Workflow

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A workflow is a depiction of a sequence of operations, declared as work of a person, work of a simple or complex mechanism, work of a group of persons, work of an organization of staff, or machines. Workflow may be seen as any abstraction of real work, segregated in workshare, work split or whatever types of ordering. For control purposes, workflow may be a view on real work under a chosen aspect, thus serving as a virtual representation of actual work.
A workflow is a model to represent real work for further assessment, e.g., for describing a reliably repeatable sequence of operations. More abstractly, a workflow is a pattern of activity enabled by a systematic organization of resources, defined roles and mass, energy and information flows, into a work process that can be documented and learned.

Workflows are designed to achieve processing intents of some sort, such as physical transformation, service provision, or information processing.

Workflow concepts are closely related to other concepts used to describe organizational structure, such as silos, functions, teams, projects, policies and hierarchies. Workflows may be viewed as one primitive building block of organizations. The relationships among these concepts are described later in this entry.

The term workflow is used in computer programming to capture and develop human to machine interaction. Workflow software aims to provide end users with an easier way to orchestrate or describe complex processing of data in a visual form, much like flow charts but without the need to understand computers or programming.

Related concepts

The concept of workflow is closely related to several other fields in operations research and other fields that study the nature of work, either quantitatively or qualitatively, such as artificial intelligence (in particular, the sub-discipline of AI planning) and ethnography. The term workflow is more commonly used in particular industries, such as printing, and professional domains, where it may have particular specialized meanings.

a) Processes: A process is a more specific notion than workflow, and can apply to physical or biological processes, for instance. In the context of concepts surrounding work, a process may be distinguished from a workflow by the fact that it has well-defined inputs, outputs and purposes, while the notion of workflow may apply more generally to any systematic pattern of activity (such as all processes occurring in a machine shop).
b) Planning and scheduling: A plan is a description of the logically necessary, partially-ordered set of activities required to accomplish a specific goal given certain starting conditions. A plan, when augmented with a schedule and resource allocation calculations, completely defines a particular instance of systematic processing in pursuit of a goal. A workflow may be viewed as an (often optimal or near-optimal) realization of the mechanisms required to repeatedly execute the same
c) Flow control is a control concept applied to workflows to divert from static control concepts applied to stock, that simply managed the buffers of material or orders, to a more dynamic concept of control, that manages the flow speed and flow volumes in motion and in process. Such orientation to dynamic aspects is the basic foundation to prepare for more advanced job shop controls, as just-in-time or just-in-sequence.
d) In transit visibility is a monitoring concept that applies to transported material as well as to work in process or work in progress, i.e., workflows.

Historical development

Organizational structure
In the 1980s, the term workflow was first used in its modern form in the software industry by Filenet vice president David Siegel.
The company called its business process automation software "Workflo".

Workflow

The development of the concept of workflow occurred over a series of loosely defined, overlapping, eras.

Pre-history

Many historical projects, such as the pyramids and cathedrals, required highly organized labor. The idea that one can create value by studying the nature of work itself can be attributed to Adam Smith.

Beginnings in manufacturing

The modern history of workflows can be traced to F. W. Taylor and H. Gantt. Together they launched the study of the deliberate, rational organization of work in the context of manufacturing. The types of workflow of concern to Taylor and his contemporaries primarily involved mass and energy flows. These were studied and improved using time and motion studies. While the assembly line remains the most famous example of a workflow from this era, the early thinking around work was far more sophisticated than is commonly understood. The notion of flow was more than a sequential breakdown of processing. The common conceptual models of modern operations research, including flow shops, job shops and queuing systems can be found in evolved forms in early 20th century industry.

Information based workflows began to grow during this era, although the concept of an information flow lacked flexibility. A particularly influential figure was Melvil Dewey (inventor of the eponymous Dewey Decimal System), who was responsible for the development of the hanging file folder. This era is thus identified with the simplest notions of workflow optimization: throughput and resource utilization.

