



Instrument Valuation Management

Management of derivative and fixed income valuations
in a multi-asset, multi-model, multi-datasource and
multi-timeframe environment.

This paper illustrates how TimeScape Pricing Services can be used to provide a valuation infrastructure that applies the principles of consistent data management to the management of pricing models and analytics, without sacrificing any of the “time to market” aspects of a front-office spreadsheet-based approach. The solution outlined reduces operational risk, reduces the need for “out of system” trades and increases transparency.



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Introduction to Instrument Valuation Management

Instrument valuation is a popular topic at the moment in financial markets. Given its fundamental importance to investment, trading and risk management decisions this should come as no surprise to anyone. Certainly not the primary cause of the recent financial crisis, but the lack of trustworthy valuations of many complex securities was a significant contributory factor to the nervousness of the markets and the liquidity squeeze that ensued.

Additionally, whilst many have warned about the limitations of risk management techniques such as Value at Risk, many of the failings of risk management during the crisis can be traced back not to the risk model itself but rather to the valuations being used in the risk model. Post-crisis, the regulators have been quick to jump on valuation transparency and with this in mind the valuation of securities looks set to become even more challenging.

Key Issues to be Addressed

Despite the fundamental importance of instrument valuation, many financial institutions do not formally and fully address valuation management as a defined process within their systems architecture. Many institutions conduct valuations on a siloed basis, with poor consistency of data and poor transparency around the many spreadsheets used to glue together analytics and models as illustrated in Figure 1 below:

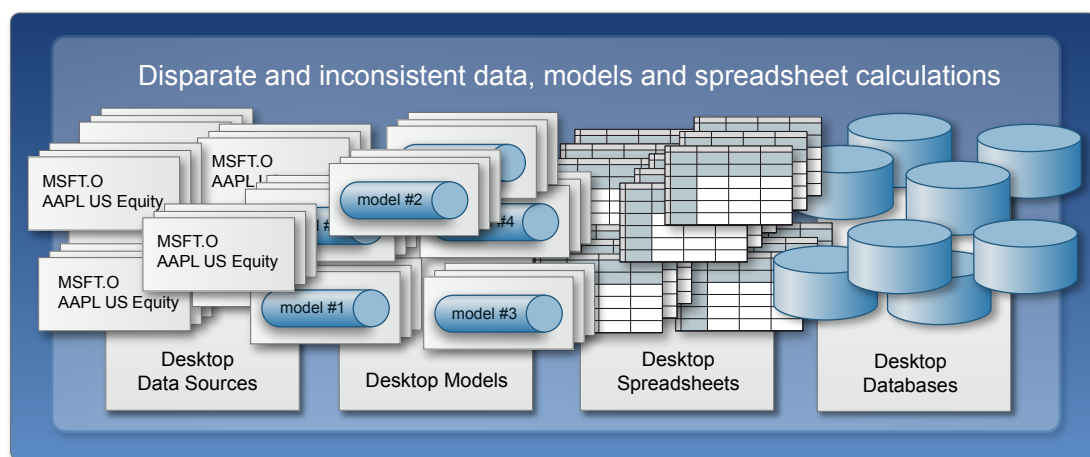


Figure 1 – Disorganised, Adhoc Valuation Architecture

This section of the paper describes some of the issues that result from the siloed and inconsistent approach illustrated above.

Transparency and Drill-Through

Regulators, auditors and investors are demanding more than ever that financial institutions are able to clearly justify the valuations they provide. Internal to the financial institution, portfolio managers, traders and risk managers recognise that it is no longer sufficient to treat valuation as an adhoc, black-box process. Not only do external parties need to understand what assumptions, models and data were used but internal participants need to know how a valuation was arrived at and be able to drill-down into the detail of any particular instrument valuation.

Quality and Comparability

Following on from the above requirement for data drill-down, it should go without saying that it is essential that the data used in the valuation is of good quality. Dealing with factual data first, then having data counterparties and underlying instruments identified correctly is both obvious and vital. Moving on to the more subjective market and market-derived data inputs, then the ability to source this data from multiple sources is also very important in order to understand and correct any exceptions/inconsistencies that may be observed.

Moving on from data to the level of the pricing model itself, then the same principles applied to comparing different data sources can also be applied to the use of more than one vendor or pricing methodology per instrument for those securities where the valuation is a complex or new process.

