within the university clinic of Ulm,
- to provide data for the federal cancer registry to ensure quality management withiin Baden Württemberg,
- to provide information on clinical trials and patients included in trials,
- to support the clinical departments with the information needed,
- to ensure benchmarking within Germany which is under the charge of the ADT (national working committee of the cancer centers).



Pict. 5. IT-Structure of the CCCU within the HIS [11]

The IT mainly consists of 5 programmes:

- HIS SAP IS-H Information H,
- CREDOS-B and CREDOS-S databases of cancer registry and Organ Centers,
- ULTIMA Tumorboard information and documentation system,
- USMS Trial documentation and information system,
- BW-QMS quality assurance system.

Besides we have a lot of temporary Solutions.

These tools are the backbone of the Information platform of the CCCU as a temporary solution.

2.3. Information platforms of the CCCU

From Pict. 1 and 3 you can derive the tasks of the IPF.

SAP IS-H is the Hospital Information System (HIS) of the university clinic Ulm and is in charge of the Hospital IT department (ZIK). SAP IS-H is the backbone of all Information platforms. The Hospital Information System (HIS) is based on the SAP R3 System with the components IS-H (Information Hospital System) and the clinical workstation system i.s.h.*med. IS-H is designed to manage the administrative, financial and medical aspects. i.s.h*med is the backbone for patient administration, care and treatment. It contains basic functions which can be used in all departments and service facilities and provides solutions designed for the special needs of the departments such as the OP-module for surgery, MEDAT for laboratory diagnostics or PACS for radiology.

A central tool of the HIS is the electronic patient file (*Patient Organizer*). It contains all relevant information of a patient's medical history such as medical reports, pathology reports or reports on diagnostic and therapeutic procedures. All guidelines/standard operating procedures for our cancer patients are accessible via the HIS electronic quality management manual (QM Hand book).

In this chapter we discuss the goals, the solution and the advantages in risk management for each tool.

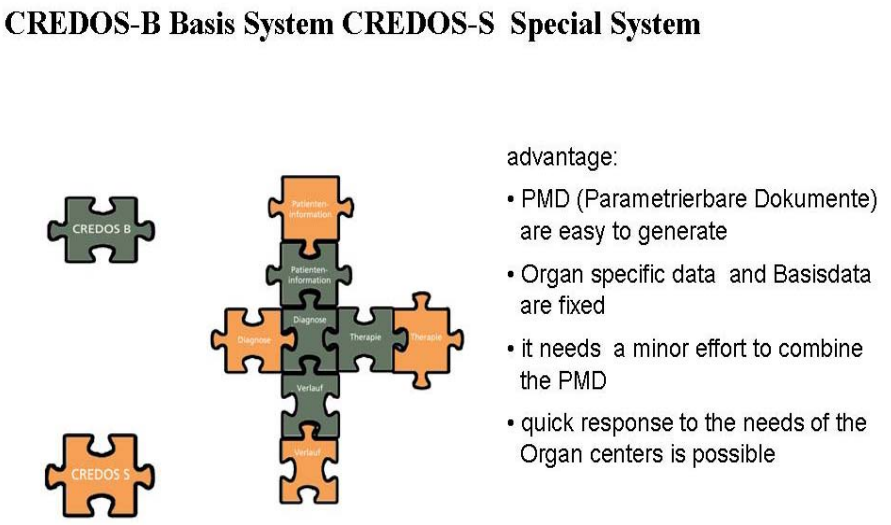
2.4. Tool CREDOS (**C**ancer **R**etrieval **E**valuation and **DO**cumentation **S**ystem) **[10]**

Goal

Ensure data capture for the needs of the Clinical Cancer Center CCR and the Organ Centers. Provide a tool for information management. Provide data for the purpose of quality control and assurance in the university like quality control of the CCR, of the tumorboards and the research activities. Providing data for the federal clinical cancer register of Baden-Württemberg according to the data registry act.

Solution

Credos consists of two Software components CREDOS-B (Basis System) and CREDOS-S (Special System) and is in charge of the CCR Clinical Cancer Registry. CREDOS-B supports data capture for all cancer sites (solid and systemic). CREDOS-S supports the data capture for the needs of the Organ centers (see Pict. 6).



