The Need for Adaptive Workflow and What is Currently Available on the Market

Perspectives from an ongoing industry benchmarking initiative

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Introduction

Organizations continually strive for increased performance in a competitive world market. Intensive competitive pressures are brought on by the ever-accelerating rate of technological changes, and constant changes in customer requirements and regulations. It is our contention that successful organizations are those that can rapidly and efficiently respond to new external demands by taking measures which directly affect the bottom line-- that is, improving profitability and reducing cycle time and outlays. These organizations have learned to dynamically adapt their structure and business processes in an environment of uncertain and incomplete information; ameliorate the coordination and collaboration mechanisms between individuals and units in the presence of conflicts; incorporate managerial concerns; and pay particular attention to the social impact of these changes on the human resource component.

Organizations have historically used several techniques to enable change, including downsizing, business process reengineering (BPR), and information technology (IT) such as workflow. The results are mixed at best. Downsizing and BPR have failed to improve productivity, and have left workforces disenchanted (Davenport, 1995). And although investment in IT has been increasing dramatically over the past decade (Brynjolfson, 1992, 1994), workflow technology specifically has converted organizations into inflexible structures rather than responsive ones liberated from arduous routine work (Watson and Chambers, 1998).

In the past, "workflow" meant high-volume transaction processing. These processes are highly structured and highly repetitive, so the automating of these processes could deliver eye-catching productivity gains – gains that were directly tied to the bottom line. For example, when an insurance company processes claims faster, the per-claim administration cost decreases dramatically. When a bank processes mortgage applications faster, it starts collecting more interest on more mortgages faster.

Today, "workflow" is considerably broader. In fact, the workflow market encompasses more application types than just so-called "production" workflow. One type is administrative processing, which is structured and repetitive, but with lower throughput and fewer participants. Another is ad-hoc processing, which typically involves creating, routing, and tracking routine forms and other
office work; ad-hoc processing is unstructured and spontaneous, and it has low throughput and few participants (Silver, 1992). Yet what is missing are adaptive workflow systems that transcend application types.

**Change Management**

With all of the effort directed at studying workflow processing, why is there a disconnect between what is needed and what is available? Discovering the reason requires a look at the factors that influence an organization’s ability to change. In our view, there are at least four factors, which limit the flexibility of organizations: handling **uncertainty and incomplete information**, resolving **conflicts** between individuals and units, and incorporating **organizational learning**. It is these three factors that lead to great variation in decision-making on how to address change.

- **Uncertainty**
  As market conditions change, managers assess many different sources of information that form the input for their decision-making process. With many decisions (if not all), there is some level of uncertainty associated with the input (Katzenstein, 1996). Variation in the source and timing of the information greatly influence the uncertainty of the input. Managers constantly weigh the uncertainty, often disregarding certain inputs in favor of others (Lipshitz and Strauss, 1997).

- **Incomplete information**
  Hand in hand with uncertainty is incomplete information. The information that managers gather to assist with their decision-making process is seldom complete (Schumacher, 1997). For example, a situation may dictate that a decision must be made, even if reports are not finished and totals are not in. And although the process to gather complete information may be possible, the cost to do so is prohibitive and untimely (Sanbonmatsu, Kardes, Posavac, and Houghton, 1997).

- **Conflicts and collaboration and irrational behavior**
  Workflow systems are generally designed with presumptions that consensus exists between individuals and units, and that collaboration is homogeneous and harmonious. As a result, the underlying theory implicitly emphasizes minimization of coordination costs. This is obviously unrealistic. Most organizations are rife with minor and sometimes even major internal conflicts of one sort of another. Still organizations work. They build and sell cars, they treat patients, and they pass laws. For genuine collaboration to occur in workflow systems, conflict resolutions must be implemented. Mechanisms, such as the conversation concept in Winograd and Flores (Winograd and Flores, 1990), for detecting, negotiating and resolving conflicts must be incorporated into the technologies purporting to support cooperation and coordination. To achieve that, it is necessary to understand the nature of conflicts in organizations.

  In our view, conflicts occur at several levels, including syntactic (operational), semantic (intelligent integration of systems and individuals, context construction) (Ouksel et al.,
1993,1996), pragmatic (conventions, managerial aspects), and social (norms and values, culture of the organization) (Ouksel, 1998). These conflicts are compounded by the uncertainty and incompleteness factors listed above. Current workflow design approaches ignore problems resulting from semantic conflicts, pragmatics and social tensions. They focus mainly based on the functional aspects of organizations, under stringent assumptions of homogeneity, harmony, and rational behavior.

