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## Tooling and Practices for Business Process Model Collections

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**Abstract.** The genesis of process models is a key determinant of the ability of organizations to harvest and reuse the resulting intellectual capital. The creation of these models varies from a deep knowledge-centric and collaborative activity to a rather tactical endeavor. In many projects, processes are neither harvested from past efforts nor intended to be a target for future reuse. In short, not all processes are born equal and thus, adequate *practices* are an imperative to create useful process model collections.

Tooling is another key factor for harvesting process knowledge into reusable collections. Process-centric tools often control enterprise modeling concepts that belong to broader organizational design concerns whose reach extends beyond behavior. Isolated process functionality detracts from the reusability and general cohesion of the models. In addition, tools seldom capture key "knowledge footprints" left by industry experts intervening in process practices. This paper proposes a workbench that goes beyond traditional process tools. The workbench integrates different functionality for modeling enterprise concerns that matter to behavioral models. Furthermore, it also provides method-centric assistance and collaborative capabilities for highly specialized teams of professionals involved in modeling practices.

**Keywords:** Process Tools, Business Architecture, Process Model Collections, Business Process Modeling Best-practices, Collaboration Tooling

## 1 Introduction: BPM Challenges and Process Model Collections

Collections of process models are at the foundation of reuse in enterprises and economies of scale at industry level targeted by Business Process Management (BPM). While the goal of this paper is not to provide a survey of BPM, it is important to stress that confusing aspects in the process management field abound. The evolution of BPM has shown some struggles, divergence and to some extent, also confusion. Several authors have recently highlighted some of these challenges [1], [2], [3], [4], [5]. Process model collections are intimately connected to the subject of process life-cycle in BPM. Thus, foundational issues in BPM translate directly into challenges for process model collections. An example of foundational issues in BPM is the meaning of business process. In spite of several decades of work in this area, the very definition of business process is still troubled by ambiguity. A review of the literature indicates that there is not a single, formal definition adopted across involved communities of practice. If taken *verbatim,* some of the existing definitions may be interpreted in such a general form that almost everything an organization does could be included within BPM. In a recent paper [4], the authors state: "*Considerable confusion exists about what Business Process Management entails …*" As in [1], Reijers et al also questioned the understanding of the actual adoption of BPM by organizations: "*… it may come as a surprise that contemporary insights are missing into which categories of organizations are adopting BPM and which type of BPM projects they are carrying out"* [4].

OMG has also recognized these ambiguities. In [6], the author states: "*there is no agreed-upon industry definition of Business Process. Instead, there are multiple definitions, each looking at the field from its own unique point of view, concentrating on its own set of concerns*". Certainly, it is not a matter of one definition being "right" and the others being "wrong", as also stated in [6]. But the varying points of view used in these definitions cannot be attributed only to differences between rigorous specifications and practical concepts from consultants or analysts: the foundations under differing views are not identical. These views yield different models of the same real-world phenomenon. For example, Event-driven Process Chains (EPC) became popular in the 1990s as a conceptual business process modeling language. Models based on EPC do not necessarily capture the same semantics of operations as those from other methods or notations, such as entity-based life cycle [7]. This means that the main efforts in process modeling standardization have not yet yielded the expected outcomes.

The BPM industry struggles are due partly to its fast pace of growth and to the multidisciplinary nature of the technical field. As important knowledge relevant to the evolution of BPM may be found across different sciences and disciplines, there is always a risk of disconnect and reinvention. Some worrisome examples are recent propositions for modeling processes with entity life-cycle techniques and claims for solutions for a supposed need to connect data and process (see [7] for a review of the state-of-the-art on these two topics).

BPM covers the entire life-cycle of processes and thus, a number of research papers addressing other stages beyond the formal definition of business process also exist [8], [9], [10]. Process models in organizational collections are generated over time by people often from several line-of-businesses, typically involving different consultants and vendors, using different tools decided at a departmental level or according to the participating stakeholders and role-players, and finally, having most likely different purposes in mind. Such models may be linked with each other or mutually overlap, supersede one another or diverge over time. They may be represented at different abstraction levels depending on the target audience and modeling purpose, and may be available in multiple languages [11], [12]. This variation may be less notorious for enterprise areas dominated by so-called *enterprise applications*. But in these more mature cases, minimal process modeling is carried out beyond the proposed references. For example, in most implementations of ERP systems, the vast majority of processes are not represented by using any visualization tool since this is considered an unnecessary cost to the project.