Pict. 6. CREDOS components [12]

CREDOS-B was developed 1999 in collaboration with Siemens Health System (SHS) and is embedded in the HIS. CREDOS uses the technique of PMD(Parameterised Documentation). CREDOS-B ensures the documentation of all patients data relevant to the Clinical Cancer Registry (CCR) and follows the national standard of the ADT (Working committee of the Cancer Centers of Germany). It is The only cancer documentation system within SAP IS-H and solves most problems of a clinical cancer center. The system is highly elaborated and has been licensed to 11 clinics amongst them university clinics of Munic (2), Braunschweig , Ulm, clinic of Bremen (4), Mannheim, Konstanz, Ravensburg and Lörrach Rheinfelden) in Germany from Munich, Ulm, Mannheim up to Bremen and Braunschweig. This enabled us, to employ 2 System programmers for System maintenance and development. This makes us independent from the producer.

CREDOS-S was developed in 2009 in collaboration with Siemens Health System (SHS) and allows releasing data bases for the certification of the Organ cancer centers according to DIN ISO EN 9100 as well as according to the rules of the Deutsche Krebsgesellschaft (German Cancer Society). By a technique, invented by the head of the cancer center (see Pict. 6), these special documentation screens can be combined With CREDOS-B in an easy manner. For the purpose of evaluation we have got a a temporary

solution outside the HIS. The CREDOS data of the HIS are downloaded on to an ACCESS data base and evaluated with EXCEL. By the help of pre-generated Excel evaluations we generate standardized evaluation reports.

Advantages in risk and change management:

The safety of the system, hardware (servers, clients), software and data are the responsibility of the IT department of our clinic. Changes in data because of new legal regulations or needed by organisational reasons can be answered quickly. We got two user groups: IT manager and documentaries, where user wishes and improvements can be discussed. We meet once a year and decide what to do next.

At the moment there exist 3 Organ Centers at the CCCU (Breast-, Colon- and Prostata Center). 2 more Organ Centers (Skin and Lung) are planned. The data registration of the Colon- and Prostata Organ centers are already implemented. We have successfully taken part in the certifying process of the Organ Centers of Prostata and Skin. Especially our combination of HIS, basic registry and Organ specific documentation got the approval of the audit authorities.

2.5. Tool ULTIMA (**U**lmer **T**umor Information and **MA**nagement **S**ystem) **[13]**

Goal: Support of execution of the tumorboards at all stages such as: documentation, administration, registration, preparing necessary information needed, formulation of the problem and finally the a protocol of the decision of the tumorboard.

Solution: ULTIMA is based on the SAP Web Dynpro technique which is available since 2008 and is under the charge of the CCCU. This web-based tool has been developed for the management of the tumorboards. It allows to register a patient at a particular board from all clients. Most information relevant to a patient's history can be accessed directly in ULTIMA (pathological findings, doctors letters, laboratory findings, tumorboard decisions, data of the clinical cancer registry (CCR).

Since ULTIMA is integrated in the HIS we don't have the problems with interfaces. The information needed for decision making can be most effectively prepared for the tumor conference. The Information can be stored in a condensed manner. The doctors taking part in the conference can inform themselves easily by just connecting via the web Browser.

Because of integration into the HIS the process automatically complies with the regulations of data privacy. Once a board decision has been made, a board protocol is generated containing the problem formulated and the tumorboard decision of the experts.

This document is deposited in the HIS electronic patient file (patient organiser) as a PDF document, and it is then accessible to all medical doctors involved in the patient's management. All the addresses of all the specialists taking part in the conference are Stored in ULTIMA so they can be invited

and informed automatically. By using ULTIMA the conferences are more effective and the number of patients being discussed in the tumor conferences increase steadily.

Advantages in risk and change management: The implementation of interdisciplinary tumor boards has been a learning process for many of the specialists involved who in the past were used to taking decisions on their own. Accordingly, in the initial phase the proportion of patients presented to the boards was rather low. Through a process of continuous education this proportion steadily increased and reached a median value of approximately 60% in 2007. It is one major goal to increase this figure to >95%. By automatic e-mailing of an invitation to the doctor's of the university needed combined with implemented rules for information flow (doctors have to confirm the invitation or name a representative) the tumorboard is assured. The same applies to the protocol of the tumorboard, so a quick response is ensured. Doctors outside the clinic are informed in the traditional way by letter. There exists a SOP according to the ways of registering a patient.