The cultural impact of workflow optimization during this era can be understood through films such as Chaplin's classic Modern Times. These concepts did not stay confined to the shop floor. One magazine invited housewives to puzzle over the fastest way to toast three slices of bread on a one-side, two-slice grill. The book Cheaper by the Dozen introduced the emerging concepts to the context of family life.

Maturation and growth

The people of the typewriter and the copier helped spread the study of the rational organization of labor from the manufacturing shop floor to the office. Filing systems and other sophisticated systems for managing physical information flows evolved. Two events provided a huge impetus to the development of formalized information workflows. First, the field of optimization theory matured and developed mathematical optimization techniques. Second, World War II and the Apollo program were unprecedented in their demands for the rational organization of work.
The classic management tome The Organization Man culturally captured the nature of work in this era.

Quality era

During the 1980s two aspects of workflow organization drew heavy criticism. First, the methods pioneered by Taylor modeled humans as simple automatons. The classical industrial-style organization of work was critiqued as being both dehumanizing and suboptimal in its use of the potential of human beings. Maslow's hierarchy of needs, which describes human needs for self-actualization and creative engagement in work, became a popular tool in this critique. This issue was acknowledged, but did not gain much traction otherwise.

The second critique had to do with quality. Workflows optimized for a particular time became inflexible as work conditions changed. Quality, in both analytic and synthetic manifestations, transformed the nature of work through a variety of movements ranging from total quality management to six sigma to more qualitative notions of business process reengineering (Hammers and Champy, 1991). Under the influence of the quality movement, workflows became the subject of much scrutiny and optimization efforts. Acknowledgement of the dynamic and changing nature of the demands on workflows came in the form of recognition of the phenomena associated with critical paths and moving bottlenecks.

The experiences with the quality movement made it clear that information flows are fundamentally different from the mass and energy flows which inspired the first forms of rational workflows. The low cost and adaptability of information flows were seen as enabling workflows that were at once highly rational in their organization and highly flexible, adaptable and responsive. These insights unleashed a whole range of information technology at workflows in manufacturing, services and pure information work. Flexible manufacturing systems, just-in-time inventory management, and other highly agile and adaptable systems of workflow are products of this era.

Virtual workflow era

The neutrality of this section is disputed.
Please see the discussion on the talk page.(May 2008)
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The Internet bust of the early years of the 21st century led to a period of caution towards ambitious conceptualizations of smart workflows. Today, a variety of actors in the economy are addressing more comprehensive models of work that are rational, flexible, take full advantage of globalized distributed work, and allow humans to use their full creative potential. An interesting development in this area is the rise of the apparently anarchic organizations that have evolved in the open source software community.

Examples

The following examples illustrate the variety of workflows seen in various contexts:

a) In military planning, a "concept of operations" is a workflow that defines particular mission types.
b) In machine shops, particularly job shops and flow shops, the flow of a part through the various processing stations is a work flow.
c) Insurance claims processing is an example of an information-intensive, document-driven workflow.
d) Wikipedia editing is an example of a stochastic workflow.
e) The Getting Things Done system is a model of personal workflow management for information workers.

Features and phenomenology

a) Modeling: Workflow problems can be modeled and analyzed using graph-based formalisms like Petri nets.
b) Measurement: Many of the concepts used to measure scheduling systems in operations research are useful for measuring general workflows. These include throughput, processing time, and other regular metrics.
c) Specialized connotations: The term workflow has specialized connotations in information technology, document management and imaging. Since 1993, one trade consortium specifically focused on workflow management and the interoperability of workflow management systems has been the Workflow Management Coalition.
d) Scientific workflows: Found wide acceptance in the fields of bioinformatics and cheminformatics in the early 2000s, where they successfully met the need for multiple interconnected tools, handling of multiple data formats and large data quantities. Also, the paradigm of scientific workflows was close to the well-established tradition of Perl scripting in life-science research organizations, so this adoption represented a natural step forward towards a more structured infrastructure setup.
e) Human-machine interaction: Several conceptualizations of mixed-initiative workflows have been studied, particularly in the military, where automated agents play roles just as humans do. For innovative, adaptive, collaborative human work the techniques of human interaction management are required.

