

Observing the use of BPM tools: A step towards flexibility

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Abstract: The development of the tools of Business Process Management (BPM) arises from the spread of the notion of process in the management universe. The application of BPM to strategic processes is blocked by the tools' rigidity. They have difficulty in handling the processes of which the structure is not clearly defined and/or those for which all information is not available at the beginning. That is why increased flexibility is sought. Having stated needs and works, we propose a new architecture exploiting the distances between prescribed processes and executed processes. On the basis of observation data, a set of techniques enables us to extract some elements which are significant for the designer. Here we present our architecture of exploitation of the observation data and give the results of an experiment aiming at checking the feasibility and the relevance of it. They reveal a real potential for development as well as a series of restrictive elements.

Following the seminal publications of Hammer [HA90] and Hammer and Champy [HC93], the spread of the process concept in the field of technology management has accelerated. Their work led to the development of "process-oriented" tools which are currently grouped under the acronym BPM. In a first approach, we recall the definition of Melchert and Winter [MW04]:

"BPM is used as an umbrella term for methodologies, metrics, processes and systems that monitor and manage the performance of an enterprise".

The acronym BPM covers three object classes. These objects are firstly methodologies of analysis and modelling of processes; secondly they are development tools for software and finally the resulting software. In its broadest definition, BPM covers an extremely wide field: It includes various description/modelling/simulation/development languages, as well as software tools dedicated to their piloting. The software types ERP, CRM, SCM and workflow are included in the definition of BPM. In a more restricted definition, BPM is more specifically focused on the modelling of the processes and their instantiation in workflow-type tools [MU04]:

“Workflow management systems (also known as Business Process Management Systems [...] support the execution of business processes through the automated coordination of activities and resources according to a formally defined model of business process (the workflow model)”.

Classically, BPM begins with an elucidation of the actors’ practices and the elucidation of the sequence of these practices, and finally describes them in a formal language constituting a process model [GR01]. This model having extracted and articulated the information useful for managing the sequence of activities to be realized, it ensures its reproducibility and its predictability and *in fine* the control. In the short term, collected information is used to evaluate the performance of the process, and in the long-term, it is used as a basis for detection of possible improvements [MW04]:

“The main idea of process performance management is to control the execution of business processes by comparing process models (i.e. to-be models of business processes) with data collected during process execution (i.e. as-is models of business processes) in order to identify potential for improving process execution and to recommend the appropriate modifications to the processes.”

BPM usually addresses operational processes (invoice processing, payment processing, order follow-up, etc) and its scope is often reduced to operational management control [AA03]:

“We define BPM as follows: Supporting business processes using methods, techniques, and software to design, enact, control, and analyze operational processes involving humans, organizations, applications, documents and other sources of information.[...] this definition restricts BPM to operational processes, i.e., processes at the strategic level or processes that cannot be made explicit are excluded”

However, processes do not constitute a class of homogeneous objects. A process of invoice treatment is not comparable to a process of co-development of a mechanical piece by a client and his/her supplier: The requirements for modelling flexibility are different. This is why typologies of process are useful: Many classifications based on a large variety of criteria have been proposed. In his work, Muehlen [MU04] provides a synthesis of them. Among the 10 attributes he proposes, we retain the structuring degree of processes. Work begun in the 1960s by H.A. Simon [SI60] led to a typology of various classes of problems obtained by crossing the accuracy and the stability of the task definition and the knowledge held a priori on their sequence. This characterization is summarized in the following diagram:

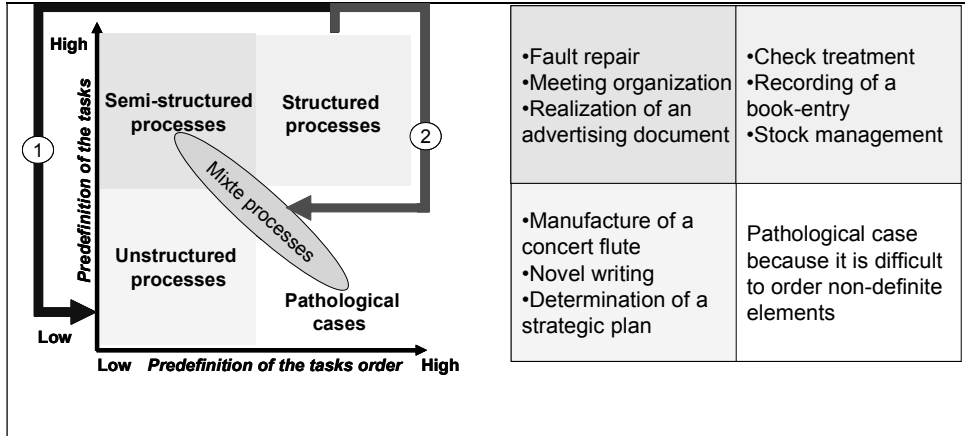


Figure 1: Typology of process types and some examples

The mixed processes correspond to the processes made up of processes of different structuring degrees [DHL01].

Increasingly insistent requests are made by firms and editors for technological solutions supporting and even initiating strategic developments [FI05]:

“As long as BPM deployments remain tactical, BPM is likely to become just another technique for squeezing out costs and making incremental performance improvements in functional departments. The full potential of BPM is about ‘enterprise business processes’ and ‘value-chain business processes’ not technical improvements here or there, or streamlining individual functions in the company. Tactical BPM only offers a way of improving what a company already does, which, though good, can mean clinging to the past. BPM’s full potential offers a strategic capability for achieving breakout competitive advantage through process innovation.”

To respond to such requests, moving from problems with the follow-up of the process execution to design problems, BPM tools must be able to control changing processes. This implies a modification of the functionalities proposed by the tools. The latter must be able to take into account instability and uncertainty. We gather all these new possibilities under the generic term “flexibility”.

This research topic, BPM tools’ flexibility, constitutes the core of this contribution. The objective of this document is, on one hand, to present the scientific work in the field of flexibility and on the other hand, to introduce the actions which we have already carried out in this direction. This paper is organized in three parts. In the first part, we specify the stakes and characterize this request for flexibility. In the second part, we proceed to a synthesis of the scientific work. It is structured according to main phases of a BPM project execution. Having highlighted the various tracks followed by the researchers in BPM in order to increase flexibility, we position our own work in the third part.

1 Stakes and characteristics of the request for flexibility

The degree of diffusion of “process-oriented” tools is very large. The penetration rate of ERPs is over 90% in large firms and nearly 50% in more modest size companies [CN02] [VA00]. For the SCM solutions, ARC Advisory considers that the world market will be 7 billion dollars in 2008. Therefore, we can practically affirm that the majority of companies already use tools based on the process concept. This characteristic of the process concept in management tools can enable process-oriented piloting. However, in their practices, many firms exploit only this possibility.

However, the latter is attractive for many reasons. Establishing personalized relations with customers (CRM) and suppliers (SCM), the signature of specific alliances with partners, the modification of access modes to the market (electronic market place), the externalisation of activities (outsourcing), are many examples of situations in which a process-based guiding proves to be interesting. However, it requires the capacity to manage collaborative, evolutionary and often short-lifespan processes. In-house, the environmental pressures regularly cause organisational reconfigurations. These reconfigurations enable policies of product personalization at the operational level (mass customization). All these elements lead to variability on production processes. Minimally, both external and internal conditions of the firms encourage the implementation of tools for modelling and piloting flexible processes. The possibility for a firm to quickly set up a tool for piloting these changing processes confers an undeniable competitive advantage. This fact is mentioned by many authors [GRI01], [SI99], [SA99], [ZH04]. This last author summarizes a widely shared position:

“To realize the idea of enterprise process management, different types of processes with various levels of structuring must be executable. One possible approach is the extension of traditional workflow concepts and architectures to control semi-structured or unstructured processes, too”.

Nevertheless, these contributions remain unsatisfactory. Confronted with technical and conceptual difficulties, the concern of the firms is no longer to radically change its processes, but rather to adjust them with the variations of the conditions in which they operate.

2 Previous work on BPM and flexibility

In the BPM field, the search for flexibility is necessarily based on the possibility to apply these tools to processes for which all the details cannot be documented before their execution. Initial work in this direction sought to check the feasibility of such an approach [SH97], [ELM97]. We propose to make a more precise inventory of up-to-date actions carried out in this direction. It is obviously impossible to propose a complete inventory of the work carried out in the field. This is why we present only a sample of work according to a diagram showing the usual course of a BPM implementation. For each article, we indicate the problems dealt with.