2.6. Tool USMS (**U**lmer **S**tudien **M**anagement **S**ystem) **[14]**

Goal: Research takes part in all the different institutions of the clinic. It is very cumbersome to get an overview of the studies being active and patients included in the studies. In 2008 we applied for Funding by the programme for the development of Interdisciplinary Oncology Centers of Excellence in Germany and needed just those data like no. of active trials, no. of patients included …etc.

About 10 people have been busy for up to 4 weeks, to get these numbers. When a patient comes into the hospital it is vital to be informed if he takes part in a trial programme. This situation is defined as an Serious Adverse Event Information SAE. By law the doctor in charge of the trial has to be informed within 24 hours, when an adverse event occurs. So every workplace where patients are treated has to know if the patient takes part in a trial.

Solution: USMS is based on the SAP Web dynpro technique like ULTIMA and is under the charge of the CCCU. It's a tool to capture data of the trials and of the patients included in trials. Of special importance are the addresses of the doctor in charge of the trial and the study nurse of the trial secretary.

Because of HIS integration USMS provides information on every working place in the clinic. There is a special feature for SAE Messages: when a patient is registered in the clinic USMS automatically sends a SAE Message to the doctor in charge of the trial and to the trial secretary concerned. This information may decide between life and death of the patient.

Advantages in risk and change management: The automated SAE message is a big step in the quality assurance of trial patients. Further vital data are the exclusion of a patient from a trial.

2.7. Tool Business BW-QM quality assurance

Goal: This report has been initiated by the request of the head of the university clinic of Ulm. The director of the clinic invested a lot of money into personnel of the tumorboards and the data registration team. The BW-QM has to provide timely data on variables such as the number of newly diagnosed cancer patients, proportion of newly diagnosed patients presented to the interdisciplinary tumor conferences, or the proportion of patients entered into clinical trials.

Solution: Business Warehouse Cancer Report
The HIS SAP IS-H provides a special Software BW (Business Warehouse). It's a data warehouse in the classical sense of informatics with all the functions such as: integration of data of different structured and distributed data pools, to enable a global sight on the data and ensure global evaluation, ensure quick and flexible access to reports, statistics and key figures to ensure the best cancer treatment for the patient.
The tool captures data from the HIS, CREDOS, ULTIMA and USMS. system. The report is generated on a quarterly basis and presented to the CCCU Executive Board and to the Board members. It allows the Executive Board to control multidisciplinary patient management and clinical trial activity.

Advantages in risk and change management: Furthermore, we will take advantage of the multidisciplinary tumor boards to significantly increase clinical trials activity, in particular in those areas, where the activity currently is low.
Finally, we aim to attract more regional specialists to use the structure of the CCCU tumor boards. To this aim, we will improve the IT - structure between the CCCU and regional specialists, e.g. by offering video conferences.

3. The Coordination platform

The characteristic of coordination is the tuning of dependent activities between the parties interested. Here we discuss at first the targets of a coordination platform, and from this result we deduce the requirements and the solutions.

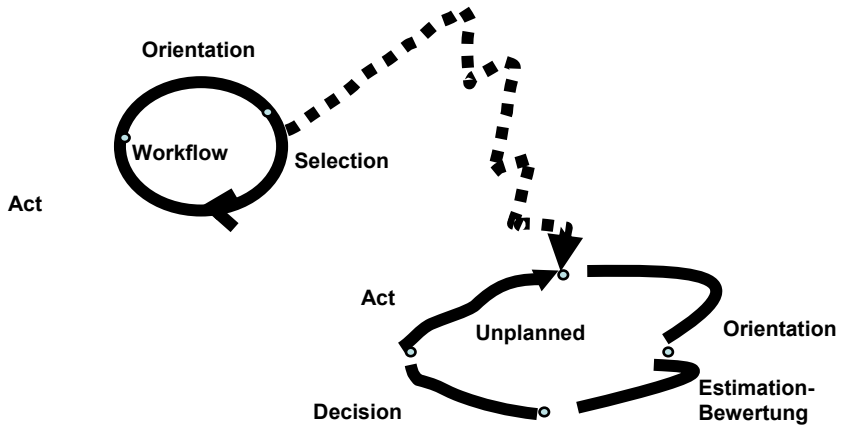
3.1. Targets and Requirements

Our target is to establish a platform to support the reaction of a recognized situation. A *distributor of Information* has to see to it that all people who are competent to estimate the influences and risks are informed automatically. If there are changes in the Workflow it is necessary to inform all people concerned about these changes. This will also be done automatically too.