Timeliness and a Matter of History

It is imperative when managing a new type of security for valuation, that existing systems are able to cope with the introduction of new instruments and models in a timely manner. Having complex instruments reside outside mainstream trading and risk management systems has long been a problem in financial institutions, and one that in boom times for new products often leaves behind a legacy of front-office valuation spreadsheets that were created because internal systems simply could not support the asset traded.

Talking of time, then in addition to the timeliness by which a new product can be supported for valuation, regulators, auditors and clients are becoming ever more insistent that a financial institution is able to "reproduce the market" at a date in time in order to show how a valuation on a particular historic date was arrived at. This requirement puts many existing systems under strain given their inability to deal with more than a few days of data before daily operational performance is negatively affected.

Data Model Flexibility and All Asset Coverage

A key issue related to the timeliness with which new products can be supported within the systems of a financial institution, is the somewhat under-exposed and under-rated issue of having systems whose data model is designed for change in terms of adding new data types and new categories of instrument. Many systems have traditional data models that are fixed in nature and require the vendor to be involved in making any changes to the model. Not only can this be costly for the client having to pay for the data model to be changed by the vendor, but the timelines for delivery are often too late to satisfy the business need. Once the business timeline is not met by core systems, this inevitably leads to an increase in operational risk through increased use of adhoc and tactical databases and systems. Looking at this problem from a regulatory reporting perspective, Dodd-Frank and new regulatory bodies such as the Office of Financial Research (OFR) in the US for example will require more stringent coverage of all asset classes and data types. The data model used and its flexibility will determine how much of a problem complying with these new regulations become.

The Gaps in Data Management

Good reference data management is a prerequisite for good valuation management, but is definitely not sufficient. Valuations and other derived data sets are amongst the most valuable pieces of data that an institution holds, yet why is it that data management seems to stop outside the back office, leaving middle and front office staff to do what they want with inconsistent, desktop-bound datasets and models. In summary, the data management process needs to be integrated in order to encompass all the front, middle and back office data.

Additionally, whilst reference and market data management solutions are relatively well understood by the market, the management of the input data going into models has long been ignored. This "model data management" encompasses key parts of the valuation process such as curve, surface and parameter management. Without managing this type of data too then you do not have a consistent way of reproducing valuations for investors and regulators.

The Need for Analytics Management

Coming back to the topic of the high "value" of valuations data, then it seems inconsistent to invest in the management of data, whilst the management of curve and pricing analytics based on that data is not managed consistently, relying again upon spreadsheets and mathematical programming environments that are de-coupled from mainstream systems and processes. Once the data leaves the data management environment to be analysed (in a spreadsheet or mathematical tool), the data has "escaped" the control of the data management system. What is needed is the application of data management principles such as quality, consistency and auditability to be applied to analytics in addition to all of the underlying input data. "In process" analytics is becoming a necessity in a world where control and auditability are being requested from all sides.

How TimeScope Pricing Services can help

Figure 2 below illustrates how TimeScope Pricing Services can be used to consolidate data, analytics and models within a centralised, controlled framework for valuation:

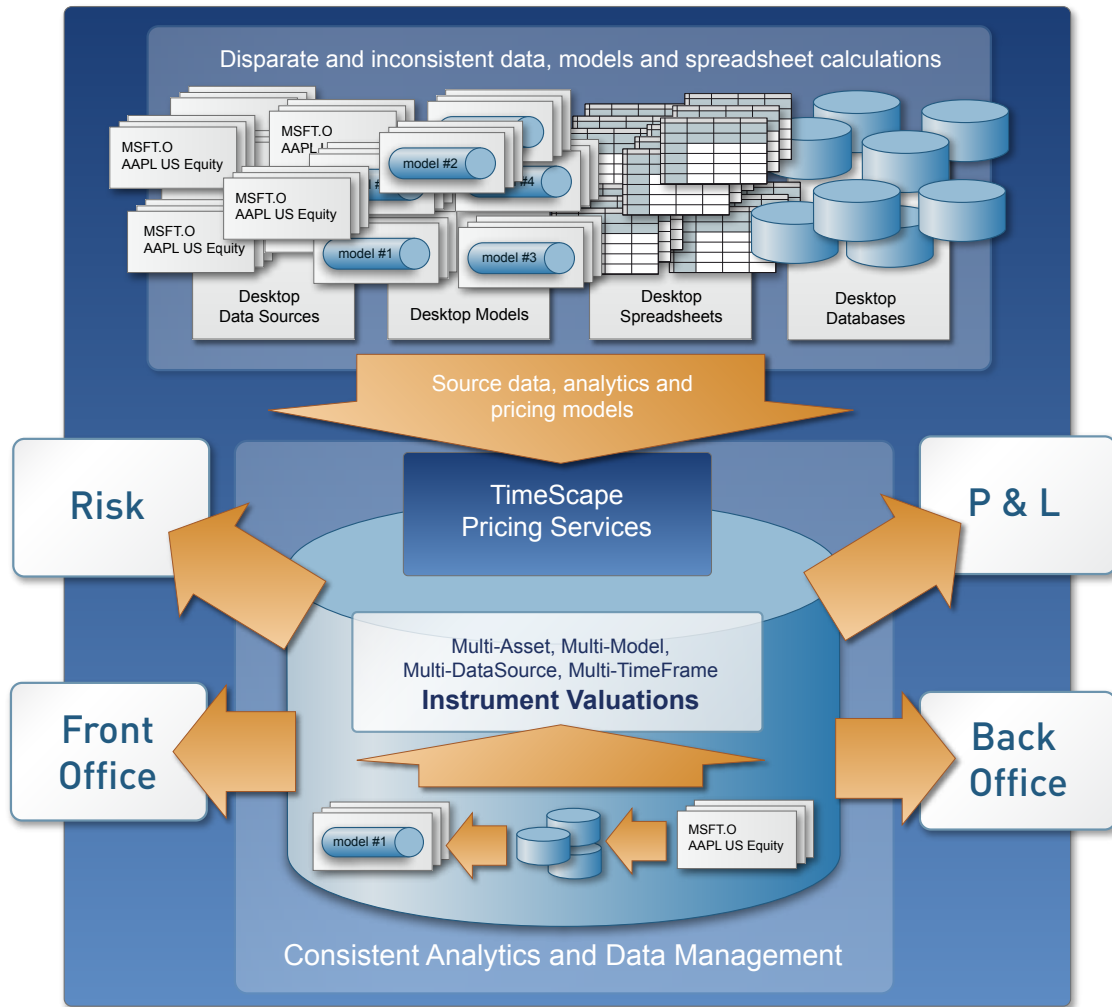


Figure 2 – Consistent Valuations with TimeScope Pricing Services

The next section illustrates some of the key features of TimeScope Pricing Services and the benefits that can result from taking a more consistent approach to the management of data, analytics and pricing models.

Key Features

- **Extensive Asset Class Coverage** – Pre-built add-in modules available for TimeScape and third-party model vendors, such as MONIS already supporting over 150 flavours of financial instrument (see Appendix 2 for more detail).
- **Describe Any Complex Asset** – Any kind of instrument of any complexity can be integrated into the system quickly and easily. The TimeScape data model has been designed from the outset to cope with complexity and change with ease.
- **Integrate Your Pricing Models** – Server-side Software Development Kits allow you to choose what proprietary in-house or 3rd party pricing and yield curve models are to be integrated into the system.
- **Curve Management** – Interest rate, zero and discount curves can be constructed both real-time and at any point in history using full historic market data and time-varying yield curve composition.
- **Integrated Data Management** – Given the nature of the data required for valuations, the system has been designed to support and make it easy to add all data types whether ID, static data, market data, complex model data, or even to store spreadsheet-like calculations as centralised data types. All data can be flagged as being stored on a multi-sourced and historic basis.
- **Integrated Data Quality** – TimeScape Pricing Services is built on the TimeScape Data Management framework, allowing input data of all types to be captured, validated and cleansed (for more detail see Appendices 3 and 4).
- **Data Source Waterfall Rules** – TimeScape Pricing Services allows data rules for missing data and data source preferences to be configured automatically for each asset class.
- **Transparent Representation of Data** – Data is presented in a visual and business-focussed manner to all users, enabling those who understand most about the products to provide their input on required data attributes to technologists and other key stakeholders.
- **Hierarchical Drill-Through** – All data is presented in a hierarchical manner enabling drill through from an instrument to its underlying asset and all supporting data such as curves and surfaces, even on a fully historic basis.

- **Statistical Analytics Coverage** – Pre-built analytics come with the package for doing time series analysis on prices and rates to calculate volatilities and correlations as inputs to models, plus time series analysis on more complex objects like curves and volatility surfaces.
- **Single Interface for any Asset** – Provides one single set of applications and normalised interfaces for pricing all types of financial instrument, so that any instrument regardless of asset class is identified and manipulated in the same way.
- **Any Input, Any Output** – SDKs allow pricing model and user-specific inputs and outputs to be specified and implemented without changing any client-side interfaces.
- **Point in Time Valuation** – A request for historic pricing of an instrument is simply specified by date and automatically re-constructs all market data, instrument reference data and yield curve data appropriate to that point in time for the instrument with no laborious work to be undertaken by the user. For example, Figure 3 below illustrates how the system is able to store even complex data such as volatility surfaces historically and how the system “drills through” the data to extract appropriate inputs for the valuation being requested.