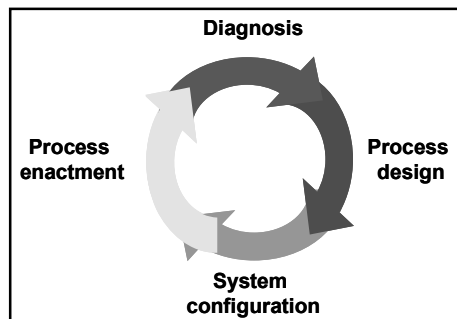


Figure 2: Activities linked to the BPM life-cycle [AA03]

Figure 2 breaks a BPM project down into four principal phases. A deliverable, corresponding to each phase, allows for the realization of the next activity. Our starting point is the design of the process which corresponds to a modelling step aimed at defining the elementary activities and the bonds which link them. Usually, a notation language is used and the associated deliverable is a functional model of the process. This latter specifies “who does what, when and with which resources”. As is, this model is not directly computable. The process is in charge of the configuration which makes the functional model achievable which allows for the start of the enactment phase. During this third phase, the workflow is then enacted (i.e. put into act). Once the activity is carried out, the designer and the manager have execution data enabling them to do diagnose the process course and even to possibly modify it through an improvement plan. Finally, the existence of a loop translates the concept of Business Process Improvement

We note that, within the framework of this contribution, we adopt a restrictive vision of the concept of enactment. By reducing the enactment to a simple implementation, we are conscious that we are far from the richness of this concept developed by [WE88] [WE95]. But, contrary to this last work, we are not interested in the constitution by the actor of an interpretative framework of the situation.

On the other hand, these mechanisms of construction of meaning by the actor are present in the posterior phases of our work. The assumptions made by the designer during his/her interpretation of the data of implementation correspond to his/her inferences based on the cognitive routines activated by the user.

We use this representation in order to position and articulate various examples of scientific contributions around the question of flexibility and dynamic adjustment of processes.

N°	Questionings and references
Design	<ul style="list-style-type: none"> • How to model in spite of a deficit of knowledge on the course of the process? [SI99], [AWG05] • Which framework to propose to tackle the question of flexibility? [HSB98] • How to treat the cases of activities started before the complete end of the preceding one? [GPS99] • How to check in the former phases the coherence and the absence of loops in processes? [LK05] • Which description language makes it possible to add, to remove and to modify the order of the tasks? [CA98b] • Which typology of activities can be proposed to the designer? [AAL03c]
Configuration	<ul style="list-style-type: none"> • How to convert the model to be able to simulate it? [HSS05] • Which is the degree of flexibility of the products based on libraries of process? [FLZ05] • How to pass from a Petri network model to a BPMN model? [FUM03]
Enactment	<ul style="list-style-type: none"> • Which various forms of flexibility are required by the mechanism of assignment people to activities? [PA05] • What are the possible types of changes by user? [EK00] • At which level of decentralization to authorize the changes in process? [ME02]
Diagnostic	<ul style="list-style-type: none"> • Which metrics to set up to evaluate the “exceptions”? [CA98a] • What is the contribution of data-mining to the exploitation from the captured data? [AGL98] [AA03b] [AWG05] • Which metrics to use for the evaluation of qualitative data? [CA02] • Which data to capture? [GRI01] • How to develop the information generated by exceptions? [GRI01] [AD05] [AH03]

Figure 3: Bibliographical synthesis

Parallel to this work focused on certain phases, some authors propose more ambitious models which include several levels such as [GRI04] and [CS05].

[GRI04] work is directly addressed to the person in charge of the process: Based on processing an authorization request for financial commitment at HP, the authors propose a complete architecture of process monitoring and improvement. Their architecture is based on the exploitation of log files using data mining tools and a feedback loop on the process definition.

The contributions of [CS05] propose a general diagram in four layers, making it possible to position the search for flexibility and to specify its nature and its object. These authors consider two application examples corresponding respectively to static adaptation and dynamic adaptation. Fourteen types of adjustment (insertion of new tasks, transformation of a connector AND into OR, etc) are established in a prototype. The work of [GRE04] is undertaken in the same spirit and leads to an implementation in the ADEPTflex tool of a module that allows them to carry out in a dynamic way a logical control of integrity (i.e. to check the admissibility of the changes considered).