With the help of an *Orientation Component* we will support all process owners to correct their processes to minimize the risks. The Component will quickly provide the measurements needed, submitted by competent people.

An Estimating Component will be supplied to classify the influences in little or large risks or catastrophe related to enterprise strategic.

To support the reaction processes means also looking at the relevant changes in the environment of an enterprise in a brisk way. All people concerned have to know about the unplanned situation and to take measurements, decided by competent people.



Pict. 7. Interrupted planned Workflow [2]

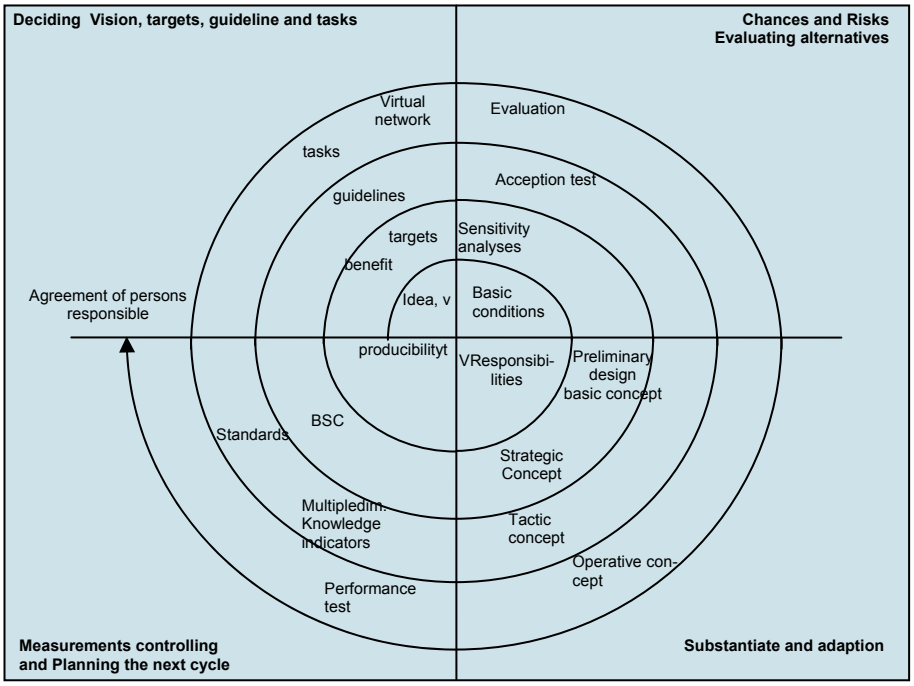
As seen in picture 7 we have to interrupt a planned workflow to react to unplanned situations, sometimes to minimize some risks, sometimes to augment some chances. So we need a workflow management system to control the planned and unplanned processes.

Influences are to be estimated and prioritised relating to the success of an enterprise.

Our proposal is to find the best measurement to minimize the risks (see in Pict. 8) according to the spiral model of Boehm [3].

Good reasons are:

- Integration of targets, alternatives and basic conditions,
- Minimizing risks,
- Identification of competent people to estimate the changes desired.



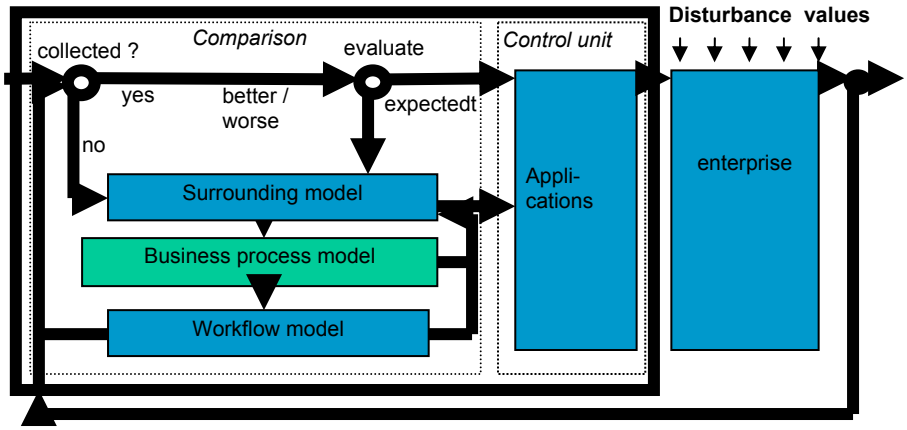
Pict. 8. Finding the best measurement [2]

3.2. Specific problems and Solutions

Being supported by a workflow management system, the GP will be able to integrate the desired measurements in the workflows in an easy and quick manner. The component orientated approach supports the multiple usage of components (also activities) and the usage of parameter to change the capacity of components.

