

Optimizing the actuarial modeling environment

Actuarial IT architecture considerations around loose and tight coupling

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Introduction

Working with models is the quintessential activity for most actuaries. From projecting reserves to pricing, almost every core activity routinely performed by actuaries involves modeling balances and analyzing the results and outputs of models. Indeed, models provide the framework for analysis, allowing actuaries to better understand uncertain future events and, therefore, address the business needs of the organization.

Typical actuarial modeling environments incorporate many technical components beyond the calculation engines that perform projections. Such components transform data, store assumptions or build reports. Collectively, they work together to enable actuaries to do their work – such as producing and reporting actuarial reserves. The effectiveness of the actuarial function depends, to a large extent, on how those components are linked, or coupled, within the actuarial environment.

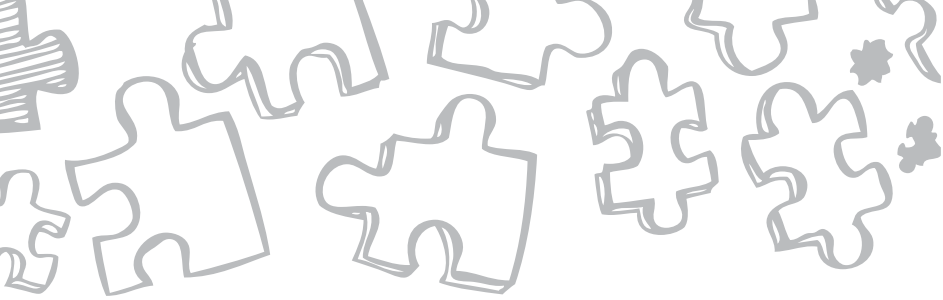
For each specific actuarial task, the actuaries or their resident systems architect must decide how the component completing that task integrates with the other components. The actuarial IT architecture can be designed such that components function independently and can be switched out for another component completing the same task without affecting the rest of the environment. In contrast, actuaries can select tools that perform the functions of multiple components that are highly dependent upon each other, so if one component is to be replaced, a larger set of associated components and functions will also be impacted. The former architecture is generally referred to as loosely coupled, while the latter is called tightly coupled.

This paper will evaluate and consider loose vs. tight coupling, describing the benefits and outlining scenarios for grouping and integrating components within actuarial modeling environments. Further, it will provide examples of loosely and tightly coupled components in action and highlight various critical success factors for those who desire to migrate to a more loosely-coupled architecture.

Architecture and coupling

According ANSI/IEEE Std 1471-2000, the definition of architecture is “The fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution” or, in other words, a conceptual blueprint that describes the various technical components and their relationships with each other. The blueprint serves as a communication tool for the actuary and IT team in designing and implementing technical components that can execute the actuarial process. The blueprint is designed with guiding principles in mind that are specific to the needs of the users of the system. An architect can strive to facilitate efficiency, automation, transparent flow of data, flexibility or many other design principles. The measure of success of a design is based on how well the components interact to satisfy design principles and meet the needs of the users.

Components interact within the architecture by passing data from one component to another. These interactions between components are a key design element for any architecture and are commonly referred to as component coupling. Components can be loosely or tightly coupled, which refers to how independent the components are from each other or, in other words, how much each component depends upon definitions and functions of other components.



Coupling considerations: loose vs. tight

In this paper the term “coupling” refers to the degree to which the components or applications depend on each other within an actuarial environment. The concept may be most easily understood by an analogy. Consider the cameras that are standard features in today’s smartphones. The camera is tightly coupled with the smartphone. If you want a better camera or you scratch the lens and you want to fix it, you must buy a new phone. While many people have given up separate cameras for everyday use, professional photographers and passionate hobbyists still carry high-powered cameras (not to mention multiple lenses, filters, lights, tripods, etc.). These accessories are necessary, in the view of the pros and serious shutterbugs for shooting in different conditions or at different types of events.