As business process model collections increase in size, tools and techniques are required to manage them. Important information technology issues arise [11], [13], [14] such as finding a particular process in a collection, managing different versions of processes, maintaining consistency when multiple people are editing the same process at the same time and so on. This includes support for quickly searching a collection for business process models that meet certain criteria. These criteria can be specified by means of a search query [15], [16], but also by means of a business process model for which similar models must be retrieved [17], [18], [19], [20], [21]. In addition, the availability of a large collection of processes opens up new possibilities, such as extracting knowledge about the operations of the organization from the collection or re-using process fragments from the collection to design new processes [22].

Building on the fact that process model discovery is a costly investment, *process mining* is aimed at extracting process-related information from event logs, e.g., to automatically discover a process model by observing events recorded by some information system [23], [24]. Furthermore, cost and time pressures pave the potential business value of reusing existing and proven process models. Various approaches that leverage reuse principles to increase process modeling efficiency have been proposed. For instance, as its name implies, reference modeling accumulates the domain knowledge in a reference, which is further customized in different application projects [25]. On the other hand, several types of patterns for process models describe recurring situations in a domain independent way. While such patterns are well-suited for model verification and generic modeling support, the existing reference models are tightly coupled with their partial domain, rendering them inappropriate for use in other settings.

Another important aspect in the life-cycle of processes is their monitoring. New legislation and increased emphasis on corporate governance are forcing organizations to follow their business activities more closely [26]. In addition, there is a constant pressure to improve the performance and efficiency of business processes. This requires monitoring facilities such as business activity monitoring and business process intelligence [23], [24]. Extending the above aspects, an interest in Business Process Analytics has also emerged. Business Process Analytics (BPA) is the family of methods and tools that can be applied to provide process participants, decision makers, and related stakeholders with insight about the efficiency and effectiveness of organizational processes [27]. From a performance perspective the intent is to shorten the reaction time of decision makers to events that may affect changes in process performance, and to allow immediate evaluation of the impact of process management decisions on process metrics. From a compliance perspective, BPA to establish the adherence of process execution with governing rules and regulations, and to ensure that contractual obligations and quality of service agreements are met [27].

The conceptual framework of this paper builds upon several facts. First, business processes in enterprises do not stand or evolve in isolation. This means that processes relate to and are heavily impacted by organizational concerns beyond the BPM domain. Second, not all business processes are born equal. Specifically, processes have a varying nature depending on what operations they intend to support and furthermore, they may be created with very different needs in mind. Consequently, different business processes may play distinct roles within a broader spectrum of intellectual capital in organizations and industries. Finally, the consequences of an inadequate genesis for process models cannot be repaired by a posteriori fixes. In particular, as process life-cycle evolves, intelligence added to repositories and other enhancements of process derivatives may not be able to retrieve what might either be irremediably lost from the models or may have never been the actual intention to represent in the models.

This paper presents some new tooling in the form of a *workbench* that also incorporates *practice-centric* experiences. Processes are about the behavior of an organization. The difficulty to harvest and reuse in process modeling shows that practices and tools have not been very successful in capturing *semantics of business operations* and *supporting industry experts and business professionals*. Good semantics goes beyond *clarity* and *understandability*. The point is that behavior modeling is inseparable from the rest of the constituent elements and attributes of the organization such as goals, capabilities, outcomes (i.e., products, services and related value-propositions), skills and resources in general, etc. In addition, people participating in process-centric projects and practices are not only limited to IT practitioners; the team may encompass business transformation experts, operational and program managers, support organizations, auditors, etc.

The workbench presented in this paper supports the modeling of processes in the broader context of organizational design by following a *Componentized Industry*

*Business Architecture* [28]. The Componentized Industry Business Architecture (CIBA) is a comprehensive concept and it also modularizes business operations by allowing the introduction of industry-specific content variation in the models.

The conceptual framework of this paper also builds upon extensive evidence that the participation of industry specialists and business professionals in the stage of process model creation is essential. These role-players provide highly specialized information and experience on industry segment and business operations relevant to the specific Line-of-Business or organization affected by the process practice. However, significant "footprints" left by these experts are not captured in practices because tooling focuses mostly on capturing automation-oriented artifacts. New tooling and practices are briefly illustrated with examples in the CIBA workbench.