Workflow improvement theories

The key driver to gain benefit from the understanding of the workflow process in a business context is that the throughput of the workstream path is modelled in such a way as to evaluate the efficiency of the flow route through internal silos with a view to increasing discrete control of uniquely identified business attributes and rules and reducing potential low efficiency drivers. Evaluation of resources, both physical and human is essential to evaluate hand-off points and potential to create smoother transitions between tasks. Several workflow improvement theories have been proposed and implemented in the modern workplace. These include:

- Six Sigma
- Total Quality Management
- Business process reengineering
- Lean systems

As a way of bridging the gap between the two, significant effort is being put into defining workflow patterns that can be used to compare and contrast different workflow engines across both of these domains.

Workflow components

A workflow can usually be described using formal or informal flow diagramming techniques, showing directed flows between processing steps. Single processing steps or components of a workflow can basically be defined by three parameters:

- Input description: the information, material and energy required to complete the step.
- Transformation rules, algorithms, which may be carried out by associated human roles or machines, or a combination.
- Output description: the information, material and energy produced by the step and provided as input to downstream steps.

Components can only be plugged together if the output of one previous (set of) component(s) is equal to the mandatory input requirements of the following component. Thus, the essential description of a component actually comprises only in- and output that are described fully in terms of data types and their meaning (semantics). The algorithms' or rules' description need only be included when there are several alternative ways to transform one type of input into one type of output – possibly with different accuracy, speed, etc.
When the components are non-local services that are invoked remotely via a computer network, such as Web services, additional descriptors (such as QoS and availability) also must be considered.

Workflow applications

Many software systems exist to support workflows in particular domains. Such systems manage tasks such as automatic routing, partially automated processing and integration between different functional software applications and hardware systems that contribute to the value-addition process underlying the workflow.

Business process management (BPM) is a method of efficiently aligning an organization with the wants and needs of clients. It is a holistic management approach that promotes business effectiveness and efficiency while striving for innovation, flexibility and integration with technology. As organizations strive for attainment of their objectives, BPM attempts to continuously improve processes - the process to define, measure and improve your processes – a ‘process optimization' process.

Overview

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Workflow

A business process is a collection of related, structured activities that produce a service or product that meet the needs of a client. These processes are critical to any organization as they generate revenue and often represent a significant proportion of costs.

Approaches within BPM

BPM articles and pundits often discuss BPM from one of two viewpoints: people and technology.

People

BPM is considered by some to be a philosophy. BPM alignment to the customer means that customer-facing staff are best suited to understand customer needs and must be empowered to make improvements. Many of these improvements can be done without the use of new technology.

Technology

BPM System (BPMS) is sometimes seen as the whole of BPM. Some see that information moves between enterprise software packages and immediately think of Service Oriented Architecture(SOA); while others believe that modeling is the only way to create the 'perfect' process, so they think of modeling as BPM.

Both of these concepts go into the definition of Business Process Management. For instance, the size and complexity of daily tasks often requires the use of technology to model efficiently. Bringing the power of technology to staff is part of the BPM credo. Many thought BPM as the bridge between Information Technology (IT) and Business.

BPMS could be industrial specific and can be driven by software such as Agilent OpenLAB BPM. Some other products may focus on Enterprise Resource Planning and warehouse management. Validation of BPMS is another technical issue which vendors and users need to be aware of, if regulatory compliances are mandatory.

The task could be performed either by an authenticated third party or by user themselves. In either way, validation documentation needs to be generated. The validation document usually can either be published officially or well retained by users.

Business process management life-cycle
The activities which constitute business process management can be grouped into five categories: design, modeling, execution, monitoring, and optimization.

Design

Process Design encompasses both the identification of existing processes and designing the "to-be" process. Areas of focus include: representation of the process flow, the actors within it, alerts & notifications, escalations, Standard Operating Procedures, Service Level Agreements, and task hand-over mechanisms.

Good design reduces the number of problems over the lifetime of the process. Whether or not existing processes are considered, the aim of this step is to ensure that a correct and efficient theoretical design is prepared.