Workflow systems as currently designed follow the classical idea of organizations, i.e., "an organization is an instrument, a deliberate and rational means of attaining goals". A logical conclusion to this description is that an organization demands "deliberate and rational behavior" of its members directed at attaining these known goals or contributing towards the possibility of attainment. Empirical evidence has shown how the concept of organizational rationality is inadequate. This is particularly so during change.

- **Learning**

Adaptive workflow systems will require a clear understanding of organizational learning [Stinchcombe, 1990], organizational memory and its relation to organization structure. Organization structure provides the framework within which various coordination and control mechanisms can be brought to bear on the learning problem. Such mechanisms are in fact types of information processing systems. These information-processing systems are used in an attempt to continually improve the decision-making performance in successful organizations. Yet, current workflow systems do not incorporate such mechanisms that will enable learning and adaptation.

It is with respect to at least these intertwined factors that the effective implementation of workflow technology becomes critical. To be sure these are not the only ones. There are several other factors, such as organizational complexity (not computational), that affect the realism of workflow systems and their flexibility to adapt to new situations. A forthcoming paper will provide more details.

Generally, if workflow systems are properly implemented uncertainty and conflicts are minimized and information is likely to be more complete. If implemented poorly, uncertainty increases and only a fraction of the information is complete. Therefore, to discover how well a firm adapts to change, it is imperative that it considers its implementation of technology with respect to three factors listed above. More importantly, technology may improve or slow a firm’s ability to adapt.

Additionally, logical independence, akin to the ANSI-SPARC architecture is needed. As depicted in the graphic below, by adding a layer of abstraction to the workflow systems deployed throughout an organization, adaptation is increased by insulating people and process from changes made to other workflows within the system.
What Is Needed vs. What Is Available

Based on Doculabs continuing research efforts and product benchmarking (Watson et al., 1995, 1996, 1997, 1998), a number of critical capabilities are needed to implement truly adaptable workflow systems, including systems that:

- transcend production and ad hoc processing (Patel and Fenner, 1997);
- provide robust transaction management while using a messaging-based communications platform (Watson and Fenner, 1997);
- support disconnected users capable of influencing downstream routing (Watson, Patel, and Fenner, 1997); and
- integrate design and run-time environments (Watson and Chambers, 1998).

Each of these needs is being partially addressed in the market today, and our analysis of these capabilities provides insight to the direction that the market will take and the limitations that remain.

Systems that transcend production and ad hoc processing

The most simple means in which workflow system users adapt to change is by creating exceptions.
These exceptions allow current workflow implementations to break the process that is predefined and attempt to solve a problem. The Workflow Management Coalition (WfMC), as part of its standards effort, has created interface four, the mechanism that governs the hand-off of work items to other workflow and messaging systems in an attempt to mediate how exceptions will be handled.

Two such systems/vendors have introduced innovations in this area. The first is FileNET, with its Workflow Connector for Visual Workflow (VFW). The connector is WfMC interface four-compliant and allows work items from VWF to be routed through its other work management system, Panagon (which incorporates the older Ensemble product). Yet, once an item is passed to Panagon, it is "suspended" in the VWF system and cannot be reintroduced into a different work process at a later point in time; thus uncertainty remains.

Eastman Software also has a similar capability that allows Open/workflow users to introduce work items into its Work Folders for Exchange (WFX) product. Although not WfMC interface four-compliant, the interface is bi-directional, as WFX users can reintroduce work dynamically into the same or different Open/workflow process.

While these systems do allow the individual users to adapt to an exception, neither provides a means for the organization to adapt. As exceptions are created, the workflow system no longer controls the flow, and more importantly cannot encapsulate the changes, should they be valid, into future processes that may need to be recreated. Another challenge of this approach is that lack of a unified view of the work process that resulted. With both systems, supervisors cannot query the production workflow system to see the status of work items (such as "suspended – team leader Tony has put a call into the customer"). Thus information concerning a work item remains incomplete.

What is needed is a status monitor that passes both the work item as well as activity status between the disparate systems, potentially resolving conflicts and reducing both uncertainty and incomplete information. It may also begin to address an organization’s ability to learn from its past activities.

**Systems that provide robust transaction management while using a messaging-based communications platform**

The figure below characterizes the current state of the market for workflow technologies (Sheth et al., 1996). At one end of the spectrum are the ad hoc applications – the less structured processes, generally handling low volumes, and capable of being addressed by the routing features of messaging systems and e-mail. At the other end are the production workflow applications – generally highly structured, high-volume, business-critical applications that require integration with databases.