## 3 Tooling and Practices for Process Model Collections

The Componentized Industry Business Architecture (CIBA) workbench hinges upon the fact that organizational design is not just behavioral but also contains intentional and aspirational aspects as well as capabilities, skills, performance metrics, roles and resources at a minimum. Process modeling should then be closely linked to and influenced by the description of these broader and critical concerns of the organization. Process tools do support modeling of processes with some of these concepts (like resources and other architectural artifacts). Unfortunately, this is the beginning of a problematic journey. These tools provide no guidance on how these features should be used in a cohesive endeavor whose coordination typically goes outside of the process project boundaries. While there is actually nothing to blame on these tools for not including any best-practice, the available functionality is an invitation for unaware users to increase the chasm by unintentionally burying semantics and intent, disconnecting the design from the rest of the enterprise and "appropriating" modeling concepts whose life-cycle should not reside exclusively in the context of process modeling. If processes designed in the project need to produce reusable intellectual capital then the practice must reflect the intent and prevent modeling to be a process-centric silo. As many process modeling exercises reside at the realm of the information technology department or within isolated business units having full control of their own destiny, tooling fuels potential disconnect and risk of creating deeper silos.

On the other hand, taxonomies and related content such as the Extended Telecom Operations Map (eTOM) from the telecommunications industry, SCOR in the supply-chain LOB, Process Classification Framework (PCF) and related industry-specific extensions bring additional challenges as they are not based on any known architecture principle. Furthermore, they do not provide any design guideline to dive into levels below the entire enterprise operations when modeling finer granularity. In spite of these issues, these frameworks still provide valuable glossaries and decompositions that inform the componentized business architecture for industries and thus, they are reconciled against other architecture elements in CIBA.

Figure 1 shows a high-level metamodel of the architecture of the business elements. This metamodel has been made into tooling support for managing the concepts in consulting practices. The metamodel includes business components, their activities, related processes, intent-oriented and performance-centric aspects and other critical elements of a business architecture. Quantitatively speaking, adding up the content from 10 typical LOBs in a single industry segment, a total of approximately 1,000 business components and 10,000 activities is produced, among several other elements of the architecture such as capabilities, key performance indicators and resources. This paves an important foundation for significant economies of scope, scale and substitution that go well beyond productivity gains of a single organization or company.