The proposed improvement could be in human to human, human to system, and system to system workflows, and might target regulatory, market, or competitive challenges faced by the businesses.

Modeling

Modeling takes the theoretical design and introduces combinations of variables, for instance, changes in the cost of materials or increased rent that determine how the process might operate under different circumstances.
It also involves running "what-if analysis" on the processes: What if I have 75% of resources to do the same task? What if I want to do the same job for 80% of the current cost?

Execution

One way to automate processes is to develop or purchase an application that executes the required steps of the process; however, in practice, these applications rarely execute all the steps of the process accurately or completely. Another approach is to use a combination of software and human intervention; however this approach is more complex, making documenting a process difficult.

As a response to these problems, software has been developed that enables the full business process (as developed in the process design activity) to be defined in a computer language which can be directly executed by the computer. The system will either use services in connected applications to perform business operations (e.g. calculating a repayment plan for a loan) or, when a step is too complex to automate, will message a human requesting input. Compared to either of the previous approaches, directly executing a process definition can be more straightforward and therefore easier to improve. However, automating a process definition requires flexible and comprehensive infrastructure which typically rules out implementing these systems in a legacy IT environment.

Business rules have been used by systems to provide definitions for governing behavior, and a business rule engine can be used to drive process execution and resolution.

Monitoring

Monitoring encompasses the tracking of individual processes so that information on their state can be easily seen and statistics on the performance of one or more processes provided. An example of the tracking is being able to determine the state of a customer order (e.g. ordered arrived, awaiting delivery, invoice paid) so that problems in its operation can be identified and corrected.

In addition, this information can be used to work with customers and suppliers to improve their connected processes. Examples of the statistics are the generation of measures on how quickly a customer order is processed or how many orders were processed in the last month. These measures tend to fit into three categories: cycle time, defect rate and productivity.
The degree of monitoring depends on what information the business wants to evaluate and analyze and how business wants it to be monitored, in real-time or ad-hoc. Here, business activity monitoring (BAM) extends and expands the monitoring tools in generally provided by BPMS.

Process mining is a collection of methods and tools related to process monitoring. The aim of process mining is to analyze event logs extracted through process monitoring and to compare them with an 'a priori' process model. Process mining allows process analysts to detect discrepancies between the actual process execution and the a priori model as well as to analyze bottlenecks.

Optimization

Process optimization includes retrieving process performance information from modeling or monitoring phase and identifying the potential or actual bottlenecks and potential rooms for cost savings or other improvements and then applying those enhancements in the design of the process thus continuing the value cycle of business process management.

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Future developments

Although the initial focus of BPM was on the automation of mechanistic business processes, it has since been extended to integrate human-driven processes in which human interaction takes place in series or parallel with the mechanistic processes. A common form is where individual steps in the business process which require human intuition or judgment to be performed are assigned to the appropriate members of an organization (as with workflow systems).
More advanced forms such as human interaction management are in the complex interaction between human workers in performing a workgroup task. In this case many people and system interact in structured, ad-hoc, and sometimes completely dynamic ways to complete one to many transactions.

BPM can be used to understand organizations through expanded views that would not otherwise be available to organize and present. These views include the relationships of processes to each other which, when included in the process model, provide for advanced reporting and analysis that would not otherwise be available. BPM is regarded by some as the backbone of enterprise content management.

Business process management in practice

Whilst the steps can be viewed as a cycle, economic or time constraints are likely to limit the process to one or more iterations.
In addition, organizations often start a BPM project or program with the objective to optimize an area which has been identified as an area for improvement.

Use of software

Some say that not all activities can be effectively modeled with BPMS, and so some processes are best left alone. Taking this viewpoint, the value in BPMS is not in automating very simple or very complex tasks, it is in modeling processes where there is the most opportunity.
The alternate view is that a complete process modeling language, supported by a BPMS, is needed; the purpose is not purely automation to replace manual tasks, but to enhance manual tasks with computer assisted automation. In this sense, the argument over whether BPM is about replacing human activity with automation or simply analyzing for greater understanding of process is a sterile debate; all processes modeled using BPMS must be executable in order to bring to life the.

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