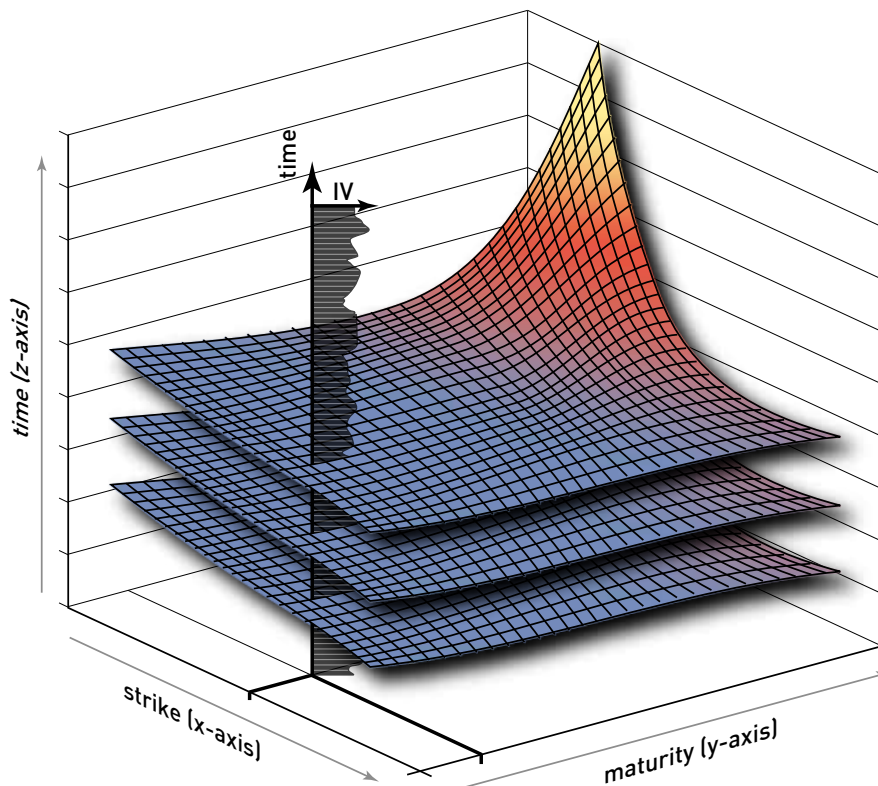


Figure 3 – Point in Time Valuation Requires Historic Storage of All Data Types

Key Benefits

- **An Independent Opinion** - Establish your own independent capability to further validate the valuations provided by external data vendors. Often vendors provide "black box" valuations without the underlying explanation that investors, auditors and regulators require.
- **Same Day Integration** - New financial instruments can be integrated into core risk management systems in short time-frames so that regulatory and compliance issues with "out of system" trades can be avoided.
- **Reduced Operational Risk** - Operational risk of spreadsheet usage is minimised since all users and systems are accessing the same, centralised instrument reference data in TimeScape Pricing Services instead of desktop-bound spreadsheets.
- **Transparent, Consistent Pricing** - Allows consistent instrument data, pricing and sensitivity calculations to be available to all users regardless of whether they are using Excel, Windows applications or accessing the Internet/intranet.
- **Control Spreadsheet Usage** - TimeScape Pricing Services enables Spreadsheets to be designed that contain all of the functionality traders want with the underlying data and calculation taking place outside of the spreadsheet. Hence everyone can access the same pricing regardless of location or preferred application environment.
- **Improved Data Quality** - A valuation is only as good as the quality of data feeding into the pricing model, and TimeScape Pricing Services can utilise all the data quality management functionality of TimeScape.
- **Compare Models for Quality** - The same instrument can be repriced using multiple pricing models for benchmarking of new models and to reduce model risk in quoting prices to clients.
- **Simple Access to Valuations** - All asset types are accessed in the same way through the instrument ID and the required data attribute such as "Fair Value".
- **Automate Compliance** - Have each instrument automatically test and flag how it was priced from input data and models, and hence enable automated compliance with regulations such as FAS 157 over pricing levels/methodology used.
- **Easy Historic Valuation** - The system allows regulator and client requests for historic valuations to be achieved by simply specifying the valuation date required.
- **Derived Data Generation** - Derived data, such as historic implied volatilities and historic price sensitivities, can easily and accurately be generated and stored for further analysis.