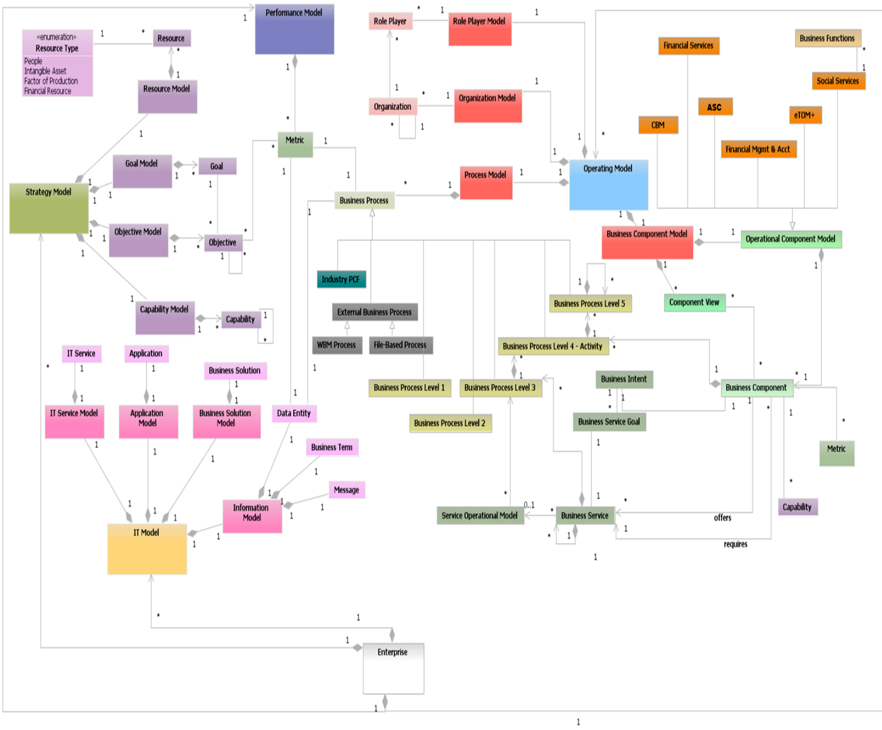


**Figure 1: A high-level Metamodel of the Componentized Industry Business Architecture concept and related software**

While processes stay at the center of the modeling and management scene, their creation are based on best-practices that bring the rich semantics of business operations beyond behavioral models. These features are part of the core functionality provided by the Component Industry Business Architecture (CIBA) tooling. CIBA supports the linkages among the different elements of the individual models while providing a workbench that integrates the different modeling tools that matter. Each of these individual tools works in a silo, i.e., a core fragment of the real-world model is created and managed in isolation. Illustrating the manner that CIBA combines the various models, Processes include Tasks, are measured by Key Performance Indicators, and contain Data (among other artifacts). These critical dimensions are not of the exclusive incumbency and control of a process modeling tool. For instance, Tasks are part of or entire Activities in the architecture of operations; they exist to support Capabilities and are based on Skills or other intangible Assets from the resource-hierarchy whose creation and disposition entails decision-making not represented in the process model. All these constructs fulfill organizational Goals that go beyond the intent and specific scope of the process model. However, tools for modeling processes tend to “appropriate” the creation, management and disposition of such modeling elements inside their own software functionality and platforms, thus making the modeling domain a rigid silo out of a holistic organizational concern [1].

CIBA provides two types of software capabilities. As a workbench, it provides the best possible *integration* of different modeling tools so that the dimensions and content from domain models follow the architecture of the business operations. This is a difficult task because existing tools are not planned for extensibility: tools rarely contemplate the possibility of connecting a new metamodel to the native one supported by the tool, adding new behavior to the provided base, etc. The silos may also reach considerable levels of insulation: making a given tool "point to" a model created by another tool is a struggle. Instead, import and export mechanisms are provided by most tools, thus duplicating content at the risk of fragmentation and inconsistency. In addition, it also provides an environment to support knowledge workers who participate in the process-centric practice. These role-players are not doing anything in their jobs that could be called "social collaboration" or "IT process implementation".

Figure 2 shows a view of the actual Componentized Industry Business Architecture (CIBA) client tool. The navigator depicts the different dimensions of the model of operations, including processes and their connections to the rest of the elements that matter to organizational design. This figure shows a business component-centric view that serves as the taxonomy to manage processes and other architecture dimensions.

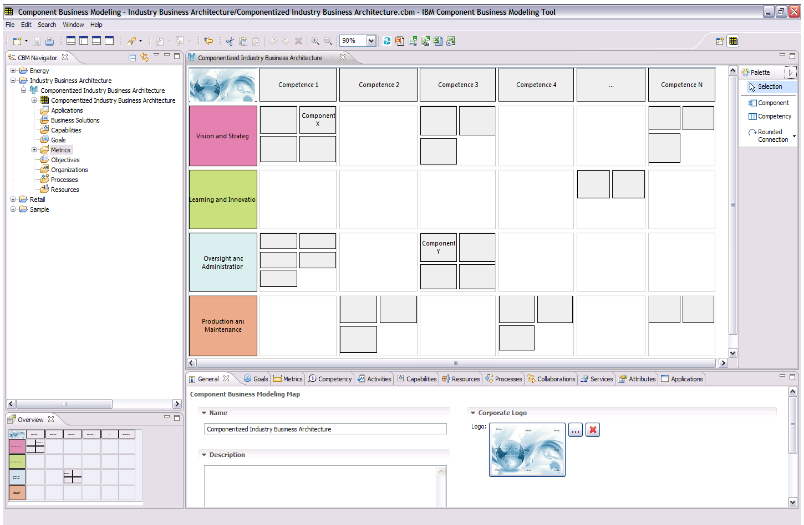

**Figure 2: Navigator and component view of the Componentized Industry Business Architecture modeling and management tool**

Figure 3 shows some screenshots of the client of the CIBA workbench with actual content. There are several important aspects to notice. A business component view and editor is provided and integrated with process-like and other editors. Furthermore, other functionality is present for managing elementary aspects of the life-cycle of certain resources (such as applications) and for governing performance

[1] This characteristic is not exclusive of process modeling tools but of all tools dedicated to a modeling domain. Reporting mechanisms, imports and exports, and other 'integration' features are provided. This functionality seeds unnecessary duplication of fragments of the models across the domains involved, loosing consistency and traceability along their life-cycle.

models. The connection of these different concerns is an essential aspect of the tool. Figure 2 shows key behavioral aspects of the model such as activities and processes connected to resources (for example, applications and capabilities), business components that modularize the business architecture and metrics that govern performance of the organization.