All this work corresponds to three aspects of the flexibility question. First, flexibility can be approached by authorizing the user to carry out modifications according to his/her interpretation. The second approach is more restrictive and binds the activity flow to a pre-established modification process. The third approach regards the definition of the process not as an injunction but rather as a resource for action. In this case, flexibility is obtained by creating macro-activities corresponding to goals to reach. The practical methods of realization depend on the user. In this last case, the addition of flexibility results from a reduction of the degree of specification of the actions. The interest of this type of work is the central position occupied by the user. Finally, we belong to the part of the BPM community who wants to take into account the concrete actions carried out by the users in situation. For instance, we can cite promising work mobilizing the activity theory [AD05], [AH03].

3 Mobilizing observation to increase flexibility: An exploratory experiment

In this part, we first situate our research. Secondly, we present our methodology, and we detail the technical solution used. Finally, we describe the principal results of a first experiment and discuss its limits.

3.1 Situating our work

Our work aims to increase the flexibility of business processes and relates primarily to the processes of low structuring degree. We postulate that the set up and the exploitation of an informational feedback loop from the user towards the process designer are useful levers for the business process improvement. This is why we seek to give the process designer the possibility to increase the congruence between, on the one hand, the practices of the users and, on the other hand, the model of the process and the tools.

This is a question of adjusting the means offered to the users for their use. On the basis of information related to the practices of users in situation, we are looking for a dynamic and idiosyncratic adjustment of the processes and tools. The dynamic aspect relates to the idea that, according to the context (user, process type, timestamp, etc), the processes are changing. The idiosyncratic aspect relates to the idea that all the users do not apply the same cognitive routines. For some, an execution of the tasks in another order than the one foreseen would make more sense, and for others, certain groups of tasks represent only one task.

Allocating such properties to BPM Suites presupposes an observation of uses. Indeed, a Workflow software program generally allows for the acquisition of execution data and the recording of it.

These traces are known under the name “log files”. While recognizing the fruitfulness of the work centred on the exploitation of the information contained in the log files, our work dissociates the latter on two points which makes our work innovative. On the one hand, our spectrum of observation is broader and on the other hand, the aim is appreciably different.

Relative to the question of the observation spectrum, we choose a recording base which is broader than log files. The events recorded in these files come exclusively from the tools implemented to enact the process. This allows us to know “who did what” with these tools but this form of observation does not make it possible to identify complementary devices mobilized by the users to carry out their tasks. However, as shown in [SST00], devices in the form of “peripheral work” (Excel files, emails, etc) and of “add on” (specific modules added to the tool) are regularly activated during the execution of the processes. Recording only activities carried out within the BPM Suites to perform a task thus collects only information related to part of the activities already described in the process model. In order to correct this insufficiency, we developed a technological platform extending the spectrum of the collect. This is detailed in the third part.

Relative to the question of the objective, work centred around the exploitation of log files quasi systematically pursues a goal of pure control and focuses on “constant process”. This is a question of detecting possible differences between prescribed and effective execution or to improve the predictability and the efficiency of a process (Business Process Intelligence). Our work falls under a new trend which uses the logs to improve the processes. The focus is the transformation of the processes.

Thus, we want to develop a conceptual and technical architecture binding rich observation and feedback loop of the uses to the modelling of the business processes. It is thus not only a question of creating a technical platform, it is also a question of determining an architecture allowing for the design and the development of assistants for the task of modelling. These assistants are addressed to the processes designers and support a step of improvement while allowing, for example, for the emergence of new activities consequently modifying the processes previously defined.

Our hope is to use the addition of intelligence sought through the analysis of the traces to ensure a better match between the practices of the actors and the traces they leave. With this intention, our examination of the collected data constitutes indications provided to the process designer in order to operate possible modifications of the limits of the tasks, their scheduling and their presentation.