While many current products address either ad hoc or production workflow, fewer offerings address
the needs of enterprises that lie somewhere in between. Indicative of these enterprises is the need to adapt and change. And, as the figure shows, that middle space between ad hoc and production workflow is precisely where the needs of many organizations currently lie.

![Figure 1 – The Current Workflow Market (Source: Amit Sheth, University of Georgia)](image)

Focusing its product on this middle space, JetForm has engineered a product that addresses the needs of both highly structured and less structured applications. InTempo leverages the message-based transport for notification and the existing operating system infrastructure for user security needs, but is able to move beyond messaging-based transport systems with its use of any relational database via ODBC. Utilizing a standard SQL database provides InTempo with a number of benefits, including transaction speed, database recovery, workflow status reporting, and an accessible central repository of workflow data. All of these capabilities are standard requirements in production-level workflows, and significantly reduce uncertainty.

Yet, this approach seems to be a poor compromise rather than a robust solution. First, providing a means for the entire enterprise to participate in a transactional system seems to be a worthwhile objective for production systems, particularly with the need for conflict resolution and learning. And while transaction management eliminates uncertainty, it does not address the need for complete information because production workflow systems have historically allowed hundreds rather than thousands of users to participate. Second, integrating transaction management is something a messaging platform should do natively. Without transaction management, uncertainty will remain.

*Systems that support disconnected users capable of influencing downstream routing*
The next area that severely limits an organization’s ability to adapt is support for disconnected users. Mobile employees traveling via plane or car discover factors that influence the processing of work items, for example, while on the phone. Traditional workflow systems depend upon on-line users to process work. Yet to be truly adaptive, there is also a need to support these disconnected users.

One product addressing this need is Floware, developed by Plexus Software. Plexus has increasingly focused on Internet-based workflow as a way of extending workflow implementation across the enterprise. The company has introduced a critical feature to the future of Web-based workflow: the ability of a disconnected user to remain an active participant in a workflow application. FlowWare accomplishes this by encapsulating workflow functions within Java applications. The series of actions taken on a work object and the paths those actions demand can be built into the Java workflow application executed by the disconnected client. Contingencies that are always an important part of every workflow can now be incorporated as part of the application, even for those Internet participants who may be online only infrequently.

Plexus has provided a clear direction for one of the problems that plague workflow applications over the Internet – how to maintain control over the work in an application when the participants are not only remote, but are literally inaccessible at times from the workflow system itself. Yet this approach cannot ensure complete information all of the time, and perhaps wireless communications will assist in addressing this concern.

**Integrated workflow design and run-time management tools**

Currently, workflows are designed, implemented, monitored, and changed if necessary. Yet the tools used to perform each of the steps are typically independent and do not pass critical information back and forth in an iterative manner. Of particular importance is the need to integrate the design environment with the run-time environment, providing the feedback loop to allow the designer to modify and adapt workflow routing. This approach could greatly reduce the uncertainty in designing or modifying a process.

Two such products reviewed in our benchmarking process are from Meta Software and First Step. Both have developed interfaces that can generate workflow designs that can be compiled and run in a number of workflow engines. But more importantly, the design tools can directly access run-time management data that is generated from the workflow engines. It is from this run-time management data that new adaptations to work processes can be developed, giving a more complete assessment of all relevant information.

Unfortunately, neither of the systems give the users of the system the ability to define workflows. Today, a specialist is still needed to define work processes, defeating a potentially tremendous source of critical data for determining the cause of exceptions and the appropriate changes. In addition, neither of the systems monitor traffic within workflow engines and recommend changes; again, the designer must determine what changes should be made.
Conclusion

Businesses continually need to change and adapt to their environments. Encapsulating complete information and reducing uncertainty are critical components of a business’s ability to succeed (Mihavics and Ouksel, 1996; Ouksel, 1998). Workflow systems must support these capabilities, providing a means to adapt to external factors and empower those with the information to act.

To do so means providing bridges between older legacy production environments and ad hoc routing mechanisms. It also necessitates maintaining the transaction integrity while creating and leveraging infrastructure such as messaging and the Web. Finally, encapsulating run-time data directly into the design environment is critical.

All of these are areas of innovation in the workflow market and make some progress toward the ultimate goal: adaptive workflow processing. Yet challenges exist: workflow systems, whether production or ad hoc, remain stand-alone and isolated. Users do not and often cannot take control over a process. And what we learn from a process is seldom used to create a new process. It is our hope that as increased attention is focused on the need for adaptive workflow processing, the market and its products will mature and enable organizations to quickly change and modify their activities to meet market needs.

References