Often, not only *one* Workflow (WF) will have to be changed by reaction of changing the environment. In this case each of the workflows concerned has to be changed explicitly. You have to find out which workflow has to be considered by the change [6].

People concerned are often surprised by changes. The question is also: does the change conform to the strategic direction of the enterprise? And if a change occurred is there also the possibility to make a new version of a WF. But who can decide which WF is the best in which situation?



Pict. 9. Principle of operation of the control component [4]

The answer is to save the influences factors of each working step. So the person in charge does not have to estimate the actual situation from the beginning again. So the risk of false decisions of a team member will be minimized because he can not estimate the actual situation.

Nobody knows all influence factors (EF). Therefore each time it must be possible to consider new influences. This can only be done by a competent person. Sometimes only a change of a value of the influence criteria is necessary. [5]

The control component (Pict. 9) controls all dependences to all WF automatically. We look at the actual and the expected values of success factors and their influences. By comparing these values with each other the selection of measurement will be done. This is only possible if all influences have been collected beforehand. But in case of small turbulences the choice of the right measurements does not have to be done by a person. In this case it can be done by an automated process.

The algorithm is as follows:

- define the list of influence-factors for the actual work-activity within the workflow,
- detect the actual values,
- find out the values and rate whether the actual values are better or worse,
- get informed about the whole situation,
- initiate the appropriate measurement and trigger information.

With the help of this function we have found very important and positive innovations to manage the business processes.

3.3. Innovations in the operational area of risk management

Our concept gives a optimal reaction support for the whole enterprise.

As a secondary effect the motivation of the team members will be improved. By describing the unplanned situation the team member can do his work competently. He is supported by well prepared measurements. The precondition is a well prepared information management, triggered by all changes.

The designer has now to learn this new approach. He has to support the integration of measurements in an active workflow.

From the technical point of view the workflow will be simplified. A strict arrangement is established to evaluate the risk, and to adapt the control flow while it is still active.

3.4. Benefits of risk Management

The key benefit is looking into the strategic direction of an enterprise because we think about the future and we build up these possibilities in our model. We describe the surrounding conditions and we describe the connection to each activity within a business process. With the help of multiple values of each influence factor we can select the best measurements with the function shown above.

On the whole we have found a method to regulate the control flow of an enterprise at any time and at any place by taking account of the actual situation. The team member has not to decide on his own what he has to do in a new situation. He will be supported in a quick and easy way. So the reaction time can be reduced.

4. The Cooperation platform for construction projects

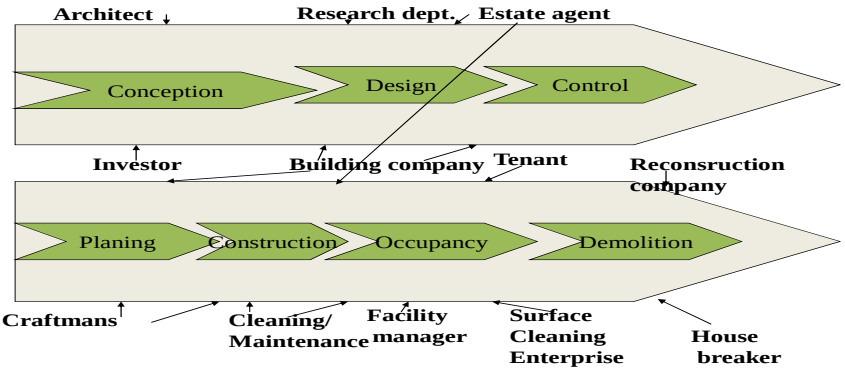
4.1. Context of the construction project

The construction process is characterised by the complexity, a huge number of actors. It is the sum of a problem solving process and a decision-making process. Cooperation is an important aspect of modern architecture and construction activities that operate in a globalized environment by taking into account the sustainable definition. Cooperation among project developers, local authorities, architects, engineers, contractors, building inspectors, clients, future users, and others, increases the pool of knowledge and skills available to undertake activities that exceed the capacities of any single person or organization on its own, thus making possible the design and construction of complex buildings.