3.2 Technical architecture

Technically, users carry out a task on a technological platform specifically developed for this purpose. This platform consists of a series of work stations equipped with keyloggers. This type of software records all the user actions (keystroke, launching of a messenger, etc). This information thus accounts for the uses of material artefacts of the actors in situation. This platform enables us to collect a large variety of information, in particular the traces coming from the software not included in the BPM Suites. Currently, we still privilege “in-laboratory observation”. It enables us to supplement the computer data with data resulting from a visual observation of the actors in situation. This observation is carried out by the people present in the room and equipped with grids of observation. The computer data are reprocessed thereafter with filtering techniques and data mining algorithms. It is then possible for us to induce the real uses of tools that generated data processed by the users. Nevertheless, the results obtained do not remain easily exploitable in this state. To be interpreted, they require a thorough expertise on the used software. To facilitate this analysis, the ergonomics of the result presentation must be improved. This is why we are developing in parallel a visualization tool positioning the tasks carried out by the various users in a formal representation. The exploitation of the grids of visual observation makes it possible to guide the designer in the development of this formal representation. For example, if a user has trouble carrying out an activity, s/he can orally ask for assistance from a neighbour (this information is collected by the grid) and if s/he does not find it, s/he can start a search on the Internet (this information is collected by the keylogger). This then makes it possible on the one hand to detect a difficulty related to a task and on the other hand to obtain indications on the manner of surmounting it. If, systematically, the answer can be found in a close environment, the placement of the actors will be crucial. The implementation of this architecture within the framework of experiment appeared promising. This is the subject of the following section.

3.3 Our experiment and first results

The experiment described here was carried out at the end of 2004 [HER05]. It concerned 36 students in third year of a graduate Business School. The recommended process was a teaching sequence, the duration was one hour and a half, and the aim was to practice the handling of image layers in the software Adobe Photoshop®. We retained four sources of observation: the recommended process (i.e. the teaching scenario imagined by the teacher), the Intranet server, the students’ computers and two human observers present in each room in order to collect information concerning the exchanges carried out between users, by specifying on a grid their content and their type. Each of these four sources generates different information. They are respectively presented in the following table and correspond, for the three first ones, to increasing levels of granularity.

Process Log (recommended)	Action “exercise 1” successfully executed with output “succeeded”	The user performed and succeeded exercise 1
Apache Log (intranet server)	192.168.102.83 - - [16/Nov/2004:11:04:05] “GET/index.php?module= pscenario & func=view_scenario&sid=2 HTTP/1.1” 20016098	The user selected an element of the scenario, this log line does not provide information about whether or not this element has been finished or even executed
Keylogger (client station)	(anonymous76398 @ 16/11/2004 11:40:00) [Backspace] Did you d[Backspace] finish ex1? [Enter]	The user seized a sentence with the keyboard. With no analysis, impossible to know if this is a communication (software used) related to the session (message content)
Grid (observers)	2004/11/16:11:10 “A asks B how to modify the layer order”	The user encounters a difficulty and questions a neighbour on a technical question relative to the task

Table 1: Different types of collected data

The files related to the first three levels are not exploitable in this state and transformations must be applied to them. They must in particular be cleaned, and recomposed in sessions with tools of pattern discovery [ZA01].

The patterns are macro-activities (blocks of systematically repeated sequences) expressed in a language. Two types of language must be mobilized: on the one hand, the natural language in order to be able to communicate, and on the other hand, a formal language in order to be able to integrate these patterns into the data-processing tool. On this last point, we developed a new language called OURL (Observed Usage Modelling Language) [HFH06]. All these reprocessings make it possible to get traces from the raw data. The detail of the transformations of the sources of raw logs into traces is presented in [HER05].

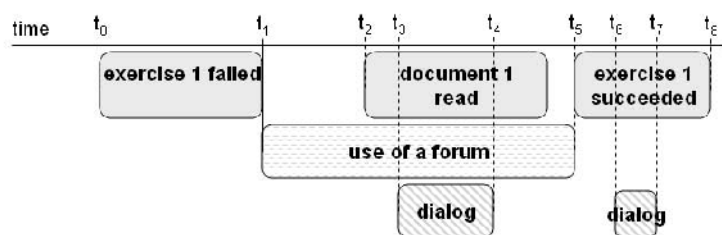


Figure 4: An interpretable trace

Figure 4 shows the advantage of our approach: a traditional observation, i.e. only on the execution of the process, could have been interpreted in the following way: “The student wanted to skip a stage of the process (reading the lesson support) but s/he failed on exercise 1. Then s/he went back to carry out the complete process and finally succeeded in doing the exercise 1. We can conclude from this that the reading of support 1 enabled him/her to complete exercise 1”. However, the trace generated by our approach offers two other interpretations which can be summarized as follows: “the student found the solution of the exercise in a discussion forum” and “the student obtained the solution from one of his/her neighbour”. This richness of interpretation coupled with a visualisation system [FRA05] enabled us to show that the multi-source approach can help the process reengineering. Finally, after reprocessing the log files, a pattern of specific behaviour leading to the success of the exercise could be identified. Figure 5 presents the standard trace of students who validated the process (i.e. who successfully performed the exercises in the assigned time).