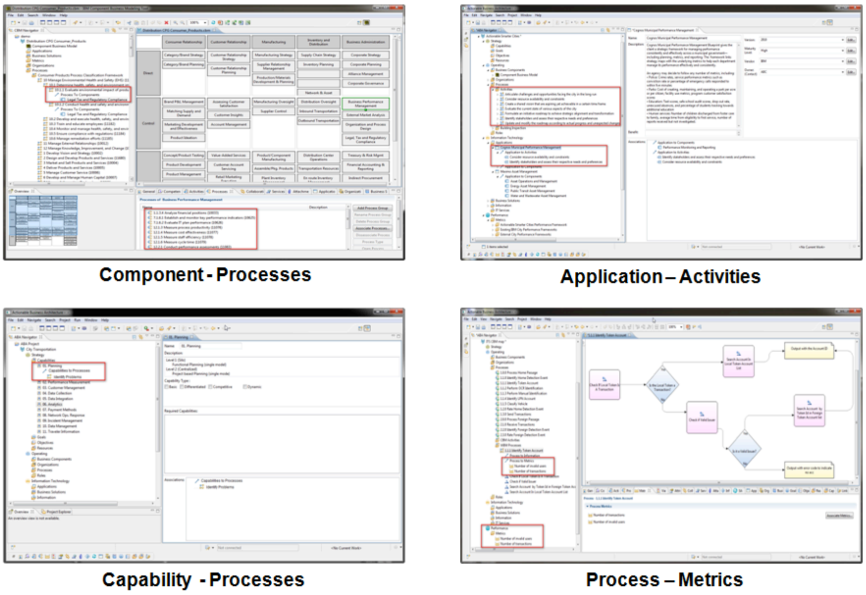


**Figure 3: Different views with an integrated ecology of editors in CIBA. Functionality to manage the connections across the different elements of the model is provided.**

On the other hand, it is clear that the complexity of managing process models also comes from a certain chaos in their genesis. These challenges translate invariably into more complexity or intractability at the time of reusing the models. While putting this statement in quantitative terms beyond anecdotic evidence is a challenge, the reason for its practical validity resides on the very BPM challenges discussed in Section 1. Moreover, the lack of adequate support for creating process models in the concert of practices executed by *business teams of subject matter and industry experts* is also evident. These professional roles do not fit well with tooling created for IT communities or social collaboration. Reusing process models calls for accessing specialized knowledge already encoded in some digital representation. This means that reusability aims to assist or even replace subsequent interventions from highly skilled professionals.

Unquestionably, the harvest of this deep intellectual capital will not happen by "forcing" key role-players to adopt tools that do not fulfill their needs, expectations or incentives. Information technology-centric process tools and team-collaboration tools are the consequence of markets whose drivers are entirely different from extracting knowledge from business experts (consultants, analysts or end-users) involved in modeling practices. The actual markets hinge respectively around *automating processes with software* and supporting *general forms of collaboration with social media*. None of the tooling capabilities derived from these markets is too relevant, let alone inviting, to highly skilled subject-matter experts involved in the creation of operating models and their digital representations.

Existing process tools support either mature operations with models made into "packaged applications" or for business agility needs. In the latter case, the main goal is to get a known process in an organization designed and implemented in the shortest possible time. These main forces make any reuse and harvesting functionality take back seat in the process tooling market.

On the other hand, collaboration in professional teams working on process-related practices is not nearly a *social business* experience. Specifically, tools such as email, repositories, wikis, activities, and other IT-centric support dedicated to generic team-collaboration create more multi-tasking [29] in highly-skilled consultants and analysts.[2] These social business environments are also disconnected from the productivity tools actually used for core modeling work and then, they create more fragmentation across different user-centric experiences and shared spaces. Finally, these collaboration tools follow loosely-coupled or completely unstructured patterns of interaction, thus making invaluable content hard to find and to harvest into a reusable knowledge base.

Figure 4 demonstrates further integration and collaboration capabilities for professional subject matter experts involved in the modeling work. Specifically, CIBA tooling provides support for professional team collaboration, methods for process models and integrated business operations as well as best-practices for content management. Notice that knowledge "footprints", i.e., decision-making, structured interventions, exchanges through notifications, formal method-step initiations and completions, documentation of evolving artifacts from the modeling job are all recorded on the repository along the execution of modeling life-cycle. This recording is completely transparent to the professional subject matter expert.