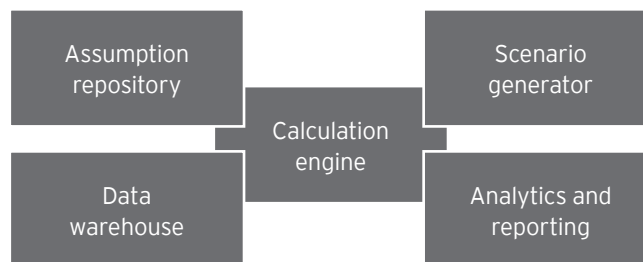
Similarly, many stereo systems include receiver, preamp, amplifier, input devices (turntable, CD player, etc.) and even speakers all contained within one box. The audiophiles among us shudder at the thought and prefer our components that stack to the ceiling allowing us to achieve a custom sound with loosely coupled or decoupled components. For some, solid state audio

components are not acceptable because they do not afford the user the flexibility of further tuning the sound to their liking as one can do with high-quality tube-based equipment where vacuum tubes within a component can be decoupled in order to achieve additional sound refinement. It is clearly possible to take decoupling of an environment to quite an extreme!

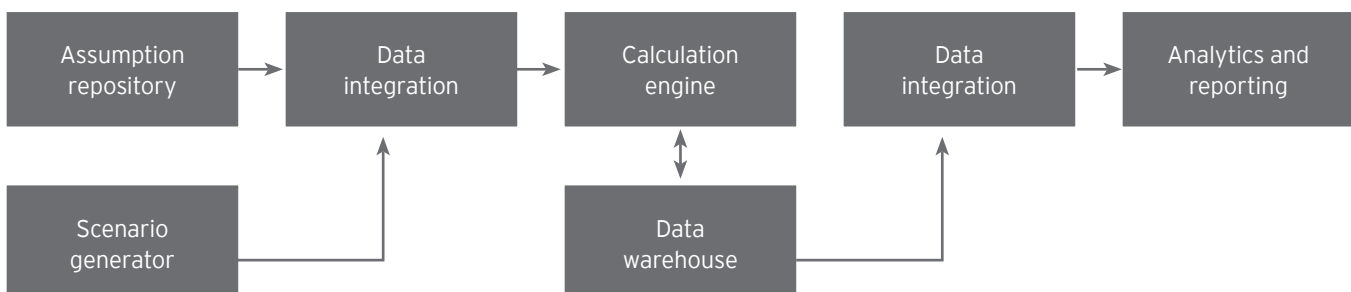
With those pictures in mind, let’s return to the actuarial environment and the implications of coupling on architecture, design and the relationships between components. First, let’s consider several areas in the actuarial process that can be a challenge to an effective architectural design:

- ▶ Where will assumptions be stored – in an assumption repository (which feeds models) or directly inside the models?
- ▶ How will data transformation be handled? Will it take place before or after data is fed into the actuarial modeling environment? Who will own data cleansing and transformation – actuarial or IT groups?
- ▶ How will change management be performed? Does the modeling software offer change controls, or will separate controls be necessary?

An example for tight coupling where the technical components are more interdependent with each other. Changes or Removal of any component impacts the other components



An example for loose coupling where the technical components are less interdependent with each other that allows users to easily plug-in and plug-out the components . The arrows represent the data exchanges.





- ▶ How will model runs be automated? Is job scheduling of the model run sufficient, or will end-to-end automation of the process from data collection to reporting be required?
- ▶ How often are new reports or changes to existing reports needed, and how responsive does the system need to be that produces these changes?

While there is no one-size-fits-all answer to the question of which is the right architectural approach, there are multiple factors that can be considered to decide how tightly or loosely coupled the integration of components within an actuarial environment should be.