The educational and disciplinary backgrounds of the participants are heterogeneous. While each participant contributes his/her own expertise, they also bring their own–often different–understandings, viewpoints, and preferences. However, it is advantageous to understand how the different parts of the process fit together. Waste, excessive cost and delays can result from poor coordination and communication among specialists [15,16,17].

4.2. Life cycle of the construction project

The construction of a building or of a facility represents a capital investment. The owner can be an individual, a private corporation or a public agency. The motivation for an investment comes from the market demands. Consultations are made by the owner(s) or by real estate developers in the case where a residential unit is sold. A real estate developer can be considered a sponsor. From the perspective of an owner, the projected life cycle for a constructed facility may be illustrated schematically in the figure below.



Pict. 10. Life cycle of the construction project

During the conceptual planning stage different alternatives can be taken into consideration. Technological and economic feasibility of each alternative is assessed and compared in order to choose the best project. In the case that different alternatives are proposed, the best one must be selected regarding the financing schemes. Then the project is programmed by respecting the time and the budget. After, the scope of the construction project is precisely defined and the final cost calculated.

In the procurement and construction stage, the delivery of materials and the working progress on the construction site are planned and controlled. When the construction is completed, there is a period of shake-down of the constructed facility when it is first occupied. Then the management of the building is given to the owner to find tenders until the building is designated for demolition or renovation.

The phases of the construction project are not sequential. Some phases are iterative, other must be carried out in parallel with, or at the same time, depending on the nature of the problem, of the size and of the urgency.

4.3. Risks of the construction process

Risks have a relevant impact on a construction project's performance in terms of cost, time and quality. Construction project, as seen, are complex

and have a large dimension. The ability to manage risks throughout the construction process has become a central element. Risks are shared between the project actors and are stated by the procurement option and by the content related contract documents. The international standard "Project risk management – Application guidelines" (IEC 2001) propose a model with four steps: risk identification, risk assessment, risk treatment, and risk review and monitoring. We include the risk of communication. The sources of risk are *controllable risks* (e.g. design, construction, management and relationships), *uncontrollable risks* (e.g. financial, economic, political, legal and environmental), and f*orce majeure risks*. *The risk response process* is directed at identifying a way of dealing with the identified and assessed project risks, risk avoidance, risk reduction, risk transfer and risk retention (IEC2001).

4.4. Cooperative environment

We define the workplace as follow. The workplace means the place in which actors work in their conventional design process. The distribution and centralisation of knowledge is similar to the design workspace in which they are called upon to work. Each team has its private workplace with its specific information (e.g. architectural team, economical and financial, electrical engineering, etc.), communication tools, agenda, simulation tools, and database with best practices. The work space is divided into a number of private design workspace.

The design workspace represents a distributed structure of private design workspaces. Each referring to one of the numerous participants involved in the design process for the implementation of expert solutions.

This structure is linked to an overall design workplace, shared by all the participants. They can visualize the merging of all the partial solutions. Then they are able to see which one should be verified. During the process each participant can create or modify his own personal design instance and his own personal workplace with the help of his expert knowledge and his own personal tools.

This is part of the overall design instance constituted by the merging of all the partial expert instances in the overall workspace. To merge them is still an open issue, unless we maintain multiple versions, each labelled with the author's name. Then someone has to merge the individual contributions into one composite.

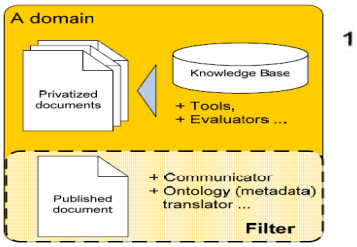
4.5. CAD and Building Information Modeling (BIM)

For a couple of years actors of a construction project use the CAD for supporting drafting and modeling. The IFC (Industry Foundation Classes" (IFC) allows the development of the 3D product model or building information modeling (BIM). Such models are based on the definition of objects (products). They support the handling of sub-processes.