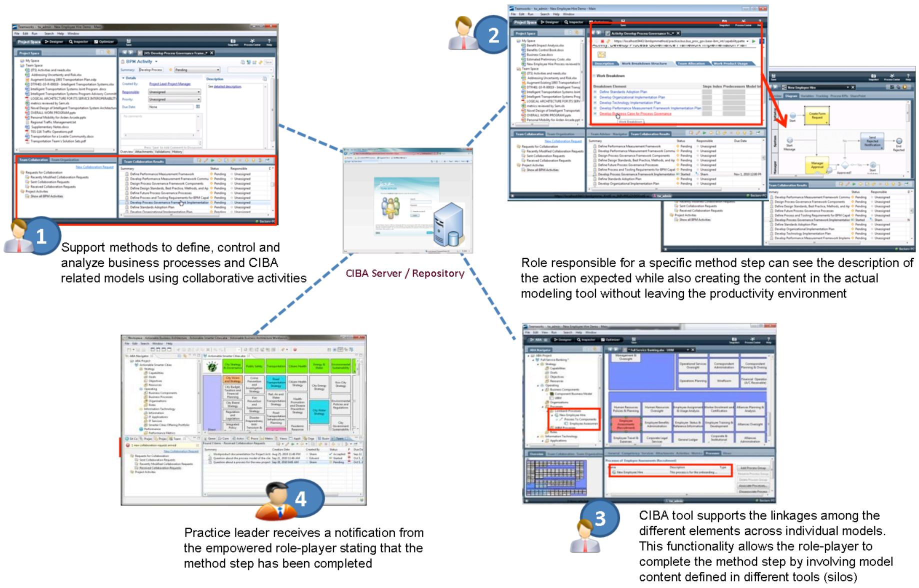


**Figure 4: Sequence showing selected CIBA tooling capabilities**

CIBA tooling supports the definition of professional teams to work in the project and their visualization by roles, the assignment of scheduled tasks to individual members according to planned method-driven requirements or unexpected

[2] A more recent phenomenon involves web-based process modeling tools. These typically fill the important need of conjoining stakeholders, management,, and consultants. They do not, however, offer the depth of analysis that this paper describes as imperative to the successful provision of process collections.

interventions that may be needed, etc. Collaborative requests may be issued from one team member to another according to roles and skills present in the modeling practice. The life-cycle of these requests is traced and the method artifacts and decisions generated among subject matter experts recorded. These actions follow method-centric interventions and are supported in a fully-integrated environment along with the productivity tools used to create the actual models. In other words, CIBA tooling integrates an ecology of individual modeling tools with customized, expert-oriented and method-centric collaboration. A simplified example of a sequence of collaborative functionality is briefly summarized in Figure 5.

Of course, the above capabilities may not be viable for all commercially available modeling tools due to software platform and architecture constraints. In CIBA, this functionality is partly viable due to the advantages of the Eclipse client-level framework and additional software technology created to extend metamodel and behavior of the individual Eclipse tools.