TimeScope Pricing Services Architecture

TimeScope Pricing Services is built on top of the TimeScope Data Management infrastructure (see Appendices 2 and 3 for more detail). As such, Pricing Services is a component within TimeScope that is aware of the concept of financial instruments and all that entails with regard to pricing models, yield curve models, statistical analytics and all input data required for valuation. A simplified overview of the architecture is shown in Figure 3 below:

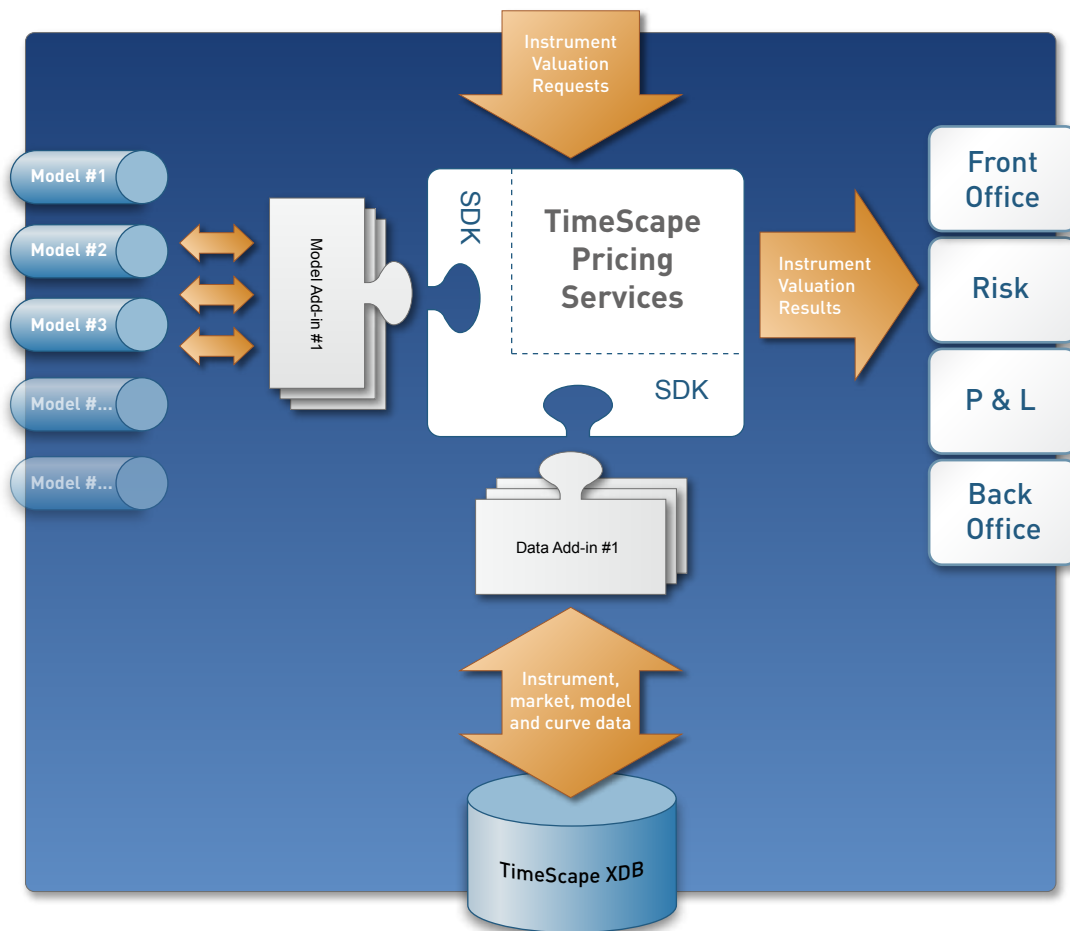


Figure 4 – TimeScope Pricing Services Model Add-in Architecture

Model and Data Add-ins

The fundamental object within TimeScape Pricing Services is an Instrument which consists of a number of input and result attributes. Each instrument is characterised by its Pricing Style that dictates the set of input and result attributes it has, and the Model Providers that support its price calculation. To price an instrument, you need to make sure it is loaded as the correct Pricing Style and its price calculated by the desired Model Provider. Pricing Styles are defined by Data Add-Ins that are registered with the Instrument Pricing Server. Model Providers are defined by Model Add-Ins that are registered with the Instrument Pricing Server. On starting up, the TimeScape Pricing Server loads all the configuration parameters and the registered Data Add-Ins and Model Add-Ins. These together provide definition of all Pricing Styles and Model Providers and other information needed for managing and pricing instruments.