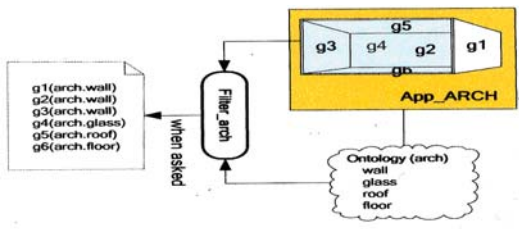
The entire process chain of construction business must be supported. The working environment contains the resources needed for the construction project (materials, machines, manpower, time, process components which are needed during the operative construction process, and the 3D-geometric-data.

Pict. 11. Construction process with BIM

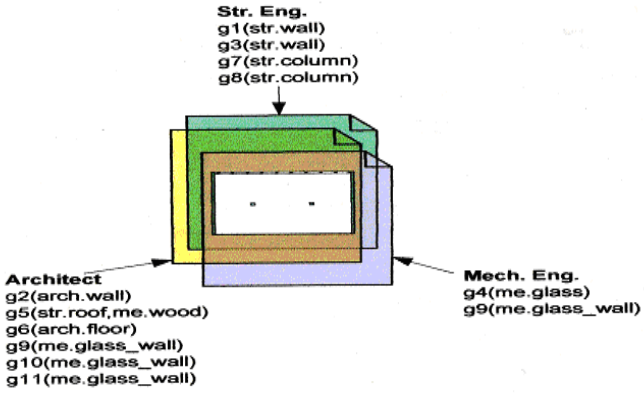
These commercial application programmers are solved within the domain they have been built for as they have very often similar, but specific, points of view, the one who first modeled the phenomenon years ago. The models underlain the application programmers themselves, as the concepts are implicit and tacit between the actors of that domain but not sufficient for supporting the cooperation between the actors. Not only data but also sharing meaning must be supported. Meaning is produced by placing the data within the appropriate cultural and professional frame of reference. Since the professionals who participate in the design of a building do not share the same educational, professional and cultural backgrounds, the frames of reference they use to construct meaning are different, resulting in different outcomes, which often lead to misunderstandings, conflicts, and ultimately construction delays and extra expenditure.



Pict. 12. the Filter



Pict. 13. Filter of the architect



Pict. 14. Global view of the project

The environment is equipped with 2 filters. The first one interfaces common knowledge with expert knowledge. The filter mechanism is the interface between shared information and private information. There is some project-dependent and some project-independent information in each part. The knowledge filter works at the level of concepts (ontologies, properties, relations, values). The second filter (instance data filter) works at the level of the individual data. It connects each individual data structure representing a personal instance to the data structure representing the overall instance. It is triggered by the first filter.

4.6. Communication and visualisation tool

The 3D design is the communication and visualization tool for the whole team. With the 3D environment, the actors can work or learn collaboratively, and later review those collaborations for better understanding.

For example, at the early stage, in the conception and design phase, the architect either plans the house (s) and designs the place in order to fulfill the requirement of the sustainable development. The house and the place must be cheap and attractive for future tenders and for future generation. To create this attractive place, the architect has various tools at his disposal like tabs, lists, text, images or videos in a universe entirely in 2D, however, the cooperative environment makes use of XML3D, which can incorporate interactive 3D scenes in the web pages desired. Unlike VRML and X3D which never managed to win because of compatibility issues and complexity, new computer language XML3D takes the basics of HTML internationally spread on the canvas and adds 3D capabilities.

The3D-design allows a process-oriented approach. It enhances the participation of the citizen in the debate in the conception phase by sending the conceptual drawing via Email. The citizen can walk around the buildings and the places sitting in front of his computer. He can annotate the 3D-design. It reduces the risk that the citizen won't accept the urban

decisions, that the tender or the user will accept to live in this place (e.g. La Courneuve where no one wanted to live. The building has been demolished). Picture 16 shows the workspace of the architect and the collected information during the feasibility phase. Picture 17 illustrates the data displayed in the common space. Interior design can also be created. The client can either create the plan, do consulting and manage the project, and focus on a high quality life standard.

4.7. Project planning

The planning from the engineering side (project scope, project plan, and evolution of 3D design on one side), and the construction side of the project (procurement, project control, change control, document management, project management guide) on the other side are linked and integrated into the construction process. By doing this, planning conflicts can be detected, costs and time by consolidating planning data are reduced. There are many take-off-meetings needed which are very time consuming. This task is performed manually by architects, engineers, etc.