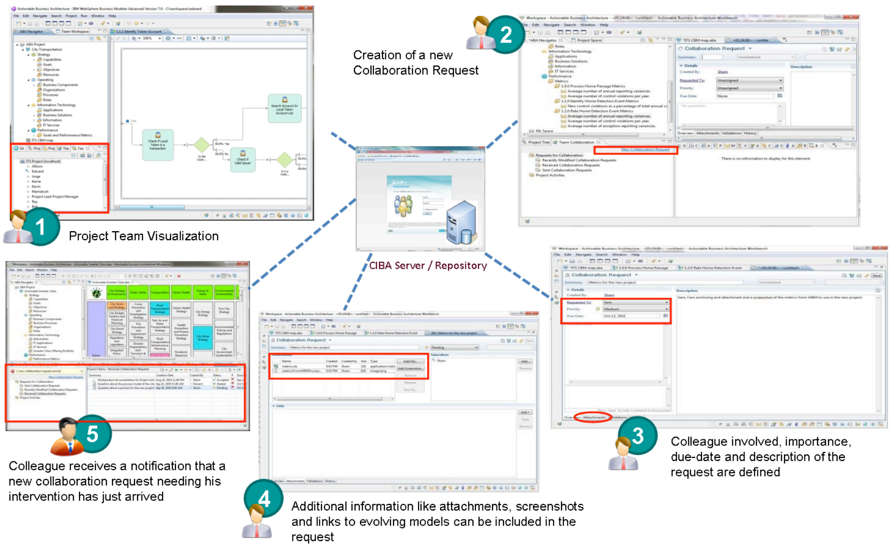


**Figure 5: Further functional support for modeling-centric professional team collaboration**

Finally, Figure 6 shows a sequence of different interventions by the same role-player demonstrating the integration of process-centric tooling with other tools supporting related modeling domains. Specifically, the client-level CIBA tool has capabilities to help integration across the distinct modeling domains involved in the architecture of the business. For example, performance metrics and the hierarchy of nested activities and tasks are extracted from an available process model. This hierarchy is automatically made into the componentized architecture tool to align and reconcile process-centric behavior with the broader operating model available for the organization. Also, the process metrics are used along with KPIs available from an industry performance model to match process metrics to existing business indicators. The latter is a key step in preparing the model for process monitoring or industry benchmarking activity.

It is also worth mentioning that the presented summary of tooling capabilities belongs to a wider effort where real software has been constructed and is operational. All the screenshots provided in this Section are actually from running applications delivering the exact functionality described.

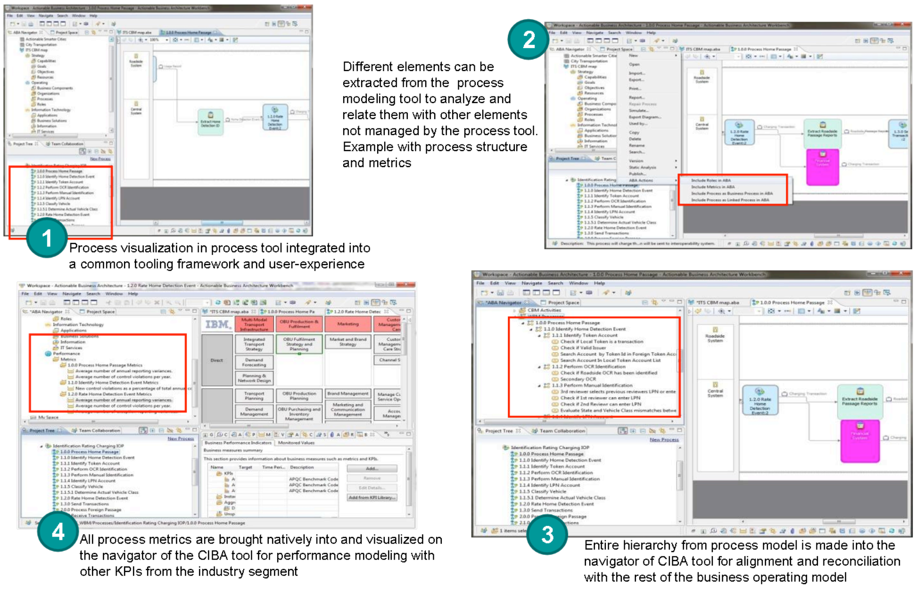


**Figure 6: Client-level integration of process-centric modeling tool in the CIBA environment**

## 4. Conclusions

As a summary, there are two types of challenges to be addressed by tooling in the support of process model collections. These challenges are at the heart of the model creation and management practices. They lead to conceptual problems that need due investigation before translating them into IT-centric support (i.e., discovering, matching, querying, finding provenance, etc) that may dive into ill-defined sets of processes. These intelligent capabilities are indeed important and very useful but not a remediation for practices that bury intent or other essential semantics from the models.

Tooling capabilities, integration and related functionality has been provided. This environment brings together an ecology of modeling tools, including process-oriented software, and customized collaborative support for industry knowledge workers intervening in modeling practices. It is known from extensive field experience that the difficulty in uncovering process-centric knowledge resides in the intent and related operations semantics being lost from the models. In part, this is due to the architecture gap addressed in this paper. But the fact that process design tooling focuses on needs unrelated to harvesting and reusing content also matters. In particular, business and industry knowledge workers need to find the incentive and excitement to document their subject expertise. This has simply not happened yet. Hopefully, the tooling capabilities from the CIBA environment will help follow the knowledge footprints left from the intervention of qualified process professionals and other business analysts. The *componentized view* of organizations offers a unique perspective to unite process and subjects through a resource-centric approach that builds well beyond the information-based notion of "things". Further research and practical field experimentation are being conducted on this specific topic.

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