Valuation Requests

On user requests for an instrument, the Pricing Server loads all required data from the TimeScape Data Server, as per definitions supplied by the Data Add-Ins to create the instrument. The instrument is then ready for pricing by any registered model provider supporting the particular pricing style. On user requests for any attribute, the Pricing Server simply returns the loaded value if it is an input attribute. If it is a result attribute, and if the instrument is not already calculated or has changed since last calculated, the Pricing Server calls the Model Add-In corresponding to the selected Model Provider to calculate the instrument and then returns the requested results. So calculating a fair value for an instrument within the system is as easy as:

```
Instrument( "securityID" ).FairValue
```

This simple call to the system does not need to change regardless of the type of asset being priced, illustrating a key practical benefit of the object-oriented approach taken in the design of the system. Extending this approach further, we can easily value an instrument on a particular date, using a specific model provider:

```
Instrument( "securityID", 10-May-07, "Monis" ).FairValue
```

The above are simple function/method calls, but the complexity that happens behind the scenes is marshalled by Pricing Services even down to the detail of the data source preferences for a particular asset type. This keeps it simple for the users and systems that need to consume this data, with only one interface to deal with and with the benefit that the interface does not need to be re-programmed every time a new asset class is added to the system.

Summary

TimeScape Pricing Services has been designed to make the management and valuation of derivative and fixed income securities easier and simpler for all users, regardless of whether the user is a specialist in finance, technology or both.

The system leverages the data management capabilities of TimeScape in order to improve data quality, consistency and transparency. The system also applies the principles of data management to pricing models, yield curve models and analytics in general, enabling consistent and transparent valuation across all asset classes.

Given that the complexity of analytics and data management is hidden from the end user, TimeScape Pricing Services enables the user to perform more complex analysis with ease, such as performing historic valuations through simply changing the value date, and switching from one model provider to another.

Finally, the system has been designed for change, so even the most complex of assets can be implemented within timeframes that meet the needs of the business and reduces the operational risk of out of system trades.

Appendix 1 – Further Reading

Case Studies:

[Insight Investment](#) - TimeScape Pricing Services being used for OTC management.

WebCasts

[Risk Magazine Roundtable: Derivatives valuation and transparency](#)

White Papers

[TimeScape SpreadSheet Inside](#) - illustrating how complex data such as spreadsheet calculations can be centralised and embedded in a data management system.

[TimeScape QL+](#) - Xenomorph's query language that has been designed for the management of instrument data and associated analytics, recently extended to support TimeScape Pricing Services.

Xenomorph Blog Posts

[A French Slant on Valuation](#)

[Pricing Model Validation: Mitigating Model Risk](#)

[Lessons for Risk Management - Wilmott and Rowe](#)

[Financial Modeler's Manifesto](#)

[RiskMinds - VaR is not dead at Citi](#)

Appendix 2 – Existing Asset Class Coverage

Below is a list of supported asset classes for TimeScape Pricing Services:

PRICING STYLE* (Asset Pricing Model)	CATEGORY PATTERN (Data Model Template)	TIMESCAPE MODEL**	MONIS MODEL***
ADR	ADR, GDR	Yes	-
Asian Option	Asian Option	Yes	-
Bond	Bond	Yes	Yes
Bond Future	Bond Future	-	Yes
Bond Future Option	Bond Future Option	Yes	Yes
Bond Option	Bond Option	Yes	Yes
CDS	Credit Default Swap, CDS	Yes	-
CFD	CFD	Yes	-
Convertible Bond	CB, CBs, Convertible Bond	-	Yes
Credit Default Curve	Credit Default Curve	Yes	-
Currency Swap	Currency Swap, Ccy Swap	Yes	-
Equity	Equity	Yes	-
Forward	Forward	Yes	-
FRA	Forward Rate Agreement, FRA	Yes	Yes
FRN	Floating Rate Note, FRN	Yes	Yes
Future	Future	Yes	-
FX	Foreign Exchange Rate, Cross FX Rate Basket, FX	Yes	-
FX Barrier Option	FX Barrier Option	Yes	-
FX Forward	FX Forward	Yes	-
FX Option	FX Option	Yes	Yes
General		Yes	-
Index Linked Bond	Index Linked Bond	Yes	-
Index Linked Swap	Index Linked Swap	Yes	-
Inflation Curve	Inflation Curve	Yes	-
IR Cap Floor	IR Cap Floor	Yes	-
IR Future	Interest Rate Future, *IR Future	Yes	Yes
IR Future Option	IR Future Option	Yes	Yes
IR Swap	Interest Rate Swap	Yes	Yes
Limited Price Index Swap	Limited Price Index Swap	Yes	-
Option	Option	Yes	Yes
Swaption	Swaption	Yes	-
Term Deposit	Term Deposit	Yes	-
Warrant	Warrant	-	Yes