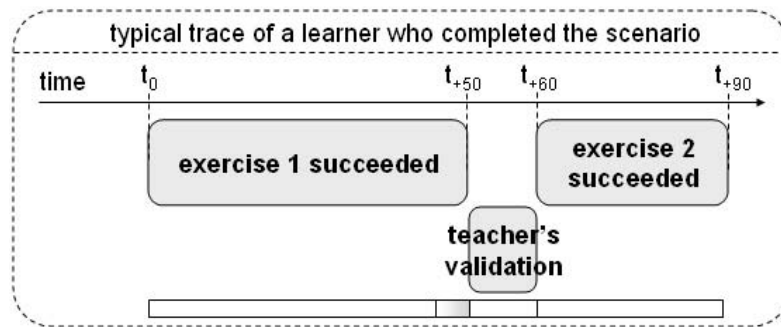


Figure 5: A typical trace of a learner who completed the scenario

It shows that the common point between these students is an additional activity, not foreseen in the prescribed process: validation of “exercise 1” by the teacher. This first result legitimates the adjustment of the process while inserting this new activity. Obviously, the system will not make such a decision itself. It is the designer of the process who will deliver his/her opinion on the validity of this possible modification.

3.4 Limits

We have identified three major limits to our work.

First, although the experiment was conducted within the framework of a specific field, it can potentially be applied to any other field. In the future, we want to generalize our approach. However, beyond the nature of the public and the object of observation, a first difficulty comes from the fact that the studied process constituted a set of individual tasks. For the emergence of activities, we proposed a metric based on the difference between realized and recommended duration for the activities. To explore the problems specific to the collaborative aspects, we plan to explore other metrics such as the degree of collaboration within an experiment about a coordination problem as well as visualization tools specific to the collaborative activities.

The second limit comes from the retained protocol of experimentation that raises ethical problems. The device of observation is undeniably intrusive since all the actions carried out on the machines and all the communications are collected.

Finally, beyond the fast growing volume of data to be treated, the application of such devices to less controlled universes is not possible in this state. Our manner of tackling the question of emergence matches the one proposed by [GR01]. Like this author, we want to take into consideration the possibilities of providing some help to users during their activities.

However the emergence of new activities, and more generally the search for flexibility of the processes, is cost-effective. A cost-benefit calculation makes it possible to match the needs for formalization of the processes and the appreciation of the operated adjustments. To go beyond the purely experimental framework, the importance of the investment in time to analyze log files makes this approach relevant only for processes having an economic stake. Even if our work seeks to automate most of the processing, it is not able to reduce the incompressible cost which represents the time devoted by the analyst. S/He only can bring some semantic information making it possible to transform an observed pattern into a recommended activity. Besides, to reduce the working time of this expert, two fields of research can be explored: on the one hand, the development of data-mining algorithms specific to the analysis of sequences of actions (sequence mining); and on the other hand the development of algorithms for the selection of patterns that are candidates for becoming recommended activities.

Conclusion

In this contribution, we pursued a dual goal. On the basis of the fact that there was a request to make BPM tools capable of piloting changing processes, we identified their intrinsic rigidity as a blocking factor. New tools for modelling piloting process, and for adapting them in a dynamic way to the changes of environmental conditions, must be developed. We indicated this aptitude by the generic term of flexibility. Initially, we identified the origins of this request for flexibility. It implied the development of tools able to control slightly structured processes. This research led to a number of publications which integrate the user only in very rare exceptions. However, his/her use of the tools informs us about the manner of responding to the always singular situations with which s/he is confronted. Wishing to take advantage of the user actions by providing them to the designer, we use BPM as a resource for the action. This is why we recommend the use observation with an aim of ensuring a greater congruence between the recommendations and the practices. Our contribution to the question of flexibility is thus about the installation of a tool of observation and analysis of the practices facilitating the Re-design of the processes.

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