- ▶ The need for periodic changes to actuarial modeling tool is an important factor to consider when deciding on a tightly or loosely coupled architecture. Some large organizations routinely review the tools they use to assess their continued effectiveness in light of changing business needs, shifting regulatory requirements, or the evolution of new and more powerful tools. A loosely coupled architecture helps an organization make such changes with minimal impact on other components (assumption repository, scenario generator, etc.) within the actuarial environment. This modular approach decreases time to market and reduces cost and time in making the changes to the modeling software since some of the externalized components can be reused within the environment.
- ▶ The degree to which the actuarial organization relies on IT resources must also be taken into account. Actuarial shops that limit the involvement of IT resources in the actuarial process may prefer a tightly coupled architecture that can be installed and configured and operated by actuaries who have responsibility for the whole process end to end. A loosely coupled architecture requires a deeper set of IT skills to design and build and, ideally, returns this investment by allowing for more involvement of IT in selected sub-functions such as data preparation and report design and development.

Critical success factors for changing the modeling environment

Architecture changes to actuarial modeling environment (including transitions from tightly coupled to loosely coupled components) are significant events. A clear vision and a solid road map are necessary for success. The following enablers and critical success factors should also be considered during design and implementation planning:

- ▶ **Implementation road map:** Transforming the actuarial IT architecture requires a well-defined implementation road map with an understanding of the existing current state, long-term goals and a target architecture that focuses on creating loosely coupled components in incremental stages.
- ▶ **Adopt guiding principles and pay attention to leading practices:** As part of the actuarial IT architectural transformation, the IT team should use IT architectural leading practices, principles and appropriate patterns to design and effectively build the loosely coupled components within the actuarial environment and to govern the architecture process, affecting the development, maintenance and use of the actuarial IT architecture.
- ▶ **Commitment:** Replacing end-user tools with industry standard components can be expensive and time-consuming. Therefore, it is paramount that all stakeholders fully commit to completing the transformation and changing the operating model to see the project through until the business case is fulfilled and the long-term benefits are realized.
- ▶ **Flexibility:** Implementing new tools and components can also leave the actuaries with a sense of lost control and inability to respond to the need for ad hoc analysis. The actuarial need for hands-on flexibility is real and meaningful. Meeting that need must be a top priority in designing or redesigning actuarial modeling environments. Effective use of development and sandbox environments and prototyping are must-haves in moving toward optimal environments.



▶ **IT-actuarial partnership:** A significant benefit to adopting de-coupled, industry-standard components within modeling environment is to facilitate the shift of management for these functions from the actuarial to the IT organization. The two groups need to form a strong partnership and be fully committed to its success. Actuaries need to clearly articulate their business needs and priorities, and IT needs to focus on delivering against those business needs first and improving the controls and total cost of ownership second.

▶ **Strong leadership:** Changes like this are transformative and will result in rethinking roles and responsibilities for the organization. Thus, there is clear need to apply proven communications and organizational change management techniques. Otherwise, fear and resistance may become substantial barriers. The mandate for change must come from the top, and leadership has to communicate its commitment to change and to explain why it is good for the business and for affected individuals.





The bottom line

Clearly, loose coupling vs. tight coupling of actuarial modeling components is only one of many factors to be considered in the design of an effective architecture. It is, however, a central factor with influence on several critical goals:

- ▶ Actuaries want to spend more time performing business-critical analysis and less time manipulating data, running models and building reports.
- ▶ The actuarial models are increasingly becoming central to producing financial results and are therefore expected to operate in a fully controlled production environment.
- ▶ The nature of the actuarial role demands the ability to make frequent changes to assumptions and logic in the models in order to test sensitivities and provide timely answers to questions posed by company leadership.

While improving or designing a new actuarial modeling environment, consideration of the appropriate interaction between key components and how those components are used is necessary in adopting an architecture that best serves the customers of the actuarial models.

There is no doubt that actuaries have better and more powerful options for modeling tools than they did even a few years ago. Effective use of this robust functionality – whether as a built-in feature or stand-alone tool – requires careful consideration and a view to the broad needs of the organization. The key to designing the optimal actuarial modeling environment is to balance the big-picture, long-term strategic objectives with the many technical details that can lead to improvements in this quintessential actuarial activity.



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1503-1425035

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