* Default coverage only and new models/assets can be added easily and quickly.

** Clients have also used leading pricing model vendors such as Numerix and FinCad, and where appropriate have integrated internally developed pricing libraries.

*** Use of Monis models will require a license from Sungard.

Appendix 3 – Business Architecture for TimeScope

Figure 5 below highlights how instrument valuation cannot be done in isolation and is dependent upon input functionality, data and processes:

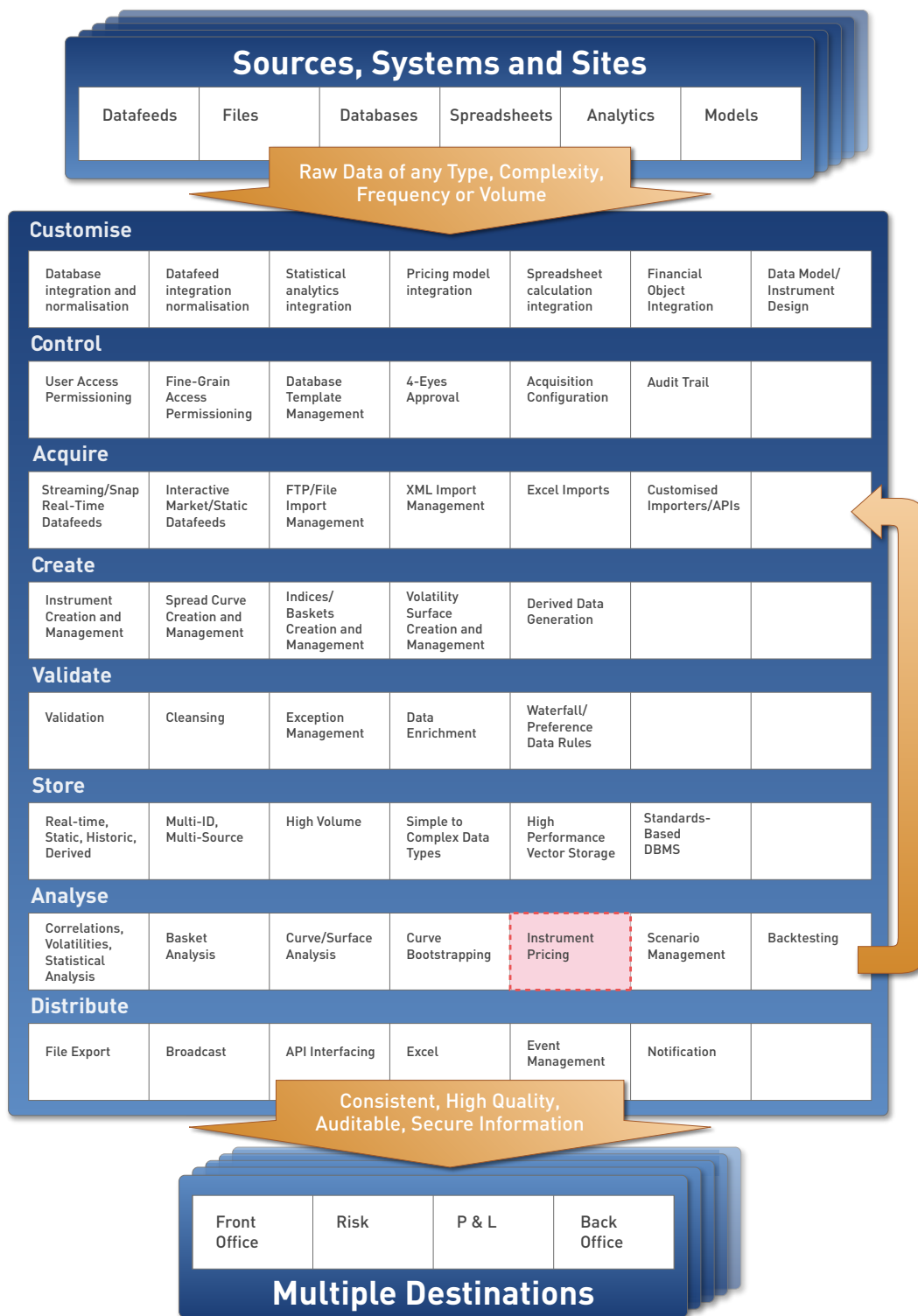


Figure 5 – Business Architecture for TimeScope

Appendix 4 – Logical Architecture for TimeScope

Figure 6 below shows the logical architecture for TimeScope, illustrating TimeScope Pricing Services as a layer built on top of TimeScope Data Services. The server-side Software Development Kits (SDKs) shown have been designed to enable the easy integration of external data sources, systems, analytics, yield curve and pricing models.

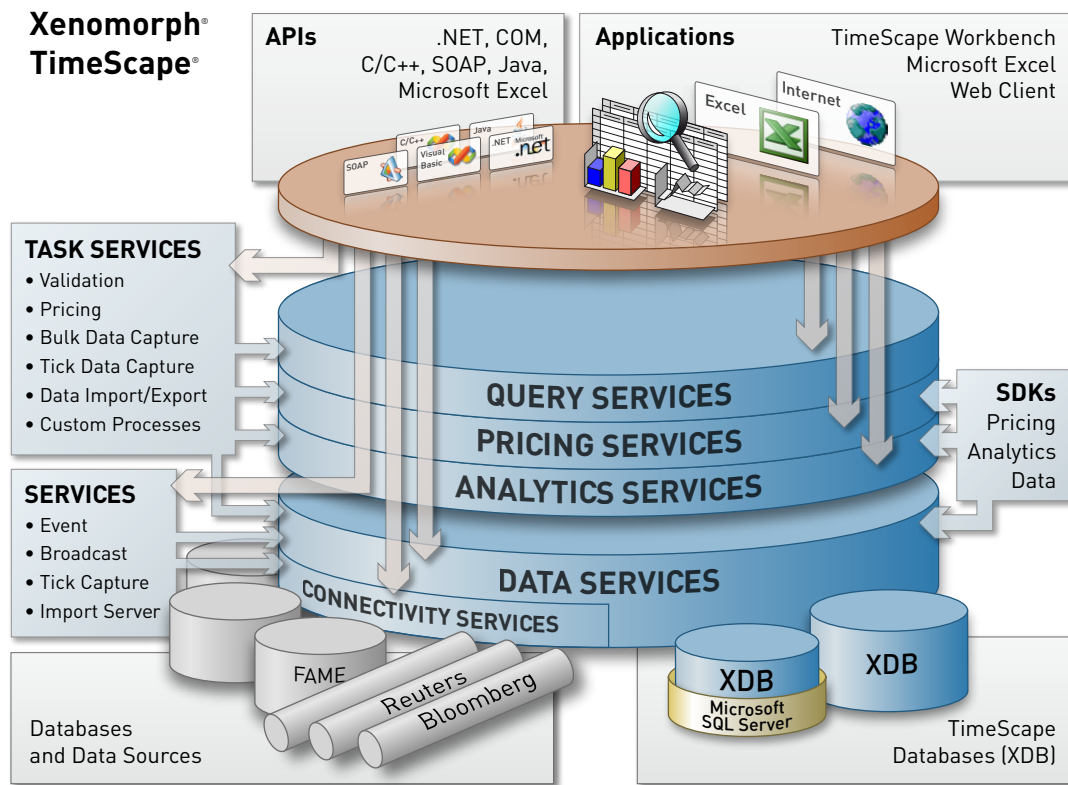


Figure 6 – Logical Architecture for TimeScope

About Xenomorph

Xenomorph delivers Analytics and Data Management (ADM) solutions to the financial markets. Our TimeScape technology leverages our clients' proprietary expertise, enabling them to analyse and manage more data with greater control and transparency.

Our focus is to make our clients more successful by closing the productivity gaps between high performance database technology, data management and end-user data analysis. Through unified and transparent access to data and data analysis, our clients achieve even higher levels of financial innovation, business process efficiency and regulatory compliance.

Trading, research, risk, product control, IT and back-office staff use Xenomorph's TimeScape data management platform at investment banks, hedge funds and asset management institutions across the world's main financial centres.

Established in 1995, Xenomorph has offices in London, New York and Singapore.

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