The quantity of calculations remains one of the big risks in a project. The main planning activities and execution quantities are calculated from the consolidated construction model. Data of the Regulations for Contracting Construction Services, international standard is implemented and allows for calculating the quantities and the costs. Various methods of calculation are possible in the planning phase due to referencing to the 3D model.

The model-based approach increases the transparency of the operations, the merging of tendering documents and the handling of contract processes.

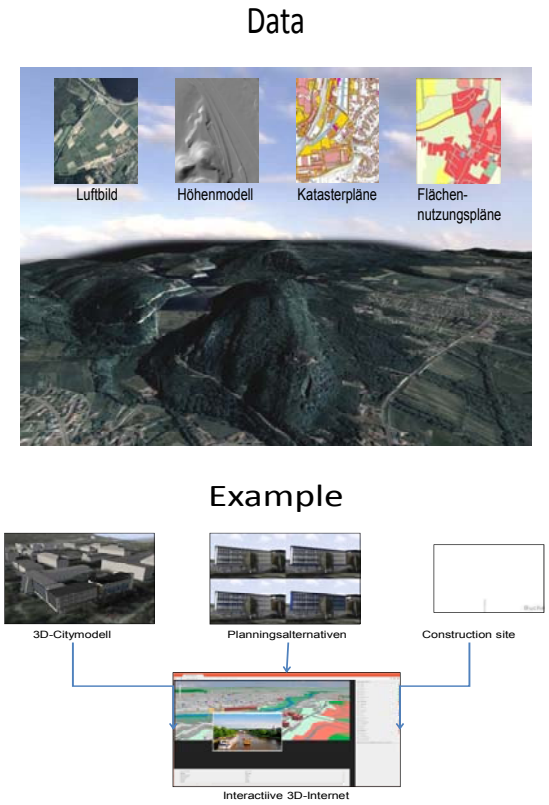
The construction model shows the planning activities and the one that has to be achieved. Cost planning, estimation of the activities that remains in the workflow can be taken from construction project that are already completed (learning process, capitalization), and linked with the geometrical model. Then they can be stored in the database and reused for other projects.

As seen above, the 3D model with time and process components and resources provides a basis for calculating cost and work forecasts, liquidity overviews and resource schedules directly from the construction model during the operative project work and for simulating and optimizing construction processes.

Data does not have to be specially exported into an external simulation tool to do this. The company therefore has a constant overview of material requirements, personnel actively working on the construction site and deployed construction machines and tools.

The client can send or print bids in electronic form. Time for information exchange regarding the price can be taken from the comparison lists. The cooperative environment reduced the following risks: failure to complete with the stipulate design and construction time, reduce the time to obtain the

outline planning and regulation approvals, latent defect in the craftsman's work, to meet quality standards, to complete the building in order that the owner can rent it in time. It helps to fulfill the requirement for sustainable development.



Pict. 16, 17. Example of use XML3D for the construction of the 3D design

5. Summary and future prospects

With the help of our IT-platform shown by the example of a Comprehensive Cancer Center (Chapter 3.) we were able to make cancer treatment more transparent, detect changes and provide information for quality assessment circles. As a side effect data conflicts and inconsistencies are discovered and resolved. In some cases like SAE messages, the risk of failure in patient treatment can be minimised.

Further improvements are the development of documentation programmes for further Organ centers and the replacement of the temporary solution of the CREDOS evaluation by a data warehouse system which will enable the user to tailor the data evaluation to his needs.

With the construction of our coordination platform in general (Chapter 4.) we have developed a support to find out the right reaction on an unplanned situation. To do this we can reduce the reaction time or prevention time on the changing environment. We can identify many risks in a methodical way and observe them. This is one of the requirements of ISO 31000. Operational risks, which will be a danger for the kernel competence of an enterprise, will be minimized. Fictions, based on the strategy of an enterprise are verbalised clearly. The knowledge of key people will be explicitly improved; the risk caused by the absence of a key person in a case of urgency will be minimized.

A cooperation platform as shown by the example of 3D visualisation used for the construction projects (Chapter 5.) allows the actors to visualise the planned model in reality. These models give a better insight in to the construction process, reduce the source of errors and risks and enhance the communication and learning process.

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